Te Mahoe Public Water Supply – Water Safety Plan

- Report Prepared for:

  Whakatāne District Council

- Report Prepared by:

  Pattle Delamore Partners Ltd

- Final, July 2018

- Report Updated by:

  Whakatāne District Council

- Version 1.05, November 2018

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Limitations:

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Executive Summary

Pattle Delamore Partners Ltd (PDP) has been engaged by Whakatāne District Council (WDC) to update the existing 'Te Mahoe Water Supply Public Health Risk Management Plan, Final V3' (March 2008) document for the Te Mahoe Public Water Supply Scheme (Te Mahoe Scheme).

This Water Safety Plan (WSP) (formerly known as Public Health Risk Management Plan, PHRMP) prepared by PDP in collaboration with WDC to identify and manage events that could occur in the Te Mahoe Scheme with potential to cause public health risks to consumers of the scheme.

The following were undertaken in the preparation of this WSP:

- Identifying components and operation of the Te Mahoe Scheme.
- Identifying Contamination and Loss of Supply events that could occur in the scheme that could result in public health risks.
- Preparing Risk Tables to identify potential risks, by identifying existing and additional barriers to contamination and critical points in the scheme. In addition evaluate if the Preventative measures currently in place are able to reduce the risks were also identified.
- Preparing an Improvement Plan by introducing new preventative measures to manage risks that are not sufficiently managed.
- Identifying Critical Control Points (CCPs) in the scheme and limits within which the CCPs are operated to prevent contamination. Control actions to be carried out when CCPs operate outside these limits were also identified.
- Preparing Contingency Plans to mitigate events of acute health risk that may occur despite preventative measures being in place.

This report was prepared in line with the methodology recommended by the Ministry of Health for preparation of Water Safety Plans. Information used in this report was gathered from documents and reports belonging to the Whakatāne District Council, during site visits carried out by PDP to the Te Mahoe water treatment plant, pump station and reservoir sites, and during a consultation workshop with WDC staff. Contributors to this report are listed in Section 11.0.

Table of Contents

Table of Figures

Table of Tables

Table of Appendices

1.0 Revision and Performance Assessment

Table 1: Revision Details

Version No.	Revision Details	Author	Date
V1	Public Health Risk Management Plan - submission to DWA	OPUS	23/08/2007
V2	Public Health Risk Management Plan – revised to account for non -conformances	OPUS	19/09/2007
V3	Public Health Risk Management Plan – revised with DWA recommendations	OPUS	03/03/2008
1.00	Prepared by PDP in collaboration with WDC, submitted to WDC for comments	PDP	15/02/2018
1.01	Modified with WDC comments for submission to DWA	WDC/PDP	18/04/2018
1.02	FINAL Version release from PDP to WDC	PDP	30/07/2018
1.03	Updated Improvement Plans and submission to Drinking Water Assessor	WDC	16/10/2018
1.04	Modification after discussion with DWA, update: wastewater risks, section 10 criteria selection, filtration details. Resubmit to Drinking Water Assessor	WDC	14/11/2018
1.05	Approved by DWA with inclusion of report on adequacy of a Drinking Water Supply's Water Safety Plan	Toi Te Ora	15/11/2018

Under Section 10.0 of the Drinking Water Standards New Zealand (DWSNZ 2008) – "Small Water Supplies, Alternative Compliance Criteria", drinking-water supplies serving up to 500 people can be classed as 'participating supplies' and shall follow a Water Safety Plan (WSP) compliance criteria approach (sections 10.2 to 10.5) to demonstrate compliance with the DWSNZ 2008. Accordingly, this WSP has applied this approach and Council considers this a 'protected catchment' which is further detailed throughout this document.

WSPs are required to be revised and re-submitted to the Drinking Water Assessor (DWA) for approval every 5 years as a minimum. Accordingly, this plan is due for revision and approval by the DWA back in 2013! In recent times Council has increased in-house resources and will keep strict control of adhering to the regulatory requirements. It should be noted that the WSP is a live document and

will be updated as required; it is therefore recommended that WDC revise and resubmit this WSP if there are significant changes to the operations or risks to the Te Mahoe Scheme within the 5-year period.

A draft plan of this WSP was reviewed by the contributors to the workshop before submitting to the DWA for final approval.

The performance of this WSP is to be assessed annually by reporting on the following items:

- any risk events.
- non-compliances or near misses that have occurred.
- contingency plans that have been used.
- changes made to the scheme operation and components.
- progress made against the Improvement Plan.
- any new risks or improvements that are required to be made and people responsible for carrying them out.

The performance assessment, in the form of a short report, will be submitted by the Manager Three Waters to the Drinking Water Assessor by 31 July each year.

The following staff will be responsible for including any relevant items arising from this report into the Annual Plan, Water Asset Management Plan and Long Term Plans: Manager Three Waters, Team Leader - Three Waters Asset Management and Planning, Manager - Capital Projects, Team Leader - Three Waters Operations.

This WSP is to be linked to the Annual Plan, the Water Asset Management Plan and the Long Term Plan.

This WSP is to be read in conjunction with the 'Catchment Risk Assessment for Te Mahoe Bore Water Supply, Whakatāne District Council' report (PDP, September 2017).

2.0 Supply Summary

Table 2: Te Mahoe Scheme Summary	
Supply Details	
Supply Name	Te Mahoe Community Water Supply
WINZ Community Code	TEM004
Supply Owner	Whakatāne District Council
General Manager Infrastructure	David Bewley
Manager Three Waters	Tomasz Krawczyk
Team Leader – Water Treatment Plant	Neal Yeates
Water Treatment Plant Operators	Ian Bowen Ross Dillon Bryan Vautier
Capital Projects Manager	Jim Finlay
Team Leader - Three Waters Assets Management and Planning	Michael Van Tilburg
Population Served by Supply[1]	100 People
Number of Connections[2]	28 Connections
Source Details	
WINZ Source Code	G01838
Type of Source	One shallow bore (Approximately 30 metres below ground level (bgl), with a screened internal between 20.8 m and 27 m bgl)
Consent No.	64943
Consent Expiry	31/07/2022
Maximum Consented water take:	50 m3/d
Map Reference (NZTM2000)	2844703 E, 6336554 N
Treatment Details	
WINZ TP code	TP00880
Treatment Processes	Filtration, Chlorination
Average Daily Demand (July 2015 – June 2018)[3]	76 m^3/day

[1] 2013 Census – Statistics New Zealand. Information based on Whakatāne District data
[2] WDC Correspondence, September 2017.
[3] WDC - Te Mahoe Water Returns for period July 2015 – June 2018

Table 2: Te Mahoe Scheme Summary	
Peak Daily Demand (July 2015 – June 2018)	250 m^3/day
Distribution Details	
WINZ Distribution Zone Code	TEM004TE
Distribution Zone materials	95% Asbestos Cement (AC)

3.0 Introduction

The Te Mahoe Scheme is owned and operated by WDC and supplies a population of approximately 100 people. The water is sourced from one bore supply and treated for bacteria and protozoa before being circulated to consumers.

Administration of the scheme is carried out at the Council head office located at Commerce Street, Whakatāne. Treatment plant operators are stationed at the main Whakatāne Water Treatment Plant located at Valley Road, Whakatāne and travel to the Te Mahoe Scheme for routine testing and inspections and when required.

Key WDC personnel responsible for the management and operation of the scheme are as follows:

- General Manager Planning and Infrastructure (GM) – David Bewley
- Manager Three Waters (MTW) – Tomasz Krawczyk
- Manager Public Affairs (M-PA) – Ross Boreham
- Team Leader - Water Treatment Plant (TL-WTP) - Neal Yeates
- Water Treatment Plant Operator (WTP-O) – Ian Bowen / Bryan Vautier / Ross Dillon
- Team Leader - Three Waters Operations (TL-O) – Luke Shipton
- Team Leader - Three Waters Administration (TL-AS) – Helen Toby
- Team Leader - Three Waters Asset Management and Planning (TL-AM) - Michael Van Tilburg
- Asset Engineer - Three Waters (AE) – Diana Kim/ Joe Xie
- Senior Project Planner (SPP) – Nicholas Woodley
- Manager - Capital Projects (PM) – Jim Finlay
- Project Engineer - Three Waters (PE) – Leilani Salanguit

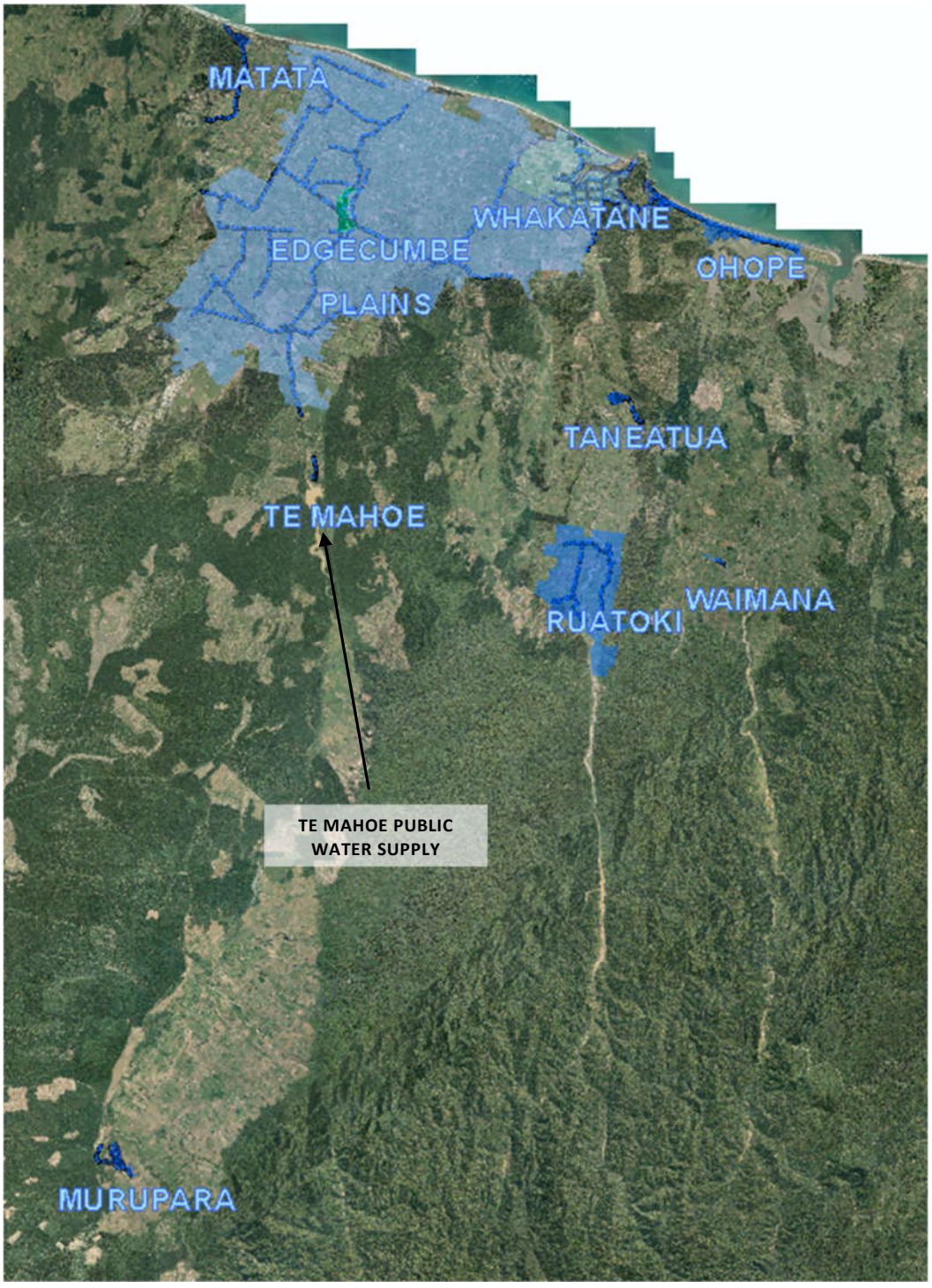

Figure 1: Whakatāne District

4.0 Description of Te Mahoe Water Supply

4.1 Scheme Details

The Te Mahoe water supply scheme was established in 1966 to supply the Te Mahoe village, a township formed to house workers working on the construction of the Matahina Dam. Population of the town reduced significantly after construction of the dam, leaving behind a system designed for a much larger population. The Te Mahoe Scheme was transferred to WDC in 2003 by Mighty River Power and is now owned and operated by WDC.

The scheme supplies all residents within the Te Mahoe water supply scheme boundary and has 28 connections[2] serving an estimated population of 100 people. The supply is mostly unmetered with two high-use consumer connections, one supplying the Te Mahoe school and another non-domestic connection supplying the Matahina Dam operations area. The remaining connections are domestic and supply residents of the village.

The average daily demand and maximum peak demand between July 2015 - June 2018 was 76 m^3/day and 250 m^3/day respectively. The water take consent is 50 m^3/day and administered by the Bay of Plenty Regional Council (BOPRC). In early 2018, Council undertook an investigation into the non-compliance and a number of factors have contributed to the exceedance, there ranging from: the power company using water during maintenance periods, Te Mahoe school filling 220 m^3 swimming pool, in accuracies with flow meter at the WTP. The non-compliance has been communicated to BOPRC along with progress steps on how it is being managed.

The consent (Consent Number 64943) expires in 2022 whereby a new water take resource consent will be required.

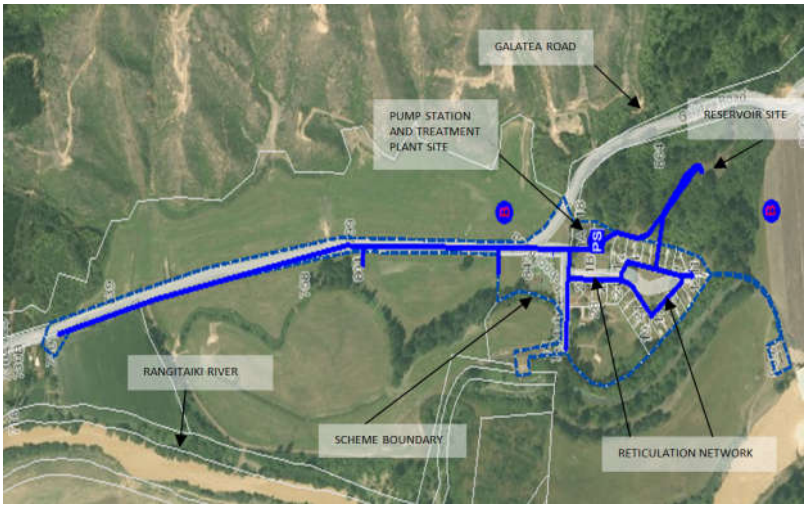

Figure 2: Te Mahoe Water Supply Scheme

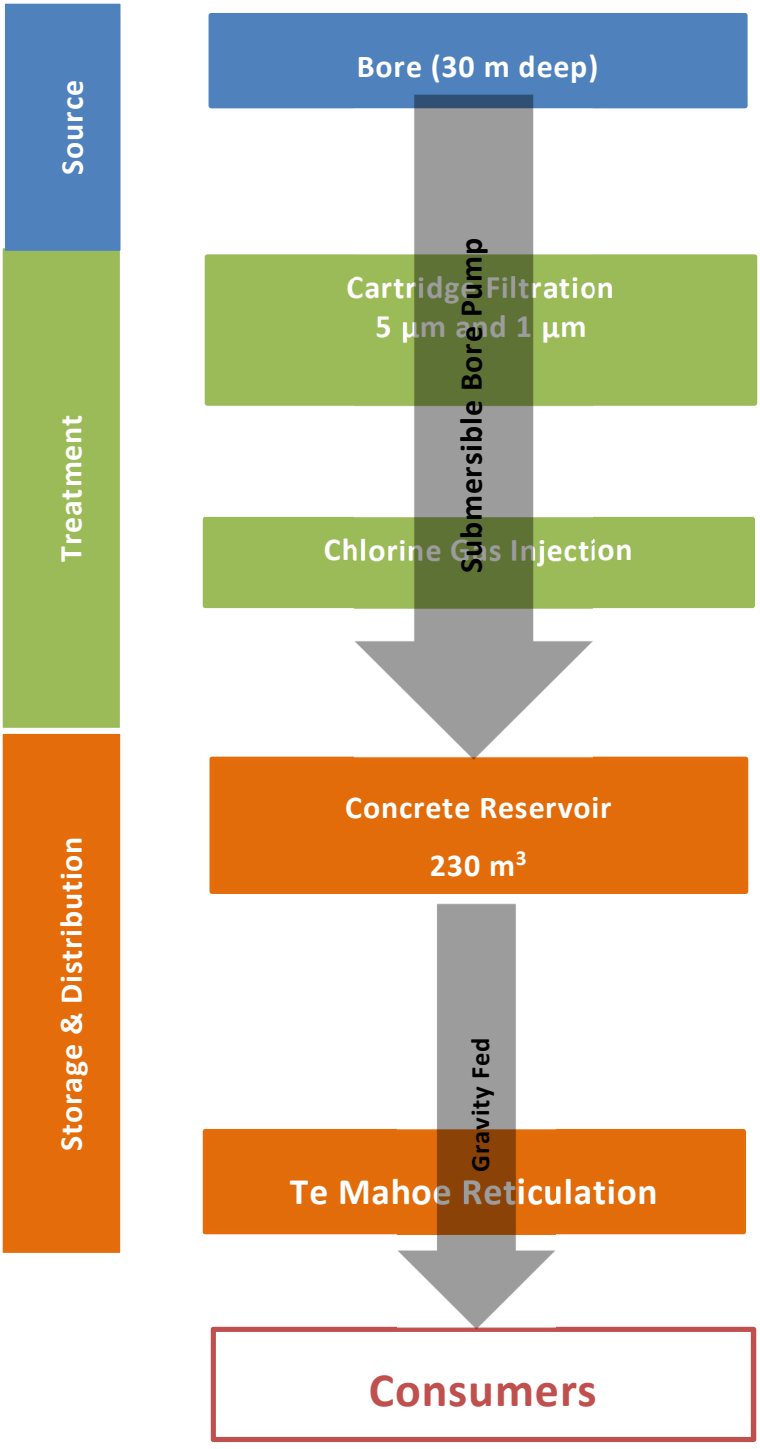

Figure 3: Schematic of Te Mahoe Water Supply Scheme

4.1.1 Water Source and Catchment

Water is abstracted from a bore located at the pump station/treatment plant site at Te Mahoe Village situated off Te Mahoe Village Road. The bore was drilled in 2007 to a depth of 30 metres below ground level (bgl) and is screened between 20.8 and 27 metres bgl.

