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Fairlie Drinking Water Safety Plan

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Mackenzie District Council

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Disclaimers and Limitations

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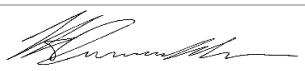
1 Revision Details

Version control

Version No	Description
V1	Prepared and approved by DWA in 2012.
V2	Prepared by Jim Graham, Principal Environmental Scientist, Opus International Consultants Ltd. Approved by DWA September 2017.
V3	Draft prepared by WSP NZ Ltd, January 2022.
V4	Final copy submitted to MDC, November 2022.

Document review and approval

Role	Name	Signature	Date
Authors	Nicole Hunter (Engineer – Water, WSP)		12/10/2022
	Lachlan Donaldson (Engineer – Water, WSP)		12/10/2022
Reviewers	Bridget O'Brien (Technical Principal – Water & Wastewater, WSP)		13/10/2022
	Geoff Horler (3 Waters Manager, MDC)		9/11/2022
Approver	John Mackie (Acting Engineering Manager, MDC)		

The Water Services Act 2021 requires Taumata Arowai to maintain a register of drinking-water suppliers. The Fairlie drinking water supply is owned by Mackenzie District Council, PO Box 52, Fairlie 7925 or 53 Main Street, Fairlie 7925. The operation and maintenance is undertaken by Whitestone Contracting Limited on behalf of Mackenzie District Council.

For the purposes of clarity:

- The Acting Engineering Manager, John Mackie, is the person responsible for the supply.
- 3 Waters Manager, Geoff Horler, is the primary contact for the supply.

Assessment of the performance of the plan

Assessment of the performance of this drinking water safety plan will be undertaken annually, under the authority of the Chief Executive, and completed by the 3 Waters Manager. The assessment will consider any events, non-compliances, near misses and unexpected situations that have occurred during the past year, progress against the improvement schedule and any changes to any of the supply elements. Any matters requiring attention will be included into the Annual Plan, the Three Waters Asset Management Plan and if requiring significant capital funding, the Council's Long Term Plan.

Reporting of the plan

A brief report on the performance of the plan, including information from the assessment of the plan will be completed and reported to the Engineering Manager annually on the anniversary of finalisation of the plan.

The report will cover the items listed above in the assessment of the performance of the plan. The 3 Waters Manager will be responsible for ensuring that any matters requiring attention will be appropriately included into the Annual Plan or the Asset Management Plan. If significant capital funding is required, the matter will be included into the Long Term Plan process (reviewed every three years).

Links to other quality systems

This drinking water safety plan will be linked to the Council's Water Supply Asset Management Plan, Activity Plan for Water Supply, Long Term Plan and Annual Plan.

2 About this Drinking Water Safety Plan

This drinking water safety plan has been prepared for the Fairlie drinking water supply to identify potential events that present public health risks and reliability of supply to consumers. Mackenzie District Council (MDC) is committed to the principles of drinking water safety planning and to the supply improvements that have been identified in this drinking water safety plan.

Supply governance is in accordance with the statutory provisions and obligations of the Local Government Act 2002. Supply delivery falls within the expressed purpose of local government namely: *to enable democratic local decision-making and action by, and on behalf of, communities; and to promote the social, economic, environmental, and cultural well-being of communities in the present and for the future.*

The drinking water safety plan is aligned to national best practice and strengthens the focus on preventive measures across the whole drinking-water supply system, moving away from a reliance on after-the-event endpoint water quality testing. It promotes a multi-barrier approach to managing risks, which safeguards against the failure of any one barrier. It was prepared in accordance with the New Zealand Drinking-water Safety Plan Framework (Ministry of Health, 2018) and to meet the requirements of the Water Services Act 2021, including the requirement for a source water risk management plan. Taumata Arowai has advised that it is up to water suppliers to determine the format of their drinking water safety plan and that using the Ministry of Health framework is acceptable.

The Fairlie water supply provides water to Fairlie (the main town in Mackenzie District) and Kimbell. The supply is classified as a large drinking-water supply under the Drinking Water Quality Assurance Rules (Taumata Arowai, 2022) and provides water to a population of approximately 1,000 people.

Water is sourced from a local spring and is chlorinated and stored prior to being distributed to the Fairlie community.

The maintenance and operation of the supply is undertaken by Whitestone Contracting Ltd under contract to MDC. Both are based in Fairlie. The key people responsible for management, maintenance and operation of the Fairlie water supply scheme are:

- Acting Chief Executive – Angela Oorsthuizen
- Acting General Manager, Operations, Planning and Regulatory Services – David Adamson
- Acting Engineering Manager – John Mackie
- 3 Waters Manager – Geoff Horler
- Treatment Plant Operator – John Wilson (Whitestone Contracting)

Preparation of the plan

The drinking water safety plan was prepared by Nicole Hunter (Engineer – Water) and Lachlan Donaldson (Engineer – Water), overseen by Bridget O'Brien (Technical Principal – Water & Wastewater, CPEng), with significant input from MDC staff via weekly meetings, site visit and a risk workshop.

WSP staff undertook a site visit of the water supply escorted by Geoff Horler (3 Waters Manager) on 15 November 2021. A risk workshop was held on 10 December 2021 via Microsoft Teams, facilitated by WSP and attended by Geoff Horler, Joni Johnson (former Engineering Manager), Tim Scott (Project Manager) and David Adamson.

The pre-circulated draft risk register was discussed with a focus on unmitigated risks that were rated high or extreme. Further information about the water supply was obtained from MDC staff

by phone and email, and through weekly meetings. Sections of the draft drinking water safety plan were submitted progressively to MDC for review between January and June 2022 and comments were received from Geoff Horler and Joni Johnson. These comments were incorporated into the final drinking water safety plan.

3 Commitment to Drinking Water Quality Management

3.1 Relationship of the Drinking Water Safety Plan to Organisational Policy and Strategy

Mackenzie District Council is committed to the six guiding principles for safe drinking-water as described in Taumata Arowai's Guidance on Drinking Water Safety Planning[1]:

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

The community outcomes that the Council's water supplies contribute to are 'a treasured environment', 'resilient successful communities', 'a strong and innovative economy' and to 'embrace heritage and diversity'. These community outcomes are described in the Council's 30 year Infrastructure Strategy and align with their vision statement 'to empower our communities and treasure our environment'.

3.1.1 Legislative Requirements

The responsibility of providing drinking water by Council is undertaken in accordance with:

- Drinking-water Standards for New Zealand 2005 (revised 2018)
- Water Services Act 2021
- Resource Management Act 1991
- Local Government Act 2002
- Health and Safety at Work Act 2015
- Civil Defence and Emergency Management Act 2002
- National Policy Statement for Freshwater Management 2020
- National Policy Statement on Urban Development 2020
- Mackenzie District Council Water Supply, Wastewater and Stormwater Bylaw 2021

The Council must deliver the water supply service to comply with:

Safe drinking water standards: The Water Services Act, supported by the Drinking-water Standards for New Zealand (DWSNZ), specifies standards for drinking water quality and securing a safe supply. This will be replaced by the Drinking Water Quality Assurance Rules, Water Services (Drinking Water Standards for New Zealand) Regulations 2022 and the Aesthetic Values 2022 on 14 November 2022[2].

Drinking water safety plan: Under the Water Services Act, a drinking water safety plan must be prepared for each of the Council's water supplies. The Council must manage and operate each water supply in accordance with the relevant drinking water safety plan.

Abstraction of raw water: The Council is consented in terms of the Resource Management Act 1991 on the volume of water which it may take from a given water resource.

[1] https://www.taumataarowai.govt.nz/for-water-suppliers/drinking-water-safety-planning/guidance-for-drinking-water-safety-planning/#e636
[2] Taumata Arowai, New Standards, Rules and Aesthetic Values: https://www.taumataarowai.govt.nz/for-water-suppliers/new-compliance-rules-and-standards/

Water services assessments: The Local Government Act 2002 requires a territorial authority to assess, from a public health perspective, the adequacy of its water supply in light of health risks, quality of service, current and future demand and regulatory compliance with drinking water standards.

Fire flow: Although the New Zealand Fire Service Firefighting Water Supplies Code of Practice is not mandatory, the Council provides fire hydrants as part of its urban water reticulation system. The Council endeavours to provide water for firefighting but does not guarantee a constant flow of water or any maximum or minimum pressure.

Development capacity to meet demand: The National Policy Statement on Urban Development 2020 directs local authorities to enable sufficient supply of land for houses and businesses and ensure that planning is responsive to changes in demand, while seeking to ensure that new development capacity enabled by Councils is of a form and in locations that meet the diverse needs of communities and encourages well-functioning, liveable urban environments.

Emergency preparedness and response: Under the Civil Defence and Emergency Management Act 2002, the Council as a local authority is required to plan and provide for civil defence emergency management in its district. It must be part of a Civil Defence Emergency Management Group and must provide suitably trained and competent personnel for effective civil defence emergency management in its area. As a lifeline utility, the Council as a water supplier must ensure that it is able to function to the fullest possible extent, even though this may be at a reduced level, during and after an emergency. It must also participate in the development of the national civil defence emergency management strategy and civil defence emergency management plans.

3.1.2 Long Term Plan and Annual Plan

The Long Term Plan (2021 – 2031, adopted 14 December 2021) provides a 10-year plan for the Council. It is supported by the 30-year Infrastructure Strategy, Activity Plans, Asset Management Plans and a Financial Strategy. The purpose of the Long Term Plan is to:

- Describe outcomes the Council aims to achieve
- Specify the services, projects and budgets that will enable those outcomes
- Provide integrated decision-making and coordination of resources, as per section 93(6)(c) of the Local Government Act
- Provide a long-term focus
- Demonstrate transparency and accountability
- Provide an opportunity for participation by the public in Council decision-making processes.

The development of the Long Term Plan is supported by the preparation of the Water Supply Activity Management Plan. The Revenue and Financing Policy describes the revenue sources, the Financial Strategy sets out capital and operational expenditure for the next 10 years and the Infrastructure Strategy identifies the significant issues for the Council over the next 30 years, the options and planned approach for dealing with those issues and forecast capital and operational expenditure.

The draft Long Term Plan is released for public consultation, providing the Council's stakeholders (including the public) an opportunity to provide direct feedback on the Council's proposed priorities and associated budgeting. The Council took the feedback into account before finalising the Long Term Plan 2021 – 2031 on 14 December 2021.

The Long Term Plan is updated every three years. In the intervening two years, the Council undertakes an Annual Plan process. The plan for the coming year as set out in the Long Term Plan is reviewed, released for public consultation as a draft Annual Plan, and then finalised before the start of the financial year on 1 July.

Budgets for the water supply programme are determined through the Council's Long Term Plan and Annual Plan processes. This includes budgets for work relating to water safety.

3.1.3 Documents related to the Fairlie Water Supply

The documents related to the Fairlie water supply are listed in Table 3-1.

Table 3-1 Documents related to the Fairlie water supply

Name	Description	Location
Fairlie Water Treatment Plant Operational Manual	Describes Fairlie water supply operation and maintenance	A hardcopy is stored at the Fairlie water treatment plant and at Council offices.
Fairlie Water Supply Standard Operating Procedures	Describes how the Fairlie water supply should be operated and maintained.	Whitestone have electronic copies of SOPs. There is an improvement action in Section 8.2 for SOPs that are missing.
MDC Long Term Plan 2021 - 2031	Documents outlining the Council's priorities, activities, services, capital programme and operational expenditure and how the Council proposes to pay for it.	https://www.mackenzie.govt.nz/council/strategies-plans-and-reports/long-term-plan-2021-2031
Mackenzie District Plan	Document provides zonings and rules for Mackenzie District's land	https://www.mackenzie.govt.nz/council/strategies-plans-and-reports/district-plan
MDC Annual Report 2020/21	Report on the performance of the Council, including water supply services	https://www.mackenzie.govt.nz/__data/assets/pdf_file/0010/512668/2019-2020-Annual-Report-Full.pdf
MDC Water Supply, Wastewater and Stormwater Bylaw 2021	Bylaws for the Mackenzie District, including a bylaw for water supply.	https://www.mackenzie.govt.nz/__data/assets/pdf_file/0009/589806/Water-Supply-Wastewater-and-Stormwater-Bylaw-2021.pdf
Activity Management Plan for Water Supply 2021-2031	Outlines Council's long-term asset management approach for the provision and intergenerational management of water throughout the district	https://www.mackenzie.govt.nz/__data/assets/pdf_file/0007/596104/Mackenzie_DC__Water_AMP_2021_4.pdf
Mackenzie District Council Map Viewer	Online GIS database showing locations of water supply assets	https://mapviewer.canterburymaps.govt.nz/?webmap=cdc3592cd33341fd9efe89361f754b59&extent=1399870,5067900,1485000,5190500,2193
Canterbury Civil Defence Emergency Management Group Plan 2018	Describes how the group will manage and respond to emergencies and sets out the operational arrangements of the group. MDC is a member of the group.	https://www.cdemcanterbury.govt.nz/media/bxwhxjcm/canterbury-cdem-group-plan-updated-june-2018.pdf
Mackenzie District Council Infrastructure Strategy 2021 - 2051	Describes how Council plans to manage its infrastructure (including water supply) over the next 30 years, taking into account issues facing the	https://www.mackenzie.govt.nz/__data/assets/pdf_file/0008/596123/Infrastructure_Strategy_

Name	Description	Location
	Mackenzie District. Capital and operating expenditure forecasts are included.	2021_-_Final_4_October_2021.pdf

3.2 Engaging Stakeholders and the Community

3.2.1 Key Stakeholders:

MDC maintains active working relationships with several key organisations and stakeholders. This allows for the ongoing management and operation of the supply, including emergency events or response to incidents relating to drinking water safety, quality, or continuity.

Table 3-2 lists the key stakeholders for the Fairlie drinking water supply. Figure 3-1 shows the MDC organisation chart for staff that have responsibility for three waters (water supply, wastewater, and stormwater).

Table 3-2 Key stakeholders

Stakeholder	Description/Relationship to supply management and operation	Contact Position	Contact Details
Taumata Arowai	Regulatory functions under the Water Services Act	Compliance Officer	https://www.taumataarowai.govt.nz/
Regional Public Health	Public health services and regulatory functions under the Health Act.	Medical Officer of Health	https://www.cph.co.nz/
Mayor and Councillors	Exercises drinking water supply decision-making responsibilities in a transparent, inclusive and lawful manner in accordance with the Local Government Act.	Mayor Graham Smith, Council Chairman	https://www.mackenzie.govt.nz/council/mayor-and-councillors
MDC Executive Leadership Team	Council's operational structure is divided into multiple groups responsible for council functions.	Angela Oosthuizen, CEO	https://www.mackenzie.govt.nz/council/executive-team
Canterbury Region Civil Defence Emergency Management Group	MDC is a member of the Canterbury Region CDEM which provides leadership and support to the community in a drinking water emergency and subsequent recovery.	Joe Rush, Emergency Operations Controller, MDC	https://www.cdemcanterbury.govt.nz/canterbury-cdem/governance-strategies-and-plans/
Environment Canterbury	Management and enforcement of RMA provisions in relation to water abstraction and allocation.	Resource Management Officer – Monitoring and Compliance	www.ecan.govt.nz; 0800 324 636

Stakeholder	Description/Relationship to supply management and operation	Contact Position	Contact Details
Fire and Emergency NZ	Response agency for CDEM events relating to drinking water. Major water user (flow and volume) during fire/emergency management incident response.	Carrie Lakin, Mackenzie Fire and Emergency Group Manager	027 405 9091
NZ Police	Response agency for CDEM events relating to drinking water.	Brad Morton, Senior Constable, Tekapo Police	021 191 2805
		Les Andrew, Senior Constable, Twizel Police	021 191 2324
		Russell Halkett, Senior Constable, Fairlie Police	03 685 8400
Alpine Energy	Operates and maintains the electricity distribution network serving treatment plants and related pump stations.	NA	https://www.alpineenergy.co.nz/
Whitestone Contracting Limited	Operation and Maintenance Contractor for the Fairlie water supply reticulation network	Padraic Lawless	https://www.whitestone.co.nz/contact/
Hills Laboratory	Provides IANZ and Taumata Arowai accredited water testing services	Craig Radford	https://www.hill-laboratories.com/
Arowhenua via Aoraki Consultant Services	Arowhenua is the principal Māori kainga of South Canterbury.	Trina Davidson, Senior Policy Advisor	https://arowhenua.org/
Temuka Transport Ltd	Registered water carrier available if required – not under contract to MDC	Graham Bolton	027 495 0394 0800 836 852

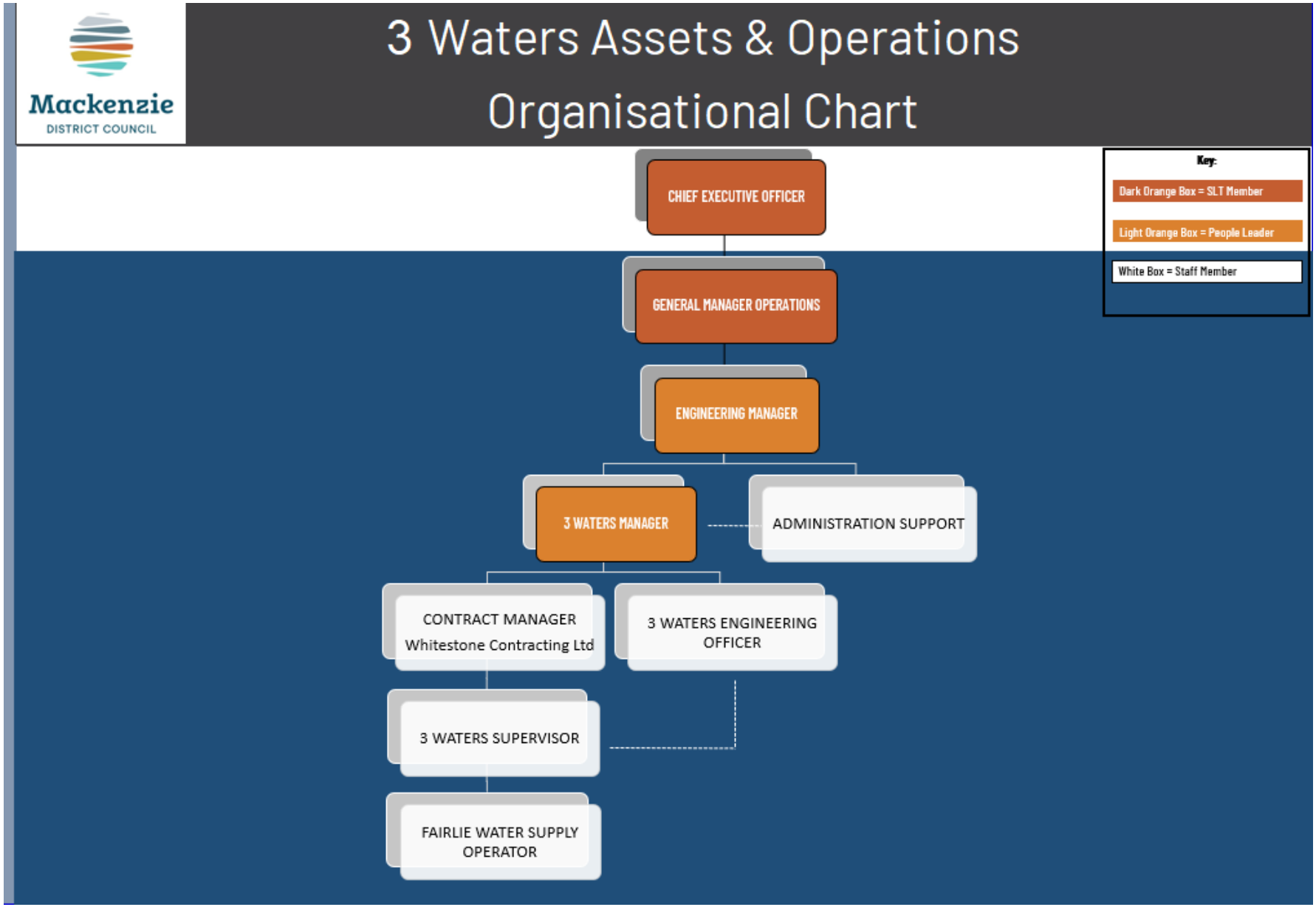


Figure 3-1 Mackenzie District Council organisational chart

3.2.2 Maintenance Contractor

Whitestone Contracting Ltd is the operations and maintenance contractor for the Fairlie water supply.

3.2.3 Public Consultation

Public consultation on the water supply is primarily through the Long Term Plan and Annual Plan process.

3.2.4 Incidents and Emergencies

Mackenzie District Council is a member of the Canterbury Region Civil Defence Emergency Management (CDEM) Group, which includes all local authorities in the Canterbury Region. The Canterbury region CDEM Group Plan was developed to provide effective and efficient management of significant hazards and risks and sets out the operational arrangements of the group. The Canterbury Region CDEM Group Public Information Team is responsible for providing accurate and timely communications to the public in the event of an emergency.

3.2.5 Customer Complaints

Customer complaints regarding water can be lodged on the Council website, email, post, free-call and in person at the Fairlie office or the Twizel office. Whitestone Contracting Ltd contact information is also provided on the council website.

3.3 Te Mana o te Wai

Policy 1 of the National Policy Statement for Freshwater Management is that freshwater is managed in a way that gives effect to Te Mana o te Wai. Te Mana o te Wai sets outs to achieve the following:

- Recognise that protecting the health of freshwater (te hauora o te wai) protects the health and well-being of the wider environment (te hauora o te taiao) and of people (te hauora o te tangata)
- Protects the mauri of the wai

Giving effect to Te Mana o te Wai requires:

- Prioritising first the health and well-being of water bodies and freshwater ecosystems
- Active involvement of tangata whenua in freshwater management and decision-making
- An integrated approach recognising the interconnectedness of the whole environment, ki uta ki tai (from the mountains to the sea).

All elements of te taiao (the environment) possess their own mauri or life force.

Hauora is a holistic understanding of health and wellbeing:

- Te hauora o te taiao (the health of the environment), te hauora o te wai (the health of the waterbody) and te hauora o te tangata (the health of the people) are interconnected
- The state of health and wellbeing of te wai and te taiao is seen as a reflection on the mana, health and wellbeing of mana whenua
- Decline in te hauora o te wai and te hauora o te taiao is also understood to impact the health and well-being of the wider community

Ki uta ki tai is the concept used to describe holistic natural resource management, recognising all environmental elements are interconnected and must be managed as a whole. It is a way of understanding the natural environment, including how it functions, how people relate to it and how it can be looked after appropriately. Ki uta ki tai:

- Reflects mātauranga (indigenous knowledge) that all environmental elements are interconnected and must be managed as such
- Includes connections throughout a freshwater system, and also the relationships between air, land, freshwater and coastal waters
- Is concerned with each of the part of the system, and also the sum of the parts
- Requires holistic management.

Te Mana o te Wai approach does not ask, "Are the adverse effects within acceptable limits?" but rather it asks, "How are we supporting the health and wellbeing of the water body?" This affects system planning in the following ways.

- Respect the mauri of each water body:

  Mauri is distinctive for each water body, reflecting whakapapa
  Reflect natural form and function – letting the river be itself
  The baseline for evaluating effects should be what happens naturally
  Unnatural mixing of the mauri of different water bodies is not appropriate.

- Enable exercise of Kaitiakitanga:

  Do not draw down "environmental capital", but protect and sustain the water body for current and future generations
  Do not manage to just meet bottom lines, but provide for healthy resilience, and do not rely on assimilative capacity; prevent contamination instead

- Mana whakahaere:

  Partnership and active involvement of mana whenua in decision-making
  Sustain iwi relationships with water bodies and provide for customary associations and uses – recognise wāhi tūpuna, avoid discharge of waste to water
  Incorporate mātauranga

- Integrated management / ki uta ki tai:

  Sustain and restore connections throughout catchment
  Recognise connections between water body and coast
  Sustain and restore habitats of mahinga kai and indigenous species
  Consider relationships between land use and water use
  Have regard to cumulative effects and climate change risks

Examples of how water supply takes, and associated infrastructure can support or be inconsistent with Te Mana o te Wai are summarised in Table 3-3.

Table 3-3 Te Mana o te Wai and water supply takes and infrastructure

Supports Te Mana o Te Wai	Inconsistent with Te Mana o Te Wai
Intake designed to allow natural flow to continue around it	Intake disrupts/diverts natural flow
Abstraction proportionate to natural flow	Abstraction takes all or most of natural flow
Maintains connections between surface water and groundwater	Treats surface water and groundwater as different resources
Ensures continuity of flow from mountains to sea	Considers only flow at point of take
Considers habitat needs holistically	Considers habitat factors narrowly

Supports Te Mana o Te Wai	Inconsistent with Te Mana o Te Wai
Intake designed to allow natural flow to continue around it	Intake disrupts/diverts natural flow
Structures located away from sensitive areas	Structures located close to mahinga kai or areas of dynamic river/coastal processes
Riparian buffers established and maintained	Structures built right next to river/ coastal margin
Fish are able to migrate naturally	Structures interrupt natural migration
Built-in resilience in terms of capacity and safeguards against overflows/leakage	Accepting a degree of overflow/failure as inevitable
Design for changing environment (especially due to climate change)	Reliance on structures/system designs that are no longer fit for purpose
Structures located away from sensitive areas	Structures located close to mahinga kai or areas of dynamic river/coastal processes

MDC gives effect to Te Mana o te Wai in the following ways:

- Engaging with mana whenua to understand the values they hold for the water bodies that MDC uses for its drinking water supplies.
- Resource consent applications for water takes have considered the wider effects on the water bodies that they draw from.
- There are no discharges of waste or chemicals to the environment from any of the water treatment plants.
- Dangerous chemicals are handled with care and measures are in place to contain spills.
- All water intake structures allow fish passage.
- Water from high quality sources is used, which results in higher quality drinking water, less waste and lower treatment costs.
- The source water risk management plans in this drinking water safety plan take an holistic view of the catchments.

