Project Number: 3-C2381.00

Burkes Pass Drinking Water Safety Plan

4 November 2022

PUBLIC

Mackenzie District Council

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150 YEARS IN AOTEAROA

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Disclaimers and Limitations

This report ('**Report**') has been prepared by WSP exclusively for Mackenzie District Council ('**Client**') in relation to the Burkes Pass Drinking Water Safety Plan ('**Purpose**') and in accordance with the Short form Agreement with the Client dated 18/10/2021. The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

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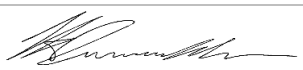
1 Revision Details

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.
V3.0	Draft prepared by WSP NZ Ltd, August 2022
V4	Final copy submitted to MDC, October 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)		14/10/2022
	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 Burkes Pass 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 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 Burkes Pass 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 Burkes Pass water supply provides water to the small community of Burkes Pass located approximately 14 kilometres directly west of Fairlie. The supply is classified as a small drinking-water supply under the draft Drinking Water Quality Assurance Rules (Taumata Arowai, October 2021) and provides water to approximately 30 houses.

Water is sourced from an infiltration gallery on Paddys Market Stream, and treated by filtration, UV disinfection and chlorination before being distributed to consumers.

The maintenance and operation of the supply is undertaken by Whitestone Contracting Ltd under contract to Mackenzie District Council. Both are based in Fairlie. The key persons responsible for management, maintenance and operation of the Tekapo 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 (Graduate 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 16 November 2021. A risk workshop was held on 17 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 Burkes Pass Water Supply

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

Table 3-1 Documents related to the Burkes Pass water supply

Name	Description	Location
Burkes Pass Water Treatment Plant Operational Manual	Describes Burkes Pass water supply operation and maintenance	A hardcopy is stored at Burkes Pass water treatment plant and at Council offices.
Burkes Pass Water Supply Standard Operating Procedures	Describes how the Burkes Pass 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 to ensure that enough of each is available and is used for its intended purpose.	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 Mackenzie District. Capital and operating expenditure forecasts are included.	https://www.mackenzie.govt.nz/__data/assets/pdf_file/0008/596123/Infrastructure_Strategy_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 Burkes Pass 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	Resource Management Officer – Monitoring and Compliance	www.ecan.govt.nz;

Stakeholder	Description/Relationship to supply management and operation	Contact Position	Contact Details
	provisions in relation to water abstraction and allocation.		0800 324 636
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 Twizel 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.	Treena Davidson, Senior Policy Advisor	https://arowhenua.org/
Cone Peaks Farm Ltd	Registered water carrier available if required – not under contract to MDC	Raymond Wallace Harrington	027 435 9632