A catchment risk assessment (CRA) carried out in September 2017 (PDP, September 2017) estimates that the bore recharges primarily from an aquifer that recharges from rainfall infiltration on the Rangitāiki River floodplain. A localised groundwater capture zone of 320 metres from the bore water supply has been identified (Appendix C) and activities within this capture zone considered to have an effect on the bore water quality are primarily forestry and agricultural activities.

One consented discharge, 260 metres north-west and downstream of the bore is for Council's municipal wastewater. An assessment of effects to groundwater and surface water carried out by URS (2014) shows that no changes occur to groundwater flow regime during Te Mahoe bore pumping. Therefore, this discharge is not considered to affect the bore water quality, along with its down-gradient position.

No HAIL activities are present within the groundwater capture zone. Further information on the activities within the Rangitāiki river catchment and localised groundwater capture zone can be found in the 'Catchment Risk Assessment for Te Mahoe Bore Water Supply, Whakatāne District Council' report (PDP, September 2017).

Figure 4: Bore Head and Container Housing for Treatment Equipment at Pump Station/Treatment Plant Site

Figure 5: Bore Head Works at Pump Station/Treatment Plant Site

A submersible pump pumps water from the bore through the water treatment plant to the storage reservoirs. There are no high lift or booster pumps in the system.

The site can experience prolonged outages of power during extreme weather conditions as power cables supplying the area run through forestry blocks and are therefore difficult to maintain (maintained by Horizons Network). However, there is sufficient storage capacity in the reservoir and site access is generally not restricted during extreme weather conditions; therefore the risk is considered manageable. A temporary generator owned by a local contractor is used to power the bore pump and treatment plant during prolonged outages.

The pump station/treatment plant site has no previous history of flooding and is situated above the modelled 1% AEP flood level[4] and is therefore not considered vulnerable to flooding.

4.1.2 Treatment

The treatment plant is located on the same site as the pump station and consists of gas chlorination followed by cartridge filtration.

Bacterial Compliance: The gas chlorination treatment available is capable of providing treatment to achieve full bacterial compliance requirements according to the DWSNZ 2008[5].

[4] Information received from Bay of Plenty Regional Council, August 2017.

[5] Drinking-water Standards for New Zealand 2005 (Revised 2008).

Protozoa Compliance: The protozoa treatment required of a log credit of 3 was assigned by the DWA in January 2018, further to the catchment risk categorisation carried out in September 2017[6]. The cartridge filtration treatment provides a protozoa log credit of 2 and therefore Te Mahoe Scheme is non-compliant for protozoa compliance requirements according to the DWSNZ 2008.

Since the establishment of the bore in 2007, water extracted has had high turbidity resulting in water run to waste for approximately 7 minutes at the start of pumping before passing through the treatment plant. The high turbidity has decreased over time as the bore settled and the run to waste time has decreased to approximately 4-5 minutes. High turbidity was experienced again in 2016 and investigations carried out concluded it was turbidity arising from stir up of leaked gland packing during construction which was unsettled due to high pump rates. The riser main was taken out with the bore pump and inspected by WDC; holes were found in the riser main which were attributed to corrosion. Subsequently, the riser main was replaced and the turbidity issue has since subsided with run to waste time returning to 4-5 minutes. A further CCTV inspection carried out by an independent contractor showed that the bore casing was intact.

The cartridge filtration treatment consists of a 5 µm cartridge and a 1 µm cartridge connected in series. The cartridges are replaced periodically depending on run-time which is recorded in a Log book. Disinfection of cartridge housing is carried out after each cartridge replacement and testing is carried out to check successful changeover by passing water at maximum flow rate through the cartridges and recording residual pressure. Cartridges are sourced from recommended suppliers and operated filtration unit is operated according to manufacturer's instructions. WTP operators are trained in operating and maintaining the cartridge system according to manufacturer's specifications and best practice.

Gas chlorination is provided via a chlorine gas cylinder with vacuum regulator/ chlorine injection and a weighing system.

A gas cylinder bottle weighs approximately 130kg which contains 70kg of chlorine gas. The cylinder is replaced once the weight reaches approximately 80kg. There are no additional chlorine cylinders stored on site; however, the cylinder weight is checked at least once a week by a treatment plant operator. Chlorine dose rate is set manually and there is no automatic flow proportional or water quality proportional dosing. Chlorine residual (Free Available Chlorine, (FAC)) leaving the treatment plant is monitored continuously and when it reaches outside operational limits the dose rate is adjusted manually to achieve the required FAC. During events that could change water quality such as during or immediately following storm events/earthquakes, treatment plant operators monitor the FAC levels frequently.

[6] Catchment Risk Assessment for Te Mahoe Bore Water Supply Report, PDP September 2017.

Regular maintenance and calibration of all water treatment plant equipment is carried out by WDC staff along with Log Records of dates they were carried out.

FAC, pH and Turbidity (NTU) are monitored continuously at the water treatment plant and the plant is designed to alarm when these parameters exceed set limits. Flow is measured continuously and differential pressures in the cartridges are measured twice a week. When certain parameters exceeded limits the plant automatically shuts down by cutting off power to the bore pumps. During some instances automatic shut -down of the plant is manually overridden by WDC to provide water to the scheme accompanied by relevant procedures such as boil water notices and appropriate notification to the DWA.

This is further discussed in Section 9.0 Process Control Summaries.

Figure 6: WTP Cartridge filtration and monitoring equipment within container housing

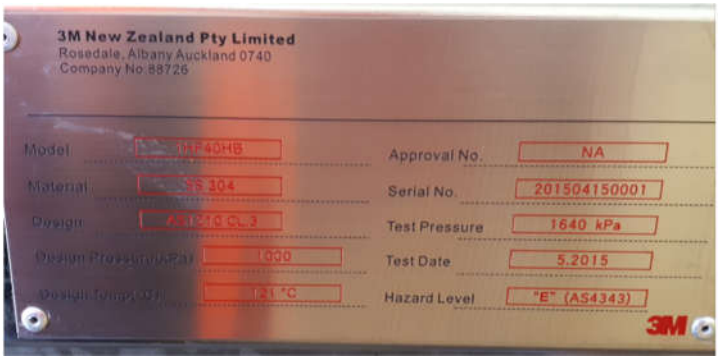

Figure 7: Te Mahoe filtration cartridge plate – model 1HF4OHB

4.1.3 Storage and Distribution

Treated water is pumped to a reservoir located nearby before being gravity fed to the Te Mahoe reticulation system. The reservoir is concrete with a capacity of 230 m^3 and storage available is sufficient to meet average daily demand and fire-

fighting flows and provide 24-hour emergency storage. Condition of the structural integrity of the reservoir is to be monitored and upgraded if required as it is reaching the end of its average useful life.

Figure 8: Concrete Storage Reservoir

The reticulated network consists 2.5 km of water pipes consisting of 2.1 km of watermains and 400 metres of rider mains. The majority of water pipes were laid in late 1960's with over 95% of the pipe material type being Asbestos Cement (AC) and thus the majority of water pipes are greater than 50 years old.

The Te Mahoe sewerage system is a reticulated network connecting the overflow of greywater from septic tanks located at individual properties within the village. Councils' contractors undertake cleaning of all the septic tanks within the village on a three-year basis and provide an inspection report outlining any septic tanks of concern. If any issues are found with the septic tank, Council programmes the rectification works to be undertaken. The latest inspection and cleaning of septic tanks commenced on 18 October and concluded 7 November 2018 with repairs undertaken where required. The level of exfiltration from wastewater network pipes to the ground is unknown. Council believes that the level of ground contamination as a direct result of septic tanks is of minor nature dew to the Council proactive arranged cleaning regime of all septic tanks in the village.

An in-house water balance carried out for the year 2017/18 according to the International Water Association (IWA) guidelines showed that the percentage of real water losses in the system was very high at 73% and the Infrastructure Leakage Index (ILI) was 9.84. The high leakage rates in the system poses risks of contamination in the water distribution network through backflow and through potentially contaminated soil, also there is an increasing risk of non-compliance

with the maximum water take conditions of the water take consent. Leak detection programmes are required to reduce the level of leaks and to stay within consented limits. The reticulation network is operated at approximately 500 kPa pressure and there are currently no plans to carry out pressure management in the Te Mahoe Scheme.

Although routine maintenance is carried out, a majority of the day-to-day operational work consists of reactive maintenance. Attention is required to develop appropriate routine maintenance schedules, procedures and protocols to ensure the system is maintained to optimise the lifecycle of the assets.

Backflow prevention devices are installed on the school and Matahina dam connection, however, no backflow prevention devices are installed on any domestic connections, as they are unmetered.

Currently no routine testing of existing backflow prevention devices is carried out. A dedicated WDC reticulation operator has recently obtained a certificate for backflow testing and is ready to undertake in-house testing once a backflow prevention policy and programme has been adopted by the Council.

There are some procedures currently in place for third party contractors/ developers working on WDC reticulation such as the extension of existing reticulation during subdivision developments. However, procedures need to be further developed, documented and strictly enforced in order to minimise risks arising from these works. It is noted that the Te Mahoe Scheme is a small scheme with relatively little work being carried out by third party contractors/developers on the network.

The isolated nature of the scheme has the potential for illegal connections to the reticulated network, therefore, implementation of a policy for identifying and dealing with illegal connections is required.

4.1.4 Monitoring & Control of Scheme

A combined telemetry and SCADA (Supervisory Control and Data Acquisition) system is used to transmit data from the remote sites of the Te Mahoe Scheme (Te Mahoe pump station/ water treatment site and reservoir site) to the WDC main control room at Valley Road, Whakatāne, where it is monitored and controlled by WDC staff.

Events causing signal failure from equipment such as power outages and malfunctioning of equipment trigger alarms via the SCADA/Telemetry system. Alarms can be seen on the control room monitors and are also delivered to operator mobile phones via text message.

Telemetry shows the bore pump status, flow rate from the bore and reservoir levels and the following parameters are continuously monitored for treated water quality leaving the treatment plant: Turbidity, pH, FAC and Flow.

Reservoir levels are monitored with the use of level sensors and the bore pump operates according to pre-set minimum and maximum reservoir levels in order to fill the reservoir.

Monitoring of water quality in the Te Mahoe reticulation system is carried out through routine manual FACE sampling (FAC and E.coli). Sampling is carried out in accordance with the DWSNZ 2008 sampling schedule.

Monitoring and control of the system is further discussed in Section 9.0.

4.2 Changes to the Scheme since last WSP Report

The following significant change has been carried out to the scheme since the previous WSP document:

- Change of chlorine supply from hypochlorite dosing to chlorine gas.

No other significant changes have been carried out to the abstraction, storage or reticulation network of the scheme since the previous WSP document.

5.0 Compliance with Drinking Water Standards

Bacterial, protozoal, chemical, radiological and cyanotoxin compliance requirements and compliance achieved for the year 2017/18 can be found in Table 4.

Te Mahoe Scheme received a MoH Grading of Ee in 2007 which was later upgraded to a Da in 2012. MoH recommends a grading of at least Cc for a drinking water supply of this size. An explanation of the grading given can be found in Table 3.

Table 3: MoH Grading for Water Supply Schemes	
Source and Treatment Grading: Assessment based on source and treatment factors:	
A1:	Completely satisfactory, negligible level of risk, demonstrably high quality.
A:	Completely satisfactory, extremely low level of risk.
B:	Satisfactory, very low level of risk when the water leaves the treatment plant.
C:	Marginally satisfactory, low level of microbiological risk when the water leaves the treatment plant, but may not be satisfactory chemically.
D:	Unsatisfactory level of risk.
E:	Unacceptable level of risk.
Distribution Zone Grading: Assessment based on reticulation condition, management, and actual water quality:	

Table 3: MoH Grading for Water Supply Schemes	
a1:	Completely satisfactory, negligible level of risk, demonstrably high quality; meets Aesthetic Guidelines and has ISO 9001:2000 accreditation.
a:	Completely satisfactory, extremely low level of risk.
b:	Satisfactory, very low level of risk.
c:	Marginally satisfactory, moderate level of risk.
d:	Unsatisfactory level of risk.
e:	Unacceptable level of risk.

Te Mahoe Scheme is assessed under Section 10.0 as a participating supply, water quality monitoring will be carried out according to section 10.4 of the DWSNZ 2008.

Council considers this a 'protected catchment' and Council's rational in this decision is due to:

- no livestock grazing is known within this township;
- the installation of a man-proof security fence surrounding the bore head and treatment facility;
- selective extraction of the water with controls in place for auto shutdown when high NTU's are experienced;
- water treatment is via cartridge filtration followed by chlorination.
- Councils monitoring and control of reticulated sewerage system and maintenance of individual village septic tanks.

Based on the Table 10.1 of the DWSNZ 2008, 'protected catchment' with controlled human access and no livestock Council will be reassessing the 'Catchment Risk Assessment of Te Mahoe Bore Water Supply' and updating where necessary.

When maximum acceptable values are exceeded or treatment failure is detected, Council will respond in accordance with Section 10.5.

Table 4: Te Mahoe Compliance Criteria (DWSNZ 2008)

Compliance Type/Location	Section of DWSNZ 2008	Monitoring Parameters	Sampling Frequency	Samples per year	Compliance Criteria	Compliance 2017/18
Bacterial Compliance						
Treatment Plant	Compliance Criterion 2A	FAC, pH, Turbidity	(per Section 4.3.2.1)	N/A	(per Section 4.3.2.1)	Compliant
Distribution Zone	Compliance Criterion 6A (Section 4.4.1)	E Coli	3 samples per quarter[1]	Required: 12 Taken: 12	<1 E coli per 100 mL sample	Compliant
Protozoal Compliance						
Treatment Plant	Section 5.12 (Table 5.4)	Turbidity	Twice a week	Number of samples with turbidity greater than 0.5 NTU does not exceed 2[1] Turbidity not > 1.0NTU in any sample. Turbidity does not exceed feed water turbidity in all samples.		Non-Compliant
		Flow	Daily	According to unit rating.		
		Differential pressure	Twice a week	Minimum differential pressure to always exceed the differential pressure corresponding to a clean filter established during commissioning.		
P2D Compliance						
Treatment Plant	No priority 2 Determinands assigned to this scheme.					
Distribution Zone	No priority 2 Determinands assigned to this scheme.					
Radiological Compliance						
Treatment Plant	Section 9.4	Alpha and beta emitting radionuclides and radon-222	Once every 10 years	Last undertaken October 2016		Compliant
Cyanotoxin Compliance						
Not applicable to bore water.						

Notes:1 According to Section 5.12.1 4b: Appendix A1.8, Table A1.4.

6.0 Critical Points and Barriers to Contamination

By considering both the existing Barriers to Contamination and Critical Points of the scheme it is possible to highlight areas in the scheme that require improvements.

Barriers to Contamination that are present in the Te Mahoe Scheme that eliminate, minimize or isolate contamination were identified and is presented in Table 5. A multi-barrier approach would provide the most robust system ensuring processes are in place to reduce contamination at each stage of the scheme.

As defined by the water safety plan guides, barriers should be present to achieve the following:

- To stop contamination of raw water;
- To remove particles from water;
- To kill germs; and
- To prevent recontamination of treated water.

Critical Points are areas in the scheme where there is potential for contamination or loss of supply of water. These were identified and presented in Table 6 and graphically in Figure 9.

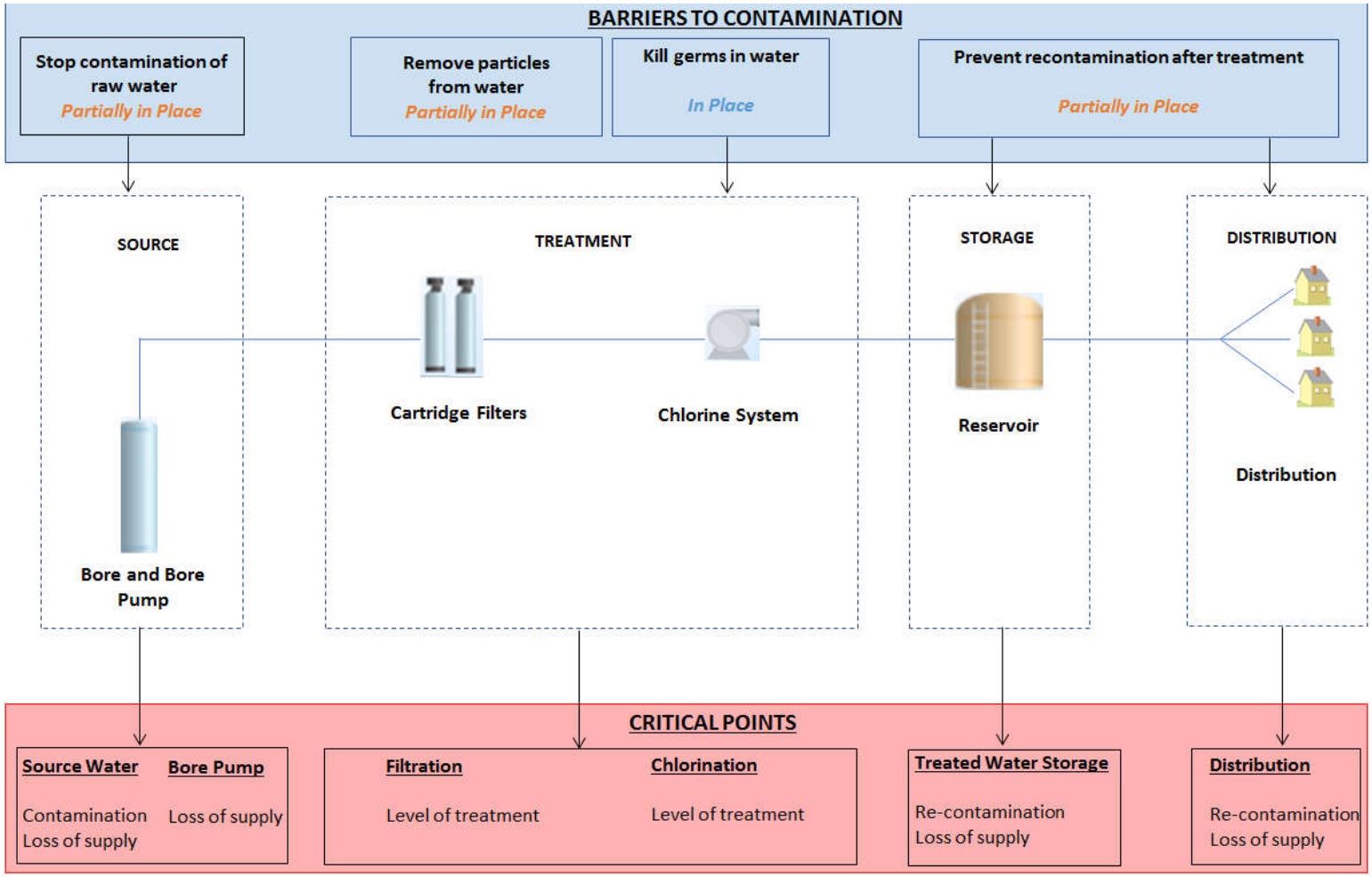

Figure 9: Barriers to Contamination and Critical Points of the Te Mahoe Scheme

Table 5: Barriers to Contamination	
Barriers to:	**Actions/Supply elements contributing to the barrier**
Stop contamination of raw water (At Source) ***Partially In Place***	• **Security of groundwater source: *In place*.** Semi-confined aquifer; not heavily influenced by activities in the catchment, however, a small risk of contamination still exists which is managed by Council. • **Abstraction point positioned and constructed to avoid contamination: *Partially in Place*.** Bore head has concrete apron; this is a village arrangement and no livestock grazing is undertaken, man-proof security fence surrounds the abstraction point and treatment facility. • **Source protected from contamination: *In Place*.** Catchment risk assessment carried out to identify activities in the catchment; ongoing monitoring of activities undertaken.
Remove particles from the water (Treatment) ***In Place***	• **Coagulation/Flocculation/Clarification or Dissolved air filtration: *Not required, Not in place*.** Selective extraction undertaken when NTU less than 0.9. High NTU water run to waste. • **Filtration: *In Place*.** Cartridge filtration in place, providing a log credit of 2.
Kill germs in water (Treatment) ***In Place***	• **Disinfection (Chlorine): *In place*.** Currently achieves bacterial removal required.
Prevent recontamination after treatment (Storage & Distribution) ***Partially In Place***	• **Measures to stop contamination of storage tanks: *Partially in place*.** Some measures in place. • **Maintenance of a disinfecting residual: *In place*.** Continuous FAC monitoring at treatment plant. FAC leaving treatment plant maintained within target limits. FAC manually sampled at different points of distribution. • **Actions taken to avoid contamination during distribution: *Partially in place*.** Some routine asset maintenance and asset replacements in place; these require further development along with current policies and procedures. • **Installation of backflow preventers: *Partially in place*.** Residential connections to be installed with check valves. BFP Policy being developed.