MDC aims to improve how it gives effect to Te Mana o te Wai in the following ways:

- Increase water efficiency through installing smart meters on all water supply connections
- Continuing to improve water efficiency and reduce leakage in its water networks.

4 Description of the Fairlie Drinking Water Supply

4.1 Overview

The Fairlie drinking water supply provides water to the communities of Fairlie (population 850) and Kimbell (population 150). The supply was established in the 1940s and has changed very little since that time. The supply has a spring source with a concrete intake structure, chlorination treatment plant and treated storage reservoir / break pressure tank.

Turbidity, pH, free available chlorine (FAC) and flow are measured continuously at the treatment plant and data is reported back to the operator and the Council office through the SCADA system. Samples are collected and analysed for *E. coli* weekly from the treatment plant and Fairlie distribution and monthly from the Kimbell distribution. Free available chlorine (FAC) is tested daily in the Fairlie distribution system and at the treatment plant.

The maintenance and operation of the supply is undertaken by Whitestone Contracting Ltd under contract to MDC.

A catchment risk assessment was prepared in June 2017 and identified that the source water has a moderate risk of protozoal contamination and requires 4-log protozoa treatment under section 5 of the DWSNZ. This was reviewed and confirmed in the source water risk assessment in Section 6 of this drinking water safety plan.

The treatment process is not designed to remove protozoa and so does not comply with DWSNZ. MDC plans to construct a new treatment plant that is fully compliant by the end of 2024.

A map of the water supply scheme is shown in Figure 4-1 and the details of the scheme summarised in Table 4-1.

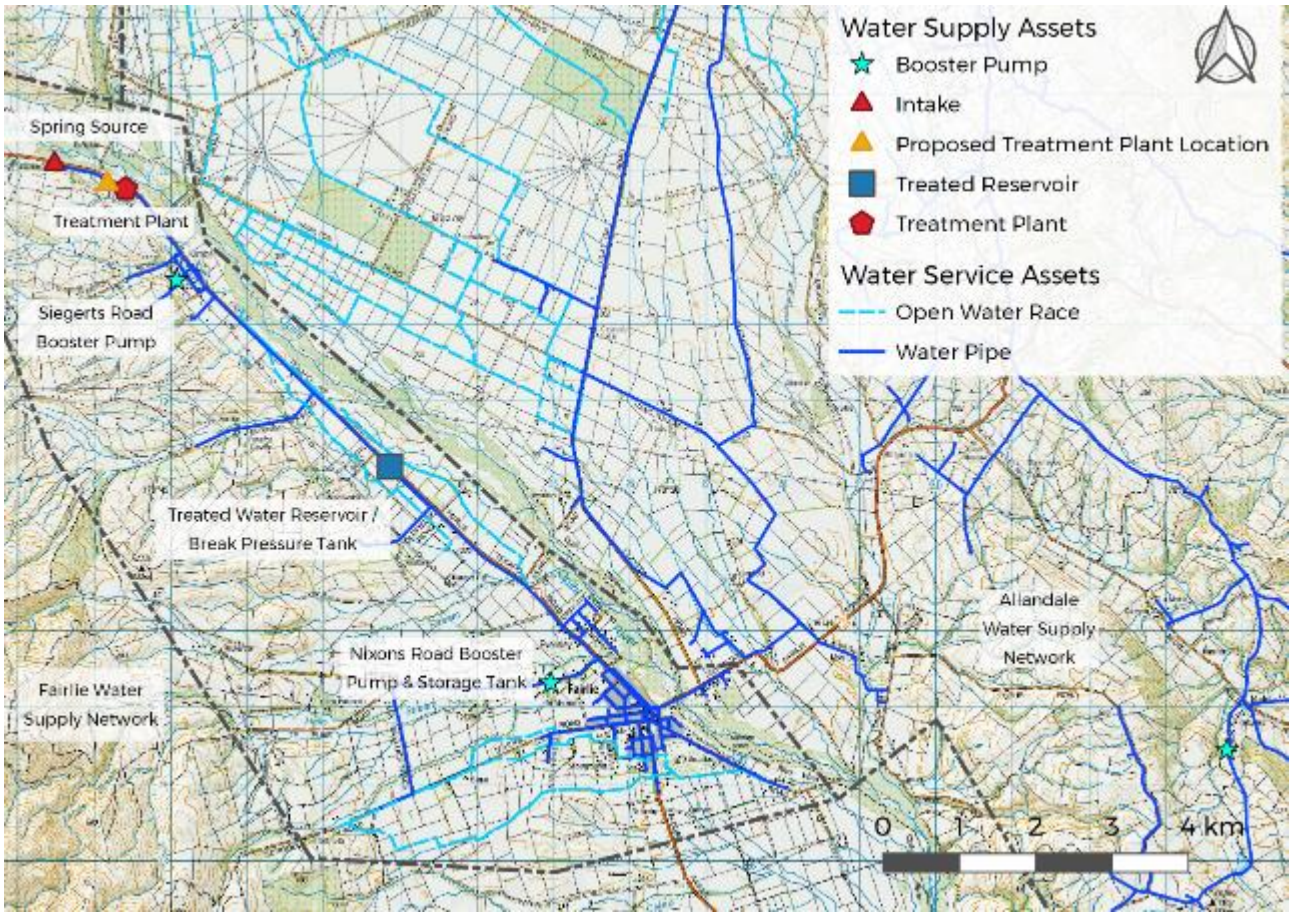


Figure 4-1 Fairlie water supply sources and treatment plant. Note: the Allandale water supply distribution network is shown to the north of the Ōpihi River. The open water races are the stock water scheme.

Table 4-1 Fairlie water supply scheme

Supply Details		
Supply Name	Fairlie	
Hinekōrako Code	FAI002	
Supply Owner	Mackenzie District Council	
3 Waters Manager	Geoff Horler	
Water Supply Operator	John Wilson (Whitestone Contractors Ltd)	
Population Served by Supply	1000	
Source Details		
Source Name	3 Springs, Fairlie	
Hinekōrako Source Code	G00249	
Type of Source	Groundwater	
Consent Number	CRC040921	
Consent Expires	19 August 2044	
Maximum Consented water take:	2,420 m^3/day	
Grid Reference of Source (NZTM)	Easting: 1418474	Northing: 5122097
Treatment		
Plant Name	Fairlie	
Plant Code	TP00373	

Location	State Highway 8, 9km northwest of Fairlie
Treatment Processes	Chlorination
Average Daily Volume	1,000 m^3/day
Peak Daily Volume	1,800 m^3/day
Distribution	
Distribution Zone Name	Fairlie
Distribution Zone Code	FAI002FA
Distribution Zone Population	850
Distribution Zone Name	Kimbell
Distribution Zone Code	FAI002KI
Distribution Zone Population	150

4.1.1 System Flow Diagrams

Figure 4-2 and Figure 4-3 show the water supply system, from source to reticulation, including the treatment plant. Figure 4-2 shows the barriers to contamination, critical points and critical control points which are discussed further in Section 9.6 (Critical Control Points).

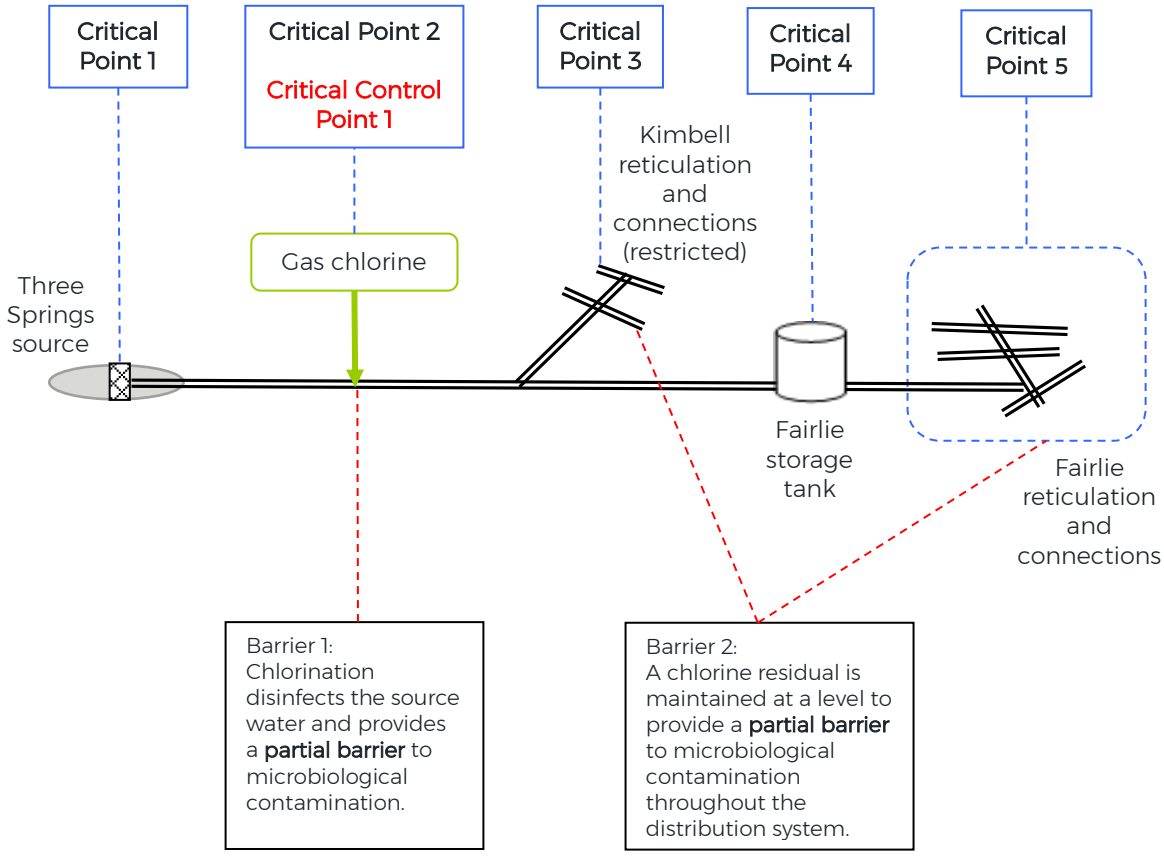


Figure 4-2 Fairlie water supply schematic showing barriers, control points and critical control points

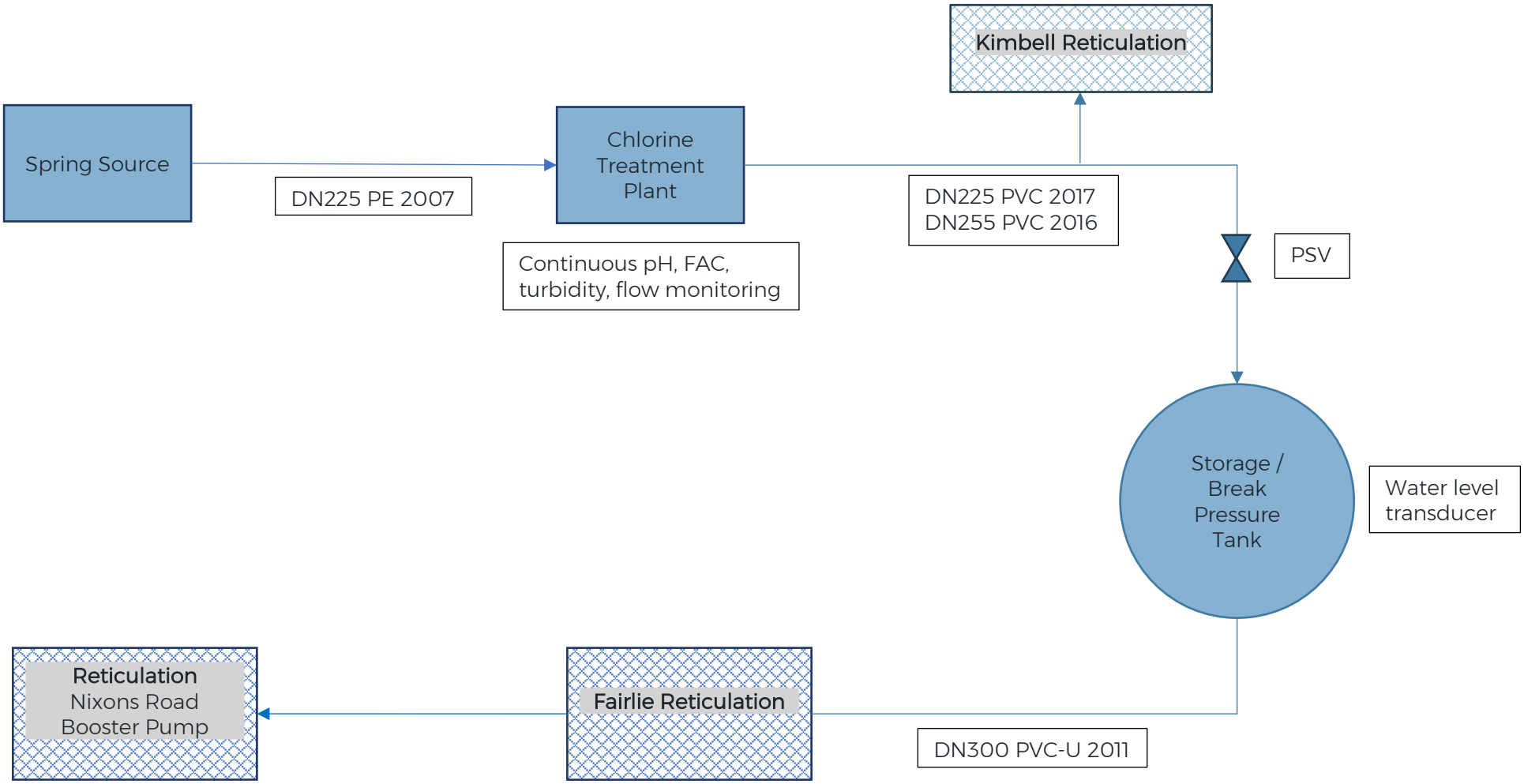


Figure 4-3 Fairlie water supply schematic including flow and water quality monitoring

The draft MDC Water Activity Management Plan 2021 – 2031 states that population growth projections in the district "predict a relatively static population growth over the period of this asset management plan" and "there will not be a significant increase or decrease in demand for Council services based on change in population" (over the next 30 years). The available quantity of the source water meets the required needs of the current and future population, even during times of drought.

The only significant development planned in the Fairlie area in the near future is a new water treatment plant. This will include modifications to the raw water intake, membrane filtration, chlorination with pH and alkalinity correction and an increase in treated water storage volume (2,000 m^3). Upgrades will ensure that the Fairlie drinking water supply complies with the Water Services Act and DWSNZ (and the Drinking Water Quality Assurance Rules that will replace it) and are expected to be completed by the end of 2024.

4.2 Water Source and Water Quality

4.2.1 Intake Details

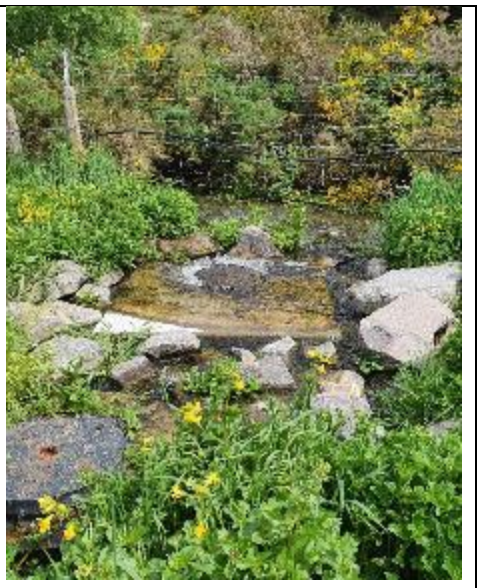
The supply abstracts water from a spring known as 3 Springs which is located adjacent to State Highway 8 approximately 9 km northwest of Fairlie. A concrete casing structure has been driven down into the spring and water is abstracted via a pipe located within the structure. Because the water flows upward through the chamber under pressure, it is unlikely that surface water ingress directly into the intake pipe is possible. The source spring is located near the Ōpihi River (> 100 m away), and it is expected that the two are hydraulically linked – evidenced by elevated turbidity during flooding. Flow from the spring is relatively constant and has not been significantly affected by drought in the past.

The spring area is enclosed by timber fencing topped with barbed wire and a locked gate to prevent unauthorised access (see Figure 4-4).

Secure fencing around spring source

Locked entrance to spring source

Overflow from spring source



Spring source

Figure 4-4 Fairlie drinking water supply spring source

4.2.2 Raw Water Quality

The raw water quality from the spring is generally good but can become turbid after rainfall. Continuous monitoring data shows that the turbidity at the treatment plant can exceed 30 NTU.

In addition to continuous turbidity monitoring at the treatment plant, raw water quality is analysed annually for the Fairlie drinking water supply. Additional raw water quality monitoring has also been completed to inform the proposed water treatment plant upgrades. Table 4-2 and Table 4-3 summarise the raw water quality results.

Interpretation of the raw water analysis below include:

- None of the determinands exceed the DWSNZ maximum acceptable values
- Alkalinity is consistently below the DWSNZ guideline value and should be corrected to prevent metals leaching from plumbing and fittings.
- pH was below the DWSNZ guideline value once in 2016 but was within the guideline range on other occasions.
- Microbiological analysis of the source water is not routinely undertaken, but it is expected that a low level of faecal contamination would be present, requiring disinfection in the treatment process.

Table 4-2 Raw Water Quality Data

Parameter	Units	DWSNZ		Measured Concentration			
		Guideline Value (GV)	Maximum Acceptable Value (MAV)	3/11/2016	8/10/2018	9/09/2020	9/09/2021
Total Alkalinity	g/m³ as CaCO3	100 - 300		34	29	27	26
pH	pH Units	7.0 - 8.5		6.8	7.3	7.3	7.2
Free Carbon Dioxide	g/m³ at 25˚C			9.9	3.1	2.9	3.1
Total Hardness	g/m³ as CaCO3	< 200		29	24	24	23
Electrical Conductivity	µS/cm			76	62	65	64
Total Dissolved Salts	g/m³			51	41	43	43
Total Arsenic	g/m³		0.01			< 0.0011	<0.0011
Total Boron	g/m³		1.4	0.0079	0.01	0.0088	0.009
Total Calcium	g/m³			9.2	7.7	7.6	7.3
Total Copper	g/m³	< 1	2	0.00124	0.004	0.00062	0.00077
Total Iron	g/m³	< 0.2		< 0.021	<0.021	< 0.021	<0.021
Total Lead	g/m³		0.01			< 0.00011	< 0.00011
Total Magnesium	g/m³			1.39	1.24	1.23	1.18
Total Manganese	g/m³	< 0.04 Stain < 0.10 Taste	0.4	< 0.00053	< 0.00053	< 0.00053	< 0.00053
Total Potassium	g/m³			0.63	0.57	0.49	0.51
Total Sodium	g/m³	< 200		3.7	3.5	3.5	3.3
Total Zinc	g/m³	< 1.5		< 0.0011	0.0022	< 0.0011	< 0.0011
Chloride	g/m³	< 250		1.2	0.8	1.4	1.6
Nitrate-N	g/m³		11.3	0.29	0.15	0.15	0.23
Sulphate	g/m³	< 250		2.1	2.1	2.4	2.6
			Key:	Less than MAV and GV	Exceeds GV or half the MAV	Exceeds the MAV	

Table 4-3 Raw Water Quality Data (treatment plant upgrade monitoring)

Parameter	Units	DWSNZ		Measured Concentration		
		Guideline Value (GV)	Maximum Acceptable Value (MAV)	29/07/2021	9/09/2021	6/10/2021
Total Suspended Solids	g/m^3			< 3	< 3	< 3
Total Dissolved Solids	(TDS) g/m^3	1000		44	41	48
Total Ammoniacal Nitrogen	N g/m^3			< 0.010	<0.010	<0.010
Reactive Silica	g/m^3 as SiO_2			8.5	7.9	7.9
Dissolved Organic Carbon	(DOC) g/m^3			2.2	1.1	1.1
Absorbance	254 nm AU cm-1			0.055	0.035	0.048
Transmittance	254 nm* %T, 1 cm cell			88.0	92.3	89.5
Total Aluminium	g/m^3	0.10		0.0155	0.0119	0.0144
Total Antimony	g/m^3			< 0.00021	<0.00021	<0.00021
Total Arsenic	g/m^3		0.01	< 0.0011	<0.0011	<0.0011
Total Barium	g/m^3		0.7	< 0.0053	<0.0053	<0.0053
Total Beryllium	g/m^3			< 0.00011	<0.00011	<0.00011
Total Boron	g/m^3		1.4	0.0097	0.0097	0.0084
Total Cadmium	g/m^3		0.004	< 0.000053	<0.000053	<0.000053
Total Calcium	g/m^3			7.6	7.6	7.2
Total Chromium	g/m^3		0.05	< 0.000053	<0.00053	<0.00053
Total Cooper	g/m^3	< 1	2	0.00118	0.00076	0.009
Total Iron	g/m^3	< 0.2		< 0.021	<0.021	<0.021
Total Lead	g/m^3		0.01	< 0.00011	<0.00011	<0.00011
Total Lithium	g/m^3			0.00024	0.00024	0.00024

Parameter	Units	DWSNZ		Measured Concentration		
		Guideline Value (GV)	Maximum Acceptable Value (MAV)	29/07/2021	9/09/2021	6/10/2021
Total Magnesium	g/m^3			1.28	1.24	1.2
Total Manganese	g/m^3	< 0.04 Stain < 0.10 Taste	0.4	< 0.00053	<0.00053	<0.00053
Total Mercury	g/m^3		0.007	< 0.00008	< 0.00008	< 0.00008
Total Molybdenum	g/m^3		0.07	< 0.00021	< 0.00021	< 0.00021
Total Nickel	g/m^3		0.08	< 0.00053	< 0.00053	< 0.00053
Total Potassium	g/m^3			0.54	0.52	0.51
Total Selenium	g/m^3		0.01	< 0.0011	< 0.0011	< 0.0011
Total Silver	g/m^3			< 0.00011	< 0.00011	< 0.00011
Total Sodium	g/m^3	< 200		3.8	3.5	3.3
Total Tin	g/m^3			< 0.00053	< 0.00053	< 0.00053
Total Uranium	g/m^3		0.02	< 0.000021	< 0.000021	< 0.000021
Total Zinc	g/m^3	<1.5		< 0.0011	< 0.0011	< 0.0011
			Key:	Less than MAV and GV	Exceeds GV or half the MAV	Exceeds the MAV

4.3 Treatment Plant and Treated Water Storage

4.3.1 Chlorination

A small roadside treatment plant is located on State Highway 8 between the intake and the Kimbell community (approximately 1.5 km west of Kimbell). Treatment consists of disinfection with chlorine gas. Two 70 kg gas cylinders are kept at the treatment plant in a duty standby arrangement. When the duty bottle is near empty, it automatically changes over to the standby cylinder. A small pump provides carry water to which the gas chlorine is dosed via a venturi system. The chlorine dose is flow proportional. Turbidity, treated water pH, treated water FAC and flow rate are reported back to the operator and the Council office through the SCADA system. FAC is tested daily in the distribution system and at the treatment plant.

The treatment plant has a backup diesel generator to continue plant operation in the event of a power outage and a heater installed to prevent water lines freezing during winter. Figure 4-5 shows photos of the treatment plant.

Chlorine treatment shed

Gas chlorine bottles

Flow and turbidity monitoring equipment

Chlorine and pH monitoring equipment

Backup diesel generator

Electrical control box and heater

Figure 4-5 Fairlie water supply treatment plant and monitoring equipment

4.3.2 Treated Water Reservoir

Following chlorination, water is distributed to Kimbell and Fairlie consumers. The Kimbell community receives a restricted supply, and each property is required to have an on-site storage tank. Fairlie has a mains pressure supply.

A 140 m^3 storage tank is located next to State Highway 8 between Fairlie and Kimbell which provides 2 – 4 hours of storage for Fairlie. A pressure sustaining valve is installed in the bulk main ahead of the storage tank to maintain pressure in the Kimbell distribution. A level transducer controls the water level in the tank by transmitting a signal to the upstream pressure sustaining valve (PSV). This also prevents leakage above the walls of the tank's Butynol liner. The tank is covered, and all entry hatches are secured. Grates and mesh over the air vent prevent access by vermin and insects.

There is a 25 m^3 tank on Nixons Road and a booster pump that feeds another 25 m^3 tank on School Road. The storage tanks are PE material and are sealed to prevent access by vermin and insects.