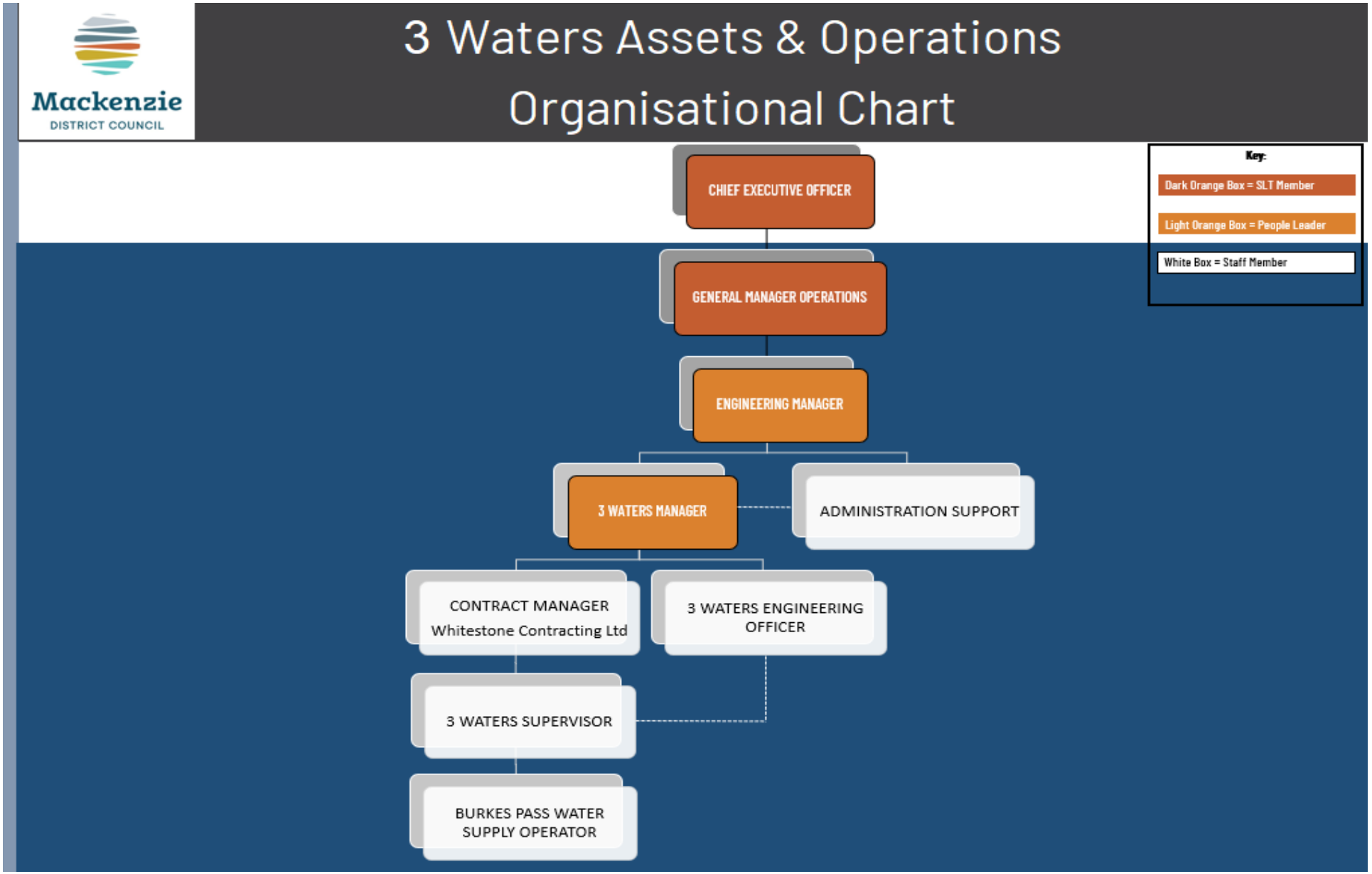


Figure 3-1 Mackenzie District Council organisational chart

3.2.2 Maintenance Contractor

Whitestone Contracting Ltd is the operations and maintenance contractor for the Burkes Pass 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.

4 Description of the Burkes Pass Drinking Water Supply

4.1 Overview

The Burkes Pass water supply was originally installed in 1940 and was upgraded in March 2021. It supplies approximately 30 people. It is classified as a small supply under the Drinking Water Quality Assurance Rules[3]. The population varies as most houses are holiday homes.

Water is abstracted from an infiltration gallery located within the bed of Paddys Market Stream and supplied to the community under gravity. Water quality is generally good but water in the stream can become turbid after rainfall. The turbidity is reduced to some degree by extraction though the infiltration gallery.

Chemical analysis of the source water has not identified any determinands that exceed the Drinking Water Standards for New Zealand 2005 (revised 2008) (DWSNZ) maximum acceptable values. Microbiological analysis of the source water is not routinely undertaken, but given that the stream is unfenced and runs through farmland, faecal contamination is assumed to be present.

Abstracted water passes through a 5 micron cartridge filter. A three way valve will be installed to send to wastewater from the initial start-up, eliminating the turbidity spike. The water is UV disinfected and chlorinated by sodium hypochlorite. The treatment plant is powered by solar panels and a backup petrol generator.

Originally the Burkes Pass supply was set up as a restricted supply, with connected properties required to have on-site storage tanks. It is now an on demand supply. Due to small bore pipes, it is intended to restore the system to restricted supply so that everyone gets water in peak demand periods.

There is continuous monitoring of turbidity, pH, FAC and flow at the treatment plant. Samples are collected and analysed for *E. coli* weekly from the treatment plant and monthly from the distribution zone. Free available chlorine (FAC) is tested weekly at the treatment plant. Turbidity is also tested weekly at the treatment plant.

The maintenance and operation of the supply is undertaken by Whitestone Contracting Ltd under contract to MDC. Operators visit the treatment plants at least weekly to check the operation of the chlorination and UV systems and test the FAC.

Based on the risks of microbial contamination identified in the catchment, a treatment process which provides 4-log protozoal removal is required (see section 6).

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

[3] Drinking Water Quality Assurance Rules (Taumata Arowai, 2022)
https://www.taumataarowai.govt.nz/assets/Uploads/Rules-and-standards/Drinking-Water-Quality-Assurance-Rules-2022-Released-25-July-2022.pdf