Table 6: Critical Points	
Critical Point	**Description**
Groundwater bores: Contamination of source supply	• Variable source water quality: Bores influenced by activity within groundwater capture zone due to unconfined nature of the aquifer. High turbidity experienced in groundwater after periods of heavy rains.
Groundwater bores: Loss of source supply	• Failure of bore pump leading to loss of supply. • Possible prolonged loss of supply due to power outages during extreme weather.
Chlorine Disinfection and Cartridge Filtration treatment	• Insufficient chlorine dosing resulting in harmful microbiological contaminants remaining in water. • Overdosing of chlorine leading to chemical contamination of water. • Insufficient particle removal by cartridge filtration system due to fluctuating source water quality and/or not maintaining adequate residual pressure. • Chlorination provides treatment sufficient for complete bacterial removal, however, cartridge filtration does not provide sufficient treatment for complete protozoal removal of log credit 3. • Insufficient maintenance of treatment equipment leading to failures and subsequent inadequate treatment. • Infrequent calibration and verification of equipment leading to false measurements of water quality.
Treated water storage	• Possible contamination of treated water storage in the concrete reservoir due to access by vermin and birds from overflow pipe. • Loss of structural integrity of reservoir leading to loss of supply.
Distribution system	• Insufficient routine maintenance such as flushing resulting in build-up of contaminants in the system. • Inadequate backflow prevention provided resulting in contamination of water. Not all connections have backflow prevention and no testing of existing devices is carried out at present. • Failure of distribution system components such as pipes, valves and hydrants due to lack of routine asset

Table 6: Critical Points	
Critical Point	**Description**
	renewals, resulting in contamination of water and loss of supply. • Inadequate maintenance procedures and policies in place to maintain the distribution system (including hygiene/disinfection procedures, procedures for contractors) resulting in contamination of distribution system. • High leakage rates in the distribution system leading to possible contamination of water through back flow. Increases risk of breach of consented takes (peak demand 250 m3/day, consented take 50 m3/day). • Possible illegal connections leading to contamination of network.

7.0 Risk Assessment Tables

Based on the Barriers to Contamination and Critical Points identified in Section 6.0, it is possible to identify 'Risk Events' that could occur in the Te Mahoe Scheme that has the potential to compromise public health by either contamination of water supply and/or loss of water supply.

These Risk Events are tabulated in the form of Risk Tables and grouped by Source, Treatment, Reservoirs and Distribution, and are found in Appendix A.

The '*Current Scenario*' section of the Risk Tables contain 'Preventative Measures' currently in place to prevent the Risk Event from occurring, and assesses the 'Current Risk' of the Risk Event occurring.

The '*To be Implemented*' section of the Risk Tables contain Preventative Measures that are to be implemented to reduce the Current Risk, and assesses the 'Residual Risk' of the Risk Event occurring once the new measures are implemented. The person/s responsible for the preventative measure/s to be implemented is also identified.

The Current Risk and Residual Risk were assessed according to the qualitative risk assessment methodology consistent with AS/NZS 4360:1999 Risk Management standard. The Likelihood scale (Table 7) and Consequence scale (Table 8) were defined and set by WDC staff according to how they perceived risks and the corresponding Risk Matrix (Table 9) was used to assign the level of Current Risk and Residual Risk as 'Low', 'Medium', 'High' or 'Extreme'.

Table 7: Likelihood Scale	
Almost Certain	Is expected to occur in most circumstances
Likely	Will probably occur (once in 1-2 Years)
Possible	Might occur (once in 5-10 Years)
Unlikely	Might occur (once in 10-20 Years)
Rare	Could occur (once in 50-100 Years)

Table 8: Consequence Scale				
	Loss of Supply	**Boil Water Notice**	**Illness**	**Operation Disruption**
Insignificant	Insignificant to none	None	No reported illness	Little disruption
Minor	Less than 1 hour	None. Aesthetic water quality event.	No reported illness	Manageable disruption
Moderate	Less than 4 hours	Up to 3 days. Water quality event that requires flushing.	No reported illness	Significant modification to normal operation
Major	Greater than 4 hours	Prolonged	Probable illness	Abnormal or cease of operation
Catastrophic	For 1 or more days	Prolonged	Severe illness and probable death	Complete failure of system

Table 9: Risk Matrix						
		Consequence				
		Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Likelihood	**Almost Certain**	High	High	Extreme	Extreme	Extreme
	Likely	Medium	High	High	Extreme	Extreme
	Possible	Low	Medium	High	Extreme	Extreme
	Unlikely	Low	Low	Medium	High	Extreme
	Rare	Low	Low	Medium	High	High

8.0 Improvement Plan

The Improvement Plan lists improvements to the Te Mahoe Scheme identified during the preparation of this WSP. Each item has been allocated to a person/ department that will be responsible for its implementation (Table 10) and the date by which WDC intends to carry it out.

Improvements are listed in order of Priority as follows: High Priority (Table 11), Medium Priority (Table 12) and Low Priority (Table 13).

Priorities were assigned by WDC based on the cost of implementation, the ease of implementation and the current risk to the Te Mahoe Scheme if the improvements are not carried out.

Table 10: Persons Responsible for Improvement Plan Items

Person Responsible	Code
General Manager Planning and Infrastructure	GM
Manager Three Waters	MTW
Team Leader - Water Treatment Plant	TL-WTP
Water Treatment Plant Operator	WTP-O
Team Leader - Three Waters Operations	TL-O
Team Leader - Three Waters Administration	TL - AS
Team Leader - Three Waters Asset Management and Planning	TL-AM
Asset Engineer - Three Waters	AE
Manager - Capital Projects	PM
Project Engineer - Three Waters	PE
Manager Public Affairs	M-PA
Senior Project Planner	SPP

Table 11: Improvement Plan – High Priority Items

Priority	Risk Table No.	Area of Work	Work To be Implemented	Responsibility	Estimated Cost/Time	Due by Date
1	**T4.1 (PM1)** **T5.1 (PM1)**	**Inadequate calibration and maintenance of treatment plant equipment**	WDC to review calibration and maintenance procedures of treatment plan equipment and incorporate into Operations and Maintenance manual with appropriate Standard Operating Procedures (SOP)	TL-WTP / WTP-O	8 hours	November 2018
2	**R4.1 (PM1)**	**Access by animals/birds**	Install a mesh on the overflow pipe.	TL-O	8 hours	November 2018
3	**D5.2 (PM1G)**	**Inadequate operating Procedures**	Review existing operating procedures and develop procedures that clearly define steps for each process, items to be recorded and objectives of the process, with reference to other documents.	TL-O/TL-WTP/WTP-O	40 hours	December 2018
4	**R2.2 (PM1)** **R4.2 (PM1)**	**Vandalism to reservoir structure**	Padlock to be installed on gate leading to reservoir site and fence to be re-instated.	TL-O	2 hours	December 2018
5	**S3.1 (PM1G)**	**Managing activities in the catchment**	WDC to liaise with pesticide application companies and make them aware of locations of water sources and to be informed of pesticide drops in vicinity of water source.	SPP / TL-AM	80 hours	December 2018
6	**S2.1 (PM4)** **S3.1 (PM3)**	**Managing activities in the catchment**	WDC to monitor activities within 250 metres of the water source. 1) To liaise with residential owners in the vicinity and make them aware of the effects of activities around the bore on water quality. 2) To liaise with forestry industries especially to ensure industry best practices are followed.	AE / TL-AM	240 hours	May 2019
7	**S3.4 (PM1)** **S3.5 (PM1)**	**Contamination of bore/well during construction**	Analysis concentration levels between 5 yearly chemical suite testing (undertaken 2013 and 2018), if variance investigate to do options. Record testing results for future comparison	TL-WTP / WTP-O	5 hours	May 2019
8	**D5.2 (PM2G)**	**Inadequate operating Procedures**	Review past documents, develop and implement SOP (Hygiene procedure) for WDC operations staff working on the water network; focus on preventing cross contamination when staff	TL-WTP/TL-O/TL-AS	4 hours	June 2019

Table 11: Improvement Plan – High Priority Items

Priority	Risk Table No.	Area of Work	Work To be Implemented	Responsibility	Estimated Cost/Time	Due by Date
			alternate on wastewater and water reticulation work. Hygiene Procedure to include sickness statement and returning to work.			
9	**S1.2 (PM1) T3.1**	**Power failure**	Investigate the installation and/or provision of a dedicated generator for this site to provide minimum flow requirement during power outage. Investigate alternative source prior to adoption of this option. For the interim, install dedicated generator plug-in point.	TL-AM	$5,000	June 2019
10	**D5.1 (PM1G)**	**Poor planning of scheduled work by WDC staff and their contractors**	Where possible utilise WDC Asset Management System to maintain an up-to-date database of critical users such as dialysis patients/hospitals/businesses. Develop robust process for critical customer rating and updating data to maintain active list.	TL-AM	20 hours	July 2019
11	**T5.5 (PM2)**	**Chlorine supply exhausted**	Arrange for installation of back up Chlorine bottle onsite	TL-WTP / WTP-O	5 hours	July 2019
12	**S2.2 (PM1)**	**Bore-head Security**	Check for 100 mm air gap at the reservoir. If absent, install a testable backflow preventer (double check) on bore head.	AE / PM	$15,000 / 2 hours	November 2019
13	**S2.2 (PM2)**	**Bore-head Security**	Refurbish boreheads to comply with DWSNZ 2008 and DWA requirements, as follows: Replace/renew concrete apron; sloping to prevent ponding of water around borehead, provide a bore casing seal and extend to at least 1 metre from the bore centre	AE / PM	$8,000	November 2019
14	**T4.4 (PM2G) T8.2 (PM1G) T8.3 (PM1G)**	**Inadequate Training Cartridge Filtration**	Develop training and competency system (T&CS) The T&CS to incorporate operators training for the replacement of cartridge for filtration systems	TL-AS / TL-WTP / WTP-O	80 hours	December 2019
15	**T4.2 (PM1)**	**Inadequate plant records and procedures**	Ensure all plant records such as manuals, drawings, procedures, emergency response plan, etc. are controlled documents within Council corporate record system and hard copy located at the Water Treatment Plant.	TL-WTP / WTP-O / TL-AS	20 hours + $500	December 2019

Table 11: Improvement Plan – High Priority Items

Priority	Risk Table No.	Area of Work	Work To be Implemented	Responsibility	Estimated Cost/Time	Due by Date
16	**T1.2 (PM1)**	**Insufficient protozoal treatment installed**	Stage 1 Investigate options of upgrading treatment plant and associated costings including installing UV to achieve 4 log credits.	TL-WTP / AE	20 hours + $2,000	December 2019
17	**D5.3 (PM1G) R4.2 (PM2)**	**Inadequate training and registers**	Review staff certificates and maintain updated training and health register. Develop a training and competency system for working on reticulated network.	TL-O / TL-AS / TL-WTP	20 hours + $500	December 2020
18	**S1.9 (PM1)**	**Resource consent limitations**	Apply for new water take consent in accordance with requirements (at least six months prior to expiry), consent expire 31/07/22.	SPP / AE / TL-AM	$60,000	December 2021
19	**S2.1 (PM2) T1.3 (PM2)**	**Managing activities in the catchment**	Catchment Risk Assessment undertaken September 2017. Programme activities to submit a catchment risk assessment to the DWA before 5 year period, for approval.	AE / TL-AM	240 hours	September 2022
20	**D1.1 (PM1G)**	**Contamination from backflow**	Develop and implement a backflow prevention policy to match device to risk level of activity, including testing requirements of the devices. This has political ramifications and will be difficult to implement thus long lead in time.	GM / MTW / M-PA / TL-AM	100 hours	December 2022
21	**T1.2 (PM1)**	**Insufficient protozoal treatment installed**	Stage 2 Programme and obtain budget to install recommended treatment pre options	TL-O / TL-WTP / TL-AM	$90,000 to $140,000	2022-2026 depending on cost and Council approval

Table 12: Improvement Plan – Medium Priority Items

Priority	Risk Table No.	Area of Work	Work To be Implemented	Responsibility	Estimated Cost/Time	Due by Date
1	**WSP**	**WSP Review**	Undertake WDC internal review of the WSP annually and report on improvement plan works that have been undertaken.	MTW / TL-WTP / TL-O / AE / TL-AM	24 hours	June (annually)
2	**D4.1 (PM2G)**	**Pressure fluctuations in the system**	Carry out a periodic water balance to identify levels of leakage in system.	AE	8 hours	August (annually)
3	**R4.1 (PM2)**	**Access by animals/birds**	Rodent stations have been installed, routine inspection of vermin/pest control to be included as part of reservoir inspection schedule	WTP-O	2 hours	November 2018
4	**S1.6 (PM1)**	**Natural disasters - Flooding and extreme storm events**	Removal of the large gum trees towering over the WTP.	TL-WTP	$2,500	November 2018
5	**T7.1 (PM1)**	**Short circuiting or lack of contact tank**	Review distribution sample points to ensure points of higher risks are covered and develop sampling point schedule (e.g. points furthest away from treatment plant, dead ends and points of low usage, points of high draw off, service reservoirs, old pipework, low pressure areas).	TL-WTP / TL-O / AE / TL-AM	8 hours	December 2018
6	**D1.1 (PM4G)**	**Contamination from backflow**	Review policy for withdrawing water from hydrants; specify the use of standpipes fitted with approved backflow preventers.	MTW / M-PA / AE / TL-O / TL-AM	4 hours	December 2018
7	**D1.1 (PM6G)**	**Contamination from backflow**	Develop and implement a policy to disconnect connections not in use, with special attention to connections provided to vacant lots during subdivisions.	MTW / M-PA / AE / TL-O / TL-AM	8 hours	December 2018
8	**D1.1 (PM7G)**	**Contamination from backflow**	Develop and implement a policy for identifying and dealing with illegal connections.	MTW / M-PA / AE / TL-O / TL-AM	4 hours	December 2018
9	**D1.1 (PM3G)**	**Contamination from backflow**	Circulate educational material to customers, especially those considered high risk, about risks of backflow prevention and ways of minimising the risk.	AE / M-PA	4 hours	December 2019

Table 12: Improvement Plan – Medium Priority Items

Priority	Risk Table No.	Area of Work	Work To be Implemented	Responsibility	Estimated Cost/Time	Due by Date
10	**D6.1 (PM4G)**	**Third party contractor/developer work on WDC reticulation (not directly engaged by WDC)**	WDC to develop policy and procedure whereby Third party contractors/developers are made liable for any damages to the network to increase accountability.	TL-O / AE / TL-AM	40 hours	December 2018
11	**R4.4 (PM1)**	**Entry of contaminants due to reservoir design**	Check 'as-builts' and programme trial run to ensure reservoir can be isolated for cleaning or in case of contamination/loss of structural integrity.	TL-WTP / WTP-0 / TL-O / AE	8 hours	May 2019
12	**D4.1 (PM4)**	**Pressure fluctuations in the system**	Install metering on all service connections.	AE / PM	$20,000	October 2019
13	**D1.1 (PM2) D4.1 (PM7)**	**Contamination from backflow**	Install backflow prevention devices on all connections; priority given to connections identified as high risk. Dual check manifolds shall be installed on residential connections as part of the meter installation programme.	AE / PM	$5,000	October 2019 (subject to Council Policy)
14	**T8.4 (PM1)**	**Cartridge Filtration**	Recorded log records to be detailed and located in corporate system for review upon request	TL-AS / TL-WTP / WTP-O	80 hours	December 2019
15	**S1.7 (PM1)**	**Natural disasters - Flooding and extreme storm events**	Develop a disaster management plan for the water supply which could be included as part of a wider disaster management plan for the district.	MTW	120 hours	December 2019
16	**D4.1 (PM3) S1.9 (PM2)**	**Pressure fluctuations in the system**	Undertake leak detection programme once water meters installed on all connections and programme for leaks to be fixed as matter of urgency.	AE / TL-O	20 hours + M & R costs	December 2019