Lined concrete reservoir / break pressure tank located next to State Highway 8 between Fairlie and Kimbell

Plastic reservoir / storage tank located on Nixons Road

Figure 4-6 Fairlie water supply treated water storage

4.4 Plant Control Measures and SCADA

There is continuous monitoring of treated water pH, turbidity, FAC and flow from the treatment plant. FAC monitoring results are used to control the level of chlorine dosing upstream.

The treatment plant is alarmed in the event of a power failure. Low and high FAC, high turbidity and low reservoir level are also alarmed.

4.5 Treated Water Quality Characteristics

4.5.1 Treated Water Quality

The water quality monitoring results at the treatment plant for Fairlie from the last 5 years is summarised in Table 4-4.

Table 4-4 Treated Water Quality Data (treatment plant)

Parameter	DWSNZ GV	DWSNZ MAV	Minimum	Average	Maximum
Total Coliforms (MPN/100mL)			< 1	< 1	5
E. coli (MPN/100mL)		<1	< 1	< 1	< 1
Turbidity (NTU)	2.5		0.087	0.553	10.62
FAC (mg/L)		5.0	0.06	0.71	2.08
pH	7.0 – 8.5		6.3	6.5	6.8

Interpretation of the treated water analysis include:

- Turbidity at the treatment plant is generally below the DWSNZ GV but can become elevated after heavy rainfall. A treatment process is needed to remove turbidity.

- pH was lower than the GV at all times, pH correction is required.
- E. coli was not detected.

The water quality monitoring data in the Fairlie and Kimbell distribution systems over the last five years is summarised in Table 4-5 and Table 4-6 respectively.

Table 4-5 Treated Water Quality Data (Fairlie distribution system)

Parameter	DWSNZ MAV	Minimum	Average	Maximum
Total Coliforms (MPN/100mL)		< 1	< 1	1
E. coli (MPN/100mL)	<1	< 1	< 1	1
FAC (mg/L)	5.0	0.01	0.45	1.46

Table 4-6 Treated Water Quality Data (Kimbell distribution system)

Parameter	DWSNZ MAV	Minimum	Average	Maximum
Total Coliforms (MPN/100mL)		< 1	< 1	< 1
E. coli (MPN/100mL)	<1	< 1	< 1	< 1

Interpretation of the water analysis in the distribution system include:

- *E. coli* is generally below the MAV but there was one transgression.
- FAC is generally above 0.2 mg/L.

Disinfection by-products have also been monitored for the Fairlie drinking water supply; all were below half the DWSNZ MAV.

4.5.2 *Water Quality Incidents and Responses*

There has been one transgression recorded in the Fairlie distribution in the last five years on 16 February 2021 when 1 MPN/100 mL of *E. coli* and 1 MPN/100 mL of total coliforms were measured. The transgression was assumed to be a sampling error and was not investigated further.

4.6 Distribution System

4.6.1 *Asset Characteristics*

The Fairlie distribution system consists of approximately 21 km of pipe, mostly PVC (43%) and polyethylene (PE) (39%) with some reinforced concrete and asbestos cement pipe. The bulk main is approximately 13 km long and has recently been replaced with PE and PVC pipe.

The raw water trunk main runs adjacent to State Highway 8 and is DN 225 PE installed in 2007. The distribution trunk main between the treatment plant and break pressure tank consists of DN 225 and DN 250 PVC pipe installed in 2016 and 2017. The trunk main from the reservoir into Fairlie is DN 300 PVC installed in 2011.

Most asbestos cement and reinforced concrete pipe has been replaced over the last five years. The replacement of all remaining asbestos cement and concrete pipe is programmed for completion as part of an accelerated renewal programme by the end of 2022. Once replaced, it is expected that no pipework in the reticulation will reach its end of life over the next 15 years. The majority of pipes in the network have an expected remaining useful life of over 50 years.

The Kimbell distribution system consists of 1.8 km of PE and PVC pipe. Water is supplied to Kimbell on a restricted basis and each property is required to have on-site storage. Air gaps at the on-site storage tanks provide backflow prevention.

4.6.2 System Water Loss and Leakage

The average daily consumption of 1,720 L/person/day[3] in the Mackenzie district far exceeds the average in New Zealand of 280 L/person/day[4]. Council is currently rolling out smart water metering of its water supplies as a demand management strategy, to identify high water users and provide more detailed information on where leakage is occurring. Water metering is intended to drive a behavioural change where both the supplier and user are more likely to fix leaks once the quantity of water being lost is identified.

Rubber ring joints of concrete pipes were identified as a major cause of leakage in the Fairlie distribution network. Renewal of asbestos cement and reinforced concrete pipe has been an ongoing priority and is programmed for completion by the end of 2022.

The Fairlie township experiences high demand periods during summer which can cause pressure loss within the reticulation to some customers. Water restrictions are imposed by Council during periods of high demand to maintain pressure in the reticulation and comply with the resource consent conditions.

4.7 SCADA Control Measures and Alarms

The treatment plant is monitored online using SCADA. All data in SCADA is stored every 15 minutes. The SCADA alarm set points for the plant are shown in Table 4-7. SCADA alarms are also raised in the event of a power outage.

The alarms are displayed on the screens in the treatment plant, as well as in SCADA which can be accessed via an app on operators' mobile phones; it also sends push notifications. The duty operator monitors and responds to alarms 24/7.

Table 4-7 SCADA Alarm Set Points

Parameter	Low Alarm	High Alarm
FAC	0.5 mg/L leaving treatment plant	5.0 mg/L leaving treatment plant
Turbidity	N/A	2 NTU
Reservoir Level	50%	N/A

[3] Mackenzie District Council 2020/21 Annual Report: /https://www.mackenzie.govt.nz/__data/assets/pdf_file/0005/629474/2020-2021-Annual-Report-Full.pdf
[4] Water NZ National Performance Review 2020/2021: https://www.waternz.org.nz/resourceuseefficiency

5 Hazards and Hazardous Event Identification and Risk Assessment

5.1 Risk Assessment Methodology

Each element of the water supply is exposed to risk events of varying likelihood and consequence. In establishing a management plan, the level of risk to public health and operations within the water supply needs to be understood, quantified and managed.

The risk assessment includes identifying hazardous events and their likely causes. Hazardous events are defined as events that introduce hazards, or fail to remove them, from the water supply. The events and causes listed in the risk register were discussed and agreed upon in the risk assessment workshop held at Council offices with MDC staff on 16 November 2021. Likelihood and consequence scoring was done by means of expert judgement by workshop attendees (see Section 2 for a list of attendees).

A risk rating for each possible hazardous event was estimated based on the likelihood of the event occurring and the consequences if it does occur (Table 5-1 and Table 5-2). The matrix is based on five categories of likelihood and five categories of consequence (Table 5-3) which were discussed and agreed at the risk workshop.

The New Zealand Drinking-Water Safety Plan Framework (Ministry of Health, 2018)[5] allows a water supplier to establish its own approach to hazard identification and risk assessment methodology. The Handbook for Preparing a Water Safety Plan (Ministry of Health, 2019)[6] provides examples of likelihood and consequence ratings. The Council developed its own risk assessment methodology taking into account the examples given in the handbook and the World Health Organisation Water Safety Plan Manual 2009, which says that the aim of the risk assessment should be to distinguish between significant and less significant risks.

Table 5-1 Risk assessment – likelihood

Likelihood Frequency	*Score*	Likelihood Description
Almost Certain	5	Is expected to occur (more often than once per week)
Likely	4	Will probably occur (more often than once per month and up to once per week)
Possible	3	Might occur at some time (more often than once per year and up to once per month)
Unlikely	2	Could occur at some time (more often than once every 5 years and up to once per year)
Rare	1	Expected to occur only in exceptional circumstances (greater than once every 5 years)

[5] Ministry of Health, 2018: New Zealand Drinking-water Safety Plan Framework: https://www.health.govt.nz/publication/new-zealand-drinking-water-safety-plan-framework
[6] Ministry of Health, 2019: Handbook for Preparing a Water Safety Plan: https://www.health.govt.nz/publication/handbook-preparing-water-safety-plan

Table 5-2 Risk assessment – consequence

Consequence Ranking	Score	Description
Catastrophic	5	Major impact on most of the population, complete failure of systems, requirement for high level of monitoring and incident management. Potential acute harm to people, declared outbreak or widespread illness and possible deaths expected
Major	4	Major impact on a sub-population, significant compromise of systems and abnormal operation, requirement for high level of monitoring and incident management. Potential acute harm to people, declared outbreak or widespread illness expected.
Moderate	3	Minor impact on most of the population, significant (but manageable) disruption to normal operation, requirement for increased monitoring. Potential widespread aesthetic issues, or repeated breach of maximum acceptable value (MAV).
Minor	2	Minor impact on a sub-population, some manageable disruption to normal operation. Potential local aesthetic issues, isolated exceedance of MAV.
Insignificant	1	Insignificant impact, little disruption to normal operation. Isolated exceedance of aesthetic parameter.

A semi-quantitative risk prioritisation approach was used where each likelihood and consequence category received a score between 1 and 5 as detailed above, and the combined risk score determines the overall risk rating as per Table 5-3 and Table 5-4.

Table 5-3 Risk assessment – scoring matrix

		Consequence				
		Insignificant	Minor	Moderate	Major	Catastrophic
	Score	1	2	3	4	5
Rare	1	1	2	3	4	5
Unlikely	2	2	4	6	8	10
Possible	3	3	6	9	12	15
Likely	4	4	8	12	16	20
Almost Certain	5	5	10	15	20	25

Table 5-4 Risk assessment – risk rating

Risk Score	1 - 4	4- 9	10 - 16	20 - 25
Risk Rating	Low	Medium	High	Extreme

5.2 Risk Assessment, Uncertainty and Acceptability

A range of factors contribute to the consequence of an event; including economic, environmental, public health, and operational impacts. This document only considers public health and operations effects, with emphasis placed on public health risks.

The Risk Table gives details of the maximum risk and residual risk i.e. without any measures in place and barriers failed, and with existing preventive measures in place respectively.

Hazard identification and risk assessment are activities of informed judgement and contain uncertainty and limitations. Uncertainty arises from factors such as lack of or variability in data and/or information. These uncertainties and limitations need to be understood and taken into consideration when determining acceptability of risks. Risk uncertainty descriptors are provided in Table 5-5. In general, an uncertain or estimated risk elevates the risk acceptability and requires further investigation.

Table 5-5 Risk assessment – uncertainty

Level of certainty	Description
Certain	At least five years of: • Continuous data (e.g., FAC), or • Monitoring data (e.g., *E. coli* monitoring), or • Monthly monitoring data (chemical), or • Inspection records which have been collated and analysed, and variability is predictable • At least five years of continuous/daily/monthly monitoring/inspection data for the duration of seasonal events which have been collated and analysed, and variability is predictable. • The hazardous event and preventive measures/processes involved are thoroughly understood.
Confident	At least two years of: • Continuous data (e.g., FAC), or • Daily monitoring data (*E. coli* monitoring), or • Monthly monitoring data (chemical), or • Inspection records which have been collated and analysed, and variability is predictable. • At least two years of continuous/daily/monthly monitoring/inspection data for the duration of seasonal events, which have been collated and analysed, and variability is predictable. • There is a good understanding of the hazardous event and preventive measures/processes involved.

Level of certainty	Description
Reliable	At least one year of: • Continuous data (e.g., FAC), or • Daily monitoring data (*E. coli* monitoring), or • Monthly monitoring data (chemical), or • Inspection records which have been collated and analysed, and variability is predictable. • At least two years of continuous/daily/monthly monitoring/inspection data for the duration of seasonal events have been collated and analysed, but variability is not predictable. • There is a good understanding of the hazardous event and preventive measures/processes involved.
Estimate	• There are limited monitoring data available. • There is a reasonable understanding of the hazardous event and preventive measures/process involved.
Uncertain	• There are limited or no monitoring data available. • The hazardous events or preventive measures/processes are not well understood.

Table 5-6 outlines the levels of risk considered:

- Acceptable risk – no further actions required to reduce the risk
- Unacceptable risk – additional actions / improvements to be taken.

Table 5-6 Risk assessment – acceptability

Risk level	Certainty	Acceptability	Management actions
Low	Certain	Acceptable	Manage within existing processes, adopting continuous improvement.
	Confident		
	Reliable		
	Estimate		
	Uncertain		
Medium	Certain	Acceptable	Implement short-term measures, and plan and implement longer-term risk reduction measures within x-year timeframe.
	Confident		
	Reliable		
	Estimate	Unacceptable	Implement short-term measures, and investigate measures to reduce level of uncertainty as soon as possible.
	Uncertain		
High	Certain	Unacceptable	Implement short-term measures immediately, and prioritise longer-term risk reduction measures.
	Confident		
	Reliable		
	Estimate	Unacceptable	Implement short-term measures immediately, and investigate measures to reduce level of uncertainty as soon as possible.
	Uncertain		
Extreme	Certain	Unacceptable	Implement short-term measures immediately, put emergency plans on stand-by and give longer-term risk reduction measures top priority.
	Confident		
	Reliable		
	Estimate	Unacceptable	Implement short-term measures immediately, put emergency plans on stand-by and immediately investigate measures to reduce level of uncertainty.
	Uncertain		

The Council has determined that a medium risk where the level of uncertainty is classified as 'Certain', 'Confident', or 'Reliable' is an acceptable risk, as illustrated in

Table 5-6. This is in line with the World Health Organisation Water Safety Plan Manual 2009, which says that the aim of the risk assessment should be to distinguish between significant and less significant risks.

Unacceptable risks requiring improvements have been identified in the improvement tables in Section 8.1. The responsibility for ensuring progress on the improvement, the timeframe for the improvement, and possible practical steps to carry out the improvement are also included in the tables.

To ensure that the work is undertaken, responsibilities have been assigned to the relevant Council staff. Roles and responsibilities are likely to change and therefore are required to be checked as part of the annual internal drinking water safety plan review process.

5.3 Risk Assessment Table

The Fairlie drinking water supply risk assessment table is provided in Appendix A.

5.4 Unacceptable Risks

The assessment of risk acceptability and level of uncertainty in Appendix A has identified five risks that are considered unacceptable and are listed in Table 5-7. Improvements to address these risks outlined in Section 8.1

Table 5-7 Unacceptable risks

Supply Element	Event Description	Cause No.	Possible Causes
Source - Spring Recharge Zone	Microbiological contamination due to surface runoff into spring recharge zone	1.01	Contamination from human or animal activity in catchment, unmonitored permitted activities, consent conditions not followed, or potential impact not considered.
Source - Spring Recharge Zone	Increased sediment load in source water	1.05	Heavy rainfall, fire in catchment
Treatment - Chlorination	Inadequate chlorination	2.02	· Gas chlorine supply exhausted · Dosing system failure · Chlorine dose rate incorrect · Chlorine demand exceeds chlorine dose due to high turbidity · Dosing line failure or leak · Power failure · Carriage water pump failure · Freezing temperatures
Post Treatment Storage	Loss of supply	3.05	Insufficient storage for peak demand
Reticulation	Chemical/microbiological contamination	4.08	Backflow from consumer connections

5.4.1 Risk 1.01 – Microbiological contamination due to surface runoff into spring recharge zone

Microbiological contamination due to surface runoff into the spring recharge zone has the potential to cause a repeated breach of the MAV for *E. coli*. This is considered possible due to the hydraulic connection between the 3 Springs source and the Ōpihi River and no filtration process prior to chlorination. The uncertainty and potential consequence correspond to a High risk that is classified as unacceptable.

The improvement action to mitigate this risk is:

- New treatment plant including protozoa barrier and increased treated water storage.

5.4.2 Risk 1.05 – Increased sediment load in the source water

An increased sediment load in the source water due to heavy rainfall or a fire in the catchment has the potential to cause a repeated breach of MAVs. This is considered possible due to the hydraulic connection between the 3 Springs source and the Ōpihi River (evidenced by elevated turbidity during flooding) and no filtration process prior to

chlorination. The likelihood and potential consequence correspond to a High risk that is classified as unacceptable.

The improvement action to mitigate this risk is:

- New treatment plant including protozoa barrier and increased treated water storage.

5.4.3 Risk 2.02 – Inadequate chlorination

Inadequate chlorination due to issues with the chlorine treatment process has the potential to cause a repeated breach of the MAV for E. coli. This is considered unlikely due to continuous monitoring of the FAC after dosing almost always exceeding 0.2 mg/L. Because there are no other treatment processes to reduce the consequence, this corresponds to a High risk that is classified as unacceptable.

The improvement action to mitigate this risk is:

- New treatment plant including protozoa barrier and increased treated water storage.

5.4.4 Risk 3.05 – Insufficient treated water storage during peak demand

Insufficient treated water storage has the potential to cause a loss of supply. Treated water storage in the Fairlie distribution system is between 2 – 3 hours during peak demand. This leaves little time to undertake maintenance and repairs or react to unforeseen supply issues. The likelihood and potential consequence correspond to a High risk that is classified as unacceptable.

The improvement action to mitigate this risk is:

- New treatment plant including protozoa barrier and increased treated water storage.

5.4.5 Risk 4.08 – Backflow from customer connections

Contaminants entering the drinking water supply due to backflow or back siphonage poses a contamination hazard to the distribution system. A lack of backflow prevention devices (as well as inadequate, faulty, or incorrectly installed backflow devices) means that there is insufficient protection to reduce the likelihood of contaminants entering the drinking water supply.

The improvement actions to reduce this risk are:

- Undertake a survey of commercial customers to determine backflow hazard (complete)
- Install backflow prevention devices on high and medium hazard connections
- Check all air gaps in Kimbell are functioning correctly
- Test all testable backflow prevention devices annually
- Create and maintain a backflow register
- Undertake assessment of backflow risk for residential connections.

6 Source Water Risk Management Plan

Source water risk management plans are a new requirement in the Water Services Act 2021. MDC has chosen to include a source water risk management plan as part of this drinking water safety plan. It is considered that the requirements of the Water Services Act are met as follows:

- This section of the WSP meets the requirements of section 43(1)
- The risk assessment, preventive measures and improvement plan in sections 5, 7 and 8 of the WSP meet the requirements of sections 43(2)a – c.
- The consideration of values identified by local authorities in section 6.4 of the WSP meets the requirements of section 43(2)d.
- Information about land use activities, potential sources of contamination, other water users and water quality data is included in section 4.2 of the WSP and meets the requirements of section 43(4)a(i-ii)
- The risk assessment in section 5 of the WSP meets the requirements of section 43(4)(a)(iii)
- The improvement actions agreed to by the local authority in section 8 meet the requirements of section 43(4)(b).

6.1 National Environmental Standards for Sources of Human Drinking Water

The current National Environmental Standards for Sources of Human Drinking Water 2007 (NES-DW) forms part of the multiple barrier approach applied in New Zealand ensure safe drinking water is supplied to customers.

The existing NES-DW requires regional councils to identify certain activities within a source water catchment and determine if they will have an adverse effect on source water quality (resulting in MAVs in excess of DWSNZ limits following treatment). The Ministry for the Environment's draft consultation document on updating the NES-DW[7] proposes defining three source water risk management areas (SWRMAs) as defined below and depicted on Figure 6-1 (for river sources) and Figure 6-2 (for aquifer sources).

- SWRMA 1 is the immediate area around the source water take where there is an immediate risk of contamination because there is very little time to respond to any contamination before it enters the water supply.
    - For aquifers, it encompasses land within a 5-metre radius around the intake (bore head).
    - For rivers, it encompasses the river and its bed 1,000 m upstream and 100 m downstream of the intake, extending 5 m into land from the river edge.
- SWRMA 2 is a larger area where activities need to be managed, to mitigate more medium-term risks of contamination. The size will vary because it is based on the time it takes for water to flow to the source.
    - For aquifers, it is the land area above where groundwater travels to the intake (bore) within a 1-year period, to a maximum of 2.5 kilometres.
    - For rivers, it is the river and bed from where water travels to the intake within an 8-hour period.
- SWRMA 3 is the entire catchment area for the source water. Persistent contaminants and cumulative effects of all activities within the catchment are the management focus in this area, and they are considered to be appropriately managed under the RMA. The proposed

[7] https://environment.govt.nz/assets/publications/nes-dw-consultation-document.pdf

amendments to the NES-DW aim to clarify that consenting decisions must address source water risks.

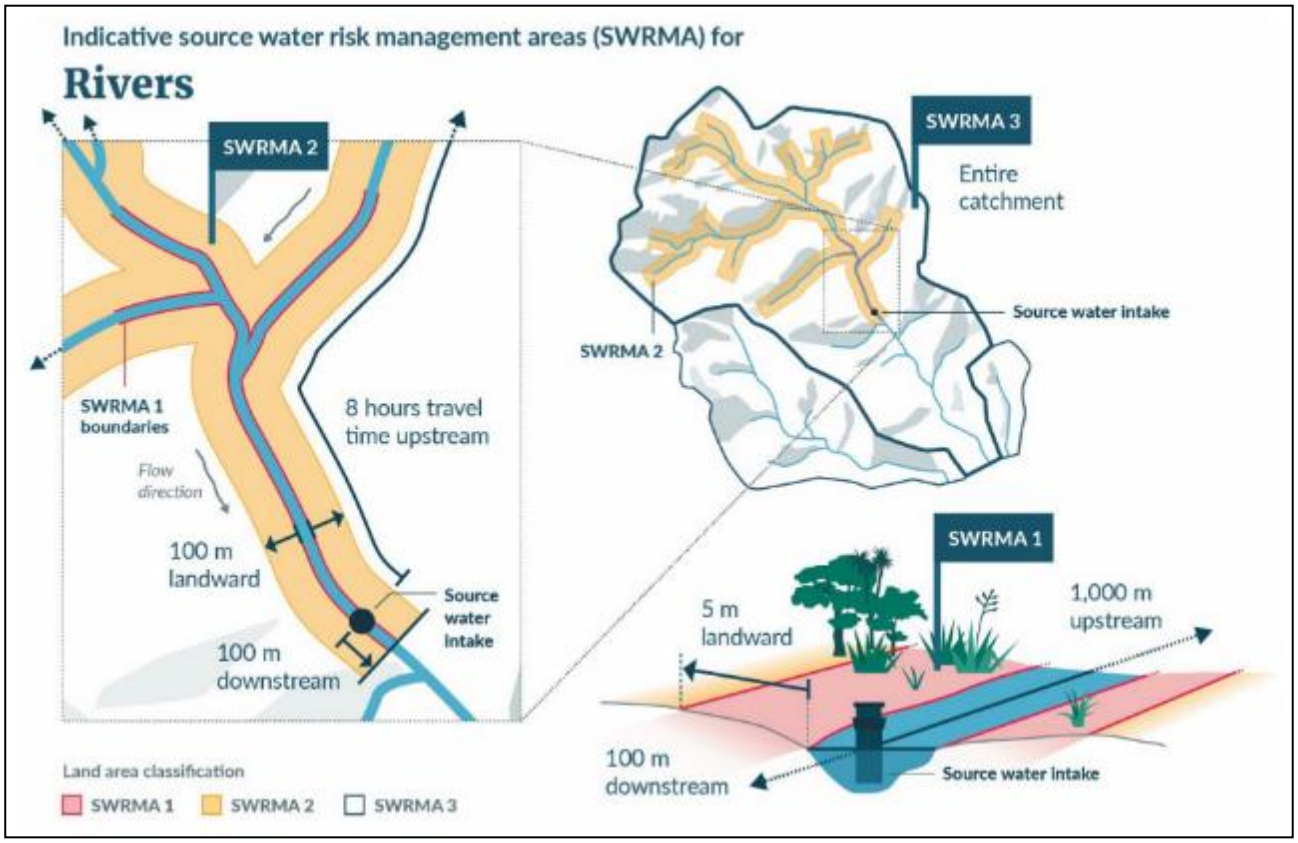


Figure 6-1 Draft NES Source Water Risk Management Areas for River Sources (Ministry for the Environment, 2021).