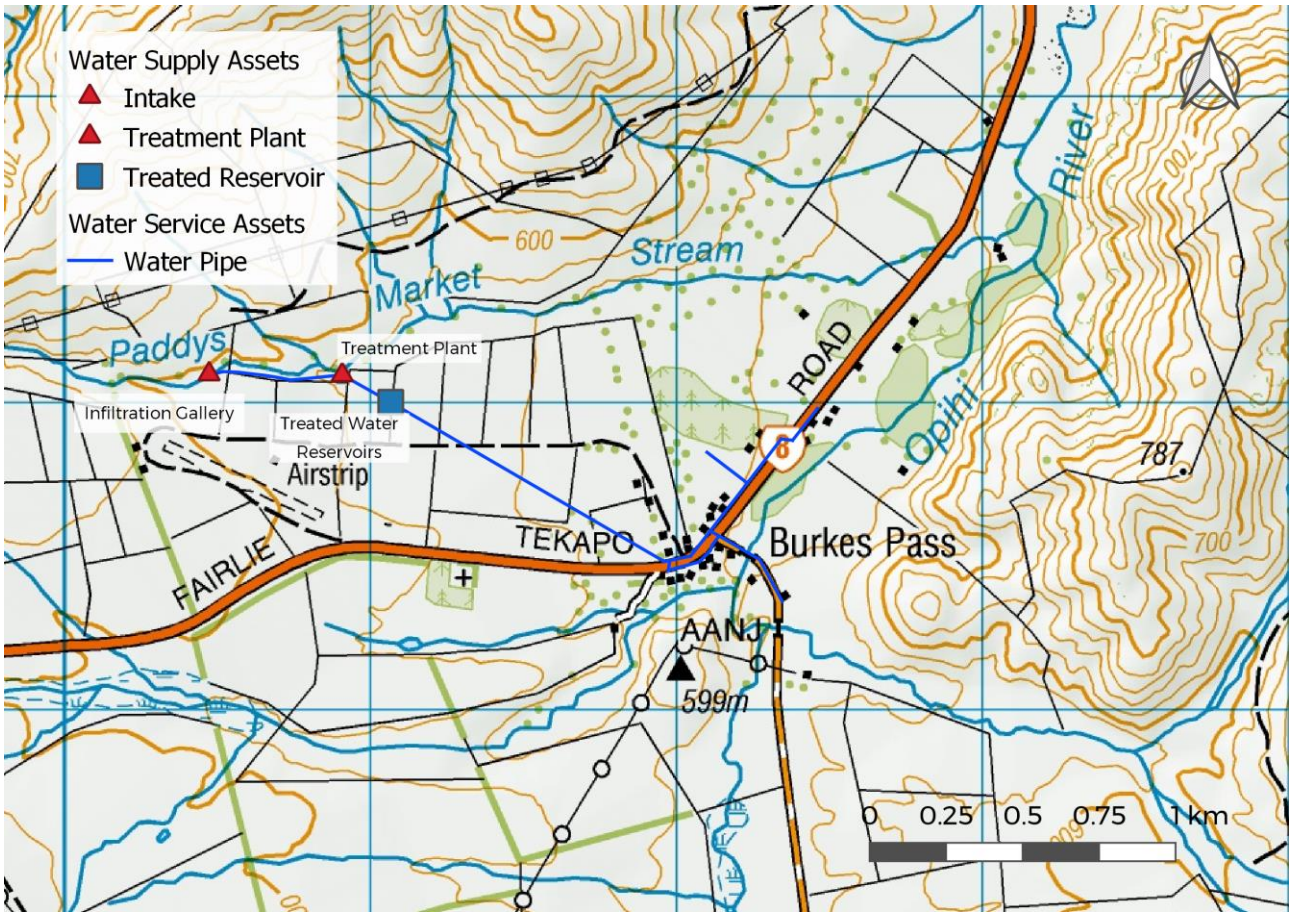


Figure 4-1 Burkes Pass water supply scheme

Table 4-1 Burkes Pass water supply scheme

Supply Details		
Supply Name	Burkes Pass	
Hinekōrako Code	BUR002	
Supply Owner	Mackenzie District Council	
3 Waters Manager	Geoff Horler	
Water Supply Operator	John Wilson (Whitestone Contractors Ltd)	
Population Served by Supply	30	
Source Details		
Source Name	Burkes Pass Creek (Paddys Market Stream)	
Hinekōrako Source Code	S00245	
Type of Source	Surface water	
Consent Number	CRC9715941	
Consent Expires	29 October 2032	
Maximum Consented water take:	Maximum rate of 6 L/s	
Grid Reference of Source (NZTM)	Easting: 1410471	Northing: 5116093
Treatment		
Plant Name	Burkes Pass	
Plant Code	TP00370	
Location	1.5 km northwest of Burkes Pass township	

Treatment Processes	Filtration, Chlorination, UV disinfection
Average Daily Volume	29 m^3/day
Peak Daily Volume	83 m^3/day
Distribution	
Distribution Zone Name	Burkes Pass
Distribution Zone Code	BRU002BU
Distribution Zone Population	30

System Flow Diagrams

Figure 4-2 and Figure 4-3 show the water supply system, from source to reticulation, including the treatment.

Figure 4-2 shows the barriers to contamination, critical points and critical control points which are discussed further in Section 8.1