Table 12: Improvement Plan – Medium Priority Items						
Priority	**Risk Table No.**	**Area of Work**	**Work To be Implemented**	**Responsibility**	**Estimated Cost/Time**	**Due by Date**
					depending on works	
17	**D3.1 (PM2G)**	**Pipe, valve and hydrant failure due to age, condition and material of pipe**	Update water asset management plan as required and republish every 3 years.	TL-AM / AE	Per system	June 2021
18	**T4.3 (PM2G)**	**Water Operator Authorisation assessment**	Water Operator Authorisation. Authorisation assessments by DWA were undertaken with WDC operators in September 2018. The next assessments will be carried out in 2021.	TL-WTP / WTP-O	8 hours	August 2021
19	**T1.4 (PM1)**	**Other - Insufficient pH treatment**	Investigate options to install pH correction and cost benefit of installation of pH correction. If feasible budget and programme for works to occur	PM / TL-AM	60 hours	June 2022
20	**T5.5 (PM2)**	**Chlorine supply exhausted**	Investigate options to install auto changeover of chlorine bottles and cost benefit of installation. If feasible, budget and programme for works to occur	PM / TL-AM	5 hours/ $8,000	June 2023

Table 13: Improvement Plan – Low Priority Items

Priority	Risk Table No.	Area of Work	Work To be Implemented	Responsibility	Estimated Cost/Time	Due by Date
1	**D2.1 (PM1G)** **D2.1 (PM2G)** **D2.2 (PM3G)** **S1.3 (PM1)** **S2.2 (PM3G)** **R2.1 (PM2)** **T4.1 (PM3G)**	Poor circulation in network Bore Pump failure Bore-head Security	Utilise Asset Management System to schedule and monitor preventative maintenance. Utilise Asset Management System to schedule the maintenance, verification and calibration of treatment plant equipment.	TL-AS / TL-O	20 hours	March 2019
2	**T8.1 (PM2)**	**Cartridge Filtration**	Identify correct cartridge/s (and suppliers) required for filtration unit and utilise Asset Management System for renewals / replacements	TL-WTP / TL-AS / AE	20 hours	March 2019
3	**D2.2 (PM1)**	**Inability to isolate or shut down the system**	Carry out a routine maintenance plan for valve exercising with priority given to critical valves i.e.-those supplying a large or critical customer base, valves on rising and falling mains and those used for bore and reservoir isolation.	TL-AS / TL-O	12 hours	March 2019
4	**R4.3 (PM1)**	**Sediment/slime accumulation and resuspension of sediment.**	Utilise Asset Management System to schedule and implement a CCTV inspection of reservoirs and vacuum cleaning programmes as required.	TL-AS / TL-O	4 hours	April 2019
5	**T6.1 (PM1)**	**Over chlorination**	Undertake WTP site assessment to determine that all practical measures are in place via Electrical, Mechanical and Physical to avoid overdosing with particular emphasis on possibility of syphoning. Details to be recorded of the assessment and any recommendations	TL-WTP / WTP-O	4 hours	April 2019
6	**T6.1 (PM2)**	**Over chlorination**	Develop supply specific flushing plan to be implemented when treatment plant over doses and include in WTP operations manual	TL-WTP / WTP-O / TL-O	4 hours	April 2019
7	**T1.4 (PM2G)**	**Other - Insufficient pH treatment**	Plumb solvency - Inform wider community and consumers about the use of copper pipes and fittings (including lead jointing) for internal plumbing by circulating information flyer and notification on Council Website	M-PA / AE	40 hours + $1,000	April 2019

Table 13: Improvement Plan – Low Priority Items

Priority	Risk Table No.	Area of Work	Work To be Implemented	Responsibility	Estimated Cost/Time	Due by Date
8	**D5.1 (PM3G)**	**Poor planning of scheduled work by WDC staff and their contractors**	Maintain a systematic workflow procedure with control checks for the update of capital works arising from projects, subdivision work and daily replacements and renewals so that all paperwork is sent to the asset engineer for recording on Asset Management System and GIS.	AE / TL-AM	20 hours	April 2019
9	**D4.1 (PM5G) D5.1 (PM2G)**	**Pressure fluctuations in the system**	Develop and adopt internal procedure for maintaining an up-to-date Asset Management System and GIS system.	AE / TL-AM	40 hours	August 2019
10	**R2.1 (PM1)**	**Loss of structural integrity of reservoirs**	Carry out condition assessment of all concrete reservoirs in 2019 and formulate a condition assessment programme thereafter.	AE	$2,000	December 2019
11	**D2.2 (PM2)**	**Inability to isolate or shut down the system**	Undertake a programme of marking valve boxes for ease of location and to indicate whether they are open or closed.	AE / TL-O	40 hours	December 2019
12	**T4.4 (PM1)**	**Inadequate training of staff**	All treatment plant operators to complete appropriate qualification for water treatment plant. WDC to keep records of training and produce when requested.	MTW / TL-WTP	$3,000	December 2021
13	**D4.1 (PM1)**	**Pressure fluctuations in the system**	Identify problem pressure areas by carrying out model network analysis coupled with customer complaint records.	AE	20 hours + $2,000	December 2020
14	**D3.1 (PM1G)**	**Pipe, valve and hydrant failure due to age, condition and material of pipe**	Develop asset renewals programme based on condition sampling and assessments, analysis of asset age, material, frequency of breakages and increase in maintenance costs. Asset renewals to prioritize critical assets such as rising mains/falling mains, pipes supplying a critical consumers or large consumer base, critical valves and hydrants.	AE / TL-AM	240 hours	June 2022
15	**S2.1 (PM4) S3.1 (PM5G)**	**Managing activities in the catchment**	Team Leader - Three Waters Asset Management and Planning to provide input into next version district plan (WDC) and regional plan (BOPRC) with regards to protection of catchment; input into activities such as sediment control from earthworks and riparian strip management.	SPP / TL-AM	240 hours	December 2026

9.0 Process Control Summaries

Several parameters within the water supply scheme known as 'Control Parameters' are routinely monitored by the operators to ensure the system is operating within the prescribed 'Target Range'. When any of these Control Parameters exceed the Target Range and reach 'Action Limits' or 'Critical Limits', the operator/s are required to undertake 'Corrective Actions' to restore the system back to the prescribed Target Range.

Effective process control occurs when operators are aware of the Target Range, the Corrective Actions required to be taken and who is responsible for carrying them out. Therefore it is recommended 'Process Control Summaries' are used as a guide by WDC treatment plant operators in day to day operations.

Table 14: Process Control Definitions	
Critical Control Points (CCP)	Points and processes in the Te Mahoe Scheme that can be controlled to prevent contamination of water.
Control Parameters (CP)	Parameters that can be measured and monitored in order to determine if a process is performing as required.
Target Range	Desired range within which each CP is required to operate in the normal day-to-day operation of the system.
Action Limits and Critical Limits	When CPs reach these limits Corrective Actions are required to be carried out by persons responsible to bring CPs back within the Target Range.
Corrective Actions	Actions to be carried out when CPs reach Action Limits and Critical Limits.
Process Control Summaries (PCS)	Target Range, Action Limits and Critical Limits for CPs and a list of corrective actions to be taken when CPs reach Action Limits and Critical Limits, along with person/s responsible for carrying them out.

Figure 10 shows the Critical Control Points (CCPs) of the Te Mahoe Scheme and the Control Parameters that shall be monitored and measured at each CCP.

Process Control Summaries have been prepared for the Treatment CCPs of the Te Mahoe Scheme. Process control summaries have not been prepared for the Source, Storage and Distribution CCPs further to guidance from the DWA.

A description of each Treatment CCP can be found in Sections 9.1 (Filtration) and 9.2 (Chlorination) and Appendix B sets out Process Control Summaries for each of the Treatment CCPs.

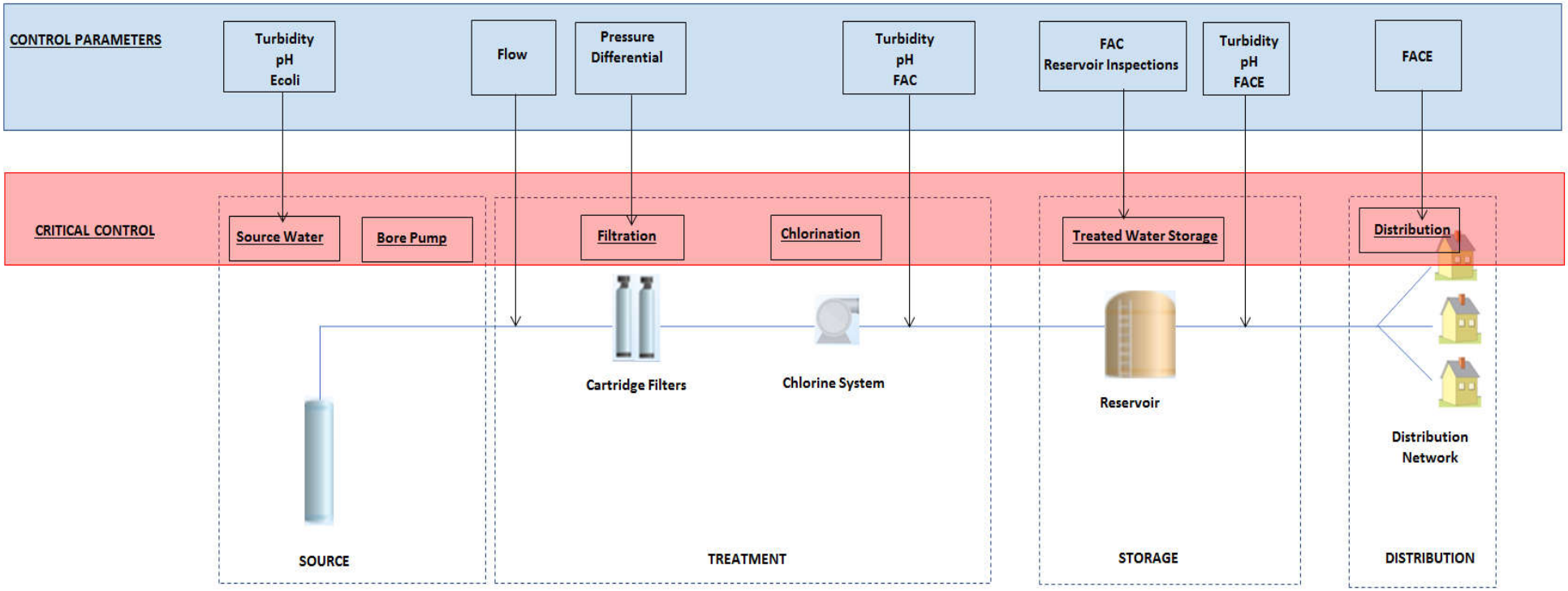

Figure 10: Critical Control Points and Corresponding Control Parameters for the Te Mahoe Scheme for Source, Treatment, Storage and Distribution

9.1 Critical Control Point: Cartridge Filtration (Particle Removal)

Process Objectives:

- Provide a particle removal critical control point to remove suspended particles containing pathogens that may have entered upstream of dosing point.

Process Location:

- Cartridge filter unit situated after the bore uptake and upstream of chlorine dosing system.

Parameters and day-to-day monitoring:

- Flow (m^3/hr) – Continuous monitoring through magnetic flow meter connected to SCADA via Telemetry. Flow rate to be within the rating specified on the cartridge filters.
- Turbidity (NTU units) – Continuous monitoring through turbidity meter connected to SCADA and Telemetry.
- Pressure Differential (KPa) – Manual monitoring, twice a week.

Parameter Monitoring Points:

- Pressure differential is monitored by two pressure gauges, one situated before and the other situated after the cartridge filter unit.
- Turbidity and Flow are both monitored immediately upstream of the filtration unit.

Process Records:

- Manual: WTP Log book, weekly and monthly sheets, manual sampling sheets, differential pressure record logs.
- Online: SCADA system to record and display data, Drinking Water Online system to record information that can be accessed by the MoH for compliance.

Process Controller:

- WDC water treatment plant operator on duty.

Supporting Programmes:

- Daily checks and calibration of monitoring instruments.
- Training and competency assessment of operators in cartridge filter unit operation and changing of cartridges, and turbidity monitoring.

9.2 Critical Control Point: Chlorination (Primary Disinfection Treatment)

Process Objectives:

- Provide a primary disinfection critical control point to inactivate bacterial, viral and some protozoan pathogens that may have entered upstream of dosing point.
- Provide residual disinfection quality control pit to help inactivate pathogens entering downstream of the dosing point.

Process Location:

- Chlorine dosing system located downstream of raw water intake, after cartridge filtration unit.

Parameters and day-to-day monitoring:

- Turbidity (NTU units) – Continuous monitoring through turbidity meter connected to SCADA and Telemetry.
- pH (pH units) – Continuous monitoring through pH meter connected to SCADA and Telemetry.
- Free Available Chlorine (FAC, mg/L) – Continuous monitoring

Parameter Monitoring Points:

- All three parameters (Turbidity, pH and FAC) are monitored immediately downstream of the chlorine injection point.

Process Records:

- Manual: WTP Log book, weekly and monthly sheets, manual sampling sheets.
- Online: SCADA system to record and display data, Drinking Water Online system to record information that can be accessed by the MoH for compliance.

Process Controller:

- WDC water treatment plant operator on duty.

Supporting Programmes:

- Daily checks and calibration of monitoring instruments.
- Periodic checks of currency of reagents and discarding of outdated reagents.
- Training and competency assessment of operators in equipment operation and monitoring.

- Lab verification checks for *E. coli* with transgression reporting to Operator and DWA if results are outside DWSNZ 2008.

10.0 Contingency Plans

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

If an event occurs despite preventive and corrective actions being in place, WDC is to consult with the Medical Officer of Health to assess the seriousness of the event.

Table 15: Contingency Plans

Event	Actions	Responsibility
Microbiological and/or Chemical contamination of source as a result of, but not limited, to the following: • High rainfall events • Change of activity in the catchment • Accidental spills	Plant to shut down by shutting off pumps when parameters exceed set limits (FAC, pH, Turbidity)	Operations
	Water to be diverted or sent to waste when parameters exceed set limits (FAC, pH, Turbidity)	Operations
	Isolate source – through turning the pump off.	Operations
	Carry out manual dosing – as per WTP reservoir dosing procedure.	Operations
	When directed by MTW or DWA notify customers using M-PA department appropriate communication plan e.g. Boil water notice. • High risk customers to be notified as a priority.	Public Affairs/ Operations
	Carry out increased monitoring according to DWSNZ 2008.	Operations
	Notify the DWA of event.	Operations
	Carry out following depending on nature of event: • Investigate changes to activities in the catchment. • If accidental spill contain the spill.	Operations
	Carry out flushing of reservoirs and distribution system that may be affected via supply specific flushing plan	Operations
Following in water leaving treatment plant: E coli, low FAC, High Turbidity, but not limited to, the following: • Malfunctioning equipment/sensors	Plant to shut down by shutting off pumps when parameters exceed set limits (FAC, pH, Turbidity)	Automatic/ Operations
	Water to be diverted or sent to waste when parameters exceed set limits (FAC, pH, Turbidity)	Automatic/ Operations
	Inspect and calibrate/verify/carry out maintenance on treatment plant equipment	Operations
	Recalculate dose rates for chlorine.	Operations
	Notify DWA of the event.	Operations
	Carry out increased monitoring according to DWSNZ 2008.	Operations

Table 15: Contingency Plans

Event	Actions	Responsibility
Following in distribution system: E coli, low FAC, High Turbidity as a result of, but not limited to, the following: • Backflow into system • Insufficient FAC residual in water leaving treatment plant • Leaks in system • Inadequate maintenance of distribution system leading to slime build up, leaching and poor circulation.	Carry out appropriate actions when treatment parameters deviate from target limits (FAC, pH, Turbidity)	Operations
	Isolate parts of the system including reservoirs. Isolate sections of the distribution network and reservoirs through manual valve isolation.	Operations
	Carry out manual dosing of the network, where required.	Operations
	When directed by MTW or DWA notify customers using M-PA department appropriate communication plan e.g. Boil water notice. • High risk customers to be notified as a priority.	Public Affairs/ Operations
	Carry out increased monitoring according to DWSNZ 2008.	Operations
	Notify the DWA of event.	Operations
	Where appropriate, carry out flushing of reservoirs and distribution system that may be affected.	Operations
	Undertake the following depending on nature of event: • Identify and fix leaks in the system and instruct customers to carry out the same on private property reticulation.	Operations
Loss of Supply of Source Water: • Prolonged loss of supply due to leaks, insufficient storage, loss of reservoir structural integrity, unplanned maintenance, pump breakdown • Seasonal loss of supply	Procedure for sourcing water from emergency supply: alternative groundwater/surface water supply or providing tankered water.	Operations
	When directed by MTW or DWA notify customers using Public Affairs Department appropriate communication plan e.g. Boil water notice. • High risk customers to be notified as a priority.	Public Affairs/ Operations
	Notify the DWA for loss of supply over 8 hours.	Operations
	Monitor reservoir levels.	Operations
	Demand management plan for seasonal loss of supply (including water conservation notice).	Operations
	Provide extra temporary storage if possible.	Operations
Loss of Supply and Contamination of water due to natural disasters and high rainfall events	Undertake contingency plan as per civil defence emergency appropriate to the scenario.	Operations
	Procedure for sourcing water from emergency supply: alternative groundwater/surface water supply or providing tankered water.	Operations
	Increased monitoring according to DWSNZ 2008.	Operations
	Notify DWA of the event.	Operations
	Carry out inspections of the components of the intake/pumps, treatment plant, reservoirs and distribution system for structural integrity.	Operations

11.0 Methodology and Consultation

This WSP has been prepared consistent with the approaches recommended by the Ministry of Health.