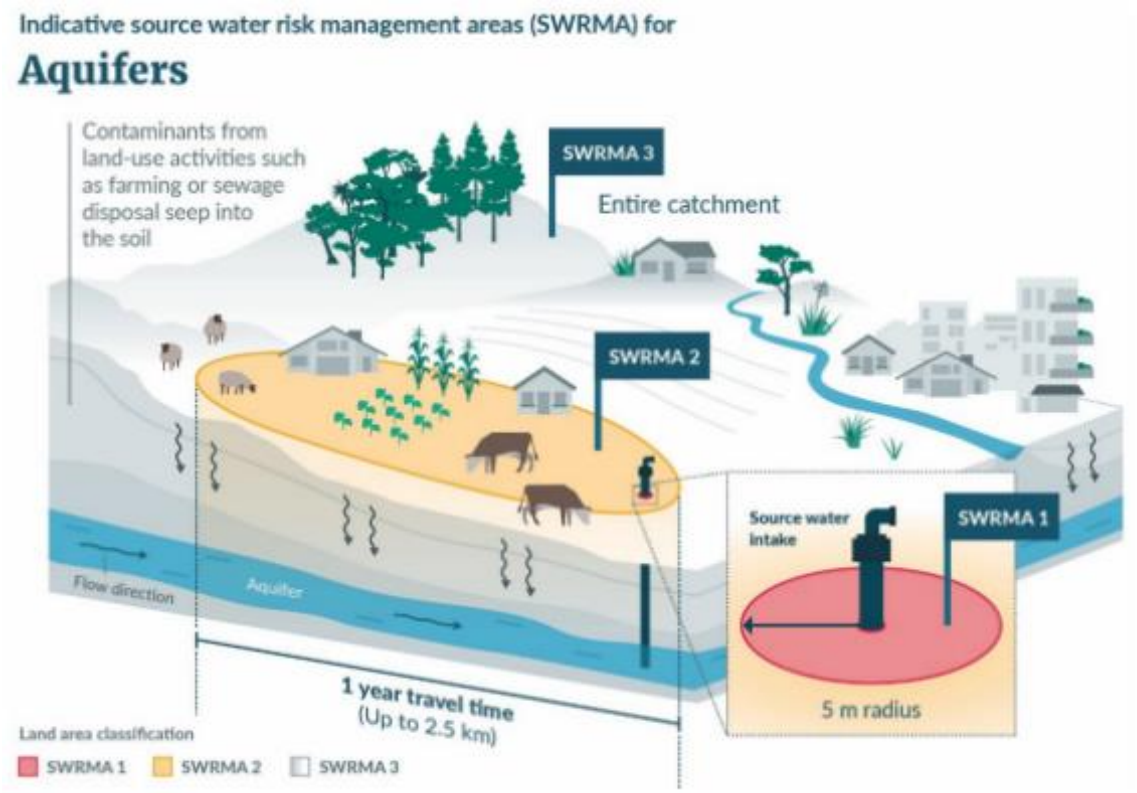


Figure 6-2 Draft NES Source Water Risk Management Areas for Aquifer Sources (Ministry for the Environment, 2021)

As the Fairlie water supply is from a spring, the SWRMA zones for both surface water and aquifer sources apply.

The extent of the SWRMA Zone 1 for the aquifer catchment is contained entirely within the surface water SWRMA Zone 1, as seen in Figure 6-3. There are two branches within SWRMA 1 as there is a small stream adjacent to the spring source (Three Springs Creek). The SWRMA Zone 2 for the aquifer source has been shown as a 2.5 km radius around the water take. The combined SWRMA zone 3 comprises of the 2.5 km radius for the aquifer source SWRMA Zone 2 and the entire surface water catchment. It is assumed that this is the entire catchment for the aquifer source. The SWRMA 3 zone includes the Ōpihi River catchment upstream of the spring.

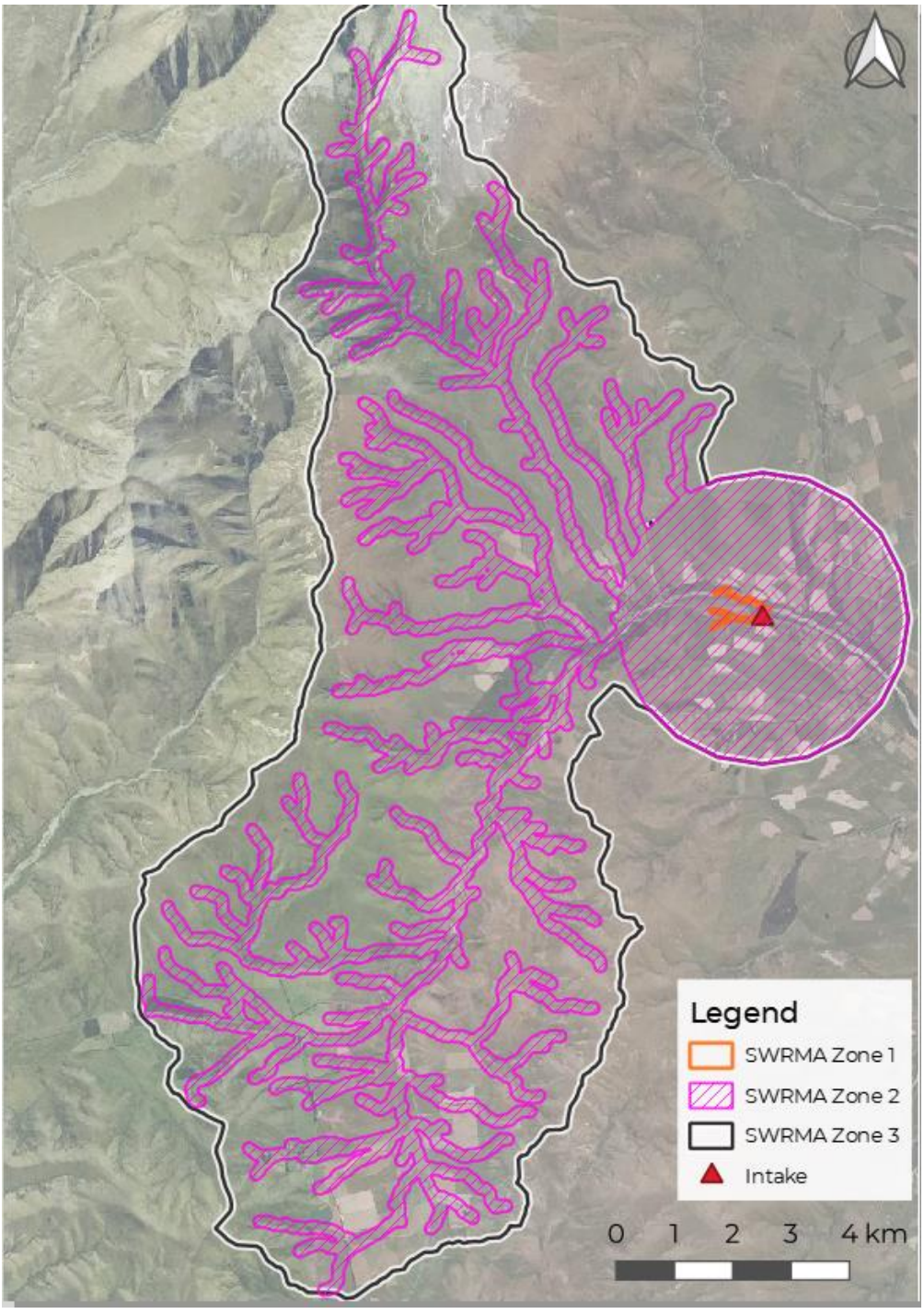


Figure 6-3 Source Water Risk Management Areas for the Fairlie Spring Source

6.2 Catchment Description

The land use in the catchment of the spring source is shown in Figure 6-4.

The spring source sits within the road reserve and has been fenced to prevent public access, as well as to exclude animals. The fence is 4.5 m from the spring source. The turbidity of the water varies depending on the turbidity in the Ōpihi River, indicating a link to the river. The Ōpihi River catchment is extensive and is owned by multiple parties.

Animals such as farm stock, as well as feral animals (including deer and rabbits) in the middle to lower portions of the catchment will contribute microbiological contamination. Little microbiological contamination would be expected to occur in the upper northern reaches of the catchment, reflecting the low populations of animals due to the severity of the alpine environment.

Within the catchment there is human habitation, including the Burkes Pass settlement (which has a reticulated wastewater system) and Kimbell settlement (which does not have a reticulated wastewater system and has multiple dwellings with associated onsite wastewater systems). There are also other human activities, such as the Mount Dobson Ski Field, agriculture, hunting and forestry. These would be expected to be a source of microbiological contamination in the catchment.

There are numerous resource consents to take water and discharge wastewater and stormwater within the catchment. Nearby resource consents to discharge wastewater are shown in Figure 6-5 and are summarised in Table 6-1. Most of these are outside of SWRMA3, with a few occurring in Burkes Pass which is several kilometres from the spring source. A consent of note is the discharge to land of treated wastewater from the Burkes Pass Wastewater Treatment Plant (CRC992607). There is no wastewater discharge consent for the Mt Dobson Ski Field, as this is listed as a permitted activity. There are several resource consents for other water takes in the catchment as shown in Figure 6-6 and summarised in Table 6-2.

ECan has provided information about hazardous activities in the catchment (Hazardous Activities and Industries List). There are six potentially contaminated sites in the catchment (see Figure 6-7 and Table 6-3).

Table 6-1 Summary of discharge consents within the Fairlie catchment (excluding permitted activities)

Consent Owner	Location	Expiry Date	Consent Purpose
Shamrock Fern Dairies Limited	1028 Hamilton Road, Corner Seddons Road & Hamilton Road and Corner Seddons Road & Monument Road, Fairlie	12/11/2024	Associated discharge permit for an incidental nutrient discharge.
Mr R J Herrick & Ms J V Reisert	2059 Fairlie Tekapo Highway, Burkes Pass	26/06/2043	To discharge contaminants to land
Mr R J Herrick & Ms J V Reisert	2059 Fairlie Tekapo Highway, Burkes Pass	6/03/2047	To discharge contaminants to land.
Mr K J & Mrs L F Guiney	1028 Hamilton Road, Kimbell	18/03/2023	To discharge contaminants to land.
Mackenzie District Council	State Highway 8, Burkes Pass	7/06/2040	To discharge contaminants into land from the Burkes Pass Wastewater Treatment Plant.

Consent Owner	Location	Expiry Date	Consent Purpose
Cascade Creek Limited	Strathallan Road, Fairlie	9/10/2030	To discharge surplus irrigation water into the Ōpihi River and Allandale Stream in the event of machine failure, power outages and heavy rainfall
Mr & Mrs G W & J L Batchelor	State Highway 8, Burkes Pass	6/08/2032	To discharge water into the Ōpihi River.
Mackenzie District Council	State Highway 8, Burkes Pass	29/10/2032	To discharge by-wash water to Paddy's Market Stream from the Burke Pass community supply scheme.
Mackenzie District Council	Burke Pass Landfill, State Highway 8, Burkes Pass	25/07/2031	To discharge contaminants into land from the Burkes Pass Landfill.
Mr K J & Mrs L F Guiney	Monument Road, Fairlie	20/03/2043	To discharge contaminants to land.
Mr S & Mrs T Harper	747 State Highway Eight, Kimbell	18/08/2029	To discharge contaminants into land
Paul Warwick Hunter	Siegerts Road, Kimbell	3/08/2030	To discharge up to 825 litres of wastewater per day to land.
Mr S & Mrs S Osbourne	21 Perambulator Lane, Kimbell	12/05/2032	To discharge domestic wastewater to land.

Table 6-2 Summary of water take consents within the Fairlie catchment

Consent Owner	Location	Consent Purpose	Expiry Date	Volume or Flow Limits
Mackenzie District Council	State Highway 8, Burkes Pass	To divert water for Burkes Pass community supply.	29/10/2032	520 m^3/day and 6 L/s
Mount Dobson Ski Area Limited	Mount Dobson Ski Area, Fairlie	To take and use water from Firewood Stream for toilet and day shelter facilities.	6/09/2034	250 m^3/week and 1 L/s
Mr & Mrs G W & J L Batchelor	State Highway 8, Burkes Pass	To divert water from Paddys Market Creek for domestic purposes.	6/08/2032	10 L/s
Mr S J & Mrs S J Kerr	Stoneleigh Road, Kimbell	To take via well I37/0011 and associated gallery I37/0012, for the irrigation of up to 18 hectares.	8/03/2035	4,536 m^3/week of groundwater and 15 L/s

Consent Owner	Location	Consent Purpose	Expiry Date	Volume or Flow Limits
Mr K J & Mrs L F Guiney & Mr P A Glassford	State Highway 8, Fairlie	To take and use water.	19/10/2030	1,306 m^3/day, 15 L/s and 205,753 m^3 between 1st July and the following 30th June
David Samson Giddings	State Highway 8, Fairlie	To take and use water	19/10/2030	1,027 m^3/day, 12 L/s and 628,690 m^3 between 1st July and the following 30th June
Mackenzie District Council	State Highway 8, Kimbell	To take and use water.	19/08/2044	2,420 m^3/day, 28 L/s and 725,000 m^3 between 1st July and the following 30th June
Mr M A & Mrs P A Guerin & Woollcombe Trustees 5 Limited	State Highway 8, Kimbell	To take and use groundwater	12/12/2035	4.9 L/s and 4,233 m^3 in any period of ten consecutive days

Table 6-3 Summary of contaminated sites within the Fairlie catchment

Title	Location	Consent Purpose
Kimbell Garage and AA Breakdown Centre	Fairlie Tekapo Road, Kimbell	F3 - Engine reconditioning workshops
Former Service Station - Burkes Pass	State Highway 8, Burkes Pass	F7 - Service stations
Kimbell Garage and AA Breakdown Centre	Fairlie Tekapo Road, Kimbell	F7 - Service stations
Former Burkes Pass Landfill	S.H. 8, Opposite Cemetery, Burkes Pass	G3 - Landfill sites
Ex CRC Pest Depot	State Highway 8, Burkes Pass	G3 - Landfill sites
Ex CRC Pest Depot	State Highway 8, Burkes Pass	A11 - Pest control

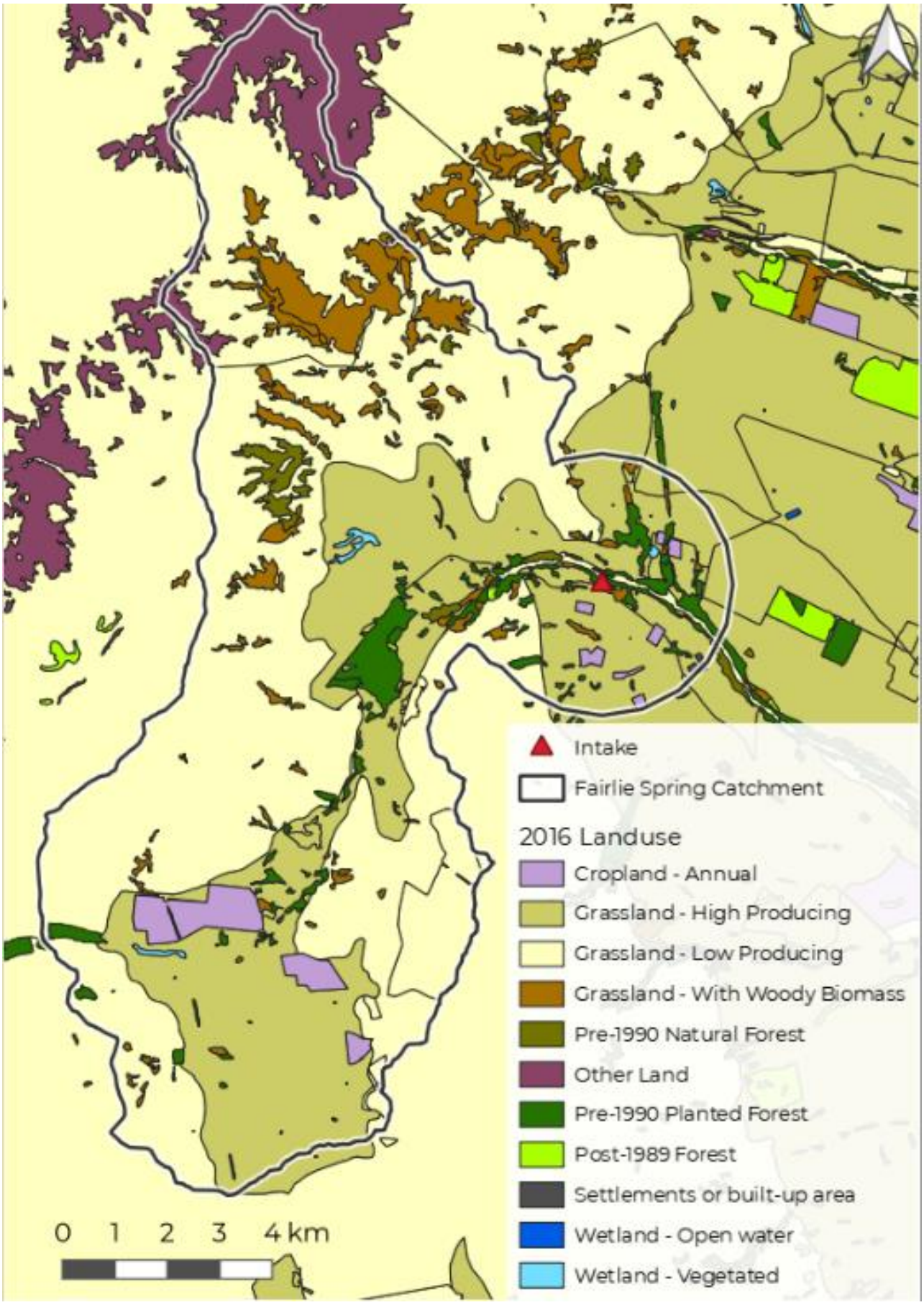


Figure 6-4 Fairlie spring water catchment land uses

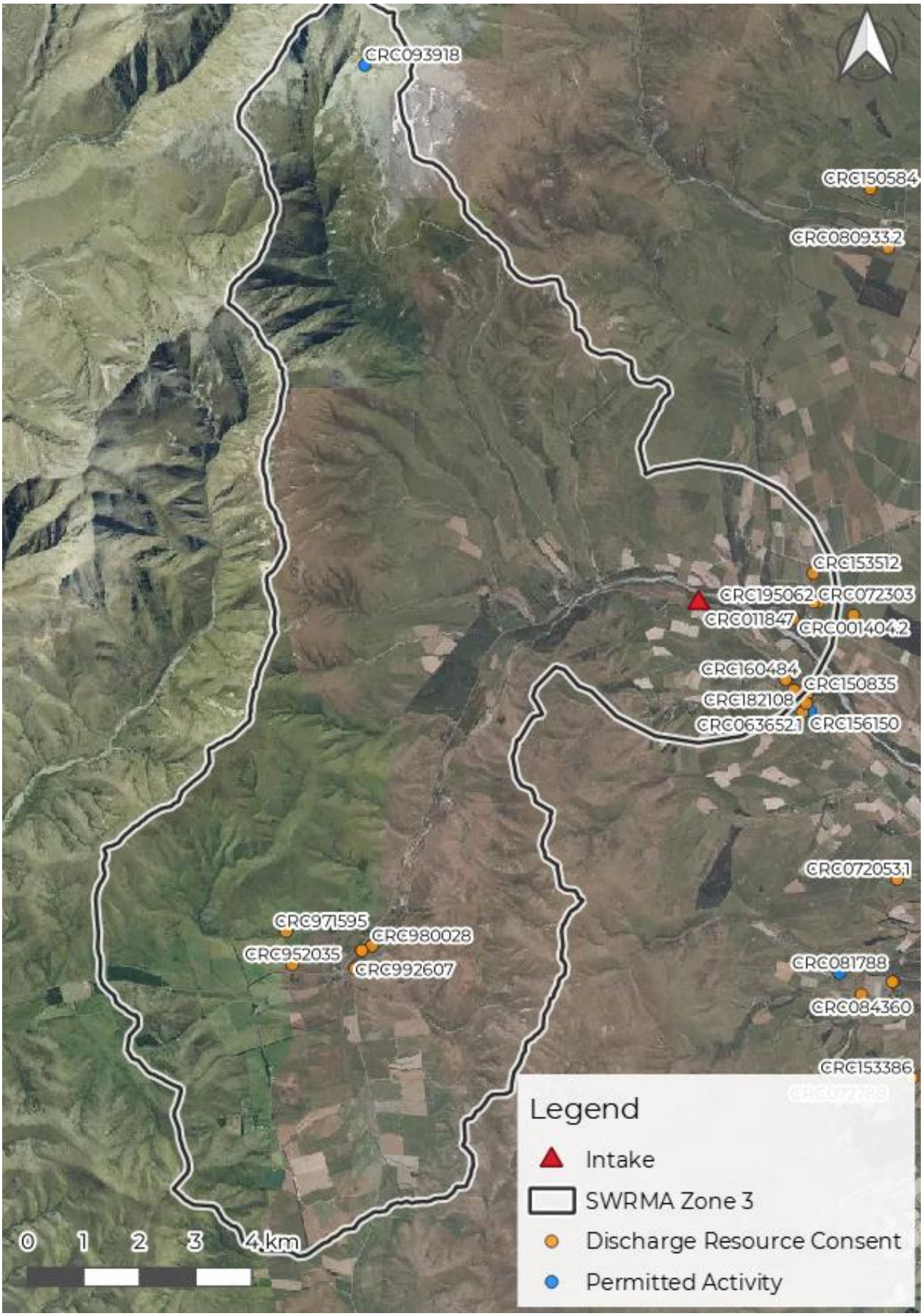


Figure 6-5 Wastewater discharge consents in the vicinity of the Fairlie spring recharge catchment.

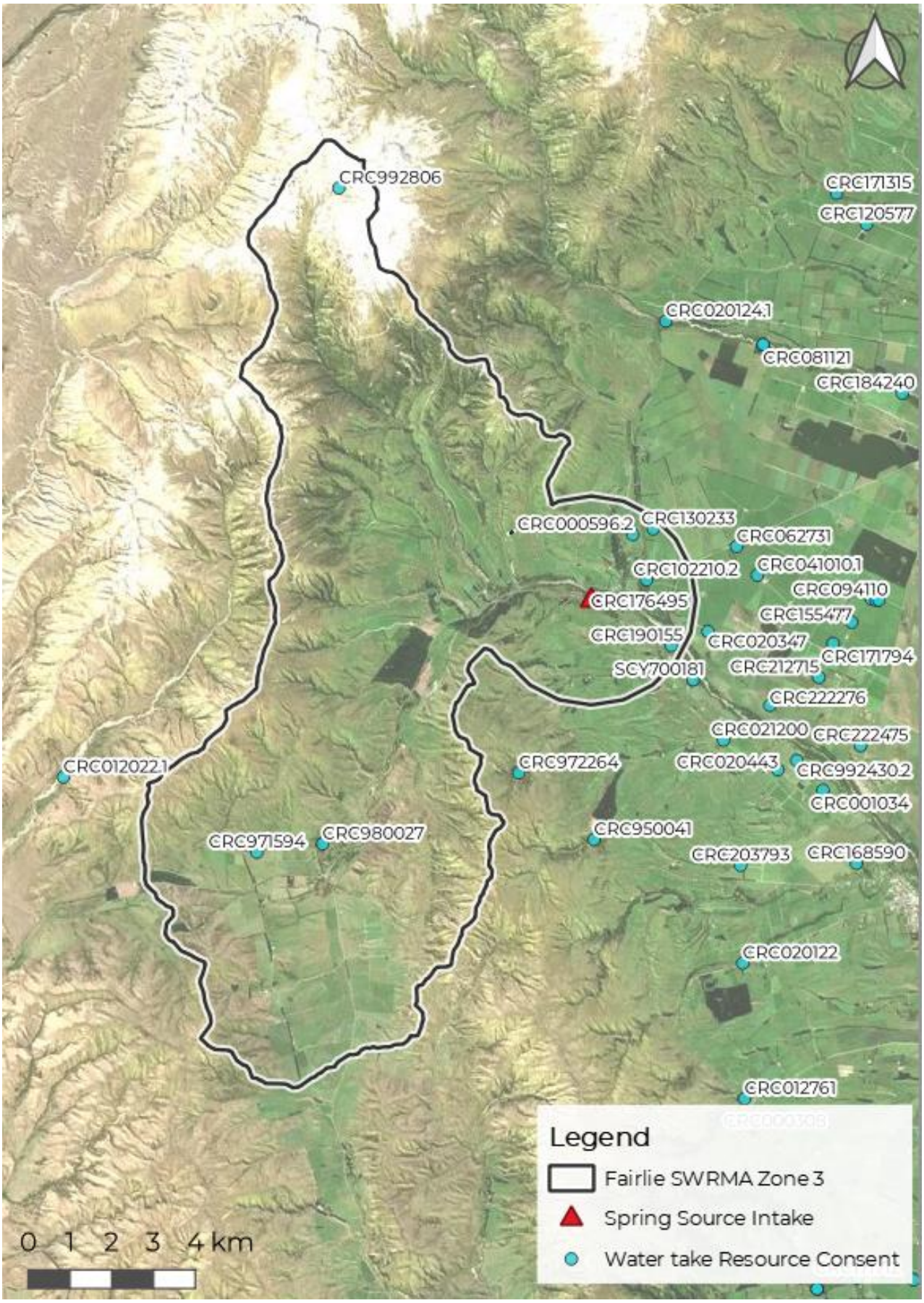


Figure 6-6 Water take consents in the vicinity of the Fairlie spring recharge catchment

Figure 6-7 Contaminated sites within the vicinity of the Failie spring catchment

6.3 Climatic Features

Climate related factors influencing catchment conditions and demand for water include rainfall and temperature. Median annual total rainfall in the Fairlie catchment is 600 – 700 mm/year and the median temperature is 9 – 10 °C (see Figure 6-8 and Figure 6-9).

NIWA Future Climate Predictions anticipate an increase in mean temperature of 2.0 – 3.0 ˚C by 2090, with 0 – 5% less precipitation in the Mackenzie area and up to 15 fewer wet days – based on RCP8.5 scenarios (https://ofcnz.niwa.co.nz/#/nationalMaps). This increased temperature and lowered rainfall is likely to increase demand for water use and affect the rate of spring recharge available for abstraction.