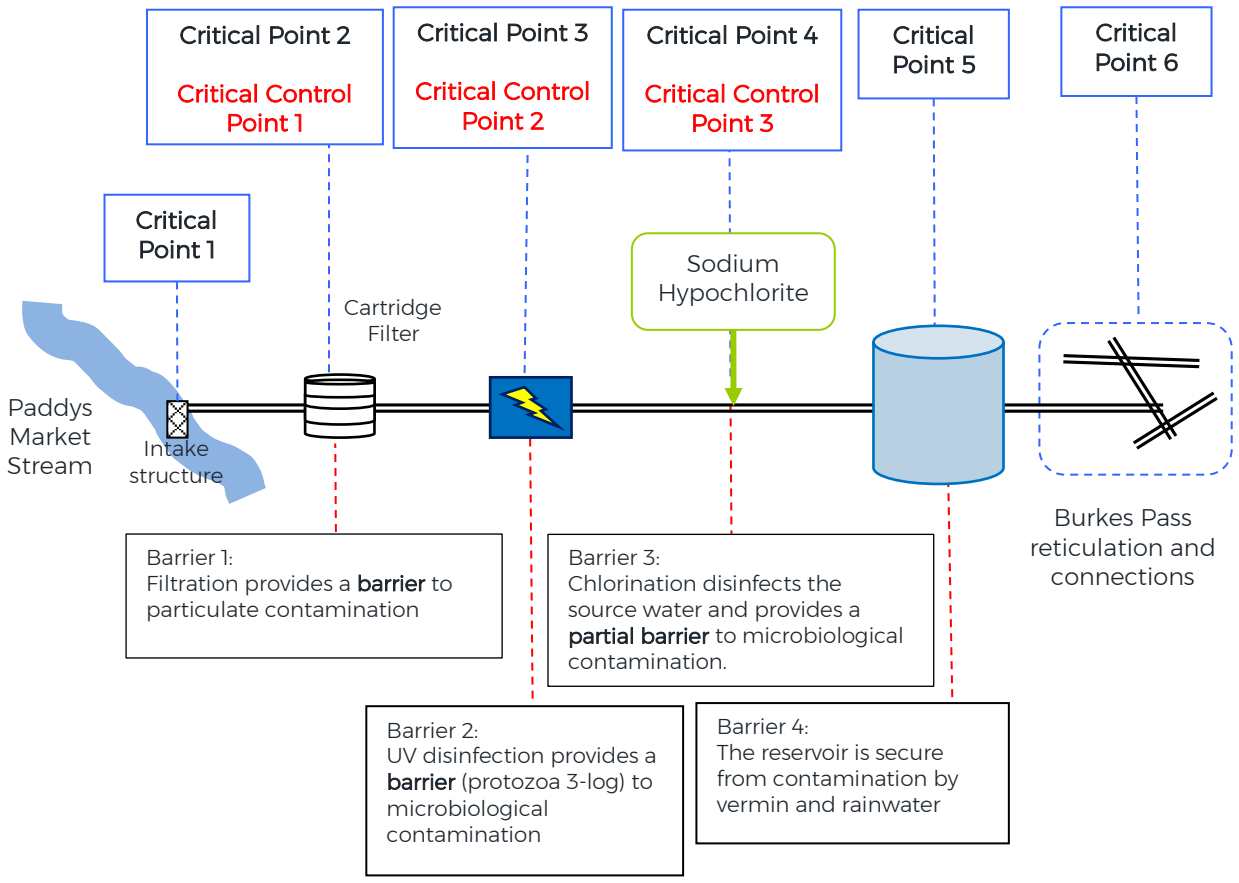


Figure 4-2 Burkes Pass water supply schematic showing barriers, control points and critical control point

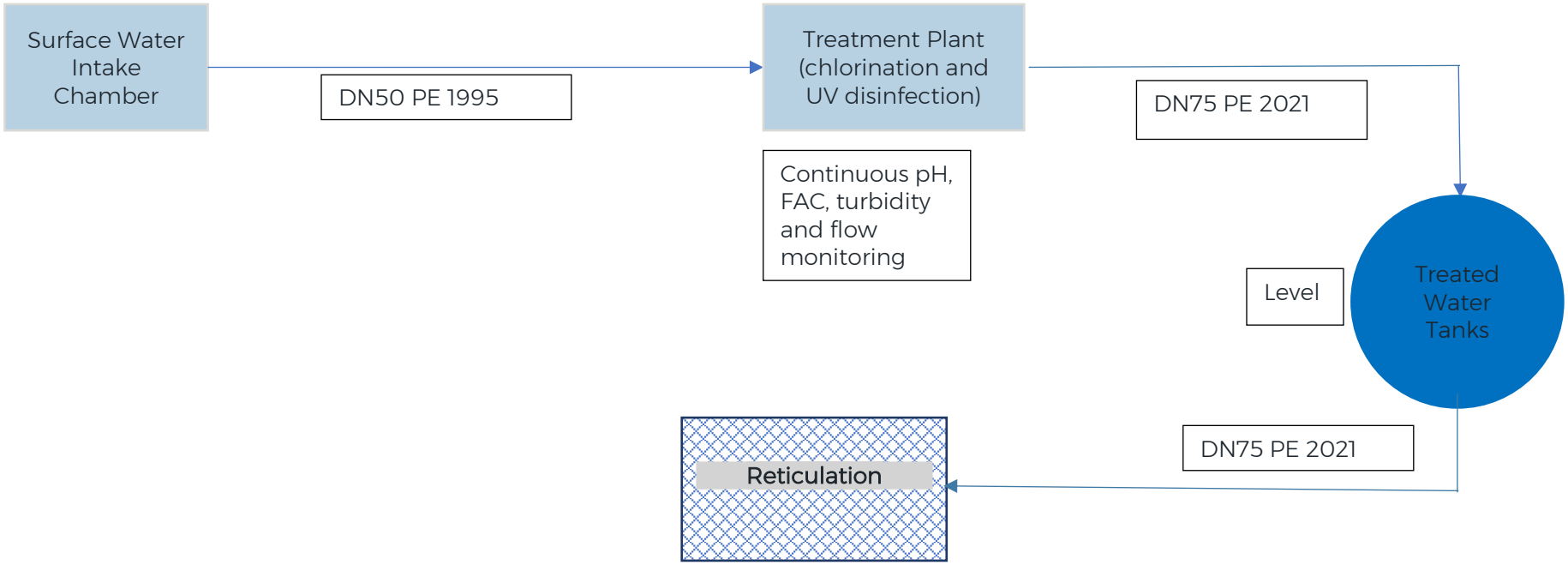


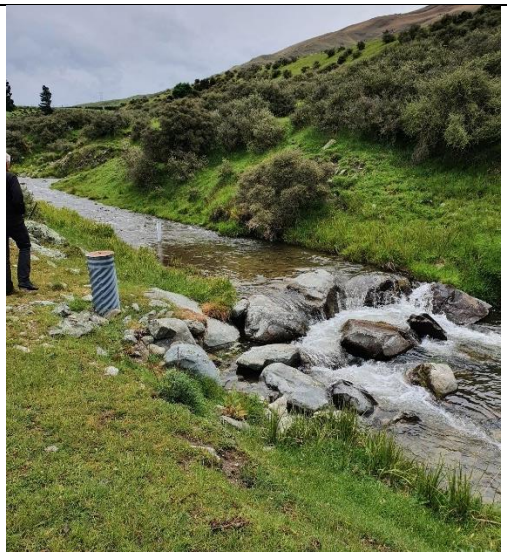
Figure 4-3 Burkes Pass water supply schematic including flow and water quality monitoring

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. There are no significant economic developments planned in the Burkes Pass area in the near future.