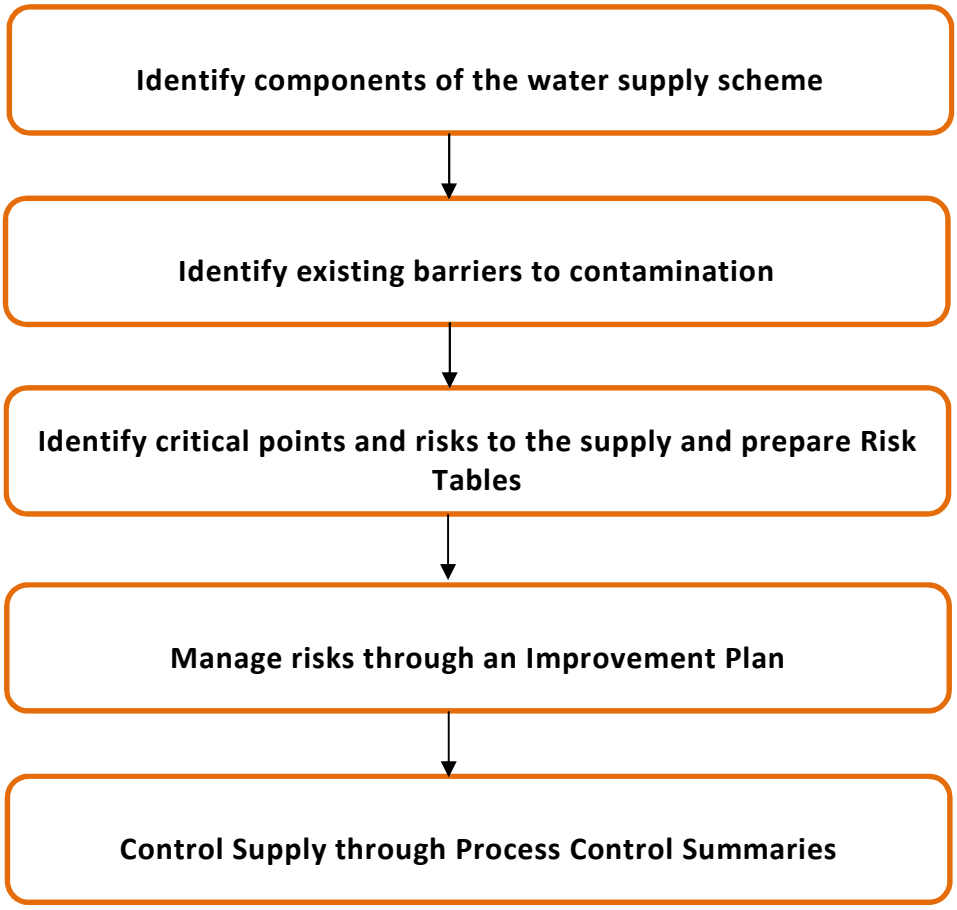

Figure 11: Methodology

The following supporting documents published by the Ministry of Health have been used in the preparation of this report:

- The series of "Water Safety Plan Guides for Drinking Water Supplies (2014)".
- The document "A Framework on How to Prepare and Develop Water Safety Plans for Drinking-water Supplies (2014)".

Information used in this report has been gathered as follows:

- Documents and reports:
  - Water Asset Management Plans (WDC).
  - Asset condition assessments for reservoirs and pipes (WDC).

  - Various Council Policies and Procedures (WDC).
  - Maintenance checklists and schedules (WDC).
  - Council Annual Plan and Long Term Plan (WDC).
  - Drinking Water Assessor Compliance Reports and PHRMP verification reports (DWA, Ministry of Health).
  - Reservoir cleaning and structural assessments (WDC).
  - Catchment Risk Assessment for Te Mahoe bore Water Supply Report (September 2017, PDP).
- Site Visits carried out by PDP to the following locations on the 17 July 2017: Te Mahoe treatment plant and pump station site, Te Mahoe reservoir site (Appendix D: Te Mahoe Scheme Reservoir Inspection Sheet).
- Consultation workshop carried out by PDP with participation of WDC, 2 September 2017.

The consultation workshop was facilitated by Sala Ranasinghe (Senior Environmental Engineer) from PDP with the participation of key WDC personnel.

The following key WDC personnel participated in the workshop and contributed to the information provided in this report:

Gareth Phillips – Manager Three Waters Operations (position held up till May 2018); Neal Yeates – Team Leader Water Treatment Plant; Luke Shipton – Team Leader Operations; Leilani Salanguit – Project Engineer; Inka Krawczyk – Project Engineer; Michael Van Tilburg – Team Leader Three Waters Assets Management and Planning; Joe Xie – Asset Engineer Three Waters Assets Management and Planning.

The aim of the workshop was to identify risks to the Te Mahoe Scheme as experienced by the operators of the scheme based on historical events and their knowledge of the scheme, and putting in place improvement measures to manage risks that are not currently managed.

The qualitative risk assessment was carried out using the AS/NZS 4360:1999 Risk Management Standard approach. A Likelihood scale and Consequence scale was defined and set by WDC staff according to how they perceived risks, and the corresponding risk matrix was used to assign risks to events.

The Improvement Plan was ranked by WDC in order of priority, taking into account current risks to the Te Mahoe Scheme if not implemented along with the cost of implementation.

Appendix A: Te Mahoe Scheme Risk Tables

Table 16: Source – Catchment and Bores

No	Cause	Indicators	Current Scenario			To Be Implemented		
			Preventative measures in place	Risk Managed?	Current Risk	Preventative measures to be put in place ('G' reference after PM number refers to Generic item across all Whakatāne Water Safety Plans)	Residual Risk	Responsibility
S1: EVENT: LOSS OF BORE WATER SUPPLY								
S1.1	Insufficient source water due to seasonal variations/drought (low levels in the river or water tables).	• Reduced or no flows. • Drop in system pressure. • Customer complaints about low pressure.	• Seasonal variations in bore water not experienced at this site.	Yes	Low (Rare x Minor)	N/A	N/A	N/A
S1.2	Power failure	• Power failure alarms. • Reduced or no flows.	• Possible prolonged loss of power supply due to disruptions to power managed by Horizon Networks Power (out of control of WDC). **PM1:** Generator hired from local contractor and taken to site when required. **PM2:** Sufficient storage available in reservoirs. **PM3:** Power failure is detected by SCADA via telemetry; alarms on the SCADA screen and text messages to operator phones	Partially	Extreme (Almost Certain x Moderate)	**PM1:** Investigate the installation and/or provision of a dedicated generator for this site to provide minimum flow requirement during power outage. Investigate alternative source prior to adoption of this options For the interim, install a dedicated generator plug-in point	High (Almost Certain x Insignificant)	**PM1:** TL-O / AE / PM
S1.3	Bore pump failure	• Pump failure alarms. • Reduced or no flows.	**PM1:** Regular bore maintenance carried out. **PM2:** Sufficient storage available in reservoirs.	Yes	Low (Possible x Insignificant)	**PM1:** Utilise Asset Management System to schedule and monitor preventative maintenance.	Low (Possible x Insignificant)	**PM1:** TL-AS
S1.4	Damage to bore headworks and pumping equipment/wiring due to vandalism and/or vermin and animals.	• Visual damage to intake/pump equipment/ electrical cables. • Reduced or no flows from bore. • No signal or no readings received from equipment and/or equipment failure.	• No vandalism experienced at this site previously. • Headworks exposed. **PM1:** Security fence installed around source. **PM2:** Treatment plant equipment placed inside a locked container housing. **PM3:** Site visited weekly for sampling and inspection.	Yes	Low (Rare x Minor)	N/A	N/A	N/A
S1.5	Restricted access to bore site due to absence of right of access.	• Restricted access to site during normal operating conditions.	• Bore/treatment plant site situated on an easement and WDC has no restrictions to access the site.	Yes	Low (Unlikely x Minor)	N/A	N/A	N/A

Table 16: Source – Catchment and Bores

No	Cause	Indicators	Current Scenario			To Be Implemented		
			Preventative measures in place	Risk Managed?	Current Risk	Preventative measures to be put in place ('G' reference after PM number refers to Generic item across all Whakatāne Water Safety Plans)	Residual Risk	Responsibility
S1.6	Natural disasters – Flooding and extreme storm events.	• Restricted access to site. • Inability to operate and maintain equipment.	• Site not in 1% AEP flood inundation zone and no historic flooding on this site. No problems with access in general during extreme storm events. • There are large gum trees overhanging the Water Treatment Plant and Bore site which may become issue during storm events staff are monitoring for any signs of deterioration	Partially	Medium (Rare x Moderate)	**PM1**:Removal of the large gum trees towering over the WTP	Low (Unlikely x Minor)	**PM1**: TL-O / TL-AM
S1.7	Natural disasters – slips and earthquakes.	• Restricted access to site. • Inability to operate and maintain equipment.	• No access issues to the site unless road is rendered unusable due to an earthquake	Yes	Low (Rare x Minor)	**PM1:** Develop a disaster management plan for the water supply which could be included as part of a wider disaster management plan for the district.	N/A	**PM1**: MTW / TL-O / TL-WTP
S1.8	Clogged bore screen/s	• Reduced or no flows.	Clogged bore screen not experienced at this bore. **PM1**: CCTV carried out on bore casing in 2015 during water turbidity investigation; no clogging of bore was observed. Pump casing was replaced due to bad condition/corrosion.	Yes	Low (Possible x Insignificant)	N/A	N/A	N/A
S1.9	Resource consent limitations	• Loss of right to abstract water. • Increase in take compared to extraction limit granted.	• Consent expires 31/07/2022; application to be made for new water take beforehand to reduce risk in delay of consent issue. • High leak rates in scheme (percentage of real water losses in the system was 73% and the Infrastructure Leakage Index (ILI) was 9.84) therefore consented take has been breached historically. **PM1:** Consent management System currently in place to alert when consents are nearing expiration (CS/VU system).	Yes	Extreme (Unlikely x Catastrophic)	**PM1:** Apply for new water take consent in accordance with requirements (at least six months prior to expiry) **PM2:** Undertake leak detection programme once water meters installed on all connections and programme for leaks to be fixed as matter of urgency.	High (Rare x Catastrophic)	**PM1:** SPP/AE/TL-AM **PM2:** AE/PE

Table 16: Source – Catchment and Bores

No	Cause	Indicators	Current Scenario			To Be Implemented		
			Preventative measures in place	Risk Managed?	Current Risk	Preventative measures to be put in place ('G' reference after PM number refers to Generic item across all Whakatāne Water Safety Plans)	Residual Risk	Responsibility
S2: EVENT: MICROBIAL CONTAMINATION OF BORE WATER								
S2.1	Discharge/leachate/runoff from the following activities in the catchment: **Forestry:** Sewage from sludge application. **Industry:** Wastewater discharges from industrial processes, biological washwater. **Human activities**: Wastewater discharge from human activities to land or water i.e. on-site disposal and septic tank. **Feral animals:** faecal matter. **Contaminated sites and landfill sites** **Other:** Stormwater runoff, construction sites, abandoned/unused bores	Water not compliant with DWSNZ 2008: • Median E. coli count over 12 months is more than 500/100 ml • Concentrations of health significant determinands, agrichemicals and other contaminants more than 50% of their MAV in the source water. • Unsatisfactory practices being used in farming and forestry activities, especially related to fertiliser application and sediment control.	• **Recharge zone:** Primary recharge from rainfall seepage (320 metre groundwater capture zone). **Activities**: Land use predominantly forestry. Bore site situated in the Te Mahoe village compound. No industrial activities within the immediate vicinity of the bore and no livestock grazing. Consented effluent discharge downstream from bore and considered not to affect bore water according to publication by URS (2014, WDC document). • Councils' contractors undertake the cleaning and inspection reporting of all the septic tanks within the village on a three-year basis. The latest inspection and cleaning was undertaken October 2018 and next schedule will be in 2021. **PM1 & PM2:** Catchment risk assessment carried out in 2008 and most recently in 2017. Through the assessment, WDC has developed an understanding of the extent of the recharge zone and nature of activities in it.	Partially	Medium (Rare x Moderate)	**PM1:** Monitor changes in activities in the catchment and modify catchment risk assessment annually. **PM2:** Submit a catchment risk assessment to the DWA every 5 years for approval. **PM3:** WDC to liaise with BOPRC as follows: BOPRC to inform WDC of new discharge consents to the recharge zone (Rangitāiki river catchment and 320 metre groundwater capture zone) and WDC to provide comments on these consents. WDC to send BOPRC submissions opposing new applications for septic tanks within 320 metre groundwater capture zone. **PM4:** WDC to monitor activities within 250 metres of the water source: Provide input into district plan (WDC) and regional plan (BOPRC) with regards to protection of catchment; input into activities such as sediment control from earthworks and riparian strip management.	Low Unlikely x Minor)	**PM1**: AE/TL-AM **PM2**: AE/TL-AM **PM3**: AE/TL-AM **PM4**: SPP/TL-AM
S2.2	Contamination of bore/well from surface ingress due to: • Inappropriate bore/ well head design, not complying with the standards set by DWSNZ 2008 and the DWA. • Bore headworks and pipework damaged. • Poor joints, cracks or corrosion, in the bore casing.	• Inspection of bore/well head shows non-compliance with DWSNZ 2008. • E coli transgressions. • No system for backflow prevention. Inappropriate casing material selected, or old casing.	• Site inspection of the bore head identified some non-compliant features against the DWSNZ 2008 and DWA requirements. However, this site not considered high risk for contamination through borehead ingress due to nature of surrounding activities and site not being prone to flooding. • No damage to bore headworks or pipework could be assessed visually. • PM4 Condition of casing good, CCTV carried out in 2015. – CCTV carried out in September 2018 and inspected cable entry and cable seals were in good condition.	Partially	High (Unlikely x Major)	**PM1:** Check for 100 mm air gap at the reservoir. If absent, install a testable backflow preventer (double check) on bore head. **PM2:** Refurbish boreheads to comply with DWSNZ 2008 and DWA requirements, as follows: Replace/renew concrete apron; sloping to prevent ponding of water around borehead, provide a bore casing seal and extend to at least 1 metre from the bore centre **PM3G:** Programme for re-CCTV inspection of bore casing utilising Asset Management System to schedule and monitor preventative maintenance.	Low (Rare x Minor)	**PM1:** TL-WTP **PM2:** TL-WTP/PM **PM3**: TL-AS / TL-O

Table 16: Source – Catchment and Bores

No	Cause	Indicators	Current Scenario			To Be Implemented		
			Preventative measures in place	Risk Managed?	Current Risk	Preventative measures to be put in place ('G' reference after PM number refers to Generic item across all Whakatāne Water Safety Plans)	Residual Risk	Responsibility
S3.1	Discharge/leachate/runoff from the following activities in the catchment: **Forestry & Pesticides**: poison from feral animal control, 1080, cyanide, brodifacoum, fuel contamination from vehicles and fuel storage. **Industry and HAIL sites**: Chemical discharges depending on industry; underground fuel storage contamination, cyanide and metal contamination from ore extraction/mining, turbidity from open cast mining and quarrying. **Roading**: Asphalt, contamination due to fuel/ oil leaks and accidental spillages. **Other**: Contaminated/ landfill sites, Stormwater runoff, increased turbidity from construction sites, abandoned/unused bores		• Primary chemical contamination risk from forestry activities carried out in the catchment and any chemical spills/discharges to the Matahina catchment. • Currently no chemical treatment carried out on source water, therefore high risk in the event of chemical contamination. **PM2G:** Pesticide suite testing on raw water was undertaken in September 2013 and again in July 2018, a comparison of results is being undertaken and report to Toi Te Ora will be prepared in December 2018. If two consecutive 5 year periods have been monitored, pesticide suits could be carried out less frequently provided no changes in limits are observed. **PM6G:** Business As Usual (BAU) - WDC is invited to comment on new discharge consents with BOPRC as follows: 1) BOPRC to inform WDC of new discharge consents to the recharge zone (Rangitāiki river catchment and 320 metre groundwater capture zone) and WDC to provide comments on these consents. 2) WDC to send BOPRC submissions opposing new applications for septic tanks within 320 metre groundwater capture zone.	No	High (Unlikely x Major)	**Also refer to S2.1** Monitor changes in activities in the catchment and modify catchment risk assessment annually. Submit a catchment risk assessment to the DWA every 5 years for approval. **PM1G:** WDC to liaise with pesticide application companies and make them aware of locations of water sources and to be informed of pesticide drops in vicinity of water source. **PM3:** WDC to monitor activities within 250 metres of the water source. 1) To liaise with residential owners in the vicinity and make them aware of the effects of activities around the bore on water quality. 2) To liaise with forestry industries especially to ensure industry best practices are followed. **PM4:** Obtain groundwater monitoring results from consent holders in the vicinity if available, as a way of early warning of source contamination. **PM5:** 3 Waters Asset Management and Planning Team to provide input into district plan (WDC) and regional plan (BOPRC) with regards to protection of catchment; input into activities such as sediment control from earthworks and riparian strip management.	Medium (Rare x Moderate)	**PM1G**: SPP / AE / TL-AM **PM3:** TL-WTP **PM4:** AE/TL-AM **PM5:** SPP/TL-AM
S3.2	Conditions suitable for algal growth such as elevated nutrient levels, sunshine, warmth, still water.	• Development of visible algal blooms, complaints of symptoms consistent with toxin poisoning. • Health-significant determinands are more than 50% of their MAV in the source water. • Elevated levels of contaminants (nutrients and	• Not applicable to bore water with no obvious influence from surface water.	Yes	Low (Rare x Minor)	N/A	N/A	N/A

Table 16: Source – Catchment and Bores

No	Cause	Indicators	Current Scenario			To Be Implemented		
			Preventative measures in place	Risk Managed?	Current Risk	Preventative measures to be put in place ('G' reference after PM number refers to Generic item across all Whakatāne Water Safety Plans)	Residual Risk	Responsibility
		toxins) in source water.						
S3.3	Saline intrusion due to very deep bores with proximity to sea, increased drawdown due to elevated abstraction causing ingress of seawater.	• Reticulated water not compliant with DWSNZ 2008.	• No historic issues with saline intrusion at this source.	Yes	Low (Rare x Minor)	N/A	N/A	N/A
S3.4	Mineral deposits in the catchment and recharge zone due to characteristics of the catchment.	• Reticulated water not compliant with (note heavy metals due to corrosion are excluded) DWSNZ 2008.	• Unsure if there are mineral deposits due to persistent turbidity. • chemical suite testing to check for iron, mineral, calcium and other deposit content in bore water.	Partially	Low Rare x Minor)	**PM1:** Analysis concentration levels between 5 yearly chemical suite testing (undertaken 2013 and 2018), if variance investigate to do options. Record testing results for future comparison	Low Rare x Minor)	**PM1**: TL-WTP / WTP-O
S3.5	Contamination of bore/well during construction by cross contamination and by residues from drilling process (e.g. barium)	• Concentrations of chemical determinands more than 50% of their MAV.	High turbidity in bore water after initial bore development in 2007 which settled over time. Turbidity issues recurred in 2015 and an investigation was carried out and bore packing was found to have leaked from bore into pump casing through a hole in the pump casing. Pump casing repaired at time thus reducing turbidity.	Partially	High (Almost certain x Minor)	**PM1:** Analysis concentration levels between 5 yearly chemical suite testing (undertaken 2013 and 2018), if variance investigate to do options. Record testing results for future comparison	Low Rare x Minor)	**PM1**: TL-WTP / WTP-O