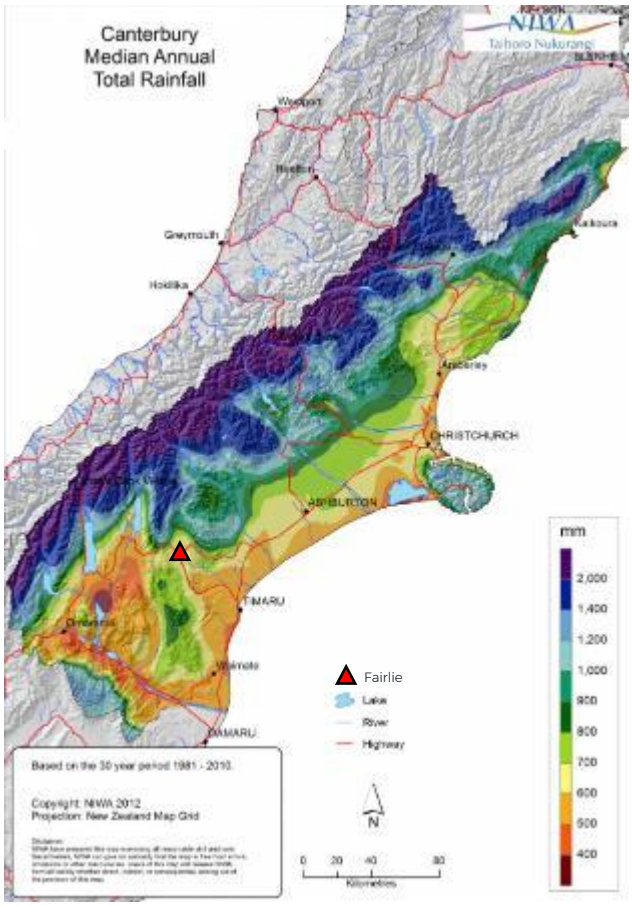


Figure 6-8 Canterbury region median annual total rainfall[8]

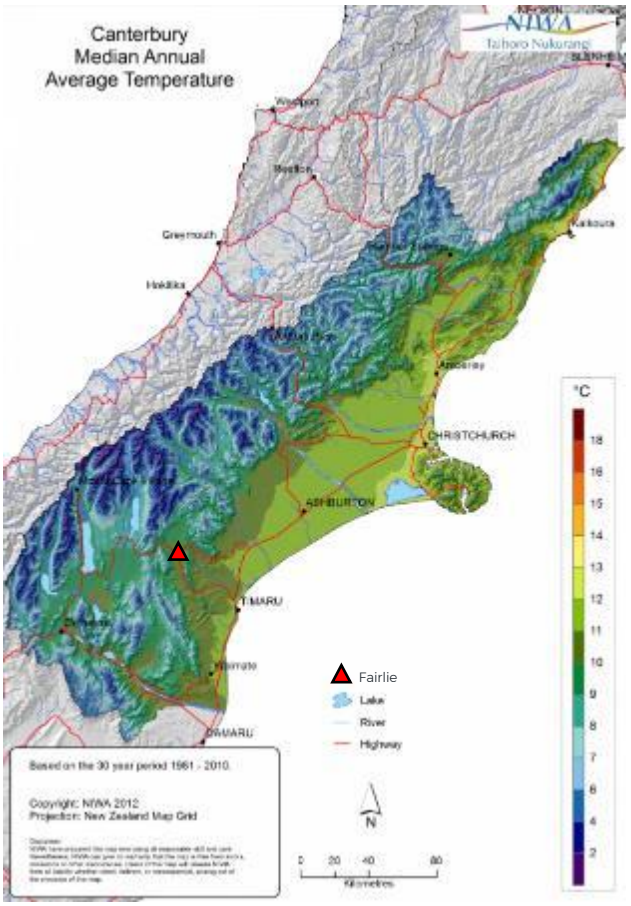


Figure 6-9 Canterbury region median annual temperature[9]

[8] Median annual rainfall for the period 1981 – 2010 from NIWA: https://niwa.co.nz/climate/national-and-regional-climate-maps/canterbury
[9] Median annual temperature for the period 1981 – 2010 from NIWA: https://niwa.co.nz/climate/national-and-regional-climate-maps/canterbury

6.4 Impacts of Catchment Activities on Water Quality

A summary of catchment impacts is outlined in Table 6-4.

Table 6-4 Catchment impacts

Land use	Percentage of Catchment Area	Comment
Grassland - Low producing	53%	Low producing grassland is likely to be lightly grazed and represents a moderate risk to the source water. This is due to the low to moderate density of domestic and feral animals which will produce faecal contamination.
High producing grassland	30%	High producing grassland is likely to be intensively grazed and represents a high risk to the source water. This is due to the high density of domestic and feral animals which will produce a high level of faecal contamination. The risk is greater during lambing/calving season.
Grassland with woody biomass	6%	Grassland with woody biomass presents a low risk to the source water, with low levels of faecal contamination expected from catchment wildlife.
Planted forest	4%	Planted forest terrain presents a low risk to the source water, with low levels of faecal contamination expected from catchment wildlife.
Other	4%	The "Other" land use in the catchment consists of the alpine environment in the northern reaches of the catchment. This includes the Mount Dobson Ski Field, which discharges wastewater as a permitted activity. It is expected that this area presents a low to moderate risk to the source water, due to the distance between the ski field and the source and the low density of feral animals.
Cropland annual	2%	Annual cropland presents a low to moderate risk to the source water due to nutrients from fertilisers or pesticides potentially leaching through the soil.
Natural Forest	1%	Natural forest presents a low risk to the source water, with low levels of faecal contamination expected from forest wildlife.
Settlement	0.3%	While Burkes Pass has wastewater reticulation, Kimbell has on site wastewater systems in SWRMA2. These present a moderate risk to the water supply.

6.5 Cyanobacteria

A cyanobacteria risk assessment found that there is a moderate risk of cyanobacteria formation (WSP, 2022). The assessment recommended that MDC:

- Monitor the source water for phosphorous, turbidity, pH and temperature quarterly during the year and monthly over summer period.
- Monitor for the presence of cyanobacteria in the Ōpihi River upstream of the infiltration gallery over the period from November to March.
- Consider fencing and riparian planting for 1 km upstream to keep stock out of the water and to minimise run off.

As there is a moderate risk of cyanobacteria formation, a cyanobacteria/cyanotoxin response plan will need to be prepared (Rule S3.8 in the Drinking Water Quality Assurance Rules).

6.6 Protozoa Log Removal Level

Section 5.2.1.2 of DWSNZ says, "The default requirement for protozoa in surface waters is 4-log inactivation or removal. Drinking water safety plans include an assessment of the catchment; if this indicates that 4-log credits may be required, Cryptosporidium monitoring is needed. Cryptosporidium monitoring is not required if the water supplier elects to provide 4-log credits."

Based on the risk of microbial contamination identified in the catchment, a treatment process which provides 4-log protozoal removal is required.

6.7 Values Identified by Local Authorities Under the National Policy Statement for Freshwater Management

A summary of the national requirements for the National Policy Statement for Freshwater Management 2020 (NPSFM) and the relevant objectives and policies of the Canterbury Land and Water Regional Plan (LWRP) and Ōpihi River Regional Plan (ORRP) as they relate to this water supply are included in Appendix A.

6.7.1 Fairlie Spring

The LWRP (including Plan Change 7 Decisions dated 17 November 2021) contains the following notations for Fairlie in the vicinity of the drinking water takes:

- Schedule 1: Community Drinking-water Protection Zone
- Spring-fed
- Fairlie Basin groundwater quality zone
- The site has a tributary that flows into the Ōpihi River. The tributary is a Spring-fed Lower Basin Water Quality Management Class, while the Ōpihi River is a Hill-fed Upland Water Management Class.
- Fairlie Basin High Nitrogen Concentration Area

It needs to be noted the LWRP does not map wetlands of importance, however the Department of Conservation Wetlands of Representative Importance layer in Canterbury Maps contains a notation on the Ōpihi River in the vicinity of the drinking water take.

Furthermore, it needs to be noted the LWRP does not map ecosystems, however the Biodiversity Projects – Ecosystem Type layer in Canterbury Maps contains a braided river notation for the Ōpihi River in the vicinity of the drinking water take.

6.7.2 Arowhenua Engagement

A meeting was held with Arowhenua on 22 June 2022 to discuss the values of the water bodies that MDC uses for its water supply. Arowhenua advised that the Ōpihi River is of immense significance to Kāti Huirapa.

The renowned Arowhenua forest and cultivations stood at the junction of the Ōpihi River and Te Umu Kaha. Several kāika were located near the lower reaches of the Ōpihi, sustained by the river's rich food supply. Foods gathered from the river included tuna, inaka, kōkopu, upokororo, kanakana, pātiki, aua, paraki, panako and pipiki.

The Ōpihi was the principal travel route from the Arowhenua takiwā to Te Manahuna, and this is reflected in the high density of rock art sites in the Ōpihi catchment. Together with the nearby catchments of Ōpuaha and Te-Ana-a-Wai, more than 250 rock art sites are located in the limestone outcrops.

A distinguishing feature of the Ōpihi River today is the lack of dams on the mainstem (although a tributary of the Ōpuaha is dammed). This has two main effects on the river ecosystem, in particular fish communities. The first is that the fish communities are more likely to have diadromous species present (species with a sea phase in their lifecycle). The

second effect is that fish can migrate between streams, allowing colonisation of previously dewatered streams.

6.7.3 Implications of the Values

A source water risk management plan must have regard to any values identified by local authorities under the NPSFM that a supplier uses as a source of drinking water. The NPSFM contains policy direction related to protecting the values of freshwater that are to be implemented by the Regional Council through the LWRP and ORRP. Notable values have been identified for the Fairlie community drinking water supply, as summarised in Table 6-5.

Table 6-5 Values Identified for the Fairlie drinking water source

	Cultural	Contact Recreation	Biodiversity Values	Ecosystem Values	Trout Fishery and Spawning	Wetlands
Fairlie spring source	✓		✓	✓		✓

'Having regard to' requires consideration of the values and what they seek to protect alongside other factors. In developing the source water risk management plan regard has been given to the values by understanding of the catchment from which drinking water is taken.

Resource Consent CRC176495 for the water take was granted in 2009 (see Figure 6-10).

1 The rate at which water is taken from Three Spring Creek, at surface water abstraction point I37/0064, map reference NZMS 260 I37:2844-8375 shall not exceed 28 litres per second, with a volume not exceeding 2,420 cubic metres per day and 725,000 cubic metres between 1 July and the following 30 June.

2 The water taken shall only be used for the Fairlie Community Supply.

3 The consent holder shall, within six months of the commencement of this consent, install an easily accessible straight pipe(s), with no fittings or obstructions that may create turbulent flow conditions, of a length at least 15 times the diameter of the pipe, as part of the pump outlet plumbing or within the mainline distribution system.

4 The consent holder shall before the first exercise of this consent:

a. Install a water meter(s) that has an international accreditation or equivalent New Zealand calibration endorsement, and has pulse output, suitable for use with an electronic recording device, which shall measure the rate and the daily volume of water taken to within an accuracy of plus or minus five percent as part of the pump outlet plumbing, or within the mainline distribution system, at a location(s) that will ensure the total take of water is measured.

b. Take readings from the water meter at least once per month; record the date and the meter readings electronically and supply these data to the Canterbury Regional Council, Attention: RMA Compliance and Enforcement Manager, each year during the month of June, or when requested in writing.

c. Ensure that the water meter is accessible to the Canterbury Regional Council at all times for inspection.

d. Ensure that the water meter is installed, maintained and operated throughout the duration of the consent in accordance with the manufacturer's instructions.

e. Take all practicable measures to ensure that the water meter is fully functional at all times.

5 Within one month of the installation of the measuring or recording device(s), or any subsequent replacement measuring or recording device(s), and at five-yearly intervals thereafter, and at any time when requested by the Canterbury Regional Council, the consent holder shall provide a certificate to the Canterbury Regional Council, Attention: RMA Compliance and Enforcement Manager, signed by a suitably qualified person certifying, and demonstrating by means of a clear diagram, that the measuring device has been installed in accordance with the manufacturers specifications.

6 Whenever the unmodified flow in the Opihi River is:

a. at or below 2.5 cubic metres per second, the taking of water in terms of this permit shall not exceed 14 litres per second and 1,210 cubic metres per day;

Figure 6-10 Fairlie water take resource consent conditions. Resource Consent CRC276495.

b. between 2.5 cubic metres per second and 8.1 cubic metres per second, the maximum rate at which water is taken shall not exceed 21 litres per second and 1,815 cubic metres per day.

c. All unmodified flows in the Opihi River referred to in this condition are as defined in the Opihi River Regional plan, estimated by the Canterbury Regional Council at State highway One Bridge (map reference NZMS 260 K38:718-591).

Advice note: To accomplish these flow restrictions, the consent holder may take steps including but not limited to imposing total irrigation bans on those using the Fairlie supply for irrigation, restricting or limiting non-domestic water use, monitoring water use and conservation, publishing water-saving tips on their website and social media, and warning the community in advance of impending water reductions.

7 The consent holder shall take all practicable steps to prevent fish entering the intake.

a. The consent holder shall ensure that any significant change in scope or nature to the Fairlie community water intake structure has fish exclusion measures designed, installed and maintained in accordance with Fish Screening: Good Practice Guidelines for Canterbury, NIWA Client Report 2007-092, October 2007. (Copy available on).

b. Details of any design proposed in accordance with (i) above shall be provided to the Canterbury Regional Council, Attention: RMA Compliance and Enforcement Manager, no less than two months prior to any significant change in scope or nature of the intake structure.

8 The consent holder shall:

a. use its best endeavours to fully implement the Fairlie water supply infrastructure renewal/replacement/maintenance programme outlined in the Mackenzie District Council Long-Term Council Community Plan 2009-2019 for the 2009/2010, 2010/11 and 2011/12 financial years; and

b. report annually until 2019 to the Canterbury Regional Council Attention: RMA Compliance and Enforcement Manager, before 1 October each year on:

c. the renewal/replacement/maintenance of the Fairlie water supply infrastructure undertaken in the preceding financial year;

d. the reasons for any departure from the annual programme for the renewal/ replacement/maintenance of the Fairlie water supply infrastructure outlined in the applicable Long-Term Council Community Plan; and

e. the estimated average water leakage in litres/property/hour from the Fairlie water supply infrastructure during the preceding financial year compared to a leakage rate of 30 litres per property per hour.

9 The Canterbury Regional Council may, on any of the last five working days of November, each year, serve notice of its intention to review the conditions of this consent for the purposes of:

a. addressing the effectiveness of Condition (6) in significantly reducing the abstraction of water during Opihi River low flow restriction periods;

b. addressing any excessive water leakage from the Fairlie water supply infrastructure that occurs after 30 June 2016; or

c. dealing with any adverse effect on the environment which may arise from the exercise of the consent.

Figure 6-10 Fairlie water take resource consent conditions. Resource Consent CRC276495 (continued).

7 Existing Preventive Measures and Barriers to Contamination

7.1 Introduction

Multi-barrier risk management is considered the best practice approach to supply drinking water as it identifies barriers that prevent contamination from entering the water at every step from catchment to tap. The quality of water supplied by the Council to consumers is secured through the use of multiple barriers to the entry of contaminants. Barriers to contamination considered in this plan extend from catchment to the end supply to consumers.

The four types of barriers are:

- Preventing hazards entering the raw water
- Removing particles, pathogens, and chemical and radiological hazards from the water
- Killing or inactivating pathogens in the water
- Maintaining the quality of the water in the distribution system.

In addition to considering barriers at each step in the physical supply chain (source, treatment, distribution, reticulation) barriers have also been considered for each step in the supply management process.

7.2 Preventing Hazards Entering the Raw Water

Raw water is sourced from a spring source just over 100 m away from the Ōpihi River. The spring source is in a robust concrete structure and is securely fenced to prevent public access. The spring source is located within the Fairlie Community Drinking Water Protection Zone (Environment Canterbury Land and Water Regional Plan).

The lack of information about the source of the groundwater means that the springs are not considered to provide a barrier to bacterial and chemical contamination.

7.3 Removing Particles, Pathogens, and Chemical and Radiological Hazards from the Water

The Fairlie water treatment plant does not have a treatment process in place to remove particles from the water prior to disinfection. While natural filtration through the aquifer removes some particles and pathogens, this is not an effective barrier for removing particles or pathogens from the water. There is an improvement action to build a new, compliant water treatment plant (see Section 8.1).

As there are no known chemical or radiological hazards present, there is no need to remove these hazards from the water.

7.4 Killing or Inactivating Pathogens in the Water

Disinfection is used to eliminate the risk of bacteria and viruses contaminating the water supply. The water supply is disinfected with chlorine gas. This is considered to provide a partial barrier to bacteria and viruses in the water, but it does not provide a barrier to protozoa. There is an improvement action to build a new, compliant water treatment plant (see Section 8.1).

7.5 Maintaining the Quality of the Water in the Distribution System

The treated water reservoir and storage tanks in the distribution are covered to prevent ingress of rainwater or contaminants and mesh is installed over the vent and overflow to prevent access by vermin and insects.

Chlorine gas is dosed at the water treatment plant. The water supply targets a free available chlorine residual of 0.8 mg/L – 1.0 mg/L in water leaving the treatment plant (before the treated water reservoir) and 0.4 mg/L in the distribution zone. The chlorine residual in the network provides a partial barrier to re-contamination.

Backflow prevention is a crucial part of maintaining the quality of water in the distribution system. Backflow prevention is required for all high and medium hazard connections to prevent contaminants entering the distribution network. There is an improvement action to install backflow prevention devices at the boundary of properties with high and medium hazard activities (see Section 8.1).

It is considered that the chlorine residual, the good condition of the distribution infrastructure and continuous positive pressure in the reticulation provides a partial barrier to maintain the quality of water in the distribution system. Once backflow prevention is in place this will be a complete barrier.

7.6 Additional Mitigation Measures

In addition to the considerations above, the following measures also assist in providing barriers in the distribution network:

MDC employs a dedicated maintenance contractor to provide services to the water supply network. Whitestone is the only contractor licensed by MDC that is permitted to work on the network and must follow Standard Operating Procedures and best-practice approaches. Other contractors may be permitted to work on the network with Council approval.

The option of providing water via tanker is a fall-back preventive measure to ensure the community continues to be provided with safe drinking water in the event of source, treatment or distribution quality and/or quantity issues. MDC can engage Temuka Transport Ltd for water delivery services in case of emergencies, who deliver potable water from Geraldine, Temuka or Timaru and are a registered water carrier.

7.7 Summary of Existing Preventive Measures

The existing preventive measures for hazards and hazardous events are listed in the risk assessment table.

7.8 Effectiveness of Preventive Measures

Based on the information presented in the risk assessment table (Appendix A) and in Section 7.2 to Section 7.6, it is considered that the preventive measures in place that contribute to the effectiveness of each of the four barrier types are inadequate.

Once the improvement measures are implemented, there will be adequate effective preventative measures for all barrier types.

Table 7-1 Summary of effectiveness of preventive measures

Type of Barrier	Statement on Effectiveness of Existing Preventive Measures
Preventing hazards entering the raw water	Existing spring water provides a fairly consistent quality of source water. Turbidity levels are known to increase following rain events and total coliforms and *E. coli* have been detected in the source water. Comprehensive source water quality monitoring shows that there are no other contaminants of major concern. Alkalinity is lower than the guideline value.
Removing particles and hazardous chemicals from the water	There is no filtration process in place to remove particles or hazardous chemicals from the water demonstrating that there is no effective barrier in place.
Killing or inactivating pathogens in the water	Chlorine gas disinfection is generally within specified ranges and no *E. coli* detected at the treatment plant demonstrates an effective treatment barrier is in place. However, there is no barrier to protozoa provided by the treatment process.
Maintaining the quality of the water in the distribution system	FAC levels are generally within specified ranges. E. coli was detected once during 2020/2021 monitoring. The transgression was not investigated. An additional barrier in the reticulation is needed to reduce the risk to an acceptable level. An improvement to add backflow prevention devices to high and medium risk connections is included in this drinking water safety plan which addresses the unacceptable risk.

The Council has identified several areas for improvement which are outlined in Section 8.

8 Identification of Additional Preventive Measures and Improvement Plan

8.1 Improvements to Address Unacceptable Risks

The risk assessment table in Appendix A includes an assessment of each risk's acceptability in light of the associated uncertainty. An improvement plan has been developed that includes several improvements which will address the unacceptable risks and help deliver a safer and more robust water supply.

Table 8-1 describes improvement actions discussed in the risk workshop, to mitigate risks deemed unacceptable. Those items that address a high risk are assigned the highest priority (1) and those that address a medium risk are the next priority (2).

The responsibility for ensuring progress on the improvement item, the timeframe for the improvement, and estimated cost are also included in the table. To ensure that the work is undertaken, responsibilities have been assigned to the relevant Council staff. Roles and responsibilities are likely to change and therefore are required to be checked as part of the annual internal drinking water safety plan review process. Senior management has endorsed these improvements approving the full drinking water safety plan, reflected in the signatures provided on page 2.

Table 8-1 Improvement Actions - Unacceptable Risks

Improvement Number	Improvement Action	Mitigates Risk No(s)	Person Responsible	Estimated Cost	Timeframe	Priority 1 = High 2 = Medium 3 = Low
1	New water treatment plant including protozoa barrier and increased treated water storage.	1.01 / 1.05 2.02 / 3.05	Engineering Manager	$7M	End 2024	1
2	• Undertake a survey of commercial customers to determine backflow hazard (complete) • Install backflow prevention devices on high and medium hazard connections. • Check all air gaps in Kimbell are functioning correctly • Test all testable backflow prevention devices annually • Create and maintain a backflow register • Undertake assessment of backflow risk for residential connections.	4.08	Engineering Manager	$50,000	End June 2023	1

8.2 Potential Additional Improvements

The Council continuously works to improve water supply delivery and during the risk workshops additional areas where improvements could be implemented were identified (see Table 8-2). These items have a lower priority than those in Table 8-1 and will be addressed when and if staff resources and funding are available. The timeframes presented are estimates only.

Table 8-2 Additional improvement actions

Improvement Number	Improvement Action	Mitigates Risk No(s)	Person Responsible	Estimated Cost	Timeframe	Priority 1 = High 2 = Medium 3 = Low
3	• Monitor the source water for phosphorous, turbidity, pH and temperature quarterly during the year and monthly over summer period. • Monitor for the presence of cyanobacteria in the Ōpihi River upstream of the infiltration gallery over the period from November to March. • Consider fencing and riparian planting for 1 km upstream to keep stock out of the water and to minimise run off. • Prepare a cyanobacteria/cyanotoxin response plan.	1.06	3 Waters Manager	$10,000	End 2023	2
4	Adjust alkalinity so it is within the guideline value	4.12	3 Waters Manager	$5,000	End of 2023	3
5	Install dedicated sampling points in the reticulation.	5.02	3 Waters Manager	$10,000	End of 2023	3
6	Review operations and maintenance manuals.	5.04	3 Waters Manager	Staff time	End of 2022	3
7	Develop emergency response plans and business continuity plans.	5.10	Engineering Manager	Staff time	End June 2023	3
8	Prepare standard operating procedures for reticulation maintenance and replacement, and contamination event response.	All treatment risks	3 Waters Manager	Staff time	End of 2023	3

9 Operational Procedures

9.1 Operational Staff Training

MDC and Whitestone Contracting Ltd staff managing and operating the Fairlie drinking water supply have the following training certificates and qualifications (Table 9-1).

Table 9-1 Staff training certificates and qualifications

Role / Position	Training Certificate	Qualification
Water Supply Operator – Whitestone Contracting Ltd	Drinking Water – Water Treatment – Level 4	National Certificate
Water Supply Operator – Whitestone Contracting Ltd	Drinking Water – Water Treatment – Level 4	National Certificate (currently training)
3 Waters Manager – Mackenzie District Council	Drinking Water – Water Treatment – Level 4 & Level 5	Training completed but qualification / certificate not held

9.2 Operations and Maintenance Manual

The Fairlie Water Operational Manual describes how the Fairlie drinking water supply should be operated and maintained. The manual was prepared, reviewed and approved in 2019. There is a potential additional improvement action to review and update the existing Operations Manual on a regular basis to maintain its currency.

9.3 Standard Operating Procedures

Whitestone Contracting Ltd has a list of standard operating procedures (SOPs) for the Fairlie water treatment plant and for potable water sampling techniques. The Operations and Maintenance Management Procedures detail routine maintenance required at the treatment plant, pump stations, and reticulation and whose responsibility it is. This also specifies training and certificates required from maintenance staff, and the programmed maintenance checks in place.

The SOP for the water treatment plant details the responsibility of the operator, health and safety requirements, and processes and timeframes for checks. A list of SOPs for the Fairlie water treatment plant is provided in Table 9-2.

Table 9-2 Fairlie water treatment plant standard operating procedures

Procedure No.	Version No.	Operations Instructions
SOP-OPS-007	Revision 03	Chlorine Handling & Storage 1
SOP-OPS-008	Revision 04	Potable Water Sample Testing
SOP-OPS-034	Revision 03	Pump Maintenance

Document/version control is in place to ensure SOPs are reviewed every two years. The document revision number, approval date, review date and authorising party are documented in the SOP header. SOPs are authorised by the Whitestone Contracting Ltd Chief Executive Officer.

The following SOPs have been added to the improvement programme:

- Reticulation maintenance and replacement
- Contamination event response
- Installing and testing backflow prevention devices.