4.2 Water Source and Water Quality

4.2.1 Intake Details

The water intake is through a wedge wire in the bed of Paddys Market Stream, with rocks placed just downstream to maintain the water level. There is a visual level gauge, which is monitored every week. There is a valve that can be shut off to enable maintenance. Figure 4-4 shows an overview of the upstream catchment and the intake structure.



Intake Structure

Paddys Market Stream directly upstream of intake

Figure 4-4 Burkes Pass water supply intake photos and view to upstream catchment

4.2.2 Raw Water Quality

The raw water quality is generally good, but water in the stream can become turbid after rainfall. In addition to continuous turbidity monitoring at the treatment plant, raw water quality is analysed annually for the Burkes Pass drinking water supply.

Table 4-2 summarises the raw water quality results. Interpretation of the raw water data 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.
- Iron was above the guideline value once, but has been less than half the guideline value on all other occasions.
- Microbiological analysis of the source water is not routinely undertaken, but it is expected that 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)	12/12/2016	13/12/2018	9/09/2020	10/09/2021
Total Alkalinity	g/m^3 as $CaCO_3$	100 - 300		24	17.7	22	19.5
pH	-	7.0-8.5		7.6	7.4	7.8	7.7
Free Carbon Dioxide	g/m^3 at 25˚C			1.1	1.5	< 1.0	< 1.0
Total Hardness	g/m^3 as $CaCO_3$	< 200		15.4	11.5	16.3	14.6
Electrical Conductivity	µS/cm			45	32	46	41
Total Dissolved Salts	g/m^3			30	21	31	27
Total Arsenic	g/m^3		0.01			< 0.0011	< 0.0011
Total Boron	g/m^3		1.4	< 0.0053	< 0.0053	< 0.0053	0.0058
Total Calcium	g/m^3			3.9	2.8	4.3	3.7
Total Copper	g/m^3	< 1	2	< 0.00053	0.00058	< 0.00053	0.00082
Total Iron	g/m^3	< 0.2		0.048	0.121	0.024	0.42
Total Lead			0.01			< 0.00011	0.00053
Total Magnesium	g/m^3			1.36	1.09	1.34	1.32
Total Manganese	g/m^3	< 0.04 Stain < 0.10 Taste	0.4	0.0034	0.0057	0.00123	0.021
Total Potassium	g/m^3			0.4	0.52	0.39	0.71
Total Sodium	g/m^3	< 200		3.3	2.8	3.9	3.2
Total Zinc	g/m^3	< 1.5		< 0.0011	< 0.0011	< 0.0011	0.0015
Chloride	g/m^3	< 250		0.7	0.5	1.1	1.1
Nitrate-N	g/m^3		11.3	< 0.05	< 0.05	< 0.05	< 0.05
Sulphate	g/m^3	< 250		< 0.5	< 0.5	< 0.5	< 0.5
			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 Filtration, Chlorination and UV disinfection

Abstracted water is gravity fed to the treatment plant located 200 m downstream of the infiltration gallery. The plant consists of a cartridge filter, UV disinfection unit and chlorination via sodium hypochlorite (Figure 4-5).

There is continuous monitoring at the treatment plant of FAC, turbidity, flow and pH.

The 5-micron cartridge filter provides 2-log protozoa treatment credits.

The UV unit is VIQUA UV Pro 50 (660003-R), validated to NSF-ANSI-55 Class A standard. This provides UV treatment at 40 mJ/cm^2 at flow rate of 272.2 m^3/day. The UV unit provides disinfection and 3-log protozoa treatment credits.

Chlorine levels are checked weekly and topped up as required by Whitestone operators. The chlorine dose is flow proportional and the turbidity, treated water pH, treated water FAC and flow rate is reported back to the operator and the Council office through the SCADA system. The treated water is then supplied to the distribution system by gravity. Free available chlorine (FAC) is tested weekly at the treatment plant.

The treatment plant is solar powered, with a backup petrol generator to continue plant operation in the event of a power outage and a heater installed to prevent water lines freezing during winter. The plant operates continuously to avoid turbidity spikes on start-up.

Treatment shed with solar panels

Chlorine dosing

Chlorine, pH, UV, and turbidity monitoring equipment

UV Unit

Figure 4-5 Burkes Pass water supply treatment plant and monitoring equipment

4.3.2 Treated Water Storage

Treated water is stored in two new PE tanks (25 m^3 each) with an old concrete tank that is no longer in service but can be replaced by a new plastic tank if demand exceeds storage. The tanks provide approximately a days' worth of treated water storage.

Figure 4-6 Burkes Pass Treated Water Storage Tanks

4.4 Plant Control Measures and SCADA

There is continuous monitoring of treated water pH, turbidity, FAC, and flow at the treatment plant.

The treatment plant also has alarms for low battery and plant faults, FAC and turbidity levels.