Table 17: Treatment – Chlorination and Cartridge Filtration

No	Cause	Indicators	Current Scenario			To Be Implemented		
			Preventative measures in place	Risk Managed?	Current Risk	Preventative measures to be put in place ('G' reference after PM number refers to Generic item across all Whakatāne Water Safety Plans)	Residual Risk	Responsibility
T1: EVENT: INADEQUATE TREATMENT INSTALLED								
T1.1	Insufficient bacterial treatment installed	• High turbidity and E coli levels	• Bacterial treatment complies with current DWSNZ 2008 requirements; Chlorination and Ultra Violet Irradiation treatment installed.	Yes	Low (Rare x Minor)	N/A	N/A	N/A
T1.2	Insufficient protozoal treatment installed	• High turbidity and E coli levels	• Current protozoa log credit of 2, investigate requirement of meeting protozoa log credit 3 **PM1**: Turbidity monitored continuously at treatment plant; pumps stop when turbidity exceeds set limits (Water run to waste if turbidity exceeds set limits).	Partially	Extreme (Possible x Catastrophic)	**PM1:** Stage 1 Investigate options of upgrading treatment plant and associated costings including installing UV to achieve 4 log credits. Stage 2 Programme and obtain budget to install recommended treatment pre options	Medium (Rare x Moderate)	**PM1:** Stage 1 TL-WTP / AE Stage 2 MTW / TL-WTP / TL-AM
T1.3	Insufficient chemical treatment installed	• Chemicals exceed set MAVs	• No priority 2 determinands assigned. **PM1:** Activities in the catchment giving rise to chemical contamination identified by carrying out a catchment risk assessment every 5 years.	Partially	High (Unlikely x Major)	**PM1:** Monitor changes in activities in the catchment and modify catchment risk assessment annually. **PM2:** Submit a catchment risk assessment to the DWA every 5 years for approval.	Medium (Rare x Moderate)	**PM1:** AE/TL-AM **PM2:** AE/TL-AM
T1.4	Other – Insufficient pH treatment	• pH below 7 or pH above 8.5	• No pH correction installed, water pH approximately 6.1. **PM1**: pH monitored continuously at treatment plant; pumps stop when pH exceeds set limits. **PM2:** Plumbosolvency notice circulated to customers in accordance with regulations	Partially	High (Possible x Moderate)	**PM1:** Investigate options to install pH correction and cost benefit of installation of pH correction. If feasible budget and programme for works to occur **PM2G:** Plumb solvency - Inform wider community and consumers about the use of copper pipes and fittings (including lead jointing) for internal plumbing by circulating information flyer and notification on Council Website	Low (Rare x Insignificant)	**PM1:** PM/TL-AM **PM2G:** M-PA / AE
T2: EVENT: INADEQUATE PROTECTION OF TREATMENT PLANT SITE AND EQUIPMENT								
T2.1	Damage to treatment plant equipment due to vandalism and/or vermin and animals.	• Visual damage to treatment equipment/electrical cables. • No signal or no readings received from equipment	• Bore and treatment plant on same site, refer to S1.4. **PM1:** Treatment plant equipment situated in locked container housing.	Partially	Medium (Unlikely x Moderate)	Bore and treatment plant on same site, refer to S1.4.	Medium (Rare x Moderate)	

Table 17: Treatment – Chlorination and Cartridge Filtration

No	Cause	Indicators	Current Scenario			To Be Implemented		
			Preventative measures in place	Risk Managed?	Current Risk	Preventative measures to be put in place ('G' reference after PM number refers to Generic item across all Whakatāne Water Safety Plans)	Residual Risk	Responsibility
		and/or equipment failure.						
T3: EVENT: POWER FAILURE TO TREATMENT PLANT SITE AND EQUIPMENT								
T3.1	Power failure.	• Power failure alarms, Reduced or no flows. • No signal or no readings received from equipment.	• Bore and treatment plant on same site, refer to S1.2	Partially	Extreme (Almost Certain x Moderate)	Bore and treatment plant on same site, refer to S1.2	High (Almost Certain x Insignificant)	**See S1.2 - PM1:** TL-O / AE / PM
T4: EVENT: INADEQUATE CALIBRATION/VERIFICATION, MAINTENANCE, PROCEDURES, SAMPLING, TRAINING								
T4.1	Inadequate calibration, verification and maintenance of treatment plant equipment.		Monitoring equipment (i.e. pH, turbidity, FAC) are compared and verified by operators devices weekly. Calibration of equipment undertaken as per manufactures requirement or yearly whichever is the least timeframe and in according to DWSNZ 2008. **PM1:** Routine maintenance of chlorination equipment (Dosing regulator, dosing pump, chlorine injector, booster pump) according to manufacture specifications. **PM2:** WDC have re-submitted Water Operator's Competence declaration and reviewed August 2018	Yes	Medium (Unlikely x Moderate)	**PM1:** WDC to review calibration and maintenance procedures of treatment plan equipment and incorporate into Operations and Maintenance manual with appropriate Standard Operating Procedures (SOP) **PM3G:** Utilise Asset Management System to schedule the maintenance, verification and calibration of treatment plant equipment.	Low (Rare x Insignificant)	**PM1:** TL-WTP / WTP-O **PM3G:** TL-AS
T4.2	Inadequate plant records and procedures		• A set of procedures are documented and plant records are maintained for equipment calibration/verification and site visits. • Not all procedures are made available at each treatment plant site.	Partially	High (Unlikely x Major)	**PM1:** Ensure all plant records such as manuals, drawings, procedures, emergency response plan, etc. are controlled documents within Council corporate record system and hard copy located at the Water Treatment Plant.	Medium (Rare x Moderate)	**PM1:** TL-WTP / WTP-O / TL-AS

Table 17: Treatment – Chlorination and Cartridge Filtration

No	Cause	Indicators	Current Scenario			To Be Implemented		
			Preventative measures in place	Risk Managed?	Current Risk	Preventative measures to be put in place ('G' reference after PM number refers to Generic item across all Whakatāne Water Safety Plans)	Residual Risk	Responsibility
T4.3	Inadequate/incorrect sampling		**PM2:** WDC treatment plant operators trained and aware of correct sampling procedures. **PM3:** MoH approved accredited labs carry out testing of samples. **PM4:** Transgressions and non – compliances followed up as per DWSNZ 2008 requirements.	Partially	Medium (Unlikely x Moderate)	**PM1:** Review internal procedures and develop robust schedule sampling regime. **PM2G:** Water Operator Authorisation. Authorisation assessments by DWA were undertaken with WDC operators in September 2018. The next assessments will be carried out in 2021.	Medium (Unlikely x Moderate)	**PM1:** TL-WTP/ WTP-O **PM2G**: TL-WTP/ WTP-O
T4.4	Inadequate training of staff		Annual budget set aside for training. **PM1:** Three treatment plant operators with national diploma certificate and one treatment plant operator on the way to completing the certificate. **PM2G:** listing of training kept in spreadsheet no evidence of competency system	Partially	Medium (Unlikely x Moderate)	**PM1:** All treatment plant operators to complete appropriate qualification for water treatment plant. WDC to keep records of training and produce when requested. **PM2G:** Develop training and competency system	Low (Rare x Minor)	**PM1:** MTW/ TL-WTP **PM2G:** TL-AS / TL-WTP / WTP-O
CHLORINATION								
T5: EVENT: MICROBIOLOGICAL CONTAMINATION DUE TO INADEQUATE CHLORINATION								
T5.1	Dosing malfunction (Dosing regulator and/or dosing pump, chlorine injector)	• FAC concentration below 0.2 mg/l. • E coli detected in water leaving treatment plant.	**PM1:** Continuous FAC monitoring at treatment plant; alarm triggered outside normal operation range, plant shuts down if critical limits reached. **PM2:** Routine maintenance of dosing regulator, dosing pump, chlorine injector.	Yes	Low (Possible x Insignificant)	**PM1:** WDC to review calibration and maintenance procedures of treatment plan equipment and incorporate into Operations and Maintenance manual with appropriate Standard Operating Procedures (SOP)	Low (Possible x Insignificant	**PM1:** TL-WTP / WTP-O
T5.2	Inadequate calibration of equipment (calibration of dosing regulator sensor)	• FAC concentration below 0.2 mg/l. • E coli detected in water leaving treatment plant.	**PM1**: Equipment verified weekly and calibrated yearly; manual checks on calibration as per DWSNZ 2008.	Yes	Low (Rare x Insignificant)	N/A	N/A	N/A

Table 17: Treatment – Chlorination and Cartridge Filtration

No	Cause	Indicators	Current Scenario			To Be Implemented		
			Preventative measures in place	Risk Managed?	Current Risk	Preventative measures to be put in place ('G' reference after PM number refers to Generic item across all Whakatāne Water Safety Plans)	Residual Risk	Responsibility
T5.3	Dosing regulator set point wrong or incorrect due to incorrect calculation	• FAC concentration below 0.2 mg/l. • E coli detected in water leaving treatment plant.	**PM1:** Continuous FAC monitoring at treatment plant; alarm triggered outside normal operation range, plant shuts down if critical limits reached.	Yes	Low (Possible x Insignificant)	N/A	N/A	N/A
T5.4	High chlorine demand and poor dose control	• FAC concentration below 0.2 mg/l. • E coli detected in water leaving treatment plant.	**PM1:** Continuous FAC monitoring at treatment plant; alarm triggered outside normal operation range, plant shuts down if critical limits reached. **PM2:** Frequency of testing increased during high water quality change periods e.g. rainfall, earthquakes.	Yes	Low (Possible x Insignificant)	N/A	N/A	N/A
T5.5	Chlorine supply exhausted	• FAC concentration below 0.2 mg/l. • E coli detected in water leaving treatment plant.	• A gas cylinder bottle weighs approximately 130kg which contains 70kg of chlorine gas. The cylinder is manually replaced once the weight reaches approximately 80kg. (cylinders placed on a weighing scale and weekly weight recorded on board next to scales). • No chlorine cylinders stored on site. **PM1:** Continuous FAC monitoring at treatment plant; alarm triggered outside normal operation range, plant shuts down if critical limits reached.	Partially	Medium (Possible x Minor)	**PM1:** Store a spare chlorine cylinder on site for ease of change over with Chlorine gas is low. **PM2:** Investigate options to install auto changeover of chlorine bottles and cost benefit of installation. If feasible, budget and programme for works to occur	Low (Unlikely x Minor)	**PM1:** TL-WTP / WTP-O **PM2:** TL-WTP / WTP-O
T5.6	Inadequate chlorine supply from chlorine booster stations	• FACE concentration below 0.2 mg/l. • E coli detected in water leaving treatment plant.	• No chlorine booster stations in the reticulation system. **PM1:** FAC leaving treatment plant maintained at 0.8 mg/L which is sufficient to last through the distribution system. **PM2:** Manual FACE sampling in distribution system as per DWSNZ 2008.	Yes	Low (Rare x Insignificant)	N/A	N/A	N/A

Table 17: Treatment – Chlorination and Cartridge Filtration

No	Cause	Indicators	Current Scenario			To Be Implemented		
			Preventative measures in place	Risk Managed?	Current Risk	Preventative measures to be put in place ('G' reference after PM number refers to Generic item across all Whakatāne Water Safety Plans)	Residual Risk	Responsibility
T6: EVENT: CHEMICAL CONTAMINATION DUE TO OVER CHLORINATION								
T6.1	Over chlorination due to dosing malfunction, inadequate calibration, dosing regulator set point wrong	• FAC concentration is more than 50% of its MAV.	**PM1:** Continuous FAC monitoring at treatment plant; alarm triggered outside normal operation range, plant shuts down if critical limits reached.	Yes	Low (Possible x Insignificant)	**PM1:** Undertake WTP site assessment to determine that all practical measures are in place via Electrical, Mechanical and Physical to avoid overdosing with particular emphasis on possibility of syphoning. Details to be recorded of the assessment and any recommendations **PM2:** Develop supply specific flushing plan to be implemented when treatment plant over doses and include in WTP operations manual	Low (Possible x Insignificant)	**PM1:** TL-WTP / WTP-O **PM2:** TL-WTP / WTP-O / TL-O
T7: EVENT: MICROBIOLOGICAL CONTAMINATION DUE TO INSUFFICIENT CHLORINE CONTACT TIME								
T7.1	Short circuiting or lack of contact	• FAC concentration below 0.2 mg/l. • E coli detected in water leaving treatment plant.	• Pumps directly to reservoir tank after chlorine injection. • No known connections off rising main. **PM1:** Manual FACE sampling in distribution system according to DWSNZ 2008.	Partially	High (Unlikely x Major)	**PM1:** Review distribution sample points to ensure points of higher risks are covered and develop sampling point schedule (e.g. points furthest away from treatment plant, dead ends and points of low usage, points of high draw off, service reservoirs, old pipework, low pressure areas).	Low (Rare x Minor)	**PM1:** TL-WTP/TL-O/AE / TL-AM
CARTRIDGE FILTRATION								
T8: EVENT: MICROBIOLOGICAL CONTAMINATION DUE TO FILTER NOT REMOVING PARTICLES TO 2-3 µM IN SIZE								
T8.1	Incorrect type of cartridge filter	• E.coli detected in water leaving treatment plant. • Scale formation on sleeve	**PM1:** Filters have been certified by FILTEC (Filtration Technologies) to ensure particles of sizes 3 Micron are removed. **PM2:** Cartridge is compatible with filter housing and purchased from certified manufacturer (FILTEC).	Yes	High (Unlikely x Major)	**PM2:** Identify correct cartridge/s (and suppliers) required for filtration unit within Asset Management System for renewals / replacements	Low (Rare x Minor)	**PM2**: TL-WTP / TL-AS / AE
T8.2	Damage to the seal (cartridge or filter housing)	• E.coli detected in water leaving treatment plant.	Pressure gauges installed on cartridge filtration unit 2018 to measure pressure differential of unit. **PM1:** Filter housing and cartridge seal condition checked during filter changes.	Yes	High (Unlikely x Major)	**PM1G:** Develop training and competency system that incorporates operators training for the replacement of cartridge for filtration systems	Low (Rare x Minor)	**PM1G**: TL-AS / TL-WTP / WTP-O

Table 17: Treatment – Chlorination and Cartridge Filtration

No	Cause	Indicators	Current Scenario			To Be Implemented		
			Preventative measures in place	Risk Managed?	Current Risk	Preventative measures to be put in place ('G' reference after PM number refers to Generic item across all Whakatāne Water Safety Plans)	Residual Risk	Responsibility
T8.3	Cartridge is incorrectly seated		Cartridge fitted according to manufacturer's instructions Pressure gauges installed on cartridge filtration unit 2018 to measure pressure differential of unit. **PM1G:** Cartridge filter changes carried out by trained water treatment plant operators aware of the procedure.	Yes	High (Unlikely x Major)	**PM1G:** Develop training and competency system that incorporates operators training with replacement of cartridge for filtration	Low (Rare x Minor)	**PM1G**: TL-AS / TL-WTP / WTP-O
T8.4	Cartridge failure		**PM1:** A log of filter maintenance kept, including any damages observed and filter change dates.	Yes	High (Unlikely x Major)	**PM1:** Log details to be located in corporate system and available upon request	Low (Rare x Minor)	**PM1**: TL-WTP / WTP-O
T8.5	Filter housing contamination		**PM1:** Filter housing disinfected during installation of cartridges and residual disinfectant flushed to waste. **PM2:** Cartridge filter changes carried out by trained water treatment plant operators aware of the procedure.	Yes	High (Unlikely x Major)	N/A	N/A	N/A
T8.6	Flowrate too high		**PM1:** Flow rate maintained and controlled by pumping and measured with the use of a magnetic flow meter out of bore.	Yes	High (Unlikely x Major)	N/A	N/A	N/A
T8.7	Growth of germs in filter		• Filters changed regularly as required. **PM1:** A log of filter maintenance kept, including any damages observed and filter change dates.	Yes	High (Unlikely x Major)	N/A	N/A	N/A
T9: EVENT: MICROBIOLOGICAL CONTAMINATION DUE TO REVIVAL OF MICRO ORGANISMS								
T9.1	Revival of micro-organisms in the distribution system.	• E coli detected in the distribution system.	**PM1:** Network is chlorinated and FACE in the distribution system is sampled.	Yes	Low (Rare x Insignificant)	N/A	N/A	N/A

Table 18: Reservoirs

No	Cause	Indicators	Current Scenario			To Be Implemented		
			Preventative measures in place	Risk Managed?	Current Risk	Preventative measures to be put in place ('G' reference after PM number refers to Generic item across all Whakatāne Water Safety Plans)	Residual Risk	Responsibility
R1: EVENT: LOSS OF SUPPLY DUE TO INSUFFICIENT STORAGE								
R1.1	Insufficient storage capacity to store treated water for daily demand.	Reservoir telemetry indicates loss in levels. Decreased or no flow, loss of pressure in the system.	**PM1:** 24 hr storage currently available (1x230 m^3 concrete tank available for maximum daily demand 50 m^3/day).	Yes	Low (Unlikely x Minor)	N/A	N/A	N/A
R2: EVENT: LOSS OF SUPPLY DUE TO STRUCTURAL FAILURE								
R2.1	Poor condition of reservoirs leading to leakages, collapse or loss of structural integrity.	Drop in reservoir levels do not match demand. Increased pump starts. Loss of supply. Insufficient pressure/flow for firefighting purposes.	• Site inspection of reservoirs showed concrete reservoir in poor condition. **PM1:** Reservoir inspections carried out monthly.	Partially	Medium (Rare x Moderate)	**PM1:** Carry out condition assessment of all concrete reservoirs in 2019 and formulate a condition assessment programme thereafter. **PM2:** Develop and implement a preventative maintenance programme for reservoirs.	Low (Rare x Minor)	**PM1**: AE **PM2**: TL-AS
R2.2	Vandalism to reservoir structure	Loss of supply. Insufficient pressure/flow for firefighting purposes.	• Gate leading to reservoir site was unlocked. • Security fence around reservoir site was missing in parts, possible vandalism.	Partially	High (Possible x Major)	**PM1**: Padlock to be installed on gate leading to reservoir site and security fence to be re-instated.	Low (Rare x Minor)	**PM1**: TL-O
R3: EVENT: LOSS OF SUPPLY DUE TO INSUFFICIENT SOURCE WATER								
R3.1	Insufficient storage capacity to store additional treated water due to seasonal variations in source.	Treated water storage levels unacceptably low. Reservoir telemetry indicates loss in levels.	No seasonal variations in source water at this site, therefore no additional storage required.	Yes	Low (Unlikely x Minor)	N/A	N/A	N/A
R4: EVENT: MICROBIAL AND/OR CHEMICAL CONTAMINATOIN OF STORED WATER								
R4.1	Access by animals/birds.	Visual evidence of animal and bird access i.e. feral animal droppings, birds' nests. Unexplained deterioration/change in water quality. FAC residual less than 0.2 mg/L and cannot be maintained and E. coli or coliforms detected in 100 mL of water.	• Visual inspection inadequate to determine possible access by birds/vermin. To be checked by WTP operator by checking inside of the reservoir (any light entering reservoir). • FAC residual tested once in 3 months. • Reservoir site inspected once a month.	Partially	High (Unlikely x Major)	**PM1:** Install a mesh on the overflow pipe. **PM2:** Carry out maintenance of the site as required to prevent breeding of vermin/animals	Medium (Unlikely x Moderate)	**PM1:** TL-WTP **PM2:** TL-WTP