9.4 Operations and Maintenance Activities

There is a list of monitoring and inspections that the maintenance contractor needs to conduct daily, weekly and monthly in the Fairlie Water Operational Manual. Maintenance tasks that need to be undertaken bi-monthly, six-monthly and annually are also listed. The Fairlie Water Data Recording Sheet template is in Appendix A of the operational manual.

Regular operations and maintenance activities are scheduled by MDC for Whitestone Contracting Ltd. These activities are recorded and saved in Laserfiche.

9.5 Operational Monitoring and Inspection

The monitoring and inspection plans are described in the maintenance contract MDC has in place with Whitestone Contracting Ltd. The monitoring and inspection plans for the Fairlie water supply are:

- Part 9.2.1 – Levels of Service
- Part 9.3 – Monitoring Inspection Duties
- Part 9.7 – Routine Maintenance

These are saved in Laserfiche (MDC's document management system). Geoff Horler and Bernie Haar (former MDC Engineering Manager) were involved in revising the existing contract in 2019/2020.

Water quality monitoring records are stored in Council's SCADA system (for parameters measured continuously) and in Laserfiche (for grab samples e.g. reticulation monitoring data). Historical data previously stored in Drinking Water Online is now stored in Laserfiche, as Taumata Arowai's Hinekōrako replaced Drinking Water Online on 30 November 2021. A more limited set of data is reported in Hinekōrako. MDC uses Lutra Infrastructure Data for storing its water quality data.

Records of contractor inspections are supplied to MDC weekly and stored in Laserfiche.

9.6 Critical Control Points

A Critical Control Point (CCP) is a point, step or procedure at which controls can be applied and a drinking water safety hazard can be prevented, eliminated or reduced to acceptable (critical) levels. The most common critical control points in a water supply where water suppliers designate critical limits, are disinfection and filtration processes.

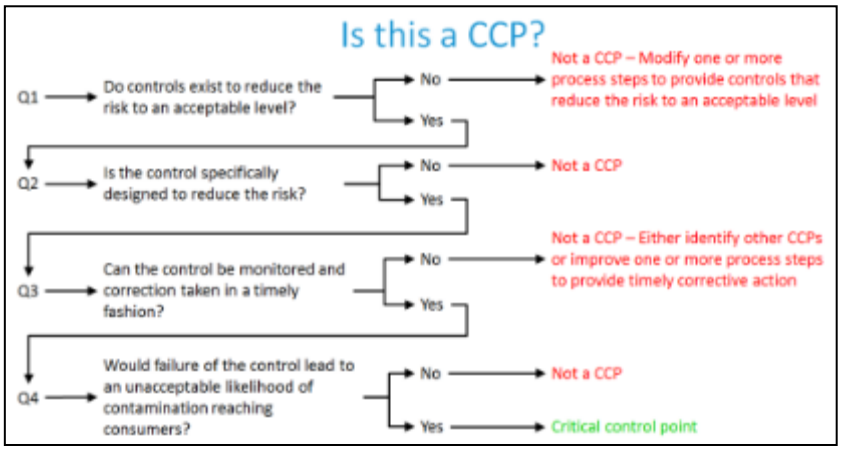


Figure 9-1 Flowchart to help distinguish a CCP, taken from the Handbook for Preparing Drinking Water Safety Plans

The Fairlie drinking water supply has one CCP over which process controls can be made. The CCP is chlorine dosing using chlorine gas and this process provides the only barrier within the supply system to microbiological contamination.

Table 9-3 Critical points and critical control points

	Critical Point	Description
1	Spring source and intake	Possible access point for microbiological or chemical contamination from surface runoff to spring or spring recharge zone.
2	***Critical Control Point*** Chlorine dosing	Chlorination controls bacterial and viral pathogens and failure removes the only treatment barrier and the residual disinfectant provided in the distribution zone. Overdosing may exceed the chemical MAV.
3	Distribution zone connections (Kimbell)	Possible recontamination of the treated water in the distribution system. A chlorine residual provides a partial barrier to recontamination throughout the distribution system. Possible access point for contamination due to backflow if air gaps are not functioning correctly.
4	Storage tanks	Possible point for microbiological contamination. The tanks are covered and have vermin protection to prevent recontamination.
5	Distribution zone connections (Fairlie)	Possible recontamination of the treated water in the distribution system. A chlorine residual provides a partial barrier to recontamination throughout the distribution system. Possible access point for contamination due to backflow.

The treatment system does not provide a barrier to fine particulate material or protozoa contamination.

9.6.1 Chlorine Disinfection – CCP1

Chlorine disinfection provides the primary **disinfection CCP** to inactivate bacterial and viral pathogens that may be present in the source water.

This also provides a **residual disinfection quality control point** to help inactivate pathogens entering downstream of the dosing point.

Table 9-4 Fairlie chlorine disinfection critical control point process objectives

OPERATIONAL DAY-TODAY MONITORING OF CONTROL PROCESSES		
What	FAC concentration	
When	Monitored daily at the treatment plant and in the distribution zone. Continuously monitored online at the treatment plant.	
Where	Designated sampling point in the distribution zone. Prior to the treated water reservoir.	
How	Portable spectrophotometer for sampling. Continuous online monitoring analysers with alarms to the operators if measurement approaches designated parameters.	
Who	Sampling undertaken by the duty operator. Results are telemetered to the duty operator.	
Records	All data is recorded digitally to the Mackenzie District Council SCADA system and Laserfiche.	
Process performance criteria at the operational monitoring point.		Correction required if performance criteria are not met.
Target Range	> 0.4 mg/L in the distribution zone 0.8 mg/L – 1.0 mg/L in water leaving the treatment plant	• Perform routine plant/supply assessment, checks, calibration, and maintenance. • Chlorine dose is automatically controlled by chlorine dosing control system, controlled by a FAC setpoint reading on the post-filtration chlorine analyser, set by the Operator. • Operator to check FAC concentration and if necessary, change dosing rate to ensure the target range is maintained. • Operator to perform routine treatment plant and chemical supply assessment and checks.
Action Limits	Low limit: 0.2 mg/L – 0.4 mg/L in the distribution zone 0.6 mg/L – 0.8 mg/L in water leaving the treatment plant High limit: 2.0 mg/L – 5.0 mg/L in water leaving the treatment plant	• Chlorine Low Alarm, or Chlorine High Alarm are initiated, going to SCADA and Operator pager system. • Operator to visit site and check calibration of chlorine analyser and pH meter. • Operator to check supplies of chlorine gas and dosing systems. • Operator to adjust chlorine gas dosing to within target limits. • Operator to record cause of failure and corrective steps taken. • Operator to advise 3 Waters Manager of incident and corrective actions taken.
Critical Limits	Low limit: < 0.2 mg/L in the distribution zone < 0.6 mg/L in water leaving the treatment plant High Limit: > 5.0 mg/L in water leaving the treatment plant	Continue with Action Limit response and: • Operator to go to site to investigate the cause of the problem and rectify. • Operator to notify the 3 Waters Manager and Engineering Manager. • Operator to notify the Taumata Arowai Compliance Officer if FAC > 5 mg/L in water leaving the treatment plant or in the distribution zone. • If FAC in water from treated water storage reservoir < 0.2 mg/L, discuss with Taumata Arowai Compliance Officer about the need to issue a boil water notice and/or provision of tankered water. • Operator to complete an investigation into the failure and record the results of the investigation and any improvement actions.

10 Verification Monitoring Programme

The effectiveness of the drinking water safety plan is determined by verification monitoring, which assesses the drinking water quality at the point at which it is supplied to a consumer's property. The assessment makes use of water quality testing and consumer complaints. The latter provides an important source of information about the aesthetic properties of the water.

10.1 Drinking Water Quality Compliance Monitoring

Compliance monitoring requirements for the Fairlie drinking water supply are flow based. Flow data is sent directly to Taumata Arowai and ECan from the SCADA system. Compliance monitoring results are stored in SCADA, on the MDC computer servers (Laserfiche) and Hinekōrako.

10.2 Microbial Reduction from Water Treatment Processes

This section describes the measures in place to comply with DWSNZ.

10.2.1 Protozoal and Bacterial Compliance

There is no barrier to protozoal contamination for the Fairlie drinking water supply and protozoal compliance is not achieved. Bacterial compliance is achieved throughout the treatment process.

The water leaving the Fairlie water treatment plant is monitored in accordance with bacterial compliance criterion 1 in section 4.2 of the DWSNZ.

The water in the distribution system is monitored in accordance with compliance criterion 6A in section 4.3.1 of the DWSNZ.

10.2.2 Treated Water Quality

Table 10-1 shows the required water quality standards and where this is sampled.

Table 10-1 Treated Water Quality Specifications

Parameter	Compliance Range	Sampling Point
E. coli	< 1 per 100 mL	WTP post treatment
Treated water turbidity	Target < 2.0 NTU	WTP post treatment
Treated water FAC target	Target > 0.2 mg/L	Reticulation network

10.2.3 Compliance with DWSNZ – Treated Water Quality Monitoring

The Fairlie drinking water supply is subject to the various performance criteria detailed in the DWSNZ. The drinking water compliance monitoring regime is carried out in accordance with the requirements set out in DWSNZ. Continuous monitoring data is stored in SCADA as part of the water treatment plant operation.

Table 10-2 provides a summary of the protozoal compliance monitoring with the DWSNZ.

Table 10-2 DWSNZ compliance - protozoal monitoring

Fairlie Treatment Plant	Control	Frequency
Flow	Flow restrictor	Permanent installation
Turbidity	Treated water turbidimeter	Continuous

Table 10-3 DWSNZ compliance assessment[10]

Standards Compliance Assessed Against	DWSNZ 2005 (revised 2018)
Bacterial compliance criteria used for water leaving the treatment plant	Criterion 1. Not achieved there was a six day gap between E. coli samples on at least one occasion, whereas the maximum allowable gap is five days.
Protozoa log removal requirement for the supply	4-log
Protozoa treatment process	None
Compliance criterion 6A is used for water in the distribution zone	Minimum of 13 *E. coli* samples collected per quarter (maximum interval of 11 days between samples, minimum of 5 different days of the week used, zero permitted exceedances)
Bacterial compliance for water leaving the treatment plant has been achieved for the last 4 quarters	Yes
Protozoa compliance for water leaving the treatment plant has been achieved for the last 4 quarters	No
Bacterial compliance for water in the distribution zone has been achieved for the last 4 quarters	No
P2 determinands allocated to supply	None
Chemical compliance achieved for the last 4 quarters	No, as plumbosolvency notification requirements were not met.
Cyanobacteria identified in the supply	N/A
Cyanobacterial compliance has been achieved for the last 4 quarters	N/A

Annual compliance with the DWSNZ requirements for the Fairlie water supply are stored in Hinekōrako. Compliance survey results with the Health Act for the past 5 years are shown in Table 10-4.

Table 10-4 Annual compliance survey results

Compliance Survey	2017/18	2018/19	2019/20	2020/21	2021/22
Supplier Complied with Duty to:					
Provide Drinking Water (69S)*	Yes	Yes	Yes	Yes	Yes
Take Steps to Protect Source (69U)	Yes	Yes	Yes	Yes	Yes
Duty to Monitor Drinking Water (69Y)	No	Yes	Yes	Yes	Yes

[10] Annual Drinking Water Compliance Report: 1 July 2021 – 30 June 2022 (WSP, 2022)

Compliance Survey	2017/18	2018/19	2019/20	2020/21	2021/22
Duty to Prepare and Implement water safety plan (69Z)	-	-	Yes	Yes	Yes
Keep Records and make them Available (69ZD)	Yes	Yes	Yes	Yes	Yes
Investigate Complaints (69ZE)	Yes	Yes	Yes	Yes	Yes
Duty to Take Remedial Actions (69ZF)	-	-	Yes	Yes	Yes
Bacterial Compliance	No	Yes	Yes	No	No
Protozoal Compliance	No	No	No	No	No

* The sections referred to in this table relate to the Part 2A of the Health Act 1956, which has now been replaced by the Water Services Act.

Protozoal compliance with the DWSNZ has not been met in previous years because the water treatment plant infrastructure is inadequate, and compliance has not been attempted.

10.3 Consumer Satisfaction

10.3.1 Customer Satisfaction

MDC carries out a 'Residents Opinion Survey' each year, to seek feedback from residents on their satisfaction with services like water supplies, roads, community facilities and rubbish collection. Satisfaction surveys have been carried out annually every year for over 10 years. The information is gathered to provide a robust measure of satisfaction with service delivery, determine performance drivers and identify the best opportunities for improving performance, and to measure progress towards long-term objectives.

The most recent survey (2020) was conducted via telephone interviews with resident and non-resident ratepayers that reside in the Mackenzie district. Key findings of the survey were:

- 80% of respondents were satisfied with the water supply and quality.
- The performance target of 80% satisfaction was met.
- Satisfaction levels were similar to the previous year (83% in 2019).
- Concerns causing dissatisfaction were in relation to chlorine content, poor taste/appearance/quality content and water supply issues.

Data collection was randomised to ensure the sample included a range of respondents based on age, location, and gender, with a quota system in place to ensure the sample was representative of the population in line with 2018 Census results. Surveyees were asked their opinion on a wide range of Council issues and the services it delivers to residents.

Residents are also encouraged to provide feedback through the Council's Consultation webpage or in person at the customer services desk.

Responses from the Community Satisfaction Survey form part of the results for Council's Annual Report.

10.3.2 Customer Service Requests and Complaints

Customers are able to lodge service requests or notify the Council of water problems at any time via:

- Customer Contact Centre, by phone or in person. This is the Council's main number, and it is available in the White Pages or on the Council's website under 'Contact Us'.
- Online via the 'Contact us, 'Ask a question' or the 'Report an issue' forms, these forms are available on the Council's website under the 'Contact Us' webpage.

Staff in the Customer Contact Centre record all calls, complaints, and letters. Service requests are tracked in MAGIQ Software called NCS. Anything that requires an action is logged and forwarded to the appropriate team for resolution. The time taken to respond and resolve the issue is recorded.

10.4 Short-term Evaluation of Results

Assessment of the performance of this drinking water safety plan is undertaken annually. This includes a review of the operational and verification monitoring and inspection results. If necessary, the drinking water safety plan will be updated in response to this annual review. This provides an early warning for any problems that may occur and allows MDC to monitor how well the plan and activities are working.

MDC holds weekly meetings with the maintenance contractor to discuss compliance data and incidents. Critical issues are reported to MDC on the day of occurrence.

Short term evaluation of results is undertaken monthly by the Council's water team as part of a routine reporting cycle to identify trends or issues at the supply and confirm whether compliance requirements have been met.

The level of compliance of the applicable water supplies is reported to the Community Boards bi-monthly.

11 Management of Incidents and Emergencies

11.1 Previous Incidents and Emergencies

The Fairlie drinking water supply has never achieved protozoal compliance with the DWSNZ. There is an improvement action in Section 8.1 to address this.

E. coli has been detected once in the last five years, during the 2020/2021 monitoring period. An investigation did not identify a cause and the transgression was attributed to the sampling process. A boil water notice was temporarily issued. The supply therefore failed to comply with the DWSNZ between 1 July 2020 to 30 June 2021. A temporary boil water notice was also issued during the May and June 2021 weather event in response to reduced quality of supply. No transgressions were recorded during this event.

11.2 Incident and Emergency Response Plan

11.2.1 Levels of Emergency

Defining and assigning a level of emergency to each type of possible incident/emergency assists with clear internal communication of the hazard threat level. Table 11-1 defines the emergency descriptors used by MDC during incident/emergency responses. Each emergency response plan indicates the range of emergency levels that may apply, which will depend on the specific event.

Table 11-1 Emergency / incident level descriptor

Incident/emergency level	Description of level
Level 5	Widespread outbreak of waterborne disease
	Declared civil defence natural disaster
	Water supply unable to be maintained
	Gross exceedance of one or more chemical MAVs (e.g. more than 5x MAV, including cyanotoxins)
Level 4	*E. coli* >10 cfu/100 mL or any pathogen detected at the treatment plant or in reticulation
	Failure of infrastructure resulting in water outages for consumers lasting > 8 hours
	Alert from District Health Board that surveillance information suggests cases of illness in the community are drinking water related
Level 3	Detection of *E. coli* (<10 cfu/100 mL) in reticulation
	Exceedance of one or more chemical MAVs
Level 2	Preventive measure failure in combination with corrective action failure
	One or more chemicals at greater than 50% of MAV
Level 1	Exceedance of a DWSNZ aesthetic guideline (GV), possibly resulting in customer complaints
	Water restrictions required to enable supply continuity

11.2.2 Emergency Response Plan

MDC is a member of the Canterbury Region CDEM Group, which includes all local authorities in the Canterbury Region. The Canterbury Region CDEM Group are responsible for developing the recovery arrangements for their group area. CDEM Groups must state and

provide strategic planning for recovery from the hazards and risks identified in their CDEM Group plan.

The Canterbury Region CDEM Group Plan describes how the group will manage and respond to emergencies and sets out the operational arrangements of the group.

MDC does not currently have an emergency response plan in place for the Fairlie drinking water supply. There is a potential improvement action in Section 8.2 to develop an emergency response plan for the plant's operation, principally for response to natural disasters in particular after a major earthquake disrupts the water supply (level 5 event, see Table 11-1).

11.2.3 Incident Response Plan

Implementation of the contingency plan actions when there is an indication of poor water quality is the responsibility of the 3 Waters Manager. These actions are detailed in Table 11-1.

Table 11-2 Fairlie water supply incident response plan

Type of Event	Required Actions
Microbiological contamination of the abstracted source water (such that treatment is ineffective) Indicators: • A contamination event in the spring recharge zone may be observed by or reported to MDC staff • High levels of E. coli or total coliforms measured in raw water • E. coli detected in distribution system • Total coliforms > 10 cfu/mL detected in distribution system • Reports of illness in the community	• Notify Taumata Arowai and the 3 Waters Manager. • Issue boil water notice to consumers in conjunction with Taumata Arowai and following Council response plans. • Commence daily E. coli testing at WTP and in the distribution system, use an enumeration test method for both. • Inspect area around spring source and surrounding areas to identify source of contamination and rectify problem as quickly as possible. • Super chlorinate the reservoir and distribution system and flush mains if they contain contaminated water. • Keep customers informed and advise once regular supply is restored. • Consider providing potable drinking water from alternative sources such as bottled water or tankered water.
Elevated turbidity of the abstracted source water and/or high turbidity in water in distribution system Indicators: • Highly turbid water identified in treated water turbidimeter or handheld meter in zone • Taste, odour, or visual complaints from consumers	• Advise the 3 Waters Manager. • Investigate the source of the elevated turbidity. • Assess the performance of the treatment processes in place to reduce turbidity at the treatment plant. • Where elevated turbidity compromised the plant's ability to adequately disinfect the drinking water, issue a boil water notice to consumers in conjunction with Taumata Arowai and follow Council response plans. • Commence daily E. coli testing. • Monitor source water turbidity. • Keep customers informed and advise once regular supply is restored.

Type of Event	Required Actions
Chemical contamination of source water Indicators: • A contamination event in the spring recharge zone observed by or reported to MDC staff. • Taste, odour, or visual complaints from consumers • Reports of illness in the community	• Notify Taumata Arowai and the 3 Waters Manager. • Advise consumers not to drink the water supply in conjunction with Taumata Arowai and follow the Council response plans. • Assess situation and advise customers regarding use/treatment/disposal of contaminated water. • Inspect area around intake to identify source of contamination and rectify problem as quickly as possible. • Consider mains isolation to avoid spread of chemical contaminants. • Flush reservoir and mains. • Arrange emergency water supply (tankers/bottles) if necessary. • Keep customers informed and advise once regular supply is restored.
Insufficient water available for abstraction or loss of ability to take water from the spring source Indicators: • Observed or reported low abstraction levels • Low reservoir levels	• Notify Taumata Arowai and the 3 Waters Manager. • Advise customers to conserve water. • Implement demand management strategies as outlined in Council response plans as required. • Arrange emergency water supply (tankers/bottles) if necessary. • Investigate and resolve any intake or pipeline issues. • Refer to business continuity plan and emergency response plans once they have been developed, refer Section 8.2 for improvement action. • Keep customers informed and advise once regular supply is restored.
***E. coli* transgression in water in distribution zone** Indicators: • Positive E. coli monitoring results • Reports of illness in the community	• Follow transgression response procedure in DWSNZ. • Notify Taumata Arowai and the 3 Waters Manager. • Commence daily E. coli testing at WTP and in the distribution system, use an enumeration test method for both. • Investigate cause, inspect plant and source. • Take remedial action. • Continue to sample for E. coli until 3 consecutive samples are free of E. coli. • If E. coli is found in any of the repeat samples, consult with Taumata Arowai, intensify remedial action, increase disinfection, issue 'Boil Water' notice.

Type of Event	Required Actions
Inadequate FAC residual in water post treatment enters distribution system Indicators: • FAC of 0.2 mg/L cannot be maintained in distribution system despite primary corrective actions • Reports of illness in the community • E. coli or total coliforms are detected in the network	• Advise the 3 Waters Manager. • Inspect treatment plant to identify cause of problem and rectify as quickly as possible. • Check quality of chlorine, quantity of chlorine and dosing equipment of levels and faults. • Hand dose sodium hypochlorite into the treated water reservoir. • Double check FAC levels in the distribution zone with calibrated equipment. • Investigate contaminant entry at the source, reservoirs and reticulation (including backflow and mains break). • Discuss the need to issue a boil water notice to consumers with Taumata Arowai and follow Council response plans. • Keep customers informed and advise once regular supply is restored.
Excessive FAC residual in water post treatment enters distribution system Indicators: • FAC >5 mg/L is measured in treated water or in distribution system • Taste and odour complaints from consumers • Reports of illness in the community	• Notify Taumata Arowai and the 3 Waters Manager. • Advise consumers not to drink the water supply in conjunction with Taumata Arowai. • Arrange emergency water supply (tankers/bottles) if necessary. • Assess situation and advise customers regarding use/treatment/disposal of contaminated water. • Identify reason for chlorine limit breach and rectify problem as quickly as possible. • Flush storage tanks and mains and advise consumers to flush taps. • Keep customers informed and advise once regular supply is restored.
Earthquake, flood or other natural disaster	Refer to the Canterbury Region Civil Defence Emergency Management Group Plan.

12 Documenting and Reporting

12.1 Management of Documentation and Records

MDC uses Laserfiche for its document management system. Key documents relating to the water supply system including water quality monitoring reports and maintenance records are stored in Laserfiche. All MDC staff have access to Laserfiche and receive training in its use.

All data that is measured continuously (e.g. treated water turbidity, FAC and pH) is stored in the Council's SCADA system historian, which is accessible to operators and MDC staff.

Lutra Infrastructure Data software is used to store monitoring data via a secure online dashboard. The software stores all SCADA data and directly uploads monitoring results processed by the lab.

Water supply staff are trained in the use of these systems and in how to fill out records properly.

Hinekōrako is used for compliance reporting to Taumata Arowai.

12.2 Reporting

Drinking water supply quality, compliance and water supply performance are reported, and publicly available online, to external stakeholders, consumers and other agencies through:

- The Annual Report on Drinking-water Quality by the Ministry of Health. The Council contributed information annually for these reports focussed on bacteriological, protozoal and chemical compliance with DWSNZ, the status of drinking water safety plans, and meeting legislative requirements. Now that Taumata Arowai has taken over from the Ministry of Health as the regulator, MDC commissioned WSP to prepare the 2021/22 annual compliance report.
- MDC Annual Report: This report is focused on MDC's performance against levels of service and provides insight into the final financial and performance results including DWSNZ compliance and Department of Internal Affairs mandatory non-financial performance measures.
- Compliance updates are reported to the three MDC Community Boards on a monthly basis.
- The Council website and social media platform Facebook are used to communicate boil water notices to the public.
- Resource consent compliance: flow data is sent directly to ECan and Taumata Arowai from SCADA.

13 Investigations

13.1 Investigative Studies

Investigations can be triggered by an incident or customer complaints. Customer complaints are loaded into the Council's MAGIQ Software NCS system by the Customer Contact Centre to be triaged and actioned by the 3 Waters Manager. All complaints are investigated with the outcome and actions taken recorded once a job is resolved. If there is a cluster of complaints, a wider investigation is undertaken.

A new water treatment plant including protozoa barrier and increased water storage are planned for the Fairlie drinking water supply to address unacceptable risks listed in Section 5.4. Completion of the new water treatment plant is planned for the end of 2024. The proposed treatment plant will include modifications to the raw water intake, membrane filtration, chlorination with pH and alkalinity correction and an increase in treated water storage volume (2,000 m^3). Upgrades will ensure that the Fairlie drinking water supply complies with the Water Services Act and DWSNZ (and the Drinking Water Quality Assurance Rules that will replace it). The plant is being designed with sufficient capacity to supply Allandale Rural water supply scheme as well as Fairlie.

MDC has also engaged WSP to complete the following work during 2022 to address improvement actions, all of which are complete:

- Undertake a cyanobacteria risk assessment for the Fairlie drinking water supply
- Develop backflow prevention policy and conduct backflow prevention surveys
- Complete an annual compliance report for the monitoring period between 1 July 2021 and 30 June 2022.