4.5 Treated Water Quality Characteristics

4.5.1 Treated Water Quality

The water quality monitoring results at the treatment plant for Burkes Pass from the last five years is summarised in Table 4-3.

Interpretation of the treated water analysis include:

- *E. coli* has exceeded the DWSNZ MAV three times in the past five years (256 samples), so is not consistently removed by the treatment process. Since the water treatment plant upgrade was completed in March 2021, there have been no *E. Coli* detected at the treatment plant (47 samples) and one instance of total coliforms detected.
- pH is consistently lower than GV.

Table 4-3 Treated water quality data (treatment plant)

Parameter	DWSNZ GV	DWSNZ MAV	Minimum	Average	Maximum
Total Coliforms (MPN/100mL)			< 1	1.5	2
E. coli (MPN/100mL)		<1	< 1	< 1	5
Turbidity (NTU)	2.5		0.05	0.51	2.35
FAC (mg/L)		5	0.06	0.79	2.48
pH	7.0 – 8.5		6.77	6.80	6.84

The water quality monitoring data in the Burkes Pass distribution system over the last five years is summarised in Table 4-4.

Table 4-4 Treated water quality data (distribution system)

Parameter	DWSNZ MAV	Minimum	Average	Maximum
Total Coliforms (MPN/100mL)		< 1	< 1	>200
E. coli (MPN/100mL)	<1	< 1	< 1	18
FAC (mg/L)	5	0.04	0.59	2.48

Interpretation of the water analysis in the distribution system include:

- *E. coli* is consistently below the DWSNZ MAV, with the exception of one event on 29/06/2020. Since the water treatment plant upgrade was completed in March 2021, there have been no *E. Coli* or total coliforms detected in the distribution system (14 samples).
- FAC is generally above 0.2 mg/L.

4.5.2 Water Quality Incidents and Responses

Investigations into transgressions over the past 5 years are shown in Table 4-5.

Table 4-5 Burkes Pass water supply transgression investigations

Sampling Date	Transgression	Cause	Resolution
6/07/2017	E. coli 1 MPN/100 mL	Heavy rain preceded sample and chlorine dosing had lost charge	3 consecutive clear Corrective Active samples taken on 11 – 13 July 2017
20/02/2018	E. coli 5 MPN/100 mL	Chlorine dosing pump failed	Contractor fixed
29/06/2020	E. Coli 18 MPN/100 mL	Chlorine dosing system not adequate to cope with heavy rain	MDC to install analyser, filter, UV and different dosing pump to be controlled with process control programming (complete).

4.6 Distribution System

4.6.1 Asset Characteristics

The Burkes Pass distribution system was established in 1940 as a restricted gravity supply, reflected in small bore DN20 PE pipes in the distribution system. The total length of reticulation is 3.3 km, of mostly galvanised iron with some alkathene, PE and PVC.

The trunk main from the treated water storage tanks to the village was replaced in 2021, and laid with 600 mm cover the entire way.

4.6.2 System Water Loss and Leakage

Known breaks and leaks are repaired as a priority and pipes in the network are replaced as leaks appear. Leakage is tracked to provide early detection and proactive replacement / maintenance of leaking pipes.

4.7 SCADA Control Measures and Alarms

The treatment plant is monitored online using SCADA. All data in SCADA is stored every 30 minutes at AD Riley (ABBEY system). The SCADA alarm set points for the plant are shown in Table 4-6.

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 4-6 SCADA alarm set points

Parameter	Low Alarm	High Alarm
FAC	0.5 mg/L leaving WTP	5.0 mg/L leaving WTP
Turbidity	n/a	2 NTU

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)[4] 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)[5] 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)

[4] Ministry of Health, 2018: New Zealand Drinking-water Safety Plan Framework: https://www.health.govt.nz/publication/new-zealand-drinking-water-safety-plan-framework
[5] 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 Burkes Pass 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 four risks that are considered unacceptable and these are listed in Table 5-7. Improvements to address these risks are outlined here and described in more detail in Section 8.1.

Table 5-7 Unacceptable risks

Supply Element	Event Description	Cause No.	Possible Causes
Source – Catchment	Increased sediment load in source water	1.05	Heavy rainfall, fire in catchment
Treatment - Chlorination	Production of disinfection by-products	2.06	Organic material in raw water results in the production of disinfection by-products
Treatment – UV disinfection	Inadequate disinfection	2.10	UV lamp failure
Reticulation	Chemical/Microbiological Contamination	4.08	Backflow from consumer connections

5.4.1 Risk 1.05 – Increased sediment load in source water due to heavy rainfall or potential fire in catchment

An increased sediment load in the source water due to heavy rainfall or a fire in the catchment has the potential to cause widespread aesthetic issues. The likelihood has been assessed as unlikely as the cartridge filter will reduce the turbidity. However, as the treated water turbidity is not measured continuously, the level of certainty is an estimate, making this medium risk unacceptable.

The improvement action to mitigate this risk is:

- Install continuous treated water turbidity monitoring.

5.4.2 Risk 2.06 – Production of disinfection by-products due to organic material in raw water

Disinfection by-products have the potential to cause a repeated breach of MAVs. This is considered possible as there is a filtration process prior to chlorination. Due to lack of testing of DBPs, the uncertainty of this medium risk classifies it as unacceptable.

The improvement action to mitigate this risk is:

- Monitor disinfection by-products.