Table 18: Reservoirs

No	Cause	Indicators	Current Scenario			To Be Implemented		
			Preventative measures in place	Risk Managed?	Current Risk	Preventative measures to be put in place ('G' reference after PM number refers to Generic item across all Whakatāne Water Safety Plans)	Residual Risk	Responsibility
R4.2	Vandalism and sabotage, staff access	Unexplained deterioration/change in water quality. FAC residual less than 0.2 mg/L and cannot be maintained and E. coli or coliforms detected in 100 mL of water.	• No incidents of vandalism to structure in the past, however, reservoir can be accessed easily by foot. • **PM1:** Disinfection procedures for staff to follow during sampling. • **PM2G**: Prior to employment within 3 Waters Operation Section, staff are vaccinated against Hepatitis A/B and Tetanus to immunised against these known water borne diseases	Partially	High (Unlikely x Major)	**PM1**: Padlock to be installed on gate leading to reservoir site and security fence to be re-instated. **PM2G**: Review staff certificates and maintain updated training and health register. Develop a training and competency system for working on reticulated network.	Low (Unlikely x Minor)	**PM1:** TL-O **PM2G:** TL-O / TL-AS / TL-WTP
R4.3	Sediment/slime accumulation and resuspension of accumulated sediment.	Visible slime/ sediment and customer complaints. FAC residual concentration less than 0.2 mg/L and E. coli or coliforms detected in 100 ml of water. High turbidity levels.	**PM1:** Reservoir inspections carried out in 2008 and 2015. **PM2:** FAC residual maintained, checked weekly **PM3**: Procedure for reservoir cleaning to include disinfection of equipment, appropriate isolation from network, minimising sediment stir up, etc.	Partially	Medium (Unlikely x Moderate)	**PM1:** Develop programme to undertake CCTV inspection of reservoirs every 5 years and vacuum cleaning as required.	Low (Unlikely x Minor)	**PM1:** TL-AS
R4.4	Entry of contaminants due to reservoir design	Deterioration of water quality following new installation. Change in water quality after rain events, increased turbidity.	Unable to check roof hatches during site inspection. **PM1**: Roof hatches designed to prevent rainwater ingress.	Partially	Medium (Unlikely x Moderate)	**PM1:** Check 'as-builts' and programme trial run to ensure reservoir can be isolated for cleaning or in case of contamination/loss of structural integrity.	Low (Rare x Insignificant)	**PM1**: AE / TL-O / TL-WTP / WTP-O
R5: EVENT: INSUFFICIENT CHLORINE CONTACT TIME								
R5.1	Insufficient turnover (Short-circuiting)	E. coli or coliforms detected in 100 mL of water despite adequate FAC residual concentration.	• Pumps directly to reservoir tank after chlorine injection. • No known connections off rising main.	Yes	Low (Unlikely x Minor)	N/A	N/A	N/A

Table 19: Distribution

No	Cause	Indicators	Current Scenario			To Be Implemented		
			Preventative measures in place	Risk Managed?	Current Risk	Preventative measures to be put in place ('G' reference after PM number refers to Generic item across all Whakatāne Water Safety Plans)	Residual Risk	Responsibility
D1: EVENT: MICROBIAL AND CHEMICAL CONTAMINATION DUE TO BACKFLOW INTO DISTRIBUTION NETWORK								
D1.1	Backflow from individual properties into the distribution system due to a pressure drop in the reticulated system/elevated pressure in individual premises, where the property has no/malfunctioning backflow prevention device	• E. coli or coliforms detected in 100 mL water sample. • Unexplained fluctuations in chemical and microbiological water quality. • Customer complaints of gross contamination of tap water.	• Backflow prevention policy is currently being developed by WDC • Te Mahoe not a fully metered scheme therefore not all residential connections fitted with dual check valves. • Testing of existing backflow preventers not currently carried out. • All new commercial and farm connections installed with backflow preventers adhering to NZ Building Code standards; triggered during building/ land use/ tradewaste consents or 'new connection' applications. Specific hydrants assigned for water withdrawal by contractors for ease of policing. Applications are made to the operations depot and water to be withdrawn using standpipes with fitted BFP device and water meter. **PM5G:** Operations department to discuss with building control department to include backflow prevention devices as part of the building control checklist when carrying out building inspections.	Partially	High (Unlikely x Major)	**PM1G**: Develop and implement a backflow prevention policy to match device to risk level of activity, including testing requirements of the devices. This has political ramifications and will be difficult to implement thus long lead in time. **PM2:** Install backflow prevention devices on all connections; priority given to connections identified as high risk. Dual check valve to be installed on residential connections as part of the meter installation programme. **PM3G:** Circulate educational material to customers, especially those considered high risk, about risks of backflow prevention and ways of minimising the risk. **PM4G:** Review policy for withdrawing water from hydrants; specify the use of standpipes fitted with approved backflow preventers **PM6G:** Develop and implement a policy to disconnect connections not in use, with special attention to connections provided to vacant lots during subdivisions. **PM7G:** Develop and implement a policy for identifying and dealing with illegal connections.	Medium (Possible x Minor)	**PM1G:** MTW / M-PA / AE / TL-O / TL-AM **PM2:** AE/PM **PM3G:** AE / M-PA **PM4G:** MTW / M-PA / AE / TL-O / TL-AM **PM6G:** MTW / M-PA / AE / TL-O / TL-AM **PM7G:** MTW / M-PA / AE / TL-O / TL-AM
D2: EVENT: CHEMICAL AND MICROBIOLOGICAL CONTAMINATION DUE TO LACK OF ROUTINE MAINTENANCE								
D2.1	Poor circulation due to lack of hydrant and mains flushing programme.	• Accumulation of sediments in the system. • Parts of the distribution network containing water with low FAC.	• The current routine maintenance schedule is being reviewed by WDC. **PM1**: Flushing of dead ends in the network is currently being carried out in adhoc manner.	Partially	Medium (Possible x Minor)	**PM1G:** Carry out a routine maintenance plan for flushing of mains and hydrants with priority given to flushing dead ends and areas of poor circulation. **PM2G:** Utilise Asset Management System to schedule and monitor preventative maintenance.	Low (Rare x Insignificant)	**PM1G:** TL-AS/TL-O **PM2G:** TL-AS

Table 19: Distribution

No	Cause	Indicators	Current Scenario			To Be Implemented		
			Preventative measures in place	Risk Managed?	Current Risk	Preventative measures to be put in place ('G' reference after PM number refers to Generic item across all Whakatāne Water Safety Plans)	Residual Risk	Responsibility
D2.2	Inability to isolate or shut down the system due to missing or failed valves.		**PM1:** Critical valves have been identified through a study carried out by OPUS in 2016.	Partially	Medium (Possible x Minor)	**PM1:** Carry out a routine maintenance plan for valve exercising with priority given to critical valves i.e. those supplying a large or critical customer base, valves on rising and falling mains and those used for bore and reservoir isolation. **PM2:** Undertake a programme of marking valve boxes for ease of location and to indicate whether they are open or closed. **PM3:** Utilise Asset Management System to schedule and monitor preventative maintenance.	Low (Rare x Insignificant)	**PM1:** AE **PM2:** AE/TL-O **PM3:** TL-AS
D3: EVENT: LOSS OF SUPPLY AND CONTAMINATION OF SUPLY DUE TO LACK OF ROUTINE ASSET REPLACEMENT								
D3.1	Pipe, valve and hydrant failure due to age, condition and material of pipe.	• Low FAC.	• Currently reactive maintenance being carried out. **PM1**: AMP for 2017 prepared but data need verification and assessment. **PM2:** Pipe sampling has been carried out in certain areas. **PM3:** New Asset Management System implement recording maintenance carried out and cost of maintenance per asset has been introduced March 2018 **PM4:** Rising main was slip lined in 2015.	Partially	Medium (Possible x Minor)	**PM1G**: Develop asset renewals programme based on condition sampling and assessments, analysis of asset age, material, frequency of breakages and increase in maintenance costs. Asset renewals to prioritize critical assets such as rising mains/falling mains, pipes supplying a critical consumers or large consumer base, critical valves and hydrants. **PM2G**: Update water asset management plan as required and republish every 3 years.	Low (Rare x Insignificant)	**PM1G:** AE / TL-AM **PM2G:** TL-AM / AE
D4: EVENT: CONTAMINATION DUE TO PRESSURE FLUCTUATIONS IN THE SYSTEM								
D4.1	Pressure fluctuations in the system due to: pipe failure, accidental penetration by contractors and leaks in the system, major fire events, Low pressure areas (hills/ extremities).		GIS system for WDC reticulation network can be accessed online by public or contractors. **PM6G:** Procedures for third party contractors/developers that require them to obtain a Permit to Work before any work is carried out as part of resource consent. Only Council approved contractors to work on council reticulation	Partially	High (Possible x Moderate)	**PM1**: Identify problem pressure areas by carrying out model network analysis coupled with customer complaint records. **PM2G**:Carry out a periodic water balance to identify levels of leakage in system **PM3**: Once hydraulic models are completed and in-line with annual water balance calculations develop and implement leak detection programme. (also see S1.9 PM2) **PM4**: Install metering on all service connections.	Low (Rare x Insignificant)	**PM1:** AE **PM2G:** AE **PM3:** AE **PM4:** AE/PM

Table 19: Distribution

No	Cause	Indicators	Current Scenario			To Be Implemented		
			Preventative measures in place	Risk Managed?	Current Risk	Preventative measures to be put in place ('G' reference after PM number refers to Generic item across all Whakatāne Water Safety Plans)	Residual Risk	Responsibility
						PM5G: Develop and adopt internal procedure for maintaining an up-to-date Asset Management System and GIS system **PM7**: Install backflow prevention devices on all connections; priority given to connections identified as high risk. Dual check manifolds to be installed on residential connections as part of the meter installation.		**PM5G:** AM/AE **PM7:** AM
D5: EVENT: CONTAMINATION AND LOSS OF SUPPLY DUE TO POOR PLANNING, INADEQUATE PROCEDURES AND INADEQUATE TRAINING								
D5.1	Poor planning of scheduled work carried out by WDC staff and their contractors.		**PM1**: Customer services department notified of work being carried out resulting in service disruption. **PM2**: Work carried out outside peak hours to ensure minimum disruption. **PM3:** Public announcements made on radio/ newspaper for major work. 24 hour letter drop notice given to smaller projects. Critical users (dialysis patients/hospitals) notified as a priority.	Partially	High (Possible x Moderate)	**PM1G**: Where possible utilise WDC Asset Management System to maintain an up-to-date database of critical users such as dialysis patients/hospitals/businesses. Develop robust process for critical customer rating and updating data to maintain active list. **PM2G**: Develop and adopt internal procedure for maintaining an up-to-date Asset Management System and GIS system. **PM3G**: Maintain a systematic workflow procedure with control checks for the update of capital works arising from projects, subdivision work and daily replacements and renewals so that all paperwork is sent to the asset engineer for recording on Asset Management System and GIS.	Low (Rare x Insignificant)	**PM1G:** TL-AM **PM2G:** AE/TL-AM **PM3G:** AE/TL-AM
D5.2	Inadequate operating Procedures.		**PM1:** Existing operations procedures are currently being reviewed and updated by WDC.	Partially	Medium (Possible x Minor)	**PM1G**: Review existing operating procedures and develop procedures that clearly define steps for each process, items to be recorded and objectives of the process, with reference to other documents. **PM2G**: Review past documents, develop and implement SOP (Hygiene procedure) for WDC operations staff working on the water network; focus on preventing cross contamination when staff alternate on wastewater and water reticulation work. Hygiene Procedure to include sickness statement and returning to work.	Low (Rare x Insignificant)	**PM1G**: MTW/TL-WTP/WTP-O **PM2G**: TL-WTP/WTP-O/TL-AS

Table 19: Distribution

No	Cause	Indicators	Current Scenario			To Be Implemented		
			Preventative measures in place	Risk Managed?	Current Risk	Preventative measures to be put in place ('G' reference after PM number refers to Generic item across all Whakatāne Water Safety Plans)	Residual Risk	Responsibility
D5.3	Inadequate training of operations staff.		• Staff provided with relevant training. All staff hold appropriate certificate in water reticulation. • Prior to employment within 3 Waters Operation Section, staff are vaccinated against Hepatitis A/B and Tetanus to immunised against these known water borne diseases • Tool box meetings carried out weekly.	Partially	Medium (Possible x Minor)	**PM1G**: Review staff certificates and maintain updated training and health register. Develop a training and competency system for working on reticulated network.	Low (Rare x Insignificant)	**PM1G:** TL-O / TL-AS
D6: EVENT: CONTAMINATION AND LOSS OF SUPPLY DUE TO THIRD PARTY CONTRACTORS								
D6.1	Third party contractor/developer work on WDC reticulation (not directly engaged by WDC).		• Some procedures currently in place however no recorded procedures or workflow. **PM1G**: implement procedures for third party contractors/developers that require them to obtain a Permit to Work before any work is carried out. **PM2G**: Contractors to submit disinfection procedures, Health and Safety plans, detailed design of work to be carried out **PM3G**: WDC to supervise subdivision work at critical stages such as pressure testing, disinfection, connection to the water main and backfilling, in the presence of the Engineer to the developer. Part of resource consent	Partially	Extreme (Possible x Major)	**PM4G**: WDC to develop policy and procedure whereby Third party contractors/developers are made liable for any damages to the network to increase accountability.	Medium (Unlikely x Moderate)	**PM4:** TL-O/AE/TL-AM

Appendix B: Te Mahoe Scheme Process Control Summaries

Chlorination – Performance Parameters

The alarms for each control parameter are set to ensure appropriate corrective action is taken before the performance parameters reach critical limits. The Target Range, Action limits and Critical limits are set within a percentage of the Maximum Acceptable Values (MAVs) set by DWSNZ 2008 for each performance parameter (FAC, pH, Turbidity).

Table 20: Chlorination – DWSNZ 2008 Limits and Process Performance Parameters

Limits		Performance Parameters		
		FAC (mg/L)	pH (pH units)	Turbidity (NTU)
DWSNZ 2008 Monitoring Parameters		<0.20 mg/L for >2% of 28 minutes	Guideline: Between 7.0 and 8.0	<1.0 NTU for >=5% of 72 minutes
		>5.00		<=2.0 NTU for >=3 continuous minutes
Target Range	Low Limit	0.80		-
	High Limit	0.90		<0.50
Action Limits	Low Alarm	0.30	5.0	-
	High Alarm	1.80	8.0	0.90
Critical Limits	Low Low Alarm	0.20	4.5	-
	High High Alarm	2.00	8.5	1.00

Plant automatically shuts down when 'Critical Limits' are exceeded.

Chlorination – Triggers and Corrective Actions

Corrective actions taken when trigger limits reached:

Table 21: Chlorination - Triggers and Corrective Actions

Limits	Triggers	Corrective Actions
Target Range	During day to day monitoring or inspection.	• Adjust chlorine dosing rate manually until target range is achieved.
Action Limits	Alarms	• Treatment Plant Operator to turn plant off by turning off pumps remotely and travel to site to carry out an inspection. • Carry out a site inspection to investigate reason for turbidity and/or pH and/or FAC outside action limits: – Check Turbidity meter/ Rotometer / pH meter for any mechanical problems e.g. a jammed rotometer. – Check if chlorine dosing is correct or if the chlorine supply exhausted. – Carry out manual tests to obtain turbidity, FAC and pH readings to verify against turbidity meter/ chlorine analyser/ pH meter readings to check equipment is operating correctly. – Sample to be collected manual for additional E. coli test. • Verify online instruments with calibrate field equipment as per the Water Treatment Plants SOP and/or the manufacturer's instructions. • Carry out a visual check of borehead, treatment plant equipment and surrounding site for signs of vandalism. Check around borehead area and vicinity for any visible signs of contamination. • Adjust chlorine dosing rate manually until target range is achieved. • Increase monitoring frequency. • Once problem is identified and resolved, remote in from laptop disable appropriate alarm and set up the plant to run automatically. Alarms to be reset once plant has settled and returned within normal target range of operation. • Log incident in the water treatment plant log book. • Record event details, manual test results any re-calibration information in the water treatment plant log book.

Table 21: Chlorination - Triggers and Corrective Actions		
Limits	**Triggers**	**Corrective Actions**
Critical Limits	Alarms and/or plant shut down.	***Plant automatically shuts down when critical limits are exceeded for FAC, pH and turbidity*** • Water Treatment Plant operator to notify Water Treatment Plant Team Leader and Water Treatment Plant Team Leader to notify Three Waters Manager. • Travel to site, inspect, test and verify as per 'Action Limits' above. • Supply of water to the reservoir to be stopped while performance parameters are in the critical limit range and scheme to be supplied with compliant stored water using emergency storage or backup/alternative supply. • Carry out contingency plan as per civil defence emergency appropriate to the scenario. • Carry out transgression sampling according to section 4.3.9 of the DWSNZ 2008. • Increase monitoring frequency. • If there is a requirement for the plant to supply water to the scheme whilst performance parameters are in the critical limit range carry out the following: – Obtain approval from TL-WTP, MTW and DWA before supplying water to the scheme that may not satisfy DWSNZ 2008 limits. – Isolate alarms in order to operate the plant. – Confirm conditions of continued operation with the DWA and carry them out (i.e. boil water notice etc.). – Reinstate alarms so that the plant runs automatically once performance parameters are back to Target Range. • WTP-O to complete an incident report for the event, and the TL-WTP to develop a full transgression report.

Cartridge Filtration – Performance Parameters

The alarms for each control parameter are set to ensure appropriate corrective action is taken before the performance parameters reach critical limits. The Target Range, Action limits and Critical limits are set within a percentage of the Maximum Acceptable Values (MAVs) set by DWSNZ 2008 for each performance parameter (Flow, NTU).