13.2 Validation of Equipment, Processes and Practice

Validation collects evidence to establish that preventive measures can perform at the expected level. The regular re-validation of procedures, treatment processes and associated controls ensures their effective operation and adequate control, especially if a process or component has been physically changed or an operational setting changed.

All new equipment is required to be validated by the supplier to confirm that it meets the specifications and is operating correctly.

Routine revalidation of equipment is undertaken by the operators. There is an improvement item to update the SOP that describes the calibration and maintenance requirements for the Fairlie drinking water supply.

14 Oversight, Review and Continual Improvement

14.1 Long-term Evaluation of Results

The Council's long-term evaluation of results is focused on water quality monitoring and system performance.

As well as monitoring for the water take consent for the drinking water supply, the Council monitors and reviews its performance against its levels of service described in the Long Term Plan and Annual Plan. Annual reports identify areas needing immediate attention with a full review every three years as part of the Long Term Plan process which contributes to the funding and development of the water supply network over a ten year period.

The results for water supply levels of service for 2020/21 are summarised in the Mackenzie District Council 2020/21 Annual Report[11]. Of the seven levels of service, three were achieved (fault response times, number of complaints and customer satisfaction). The exceptions were:

Provide safe drinking water:

- 25% of MDC drinking water supplies achieved bacterial compliance in accordance with DWSNZ, compared with a target of ≥ 95%.
- 0% of MDC drinking water supplies achieved protozoal compliance in accordance with DWSNZ. MDC aims to have 3 of 5 supplies compliant by 2023/2024.

Provide demand management of water supply services:

- The average consumption of drinking water per day per resident within the district was 1.72 m^3, compared with a target of ≤ 1.2 m^3.
- 26% water loss, compared with a target of <25%.

The maintenance contractor is required to report any defects observed during day to day duties. There is an ongoing inspection and maintenance regime under the routine maintenance contract and information recorded is used to inform the condition of assets. Almost 90% of water supply assets are estimated to be in good condition and only 3% assumed to be in poor condition. The overall performance of water supply assets is adequate. The primary concern is achieving DWSNZ compliance.

The Council also records information relating to DWSNZ compliance and transgression information. This was provided annually for the Ministry of Health's annual report on drinking water quality. Historical information on the Fairlie water supply can be evaluated from the Ministry of Health's Annual Review of Drinking-water Quality in New Zealand. Reporting is now to Taumata Arowai.

Section 17A of the Local Government Act 2002 requires the Council carry out service delivery reviews. These reviews are a method of determining whether the existing means for delivering a service remain the most efficient, effective, and appropriate means for delivering that service. The most recent review for three waters was carried out in 2019/2020. Reviews are required to be carried out no later than six years following the last review.

14.2 Audit of Drinking Water Quality Management

An annual review is undertaken to assess compliance with the DWSNZ and the Water Services Act. Annual reviews of the water safety plan are also completed to ensure improvement actions are implemented within agreed timeframes. Lutra Infrastructure Data software is used to store

[11] https://www.mackenzie.govt.nz/__data/assets/pdf_file/0005/629474/2020-2021-Annual-Report-Full.pdf

monitoring data via a secure online dashboard. The software stores all SCADA data and directly uploads monitoring results processed by the lab.

14.3 External Audit of Drinking Water Quality Management

External audits of the water supply are undertaken by Taumata Arowai. These were previously undertaken by the Drinking Water Assessor, including a three-yearly review of compliance with the drinking water safety plan. The most recent external audit was carried out in 2020.

Appendix A
Fairlie Drinking Water Supply – Risk Assessment Table

Fairlie Water Supply - Draft Risk Assessment Table

	Hazardous Event			Hazards (associated with the hazardous event)				MAXIMUM Risk (with no preventive measures in place and all barriers failing)							RESIDUAL Risk (with existing preventive measures)								LEVEL OF UNCERTAINTY AND RISK ACCEPTABILITY				
Supply Element	Event Description	Cause No.	Possible Causes	Bacteria / Viruses	Protozoa	Chemicals / Aesthetics	Disruption to Supply	Likelihood of HAZARDOUS EVENT occurring	Assessment Rationale - Likelihood	Consequence of the HAZARD	Assessment Rationale - Consequence	MAX L	MAX C	Maximum (unmitigated) Risk	Existing Measures to Identify the Hazard	Existing Preventive measures	Modified Likelihood of HAZARDOUS EVENT occurring	Assessment Rationale - Modified Likelihood	Modified Consequence of the HAZARD	Assessment Rationale - Modified Consequence	MOD L	MOD C	Residual Risk	Level of Uncertainty	Residual Risk Score	Risk Acceptability	Additional Preventive Measure Required?	Improvement Plan Reference
Source - Spring Recharge Zone	Microbiological contamination due to surface runoff into spring recharge zone, community wastewater systems, dairy effluent ponds or septic tank systems	1.01	Contamination from human or animal activity in catchment, unmonitored permitted activities, consent conditions not followed, or potential impact not considered.	☑	☑			Almost Certain	Assumes no land use controls	Major	Potential acute harm to people, declared outbreak or widespread illness and possible deaths expected	5	4	Extreme	• Continuous turbidity, pH and FAC monitoring in treated water • SCADA controls and alarms • Illness in community	• Supply is chlorinated - manual adjustment • Limited treated water storage available for selective abstraction •Spring recharges >100m from the Opihi River, providing natural filtration • Community drinking water protection zone in Land and Water Regional Plan • Use of tankered water • SOP's and O&M manual	Possible	Spring source reduces likelihood	Major	Chlorination reduces consequence of bacterial and viral contamination somewhat, but not protozoal contamination	3	4	High	Estimate	12	Unacceptable	Yes	1
Source - Spring Recharge Zone	Chemical contamination from surface runoff containing chemical contaminants from agricultural activities. (e.g. pesticides, fertilisers etc)	1.02	Poor fertiliser / pesticide application practices, landowners in catchment unaware of drinking water catchment area			☑		Possible	Assumes no land use controls	Major	Potential repeated exceedance of MAV	3	4	High	• Taste and/or odour complaints • Source water chemical suite is analysed annually	• Community drinking water protection zone in Land and Water Regional Plan •Spring recharges >100m from the Opihi River, providing natural filtration • Use of tankered water • swale and elevated from surrounding area	Unlikely	Protected recharge zone and elevated area reduces likelihood	Major	PMs don't reduce consequence	2	4	Medium	Reliable	8	Acceptable	No	
Source - Spring Recharge Zone	Chemical contamination due to naturally occurring chemical contaminants or land use intensification	1.03	Naturally occurring chemical contaminants from local geology or from land use intensification			☑		Unlikely		Moderate	Potential widespread aesthetic issues, or repeated breach of maximum acceptable value (MAV)	2	3	Medium	• Taste and/or odour complaints • Source water chemical suite is analysed annually	• No contaminants of concern found in annual monitoring • Weekly calibration of equipment	Unlikely	Source water monitoring shows no indication of natural chemical contaminants	Moderate	PMs don't reduce consequence	2	3	Medium	Reliable	6	Acceptable	No	
Source - Spring Recharge Zone	Chemical contamination	1.04	Chemical spill in water upstream of spring recharge zone			☑		Possible	Spring is beside state highway	Major	Potential repeated exceedance of MAV	3	4	High	• Taste and/or odour complaints • Chemical spill is reported	• No bulk storage of chemicals near spring • Swale between state highway and spring diverts chemicals away from spring • Community drinking water protection zone in Land and Water Regional Plan • Treated water storage • Use of tankered water • Artesian spring • Diesel floats on water	Unlikely	Artesian spring source reduces likelihood	Major	PMs don't reduce consequence	2	4	Medium	Reliable	8	Acceptable	No	
Source - Spring Recharge Zone	Increased sediment load in source water	1.05	Heavy rainfall, fire in catchment			☑		Likely		Major	Potential widespread aesthetic issues	4	4	High	• Continuous turbidity, pH and FAC monitoring in treated water • SCADA controls and alarms • Visual observation	• Intake through spring source filters sediment • Limited treated water storage • Use of tankered water	Possible	Turbidity increases following rain events and can remain above 2 NTU for several days	Major	PMs don't reduce consequence	3	4	High	Reliable	12	Unacceptable	Yes	1
Source - Spring Recharge Zone	Cyanotoxin Contamination	1.06	Cyanobacteria growth in source water	☑		☑		Unlikely	No indication of cyanobacteria	Moderate	Potential widespread aesthetic issues	2	3	Medium	• Taste and/or odour complaints • ECan report cyanobacteria in area	• Spring source, so low risk of cyanobacteria • Water is abstracted before it is exposed to the environment • Operators check condition of the springs regularly • Use of tankered water	Rare	Spring source reduces likelihood	Moderate	PMs don't reduce consequence	1	3	Low	Estimate	3	Acceptable	No	
Source - Spring Recharge Zone	Loss of Supply	1.07	Drought reduces quantity of water that can be abstracted				☑	Unlikely		Major	Significant compromise of systems and abnormal operation	2	4	Medium	• Flow meter • Reservoir level indicator • SCADA controls and alarms • Prolonged drought or low rainfall conditions • Opihi River levels / spring flows	• Spring recharge remains constant during periods of drought • Water restrictions • Use of tankered water	Rare	Consistent recharge from spring source	Major	PMs don't reduce consequence	1	4	Medium	Reliable	4	Acceptable	No	
Source - Spring Recharge Zone	Loss of Supply	1.08	Flood event				☑	Unlikely		Major	Significant compromise of systems and abnormal operation	2	4	Medium	• Extreme rainfall • Opihi River levels	• use of tankered water	Rare		Major	PMs don't reduce consequence	1	4	Medium	Reliable	4	Acceptable	No	
Source - Spring Recharge Zone	Loss of supply	1.09	Consent to take water is not renewed or is declined by the Regional Council or less volume granted				☑	Possible		Major	Significant compromise of systems and abnormal operation	3	4	High	• Regional Council raises issues about water consents prior to consent application	• Current consent expires in 2044 • Protected catchment with land owned by Ministry of Defence and Dept of Conservation • NPS Freshwater Management prioritises drinking water over other consumptive uses	Unlikely		Major	PMs don't reduce consequence	2	4	Medium	Reliable	8	Acceptable	No	
Source - Spring Water	Loss of supply	1.10	Intentional vandalism or accidental damage to spring intake structure or associated equipment				☑	Possible		Major	Significant compromise of systems and abnormal operation	3	4	High	• Flow meter • Reservoir level indicator • SCADA controls and alarms • Obvious signs of damage to structure • Customer reports	• Spring is securely fenced and locked • Spring is beside state highway in a highly visible area • If intake structure is damaged, water can be directly pumped from the spring to the supply pipeline • Storage tanks • Tankered water	Rare		Moderate		1	3	Low	Reliable	3	Acceptable	No	
Source - Raw Water Pipeline	Loss of Supply	1.11	Raw water pipeline failure between intake and treatment plant Damage to pipeline by landowner/contractor				☑	Possible		Major	Significant compromise of systems and abnormal operation	3	4	High	• Flow meter • Visual inspection • Customer complaints • SCADA controls and alarms • Condition and type of materials of pipeline • Records of pipeline failures and repairs	• Pipeline is PVC / PE and is in excellent condition (replaced from 2003 onwards) • Most breaks can be repaired quickly by maintenance contractor • Maintenance contract requires rapid response to repair pipe failures (KPIs) • Pipeline locations published online on Canterbury Maps • Spare pipes and couplings stored at contractor yard • Water use restrictions • Use of tankered water	Unlikely	Pipe is in excellent condition and location is known and published online	Moderate	Significant (but manageable) disruption to normal operation	2	3	Medium	Reliable	6	Acceptable	No	
Source - Raw Water Pipeline	Inadequate quantity of water supplied	1.12	Size of raw water pipeline is inadequate				☑	Possible		Moderate	Significant disruption to normal operation	3	3	Medium	• Flow meter • Hydraulic calculations, modelling • Customer complaints • SCADA controls and alarms	• Calculations show that pipeline is correctly sized • Gravity provides a minimum pressure and flow and a PRV is required	Rare	No issues meeting peak demand	Moderate		1	3	Low	Estimate	3	Acceptable	No	
Treatment - Chlorination	Inadequate Chlorination	2.01	Inadequate contact time	☑	☑			Likely		Major	Potential acute harm to people, declared outbreak or widespread illness and possible deaths expected	4	4	High	• Calculation of contact time • Continuous turbidity, pH and FAC monitoring in treated water • SCADA controls and alarms	• Chlorine dose is almost always above 0.2mg/L (measured straight after dosing) • Target of 0.4 mg/L FAC in town	Unlikely		Major	No other treatment to reduce consequence	2	4	Medium	Reliable	8	Acceptable	No	

Fairlie Water Supply - Draft Risk Assessment Table

	Hazardous Event			Hazards (associated with the hazardous event)				MAXIMUM Risk (with no preventive measures in place and all barriers failing)							RESIDUAL Risk (with existing preventive measures)								LEVEL OF UNCERTAINTY AND RISK ACCEPTABILITY				
Supply Element	Event Description	Cause No.	Possible Causes	Bacteria / Viruses	Protozoa	Chemicals / Aesthetics	Disruption to Supply	Likelihood of HAZARDOUS EVENT occurring	Assessment Rationale - Likelihood	Consequence of the HAZARD	Assessment Rationale - Consequence	MAX L	MAX C	Maximum (unmitigated) Risk	Existing Measures to Identify the Hazard	Existing Preventive measures	Modified Likelihood of HAZARDOUS EVENT occurring	Assessment Rationale - Modified Likelihood	Modified Consequence of the HAZARD	Assessment Rationale - Modified Consequence	MOD L	MOD C	Residual Risk	Level of Uncertainty	Residual Risk Score	Risk Acceptability	Additional Preventive Measure Required?	Improvement Plan Reference
Treatment - Chlorination	Inadequate Chlorination	2.02	• Gas chlorine supply exhausted • Dosing system failure • Chlorine dose rate incorrect • Chlorine demand exceeds chlorine dose due to high turbidity • Dosing line failure or leak • Power failure • Carriage water pump failure • Freezing temperatures	☑	☑			Likely	Assumes inexperienced operators and no O&M procedures	Major	Potential acute harm to people, declared outbreak or widespread illness and possible deaths expected	4	4	High	• Illness in community • Continuous turbidity, pH and FAC monitoring in treated water • FAC and E. coli monitoring in distribution system • SCADA controls and alarms	• Operator visits the plant 1-2 times weekly to check supply of gas chlorine • SCADA registers low chlorine supply • Two 70kg gas bottles with automatic changeover • Chlorine dose rate automatically adjusts based on flow and FAC • Chlorine gas leak sensor and alarm installed at treatment plant • Spare tubing and fittings held by contractor • Chlorine dosing system serviced annually by Filtec • Operations and maintenance manual • Standard operating procedures • Small diesel generator available • Trained and experienced operations staff • Heaters in shed and checked weekly in winter	Possible	O&M procedures and trained staff reduce likelihood. Turbidity increases following rain events and can remain above 2 NTU for several days	Major	No other treatment to reduce consequence	3	4	High	Reliable	12	Unacceptable	Yes	1
Treatment - Chlorination	Inadequate Chlorination	2.03	pH too high for chlorination to be effective	☑	☑	☑		Unlikely		Moderate	Potential acute harm to people, declared outbreak or widespread illness and possible deaths expected	2	3	Medium	• Illness in community • Continuous turbidity, pH and FAC monitoring in treated water • FAC and E. coli monitoring in distribution system • SCADA controls and alarms	• pH of source water is fairly constant, between 6.8 - 7.3 over past 4 years of monitoring	Unlikely	pH consistently less than 8 so unlikely to affect chlorination	Moderate	No other treatment to reduce consequence	2	3	Medium	Reliable	6	Acceptable	No	
Treatment - Chlorination	Over-chlorination	2.04	• Dosing system failure • Chlorine dosage rate is too high due to equipment malfunction or reduction in demand for chlorine in the source water			☑		Unlikely	Assumes inexperienced operators and no O&M procedures	Moderate	Repeated breach of MAV	2	3	Medium	• Continuous turbidity, pH and FAC monitoring in treated water • FAC and E. coli monitoring in distribution system • SCADA controls and alarms • Odour and taste complaints	• Chlorine dose rate automatically adjusts based on flow and FAC • Operator visits the plant at least weekly to check operation of chlorination system • Operator checks FAC in distribution system daily • Chlorine dosing system serviced annually by Filtec • Operations and maintenance manual • Standard operating procedures • Trained and experienced operations staff • Gas chlorine less likely to overdose than hypochlorite (can't siphon)	Unlikely	Continuous monitoring for six years shows FAC always below 5 mg/L	Moderate	PMs don't reduce consequence	2	3	Medium	Confident	6	Acceptable	No	
Treatment - Chlorination	Production of disinfection by-products	2.05	Organic material in raw water results in the production of disinfection by-products			☑		Likely		Moderate	Repeated breach of MAV	4	3	High	• High organic loading in source water without a filtration process prior to chlorination	• Gas chlorine less likely to create disinfection by-products than hypochlorite • DBPs measured in three locations and not found	Unlikely	DBPs haven't been found in distribution system	Moderate	PMs don't reduce consequence	2	3	Medium	Reliable	6	Acceptable	No	
Treatment	Fire within treatment plant building	2.06	• Faulty switchboard or other malfunction • Vandalism or sabotage				☑	Possible		Major		3	4	High	• Obvious signs of damage to structure • Reported by residents	• Concrete block building • Yearly electrical inspection • Treated water storage • Use of tankered water	Rare		Major		1	4	Medium	Reliable	4	Acceptable	No	
Post-Treatment - Storage	Microbiological Contamination	3.01	• Access by birds or vermin • Leakage through reservoir roof or other parts of structure	☑	☑			Possible		Major	Potential acute harm to people, declared outbreak or widespread illness and possible deaths expected	3	4	High	• Visual evidence of leakage • Condition assessment • FAC and E. coli monitoring in distribution system • Weekly inspection of reservoir by Contractor	• Chlorine residual • Reservoirs are covered and all entry hatches are secured and locked against unauthorised access • Grates over vents • Reservoirs can be bypassed • Concrete reservoir is in good condition, walls and floors were lined with neoprene liner <20 years ago • smaller PE tanks in good condition (Siegerts Road for Kimbell, School Road, Nixon Road)	Unlikely	Grates prevent access by larger vermin but not insects Air vent is uncovered	Major	Chlorine residual reduces consequence of bacterial or viral contamination but not protozoal contamination	2	4	Medium	Reliable	8	Acceptable	No	
Post-Treatment Storage	Microbiological or chemical contamination	3.02	Vandalism to reservoir	☑	☑	☑		Possible		Moderate	Potential repeated exceedance of MAV	3	3	Medium	• FAC and E. coli monitoring in distribution system • Reports from the neighbour or the public	• Chlorine residual • Reservoirs are covered and all entry hatches are secured and locked against unauthorised access • Reservoirs can be bypassed • Reservoirs are visible and accessible from the road	Possible		Moderate	Chlorine residual reduces consequence	3	3	Medium	Reliable	9	Acceptable	No	
Post-Treatment Storage	Aesthetic Contamination	3.03	Sediment accumulation and release from reservoir			☑		Possible		Moderate	Potential widespread aesthetic issues	3	3	Medium	• Visible suspended matter in water exiting reservoir • FAC and E. coli monitoring in distribution system • Customer complaints	• Operates between 70% and 90% • Reservoirs can be bypassed	Unlikely		Moderate	PMs don't reduce consequence	2	3	Medium	Reliable	6	Acceptable	No	
Post-Treatment - Storage	Loss of Supply	3.04	Failure of reservoir e.g. due to structural failure or earthquake damage				☑	Unlikely		Major	Major impact on most of the population, complete failure of systems, requirement for high level of monitoring and incident management	2	4	Medium	• Customer complaints • Obvious signs of leakage or failure at reservoir site • Weekly inspection of reservoir by Contractor • Reservoir level indicator • SCADA controls and alarms	• Reservoirs are in good condition • Reservoirs can be bypassed with PSV / PRV • Water restrictions • Use of tankered water	Rare	Reservoir condition reduces likelihood	Major		1	4	Medium	Reliable	4	Acceptable	No	
Post-Treatment - Storage	Loss of Supply	3.05	Insufficient storage for peak demand				☑	Likely		Major	Significant compromise of systems and abnormal operation	4	4	High	• Customer complaints • Reservoir level indicator • SCADA controls and alarms	• Less than 4 hours of treated water storage at peak demand • Water restrictions • Use of tankered water	Possible	Limited storage volume leaves little time to undertake repairs and maintenance	Major		3	4	High	Reliable	12	Unacceptable	Yes	1
Reticulation	Loss of Supply	4.01	Failure of critical supply main from reservoir to town due to break, structural failure or contractor damage				☑	Possible		Catastrophic	Major impact on most of the population, complete failure of systems, requirement for high level of monitoring and incident management	3	5	High	• Customer complaints • Pipeline condition assessment • Reservoir level indicator • SCADA controls and alarms	• Pipe failures are repaired as a priority by maintenance contractor • Maintenance contract KPIs • Pipe renewals programme • Pipe location on Canterbury Maps GIS • Water restrictions • Use of tankered water • PE / PVC fairly new in good condition	Rare		Catastrophic	PMs don't reduce consequence Single pipeline	1	5	Medium	Reliable	5	Acceptable	No	
Reticulation	Loss of Supply	4.02	• Excessive demand in the network • Inadequate distribution system capacity • Failure of booster pump station				☑	Possible		Moderate		3	3	Medium	• Customer complaints • Reservoir level indicator • SCADA controls and alarms	• Pipe renewals programme • Water restrictions • Use of tankered water	Rare	No issues meeting peak demand	Moderate		1	3	Low	Reliable	3	Acceptable	No	
Reticulation	Microbiological Contamination	4.03	• Inadequate controls on maintenance and construction work • Contractors other than the nominated maintenance contractors carry out work on the water supply network	☑	☑			Possible		Moderate		3	3	Medium	• Complaints from consumers about taste or odour • E. coli present in reticulation system • Less than expected FAC in reticulation • Contractor or staff notification	• Chlorine residual • Only Council approved contractors can work on the water supply network • Maintenance and replacement work is undertaken by trained qualified and experienced contractors	Unlikely		Moderate		2	3	Medium	Reliable	6	Acceptable	No	