5.4.3 Risk 2.10 – Inadequate disinfection due to failure of UV lamps

The likelihood of inadequate UV disinfection due to failure of UV lamps is considered unlikely with major consequence of a declared outbreak or widespread illness. Filtration and chlorination reduce the consequence if the UV lamps did fail. This medium risk is considered unacceptable due to the uncertainty of UV failure.

The improvement actions to mitigate this risk is:

- Add UV alarms to SCADA.

5.4.4 Risk 4.08 – Introduction of contamination due to no / inadequate / faulty / incorrectly installed backflow prevention device

Contaminants entering the drinking water supply due to backflow or back siphonage poses a contamination hazard to the distribution system. While the backflow survey found that there are no high or medium hazard activities on commercial properties in Burkes Pass, medium hazard activities on residential properties may be present. Continuous positive pressure in the gravity fed supply reduces the likelihood to possible and the lack of high hazard activities reduces the consequence to moderate, so the overall risk rating is medium. However, the lack of information about medium hazard activities on residential properties and whether appropriate backflow prevention devices are present mean that this is an estimate and so this is an unacceptable risk.

The improvement actions to reduce this risk are:

- Undertake a survey of commercial customers to determine backflow hazard (complete).
- Undertake assessment of backflow risk for residential connections
- Install backflow prevention devices on medium hazard connections. Alternatively, revert Burkes Pass scheme to a restricted supply with air gaps on tanks.
- Test all testable backflow prevention devices annually.
- Create and maintain a backflow register.

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 draft NES-DW proposes defining three source water risk management areas (SWRMAs) for river sources as defined below and depicted on Figure 6-1.

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

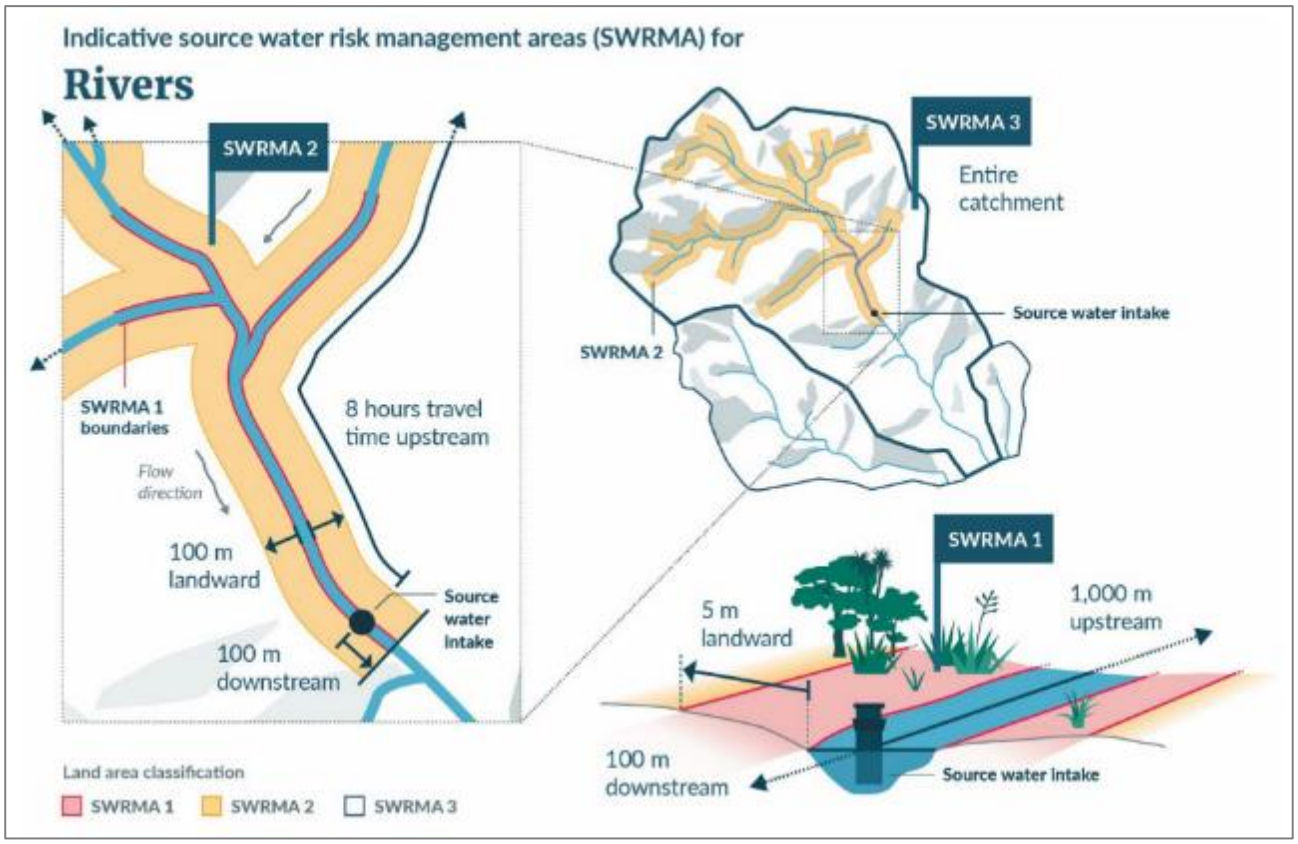


Figure 6-1 Draft NES Source Water Risk Management Areas for River Sources (Ministry for the Environment, 2021).