Table 22: Cartridge Filters- DWSNZ 2008 Limits and Process Performance Parameters

DWSNZ 2008 Monitoring Parameters:	
• Flow below 79.5 m3/hr. • Number of samples with turbidity greater than 0.5 NTU does not exceed 2. • Turbidity not >1.0 NTU in any sample. • Turbidity does not exceed feed water turbidity in any samples. • Minimum differential pressure to always exceed the differential pressure corresponding to a clean filter.	
Performance Parameters and Criteria:	
Target Range	• Pressure into filter is maintained at 1000 KPa. • NTU: <0.5
Action Limits	• NTU: 0.9
Critical Limits:	• NTU 1.0
Plant automatically shuts down when turbidity exceeds 1.0 NTU.	

Cartridge Filtration – Triggers and Corrective Actions

Corrective actions to be taken when trigger limits are reached:

Table 23: Cartridge Filtration - Triggers and Corrective Actions

Limits	Triggers	Corrective Actions
Target Range	During day to day monitoring or inspection.	• Adjust flow rate. • Change filters when reaching below minimum differential pressure limits.
Action Limits	During day to day monitoring or inspection.	• Treatment Plant Operator to turn plant off by turning off pumps remotely and travel to site to carry out an inspection. • Cartridge filter checks: – Check filter housing and seal and cartridge seals for leaks or incorrect seating. – Flush flow to waste before putting the filters back online. – Check log books to identify date of last filter replacement and replace if required. • If high turbidity, carry out a site inspection to investigate reason and rectify situation if possible: – Check Turbidity meter for any mechanical problems. – Carry out manual tests to obtain turbidity readings to verify against turbidity meter to check equipment is operating correctly. – Re-calibrate field equipment against equipment calibrated at Whakatāne WTP. – Run lines to waste until turbidity reaches target range. – Carry out a visual check of boreheads, treatment plant equipment and surrounding site for signs of vandalism. Check around borehead area and vicinity for any visible signs of contamination. – Carry out manual E. coli test. • Increase monitoring frequency. • Once problem is identified and where possible resolved, notify Water Treatment Plant Team Leader, Manager Three Waters and Drinking Water Assessor of transgression. • Log incident in the water treatment plant log book.

Table 23: Cartridge Filtration - Triggers and Corrective Actions		
Limits	**Triggers**	**Corrective Actions**
		• Record event details, manual test results any re-calibration information in the water treatment plant log book.
Critical Limits	Alarms and/or plant shut down.	***Plant automatically shuts down when turbidity exceeds 1.0 NTU.*** • Water Treatment Plant operator to notify Water Treatment Plant Team Leader and Water Treatment Plant Team Leader to notify Manager Three Waters. • Travel to site, inspect, test and verify as per 'Action Limits' above. • Carry out contingency plan as per civil defence emergency appropriate to the scenario. • Carry out transgression sampling according to section 4.3.9 of the DWSNZ 2008. • Increase monitoring frequency. • Supply of water to the scheme is stopped while performance parameters are in the critical limit range. • If there is a requirement for the plant to supply water to the scheme whilst performance parameters are in the critical limit range carry out the following: – Obtain approval from TL-WTP, MTW and DWA before supplying water to the scheme that may not satisfy DWSNZ 2008 limits. – Isolate alarms in order to operate the plant. – Issue a boil water notice when indicated by DWA – Reinstate alarms so that the plant runs automatically once performance parameters are back to Target Range. • WTP-O to complete an incident report for the event, and the TL -WTP to develop a full transgression report.

Appendix C: Te Mahoe Scheme Localised Groundwater Capture Zone

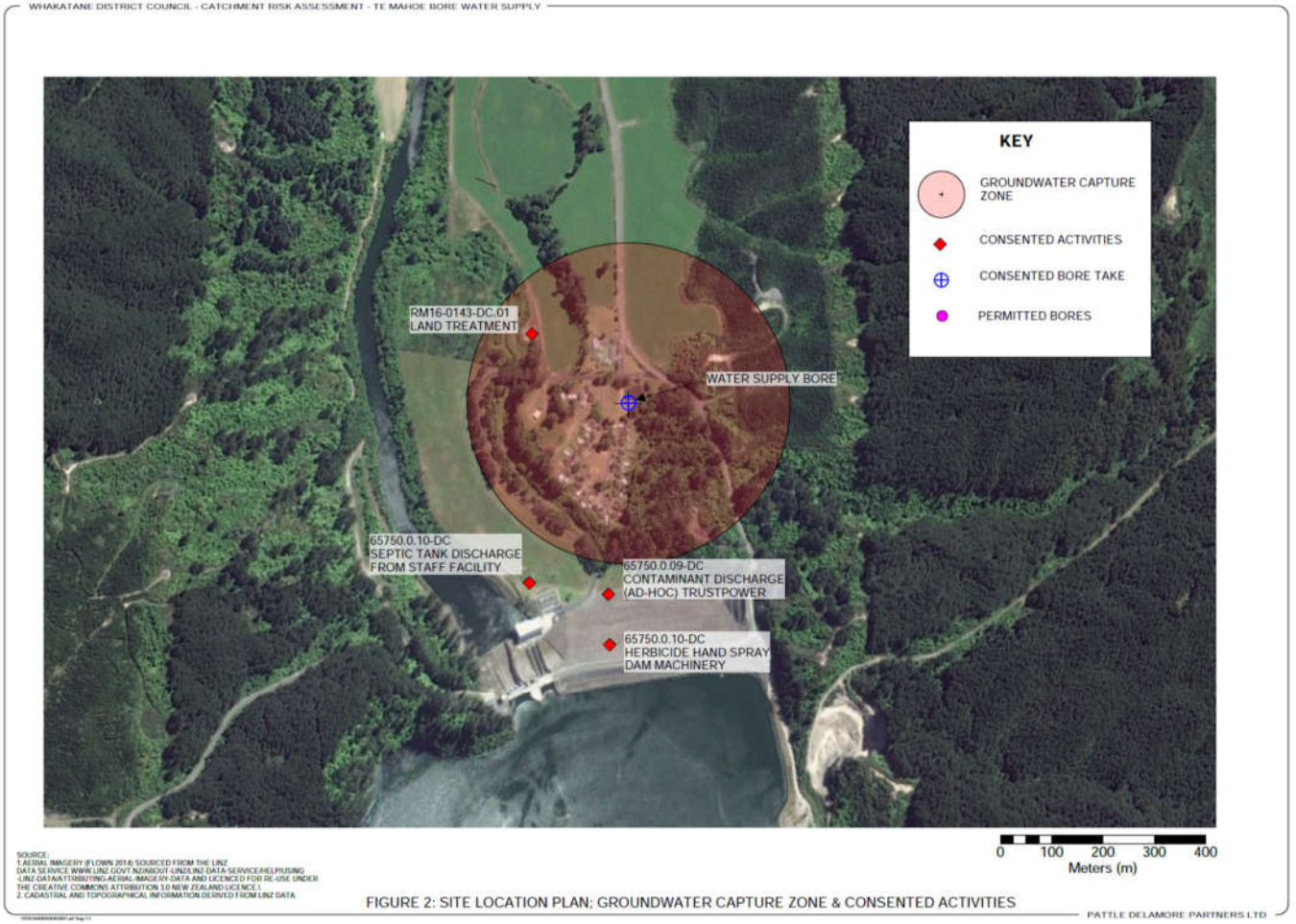

FIGURE 2: SITE LOCATION PLAN; GROUNDWATER CAPTURE ZONE & CONSENTED ACTIVITIES

Appendix D: Te Mahoe Scheme Reservoir Inspection Sheet

Reservoir Inspection

General Information

Project:	Te Mahoe Water Safety Plan
Survey Carried out by:	Sala Ranasinghe/Dave Stafford
Date of Site Visit:	17th July 2017
Location of Reservoir/s:	State Highway 2
Number of Reservoirs on site:	1
Client Details:	Whakatane District Council

Assessment

Access to reservoir:	Gravel road			
Security to reservoir site:	Padlocked gate leading from the main road and security fence arund reservoir, however, security fence vandalised.			
Security fence or stock fence?	Security fence at reservoir site vandalised with a large opening on the gate mesh.			
Reservoir construction material (Concrete/Timber/Steel/Plastic/Other):	**Material:**	Concrete (250 m3)	**No:**	1
	Material:		**No:**	
	Material:		**No:**	
	Material:		**No:**	
Condition of Reservoirs (Good/Average/Bad) please comment:	**Reservoir 1:**	Concrete reservoir - Visual inspection, average to bad condition, rising main possibly required replacement, further inspection required to determine structural integrity.		
Evidence of human or animal access on site?	Vandalism to security gate an obvious sign of human access. No signs of structural damage or defamation of reservoir structure.			
Evidence of vandalism?	As above.			
Any points of possible entry of animals into reservoir?	Possible entry through roof, to be checked by WDC.			
	Overflow wasn't meshed to prevent animal entry.			
Any signs of leaks?	No obvious signs of leak but further investigation required due to age and apparent condition of reservoir.			
Check reservoir roof	As above.			
Any reservoirs not being used?	In use.			
Is ladder access restricted?	No ladder access to tank onsite.			
Are roof hatches designed to prevent rainwater ing	Roof has padlocked roof hatches designed to prevent rainwater ingress.			
Are roof hatches padlocked?	As above.			

Photos

Reservoir Structure

Appendix E: Improvement Plan – Completed Projects

Table 24: Improvement Plan – Completed Items

Priority	Risk Table No.	Area of Work	Work To be Implemented	Responsibility	Comment	Date
Low	**D4.1 (PM6G) D6.1 (PM1G)**	**Third party contractor/developer work on WDC reticulation (not directly engaged by WDC)**	This is part of engagement of contractors. Contractors to submit disinfection procedures, Health and Safety plans, detailed design of work to be carried out and communications plan for affected customers to the relevant WDC staff for approval before work is carried out.	Contractors and AE / PE	Implemented	March 2018
Low	**D3.1 (PM3G)**	**Pipe, valve and hydrant failure due to age, condition and material of pipe**	Record condition of asset, maintenance carried out and cost of maintenance against each asset on the Asset Management System during routine maintenance/repair programmes in order to utilise this information in asset renewal programmes.	TL-AM / TL-O	Implemented with new Asset Management System	March 2018
Medium	**S2.1 (PM3) S3.1 (PM6G)**	**Managing activities in the catchment**	WDC to liaise with BOPRC as follows: 1) BOPRC to inform WDC of new discharge consents to the recharge zone (Rangitāiki river catchment and 320 metre groundwater capture zone) and WDC to provide comments on these consents. 2) WDC to send BOPRC submissions opposing new applications for septic tanks within 320 metre groundwater capture zone.	Business as usual with resource consents	implemented	March 2018
Medium	**T4.3 (PM1)**	**Inadequate/incorrect sampling**	Review treatment plant sampling spreadsheet periodically for anomalies.	TL-WTP	completed	June 2018

Table 24: Improvement Plan – Completed Items						
Priority	**Risk Table No.**	**Area of Work**	**Work To be Implemented**	**Responsibility**	**Comment**	**Date**
Medium	**S2.2 (PM4)**	**Bore-head Security**	Carry out checks to determine adequacy of cable gland seals and bore head seals including replacing any deteriorating gaskets with water tight gaskets.	TL-WTP	5 hours	June 2018
High	**S3.1 (PM2G)**	**Managing activities in the catchment**	Pesticide suite testing on raw water was undertaken in September 2013 and again in July 2018, a comparison of results is being undertaken and report to Toi Te Ora will be prepared for December 2018.	TL-WTP	Completed	July 2018
Low	**D1.1 (PM5G)**	**Contamination from backflow**	Operations department to discuss with building control department to include backflow prevention devices as part of the building control checklist when carrying out building inspections.	AE / TL-AM	Discussions held - Part of building inspection process for consented works	July 2018
Medium	**T4.3 (PM2G)**	**Water Operator Authorisation assessment**	Water Operator Authorisation. Authorisation assessments by DWA were undertaken with WDC operators in September 2018. The next assessments to be carried out in 2021.	TL-WTP / WTP-O	8 hours	September 2018

Appendix F: Report on adequacy of a Drinking Water Supply's Water Safety Plan

CNIDWAU
Central North Island Drinking Water Assessment Unit

IANZ
ACCREDITED INSPECTION BODY

Report on adequacy of a Drinking Water Supply's Water Safety Plan

Drinking Water Supply
Te Mahoe Public Water Supply (TEM004)

Central North Island Drinking Water Assessment Unit – Toi Te Ora
PO Box 2120
Tauranga 3110

Report Identifier
TEM004_Te_Mahoe_WSPadequacy_021118_v1

Executive Summary

Water Safety planning is internationally recognised as the most effective means of consistently ensuring the safety of a drinking-water supply Six principles underpin the foundation of effective water safety planning:

1. A high standard of care must be embraced
2. Protection of source water is of paramount importance
3. Maintain multiple barriers against contamination
4. Change precedes contamination
5. Suppliers must own the safety of drinking water
6. Apply a preventive risk management approach

Please be aware that under the Health Act, this water supply is not legally required to have an approved Water Safety Plant (WSP). The supplier must however take all practicable steps to comply with the Drinking Water Standards for New Zealand under Section 69V. If a decision has been made to seek compliance under Section 10 of the Drinking Water Standards, having an approved and implemented water safety plan is a mandatory requirement. In some cases a Medical Officer of Health can require a small, neighbourhood or temporary drinking water supply to prepare and implement a water safety plan (under Section 69ZA).

The Te Mahoe Public Water Supply - Water Safety Plan comprehensively sets out details of the water supply including descriptions, control points and critical control points, risk identification and assessment information, planned improvements, and corrective actions and contingency plans. Whakatane District Council's (WDC) adoption of a more comprehensive approach to water safety planning is commendable and acknowledged by the Bay of Plenty and Lakes District Health Boards.

The WSP for the Te Mahoe public water supply has been approved with no recommendations or non-conformances made.

Description of drinking water supply

The WSP describes a WDC owned and operated public water supply consisting of a groundwater source (30 m bore screened at 20 m) with a groundwater capture zone that includes primarily primarily forestry and agricultural activities. Treatment consists of cartridge filtration (5 µm and 1 µm filters) and gas chlorine. Chlorine residual disinfection is maintained in the reticulation. Storage consists of a single 230 m^3 concrete reservoir. The population supplied is approximately 100 people. Known commercial connections are metered and have a backflow prevention device. Residential connections do not have a backflow prevention device. Te Mahoe properties have a reticulated septic tank wastewater system with consented discharge to land 260 metres north-west and downstream of the bore. The wastewater system is maintained by WDC.

Adequacy of risk assessment methodology

Risk assessment methodology is based on a mixture of Ministry of Health Guides and the AS/NZS 4360:1999 standard. The methodology, scope and description of the water supply, including identification and description of critical points and critical control points is adequate.

Adequacy of risk identification and analysis

The risk identification and analysis is adequate. Public health risks for all common supply elements and their possible causes have been adequately identified. The qualitative risk assessment is adequate.

Adequacy of control measures (including Critical Points and Critical Control Points)

Preventative or control measures have been identified for most public health risks/events and are considered to be adequate. Critical Points have been clearly identified. Chlorination and cartridge filtration have been identified as the current operational Critical Control Points. Continuous free available chlorine, pH and turbidity have been identified as the monitored and alarmed parameters. Critical limits for these parameters are clearly listed. Corrective actions associated with each critical limit are included and considered adequate for this supply. Preventative measures and indicators for non-Critical Control Point risks are considered adequate for this small supply.

Contingency plans are included for typical major adverse events and are considered adequate.

Adequacy of improvement schedule

An improvement schedule is included and appears to be aimed at addressing preventative measures, monitoring or corrective actions that are currently absent or ineffective. Many improvement schedule items cover multiple council-owned water supplies. The scope and detail of the improvement item is considered adequate.

Decision

WSP for Te Mahoe public water supply has been approved.

It is expected that the water supplier begin to implement this WSP within one month. The WSP approval remains in force for a maximum period of five years (earlier if otherwise stated in the WSP). Please be aware that if significant changes are made to either the processes used to treat water or to the raw water source, the WSP must be revised and re-submitted for approval by a drinking water assessor.

Information in this report will be provided to the Ministry of Health (in accordance with requirements of Section 69ZZZB of the Health Act).

Attachments
Nil.

Completed 15 November 2018

Grant King
Drinking Water Assessor
Central North Island Drinking Water Assessment Service – Toi Te Ora

Assessment Report Information

Report identifier	TEM004_Te_Mahoe_WSPadequacy_021118_v1
Drinking Water Assessment Unit (Inspection Body)	Central North Island Drinking Water Assessment Unit – Toi Te Ora PO Box 2120 Tauranga 3110 07 5773788
District Health Board	Bay of Plenty District Health Board
Drinking Water Assessor	Grant King
Assessment Date	02/11/2018
Description of assessment work	Assessment of adequacy of Water Safety Plan for: Supply: TEM004 Te Mahoe Zone: TEM004TE Te Mahoe Plant: TP00880 Te Mahoe Source: G01838 Te Mahoe Bore, Hodges Road
Equipment Used	Drinking Water Online Database.
Water Supply Owner / Person Responsible	Whakatane District Council Tomasz Krawczyk , Manager Three Waters
Assessment method	Standard assessment as per Scope Procedure 3 Standard specified in Health Act 1956
Documents and Information	• Drinking Water Standards for New Zealand 2005 (revised 2008) • Te Mahoe Public Water Supply –Water Safety Plan Draft Version 1.03, October 2018 T01616400R012 WSP Te Mahoe_Final.docx. WDC OBJECTIVE FILE A1254230. • Te Mahoe Public Water Supply –Water Safety Plan Draft Version 1.04, November 2018 T01616400R012 WSP Te Mahoe_Final.docx. WDC OBJECTIVE FILE A1254230. • Pattle Delamore Partners Catchment Risk Assessment for Te Mahoe Bore Water Supply, Whakatane District Council, Dec 2017 (T01616400R002)
Site of Assessment	Toi Te Ora, 510 Cameron road, Tauranga
Omissions from proposed assessment	Nil.
Sub-contracted work	Nil.
Document checked by:	Braden Leonard IANZ Accredited Drinking Water Assessor Date: 15 November 2018
Release of report authorised by:	Grant King IANZ Accredited Drinking Water Assessor Signature:  Date: 15 November 2018

If you do not agree with the findings of this report a written appeal must be lodged with the Technical Manager, Peter Wood, PO Box 11036, Palmerston North 4440, within 2 months of receipt of this report. The Technical Manager will arrange for a review to be undertaken using the Ministry of Health appeals procedure.