Fairlie Water Supply - Draft Risk Assessment Table

	Hazardous Event			Hazards (associated with the hazardous event)				MAXIMUM Risk (with no preventive measures in place and all barriers failing)							RESIDUAL Risk (with existing preventive measures)								LEVEL OF UNCERTAINTY AND RISK ACCEPTABILITY				
Supply Element	Event Description	Cause No.	Possible Causes	Bacteria / Viruses	Protozoa	Chemicals / Aesthetics	Disruption to Supply	Likelihood of HAZARDOUS EVENT occurring	Assessment Rationale - Likelihood	Consequence of the HAZARD	Assessment Rationale - Consequence	MAX L	MAX C	Maximum (unmitigated) Risk	Existing Measures to Identify the Hazard	Existing Preventive measures	Modified Likelihood of HAZARDOUS EVENT occurring	Assessment Rationale - Modified Likelihood	Modified Consequence of the HAZARD	Assessment Rationale - Modified Consequence	MOD L	MOD C	Residual Risk	Level of Uncertainty	Residual Risk Score	Risk Acceptability	Additional Preventive Measure Required?	Improvement Plan Reference
Reticulation	Microbiological Contamination	4.04	Contaminants permeate from pipeline installed in contaminated land			☑		Unlikely		Moderate	Repeated breach of maximum acceptable value	2	3	Medium	• Customer complaints • Water quality monitoring • Resource consents for contaminant plumes	• HAIL (hazardous activities and industries list) sites checked when building new subdivisions	Unlikely		Moderate		2	3	Medium	Reliable	6	Acceptable	No	
Reticulation	Microbiological Contamination	4.05	Standard hygiene practices not adhered to or inadequate flushing and disinfection practices during repairs or commissioning of new mains and new connections	☑		☑		Possible		Major	Potential acute harm to people, declared outbreak or widespread illness and possible deaths expected	3	4	High	• FAC monitoring • Contractor reports breach of disinfection procedure	• Chlorine residual • Only Council approved contractors can work on the water supply network • Council audit of contractors • Maintenance contractor follows 'chain of cleanliness' • Water main disinfection and water quality testing after mains repairs • Maintenance contractor follows contractor plans and uses disinfection when carrying out repairs	Possible		Moderate	Chlorine residual reduces consequence	3	3	Medium	Reliable	9	Acceptable	No	
Reticulation	Microbiological Contamination	4.06	Breaks / leaks due to pipe condition or significant flow and pressure fluctuations, or accidental damage to water mains	☑	☑		☑	Possible		Major	Potential acute harm to people, declared outbreak or widespread illness and possible deaths expected	3	4	High	• Visual inspection • Water quality monitoring • Customer complaints • Reports from contractors • Reports of illness	• Chlorine residual • Gravity flow provides a minimum pressure and flow • Only Council approved contractors can work on the water supply network • Pipe locations on Canterbury Maps • Council audit of contractors • Maintenance contractor follows 'chain of cleanliness' • Pipe failures are repaired as priority (maintenance contract KPIs) • Asset knowledge is held on pipe ages, material and condition • Reticulation is mostly PE and PVC and is in good condition • Failures, maintenance and renewals are recorded in Council asset management system • Pipeline renewals programme (replacing old AC) • Water restrictions • Use of tankered water	Unlikely	Contractor processes and audits, and mostly new PE and PVC network reduce likelihood	Moderate	Chlorine residual reduces consequence	2	3	Medium	Reliable	6	Acceptable	No	
Reticulation	Microbiological Contamination	4.07	Cross contamination from wastewater and water supply sampling	☑	☑			Likely	Assumes no sampling controls	Major	Potential acute harm to people, declared outbreak or widespread illness and possible deaths expected	4	4	High	• Contaminants identified in the reticulation system. • Taste or odour complaints from consumers.	• Chlorine residual • Water supply samples are taken on separate sampling rounds to wastewater samples • Trained and experienced water sampling staff • Backup sampling staff available • Standard operating procedures	Unlikely		Minor	Chlorine residual reduces consequence	2	2	Low	Estimate	4	Acceptable	No	
Reticulation	Chemical/Microbiological Contamination	4.08	Backflow from consumer connections	☑	☑			Likely		Major	Repeated breach of maximum acceptable value	4	4	High	• Contaminants identified in the reticulation system. • Taste or odour complaints from consumers.	• Gravity flow provides a minimum pressure and flow • Chlorine residual • Town swimming pool has backflow device fitted • Building consent process requires a backflow prevention device if there is a backflow hazard • Check valves in new manifolds on most properties. Double check valve on new connections	Unlikely	Only one boundary backflow device installed in Fairlie	Major	Chlorine residual reduces consequence of microbial contamination but not chemical contamination	2	4	Medium	Estimate	8	Unacceptable	Yes	2
Reticulation	Loss of water	4.09	Unidentified leakage or illegal connections				☑	Likely		Moderate		4	3	High	• Consumption exceeds calculated expectation	• Known breaks and leaks repaired as a priority (maintenance contract KPIs) • Disconnect or legitimise illegal connections • Estimated 20% leakage, minimum overnight flow unknown	Possible	Leakage ~20%	Minor		3	2	Medium	Reliable	6	Acceptable	No	
Reticulation	Supply of Turbid Water	4.10	Silt build up within reticulation pipes			☑		Possible		Minor		3	2	Medium	• Reduced flows in reticulation. • Complaints from consumer about quality of water	• Flushing undertaken if required in response to complaints • few dead ends in network, locations known	Unlikely	Few complaints	Minor		2	2	Low	Estimate	4	Acceptable	No	
Reticulation	Inadequate Supply of Water	4.11	Poor quality workmanship or inappropriate materials used for reticulation pipes and fittings			☑		Possible		Moderate	Significant disruption to normal operation	3	3	Medium	• Contaminants identified in the reticulation system. • Taste and odour complaints from consumers • Reduced FAC in water	• Council requires all work and materials used in reticulation to meet standard specifications • Best practice reticulation approach taken to reticulation work	Unlikely		Moderate		2	3	Medium	Reliable	6	Acceptable	No	
Reticulation	Loss of water	4.12	Corrosive or scale forming water causes damage to pipes, fittings and consumers hot water cylinders				☑	Possible		Moderate	Significant disruption to normal operation	3	3	Medium	• Continuous pH monitoring • Rate of pipe failures is higher than expected • Complaints about hot water cylinder failures • Source water chemical suite is analysed annually • pH, alkalinity and hardness Langelier saturation index of water	• pH and alkalinity of source water is analysed annually • Monitoring shows that pH is generally stable	Possible	Source water alkalinity is consistently monitored below the guideline value	Moderate		3	3	Medium	Reliable	9	Acceptable	No	3
Reticulation	Loss of water to reticulation reservoirs	4.13	Booster pump failure				☑	Unlikely		Moderate		2	3	Medium	• reservoir levels • loss of flow and pressure • customer complaints • SCADA controls and alarms	duty / standby pumps treated water storage in smaller tanks	Rare		Moderate		1	3	Low	Reliable	3	Acceptable	No	
Systems and Processes	Sampling failure	5.01	Inadequate sampling programme or sample collection error.	☑	☑			Likely		Moderate		4	3	High	• DWSNZ compliance failure due to days of week, days between samples, insufficient samples, information gaps, positive results or sampling error	• Sampling programme prepared and checked against DWSNZ	Possible		Moderate		3	3	Medium	Reliable	9	Acceptable	No	
Systems and Processes	Incorrect or inadequate water quality data used for water supply management	5.02	Not enough sampling points	☑	☑			Likely		Insignificant		4	1	Medium	• Drinking water compliance audits identify missing or incorrect sample results	• Sufficient sampling points	Possible		Insignificant		3	1	Low	Estimate	3	Acceptable	No	4
Systems and Processes	Unidentified Operational Failure	5.03	Insufficient monitoring and alarming of key operational data	☑	☑	☑	☑	Possible		Moderate		3	3	Medium	• SCADA controls and alarms	• Manual sampling of chlorine process • Continuous monitoring and SCADA	Unlikely		Major		2	4	Medium	Reliable	8	Acceptable	No	
Systems and Processes	Failure of supply	5.04	Insufficient, inadequate, out of date or incorrect manual of operational procedures.					Almost Certain		Moderate		5	3	High	• Operational Manuals not up to date / require review	• O&M manual updated in 2019 • Standard operating procedures	Unlikely		Moderate		2	3	Medium	Reliable	6	Acceptable	No	5

Fairlie Water Supply - Draft Risk Assessment Table

	Hazardous Event			Hazards (associated with the hazardous event)				MAXIMUM Risk (with no preventive measures in place and all barriers failing)							RESIDUAL Risk (with existing preventive measures)								LEVEL OF UNCERTAINTY AND RISK ACCEPTABILITY				
Supply Element	Event Description	Cause No.	Possible Causes	Bacteria / Viruses	Protozoa	Chemicals / Aesthetics	Disruption to Supply	Likelihood of HAZARDOUS EVENT occurring	Assessment Rationale - Likelihood	Consequence of the HAZARD	Assessment Rationale - Consequence	MAX L	MAX C	Maximum (unmitigated) Risk	Existing Measures to Identify the Hazard	Existing Preventive measures	Modified Likelihood of HAZARDOUS EVENT occurring	Assessment Rationale - Modified Likelihood	Modified Consequence of the HAZARD	Assessment Rationale - Modified Consequence	MOD L	MOD C	Residual Risk	Level of Uncertainty	Residual Risk Score	Risk Acceptability	Additional Preventive Measure Required?	Improvement Plan Reference
Systems and Processes	Failure due to Inadequate Maintenance	5.05	Supply equipment fails due to inadequate asset information and inadequate maintenance planning	☑	☑	☑	☑	Almost Certain		Moderate		5	3	High	• Unexpected plant equipment failure. • Not having an asset register and maintenance programme	• Very little in the way of treatment equipment at this supply • Council and contractor have a good understanding of water supply assets allowing maintenance to be planned and undertaken • Failure are attended to as a priority (maintenance contract KPIs) • Asset knowledge is held on pipe ages, material and condition • Water supply renewals programme in Long Term Plan	Unlikely		Moderate		2	3	Medium	Reliable	6	Acceptable	No	
Systems and Processes	Operator Error or Mismanagement	5.06	• Insufficient qualified and experienced operators to operate and manage the water treatment plant to meet DWSNZ compliance requirements • Inadequate training, professional development and up-skilling of operators	☑	☑	☑	☑	Almost Certain		Major		5	4	Extreme	• Poor operation of plant. • Plant compliance failure. • Loss of supply. • Audits • DWSNZ compliance • Operational issues • Staff feedback • Failure to comply with QA procedures	• Operator has Level 4 Water Treatment qualification and 1 other is in training for Level 4 Water Treatment • Provide in-house training where abilities are in deficit • Operations and maintenance manual • Standard operating procedures • Maintenance contract has requirement for qualified staff	Possible		Moderate		3	3	Medium	Reliable	9	Acceptable	No	
Systems and Processes	Water treatment technician error or mismanagement	5.07	Loss of staff, inability to attract and retain staff				☑	Possible		Major		3	4	High	• Resignations / staff turnover • Poor operation of plant • Plant compliance failure • Loss of supply	• Automated treatment processes • Standard operating procedures • Succession planning • On-going training and up-skilling is provided for Water Treatment Technicians	Unlikely		Major		2	4	Medium	Reliable	8	Acceptable	No	
Systems and Processes	Failure to Provide Safe Water	5.08	Inadequate data collection, reporting and control systems	☑	☑			Likely		Moderate		4	3	High	• Information about how the supply is operating is not available • Continuous monitoring of pH, turbidity and FAC in treated water plus manual sampling	• FAC and turbidity results • Recording of manual sampling results • Sample schedule is prepared in accordance with DWSNZ	Unlikely		Moderate		2	3	Medium	Reliable	6	Acceptable	No	
Systems and Processes	Failing to meet the requirements of the DWSNZ	5.09	Treatment processes are not sufficient to comply with the requirements of the DWSNZ	☑	☑			Almost Certain		Major		5	4	Extreme	Treatment processes comply with DWSNZ requirements	• Chlorination • Continuous monitoring • Low risk catchment • Low turbidity source water	Rare		Moderate		1	3	Low	Reliable	3	Acceptable	No	
Systems and Processes	Civil emergency	5.10	Catastrophic natural disaster or failure including earthquake, flooding etc.	☑	☑	☑	☑	Unlikely		Catastrophic		2	5	High	• Major natural disaster occurs • Intense sustained weather • Land slide, flooding, volcanic eruption • Total plant failure is evident • Warnings from Govt agencies incl Met Office, NIWA, Civil Defence, Regional Council or Police	• Prior warning from Govt agencies incl Met Office, Niwa, Civil Defence, Regional Council or Police • Robust secure plant structures and buildings • Implement all measures necessary to ensure plant continues to operate in a natural disaster • Chlorine residual • Water restrictions • Treated water storage • Use of tankered water	Rare		Major		1	4	Medium	Reliable	4	Acceptable	No	6
Systems and Processes	Operator, contractor and other management issues	5.11	Inadequate QA / management systems	☑	☑			Possible		Minor		3	2	Medium	• Third party audits	• Contract audits and QA • Laboratory is IANZ accredited and Taumata Arowai approved	Unlikely		Minor		2	2	Low	Reliable	4	Acceptable	No	
Systems and Processes	Operator, contractor and other management issues	5.12	Inadequate supply planning and management	☑	☑			Possible		Major		3	4	High	• Third party audits • DWSNZ compliance • Operational issues • Budgets exceeded due to unplanned reactive work	• Asset management plan • Infrastructure strategy • Long Term Plan • Suitably qualified and experienced staff at Council	Unlikely		Moderate		2	3	Medium	Reliable	6	Acceptable	No	
Systems and Processes	Operator, contractor and other management issues	5.13	Not updating/reviewing risks in the water safety plan following incidents or major changes to the water supply	☑	☑		☑	Likely		Minor		4	2	Medium	• Water safety plan audits	• Continual tracking of progress against improvement actions in water safety plan	Possible		Moderate		3	3	Medium	Reliable	9	Acceptable	No	
Systems and Processes	Disruption to operation of water treatment processes or SCADA	5.14	Cyber security attack				☑	Rare		Moderate		1	3	Low	• IT security reviews • Disruption to supply management systems	• Running two systems: SCADA and Industrial Control (one system would flag issues with the other) • Can manually operate plant if required • SCADA is read-only so if unauthorised access occurs the impact would be minimal	Rare		Minor		1	2	Low	Reliable	2	Acceptable	No	

Appendix B
National Policy Statement for Freshwater Management 2020 (NPSFM) and Canterbury Land and Water Regional Plan Requirements

National Requirements

The National Policy Statement for Freshwater Management 2020 (NPSFM) contains an objective and policies relating to safeguarding New Zealand's freshwater values. These impose directions primarily on Regional Councils who then need to ensure that regional plans to give effect to those directions.

The following objective of the NPSFM is relevant to protecting drinking water supplies.

1. *The objective of this National Policy Statement is to ensure that natural and physical resources are managed in a way that prioritises:*
    a. *first, the health and well-being of water bodies and freshwater ecosystems*
    b. *second, the health needs of people (such as drinking water)*
    c. *third, the ability of people and communities to provide for their social, economic, and cultural well-being, now and in the future.*

The following policies give effect to the above objective and are considered relevant to protecting the Fairlie drinking water supply:

Policy 1	*Freshwater is managed in a way that gives effect to Te Mana o te Wai.*
Policy 3	*Freshwater is managed in an integrated way that considers the effects of the use and development of land on a whole-of-catchment basis, including the effects on receiving environments.*
Policy 5	*Freshwater is managed through a National Objectives Framework to ensure that the health and well-being of degraded water bodies and freshwater ecosystems is improved, and the health and well-being of all other water bodies and freshwater ecosystems is maintained and (if communities choose) improved.*
Policy 7	*The loss of river extent and values is avoided to the extent practicable.*
Policy 11	*Freshwater is allocated and used efficiently, all existing over-allocation is phased out, and future over-allocation is avoided.*
Policy 12	*The national target (as set out in Appendix 3) for water quality improvement is achieved.*
Policy 13	*The condition of water bodies and freshwater ecosystems is systematically monitored over time, and action is taken where freshwater is degraded, and to reverse deteriorating trends.*
Policy 14	*Information (including monitoring data) about the state of water bodies and freshwater ecosystems, and the challenges to their health and well-being, is regularly reported on and published.*

The following specific requirements of the NSPFM are relevant to the management of freshwater and must also be implemented by Regional Councils.

3.24 Rivers[12]

1. *Every regional council must include the following policy (or words to the same effect) in its regional plan(s):*
    "The loss of river extent and values is avoided, unless the council is satisfied:
        (a) that there is a functional need for the activity in that location; and
        (b) the effects of the activity are managed by applying the effects management hierarchy."
2. *Subclause (3) applies to an application for a consent for an activity:*
    a. *that falls within the exception to the policy described in subclause (1); and*

[12] A river is defined in the Resource Management Act 1991 as a continually or intermittently flowing body of fresh water; and includes a stream and modified watercourse; but does not include any artificial watercourse (including an irrigation canal, water supply race, canal for the supply of water for electricity power generation, and farm drainage canal).

b. would result (directly or indirectly) in the loss of extent or values of a river.

3. Every regional council must make or change its regional plan(s) to ensure that an application referred to in subclause (2) is not granted unless:

a. the council is satisfied that the applicant has demonstrated how each step in the effects management hierarchy will be applied to any loss of extent or values of the river (including cumulative effects and loss of potential value), particularly (without limitation) in relation to the values of: ecosystem health, indigenous biodiversity, hydrological functioning, Māori freshwater values, and amenity; and

b. any consent granted is subject to conditions that apply the effects management hierarchy.

4. Every regional council must:

a. develop and undertake a monitoring plan that:

i. monitors the condition of its rivers; and

ii. contains sufficient information to enable the council to assess whether its policies, rules, and methods are ensuring no loss of extent or values of the rivers; and

b. have methods to respond if loss of extent or values is detected.

Canterbury Land and Water Regional Plan

The Canterbury Land and Water Regional Plan (CLWRP) contains a number of objectives and policies that are relevant to protecting the values of the Fairlie drinking water supply.

Objective 3.2	Water management applies the ethic of ki uta ki tai – from the mountains to the sea – and land and water are managed as integrated natural resources recognising the connectivity between surface water and groundwater, and between fresh water, land and the coast.
Objective 3.6	Water is recognised as essential to all life and is respected for its intrinsic values.
Objective 3.7	Fresh water is managed prudently as a shared resource with many in-stream and out-of-stream values.
Objective 3.8	The quality and quantity of water in fresh water bodies and their catchments is managed to safeguard the life-supporting capacity of ecosystems and ecosystem processes, including ensuring sufficient flow and quality of water to support the habitat and feeding, breeding, migratory and other behavioural requirements of indigenous species, nesting birds and, where appropriate, trout and salmon.
Objective 3.12	When setting and managing within limits, regard is had to community outcomes for water quality and quantity.
Objective 3.13	Groundwater resources remain a sustainable source of high quality water which is available for abstraction while supporting base flows or levels in surface water bodies, springs and wetlands and avoiding salt-water intrusion.
Objective 3.16	Freshwater bodies and their catchments are maintained in a healthy state, including through hydrological and geomorphic processes such as flushing and opening hāpua and river mouths, flushing algal and weed growth, and transporting sediment.
Objective 3.23	Soils are healthy and productive, and human-induced erosion and contamination are minimised.
Objectives 3.24	All activities operate at good environmental practice or better to optimise efficient resource use and protect the region's fresh water resources from quality and quantity degradation.
Policy 4.1	Lakes, rivers, wetlands and aquifers will meet the fresh water outcomes set in Sections 6 to 15 within the specified timeframes. If outcomes have not been

	established for a catchment, then each type of lake, river or aquifer should meet the outcomes set out in Table 1 by 2030.
Policy 4.2	The management of lakes, rivers, wetlands and aquifers will take account of the fresh water outcomes, water quantity limits and the individual and cumulative effects of land uses, discharges and abstractions will meet the water quality limits set in Sections 6 to 15 or Schedule 8 and the individual and cumulative effects of abstractions will meet the water quantity limits in Sections 6 to 15.
Policy 4.4	Groundwater is managed so that: (a) groundwater abstractions do not cause a continuing long-term decline in mean annual groundwater levels or artesian pressures; (b) the individual and cumulative rate, duration and volume of water pumped from bores is controlled so as to prevent seawater contamination; (c) the rate and duration of individual abstractions is controlled to ensure that individually or cumulatively, localised pressure reversal does not result in the downward movement of contaminants; (d) in any location where an overall upwards pressure gradient exists, restrict the taking of groundwater so that at all times the overall upward pressure difference is maintained between any one aquifer and the next overlying aquifer; (e) overall water quality in aquifers does not decline; and (f) the exercise of customary uses and values is supported.
Policy 4.5	Water is managed through the setting of limits to safeguard the life-supporting capacity of ecosystems, support customary uses, and provide for community drinking-water supplies and stock water, as a first priority and to meet the needs of people and communities for water for irrigation, hydro-electricity generation and other economic activities and to maintain river flows and lake levels needed for recreational activities, as a second priority.
Policy 4.7	Resource consents for new or existing activities will not be granted if the granting would cause a water quality or quantity limit set in Sections 6 to 15 to be breached or further over allocation (water quality and/or water quantity) to occur or in the absence of any water quality standards in Sections 6 to 15, the limits set in Schedule 8 to be breached. Replacement consents, or new consents for existing activities may be granted to: (a) allow the continuation of existing activities at the same or lesser rate or scale, provided the consent contains conditions that contribute to the phasing out of the over allocation (water quality and/or water quantity) within a specified timeframe; or (b) exceed the allocation limit (water quality and/or water quantity) to a minor extent and in the short-term if that exceedance is part of a proposal to phase out the overallocation within a specified timeframe included in Sections 6 to 15 of this Plan.
Policies 4.12-22, 24-69 & 75-98	Seeks to protect the environment by managing how the following activities are undertaken: - Discharge of contaminants to land or water - Stormwater and community wastewater systems - Earthworks, land excavation and deposition of material into land over aquifers

- Soil stability
- Hazardous substances and hazardous activities
- Livestock exclusion from waterways
- Discharges of collected animal effluent
- Nutrient management
- Damming and diversion of water bodies
- Abstraction and efficient use of water
- Flow sensitive catchments
- Site dewatering
- Hydrocarbon exploration or production, including 'fracking'
- Fine sediment removal and habitat restoration
- Gravel extraction

Policy 4.23	Any water source used for drinking-water supply is protected from any discharge of contaminants that may have any actual or potential adverse effect on the quality of the drinking-water supply including its taste, clarity and smell and community drinking water supplies are protected so that they align with the CWMS drinking-water targets and meet the drinking-water standards for New Zealand.
Policy 4.23A	The quality of water abstracted from community drinking-water supply sources is protected through: (a) the application of a provisional protection zone around the source of any existing community drinking-water supply, unless a specific protection zone is included as a condition in the permit to take or use water; and (b) requiring applications for new or replacement permits to take or use water for community drinking-water supply to include an assessment of the specific protection zone required, taking into account the factors set out in Schedule 1; and (c) providing, by way of resource consent, for the replacement of provisional protection zones with specific protection zones which reflect the level of protection required for that supply.
Policy 4.23B	In considering resource consent applications to take or use water for a community drinking water supply, the consent authority shall have regard to: (a) the factors set out in Schedule 1; and (b) the extent to which the application reflects those factors set out in Schedule 1 when establishing the extent of the proposed protection zone; and (c) the level of additional restriction the proposed protection zone will impose on land users within the proposed protection zone.
Policy 14.4.5	Seeks to protect cultural values by requiring an assessment on springs for water take activities,
Policies 14.4.7-9	Seeks to protect groundwater levels through an allocation system.

Policy 14.4.10	Seeks to provide for community water supplies through not needing to comply with allocation limits, minimum flows, residual flow or partial restrictions.
Policy 14.4.15-16	Seeks to protect waterbodies and cultural values through excluding livestock from waterbodies., including springs and wetlands.
Policy 14.4.17-20B	Seeks to protect water quality through nutrient management.
Policies 14.4.34-40	Seeks to protect water quantity through managing surface water flows.

Ōpihi River Regional Plan

The Ōpihi River Regional Plan (ORRP) contains a number of objectives and policies that are relevant to protecting the values of the Fairlie drinking water supply.

Objective 1 – SW Quantity	Achieve sufficient quantities of water in the Ōpihi River and lagoon, its tributaries and hydraulically connected groundwater to enable present and future generations to gain cultural, social, recreational, economic and other benefits from those water resources; while: a) Safeguarding their existing value for efficiently providing sources of drinking water for people and for the reasonable needs of an individual's animals; b) Safeguarding the life supporting capacity of the water, including its associated: aquatic ecosystems, significant habitats of indigenous fauna, and areas of significant indigenous vegetation; c) Safeguarding their existing value for providing mahika kai for Takata Whenua; d) Protecting wahi tapu and other wahi taonga of value to Takata Whenua; e) Preserving the natural character of lakes, and rivers, and their margins and protecting them from inappropriate use and development; f) Protecting habitat of trout and salmon; and g) Maintaining, and where appropriate enhancing, amenity values.
Policy 1 - SW Quantity	Seeks to manage water takes while: - safeguarding sources of drinking water, life supporting capacity of the water including aquatic ecosystems, significant habitats and areas of indigenous fauna and vegetation, and existing value for providing mahika kai - protecting cultural values, and habitats of trout and salmon - preserving natural character - maintaining, and where appropriate, enhancing, amenity values
Policies 3-4 – SW Quantity	Seeks to provide for community water supply schemes through providing lessor restrictions.
Objective 2 – SW Quantity	Provide for the augmentation of the flows in the Ōpihi River Catchment to protect and enhance its overall ecological functioning and other instream values and to enable the efficient and equitable use of the water by those who augment the river flows.
Policy 7 – SW Quantity	Those who augment the Ōpihi River flows will be enabled to abstract water, from the river and hydraulically connected groundwater, provided that, along with other relevant consent conditions, instream flow requirements in the vicinity and

	downstream of the take are met and that stored or diverted water is released as necessary to meet minimum flow requirements for the augmentation scheme.
Policy 8 – SW Quantity	Those who abstract from the Ōpihi River and its tributaries and from hydraulically connected groundwater and who are not augmenting the river flows will only be able to abstract on the basis of the unmodified flow in the Ōpihi River as estimated by Environment Canterbury, rather than on the basis of the actual flow.
Objective 1 – SW Quality	Enable present and future generations to gain cultural, social, recreational, economic and other benefits from the water quality of the Ōpihi River, its lagoon and its tributaries through the enhancement of water quality and the elimination of discharges of human sewage while: (a) Safeguarding their existing value for efficiently providing sources of drinking water for people; (b) Safeguarding: the life supporting capacity of the water, including its associated: aquatic ecosystems, significant habitats of indigenous fauna, and areas of significant indigenous vegetation; (c) Safeguarding their existing value for providing mahika kai for Takata Whenua; (d) Protecting wahi tapu and other wahi taonga of value to Takata Whenua; (e) Preserving the natural character of lakes, and rivers, and their margins and protecting them from inappropriate use and development; (f) Protecting the habitat of trout and salmon; and (g) Maintaining, and where appropriate, enhancing amenity values.
Policy 1 – SW Quality	(a) No new discharges of treated or untreated human sewage should be made: (i) into the Ōpihi River or its tributaries; or (ii) onto or into land in circumstances which may result in that sewage entering the Ōpihi River or its tributaries. (b) Existing discharges of treated or untreated human sewage into the Ōpihi River or its tributaries, or onto or into land in circumstances which may result in that sewage entering the Ōpihi River or its tributaries should cease by 31 December 2003. (c) Contaminants emanating from natural processes as a result of the discharge of treated or untreated human sewage onto or into land, should only enter the Ōpihi River or its tributaries, after passing through soil. (d) Set and maintain water quality standards for the Ōpihi River and its tributaries that improve their value for cultural purposes, and provide water quality suitable for aquatic ecosystem purposes, for water contact recreation and as sources of water for public water supply systems.
Policy 2 – SW Quality	Promote land use practices and investigate controls on land use which improve the water quality of the Ōpihi River and its tributaries to improve cultural values and provide water quality suitable for aquatic ecosystems purposes, for water contact recreation and as sources of water for public water supply systems.

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