The three different SWRMA areas for the Burkes Pass intake are shown in Figure 6-2.

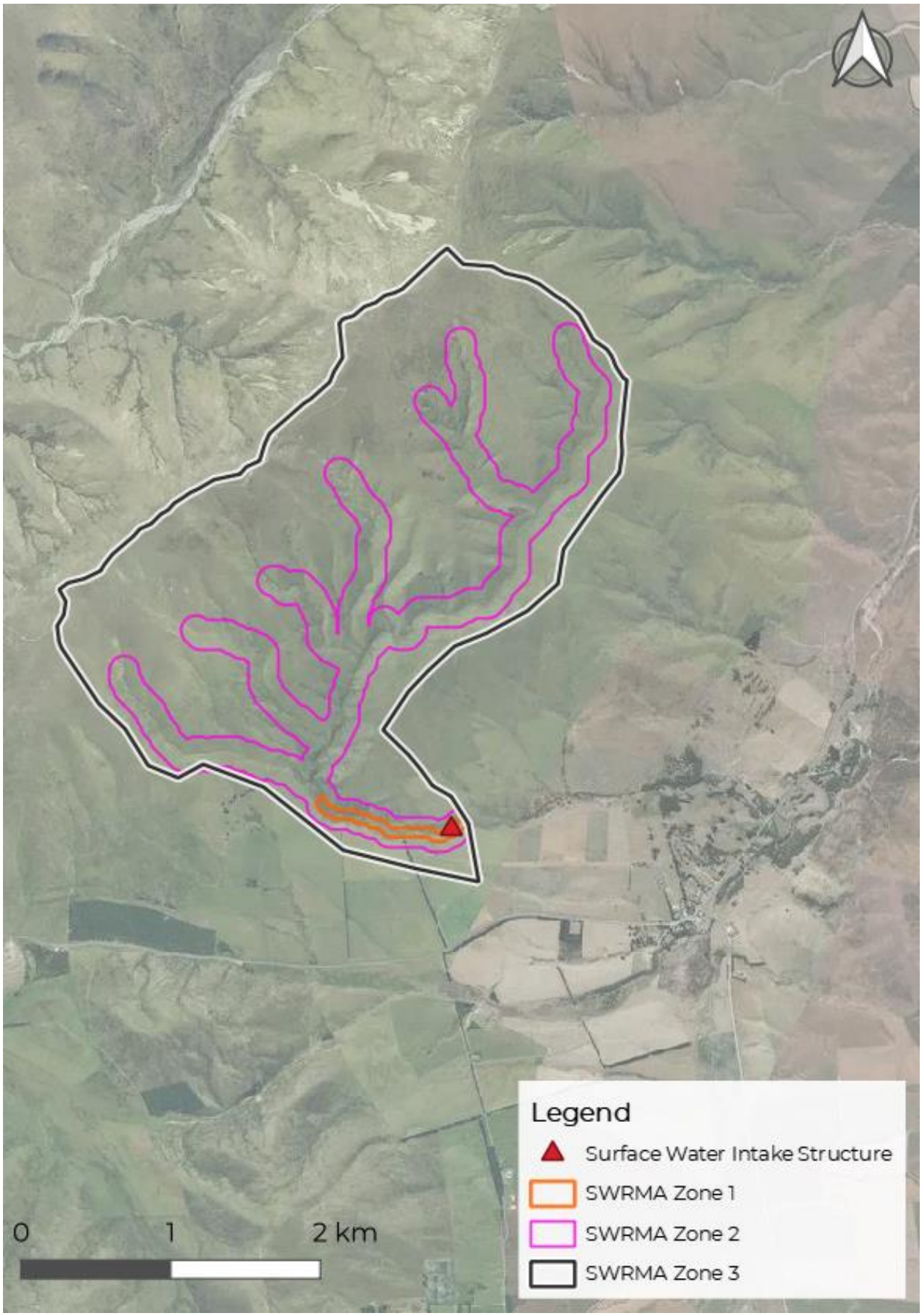


Figure 6-2 Source Water Risk Management Areas for the Burkes Pass Surface Water Source

6.2 Catchment Description

The catchment upstream of the surface water source and its land use is shown in Figure 6-3. The catchment area was estimated based on the surrounding topography and likely overland flow paths. The surface water take is located on private farmland in a paddock which has sheep in it. There are no fences around the intake or the stream to prevent animal access.

The upper part of the catchment is privately owned and is predominantly hilly high-country terrain, some of which is grazed. Sources of microbial risk are considered to be include farm animals (primarily sheep) and catchment wildlife (e.g. birds, wild deer and rabbits).

Within the catchment there is no human habitation and human activities are likely limited to farming and hunting. These would be expected to be a minor source of microbiological contamination in the catchment.

Nearby resource consents to discharge wastewater are shown in Figure 6-4, none of which occur within the catchment. All occur in Burkes Pass which is downstream of the intake structure and catchment. There is a single resource consent for another water take in the vicinity of the catchment. As seen in Figure 6-5 this is downstream of the water intake structure and therefore outside the catchment boundary. There are no buildings or septic tanks within the catchment.

ECan has provided information about hazardous activities in the catchment (Hazardous Activities and Industries List). From this, it was identified that within the catchment there are no contaminated sites. Contaminated sites within the vicinity of the catchment are shown in Figure 6-6 and are downstream of the intake structure. There is limited pest control allowed in the catchment, but not permitted within 1,000 m of the stream.

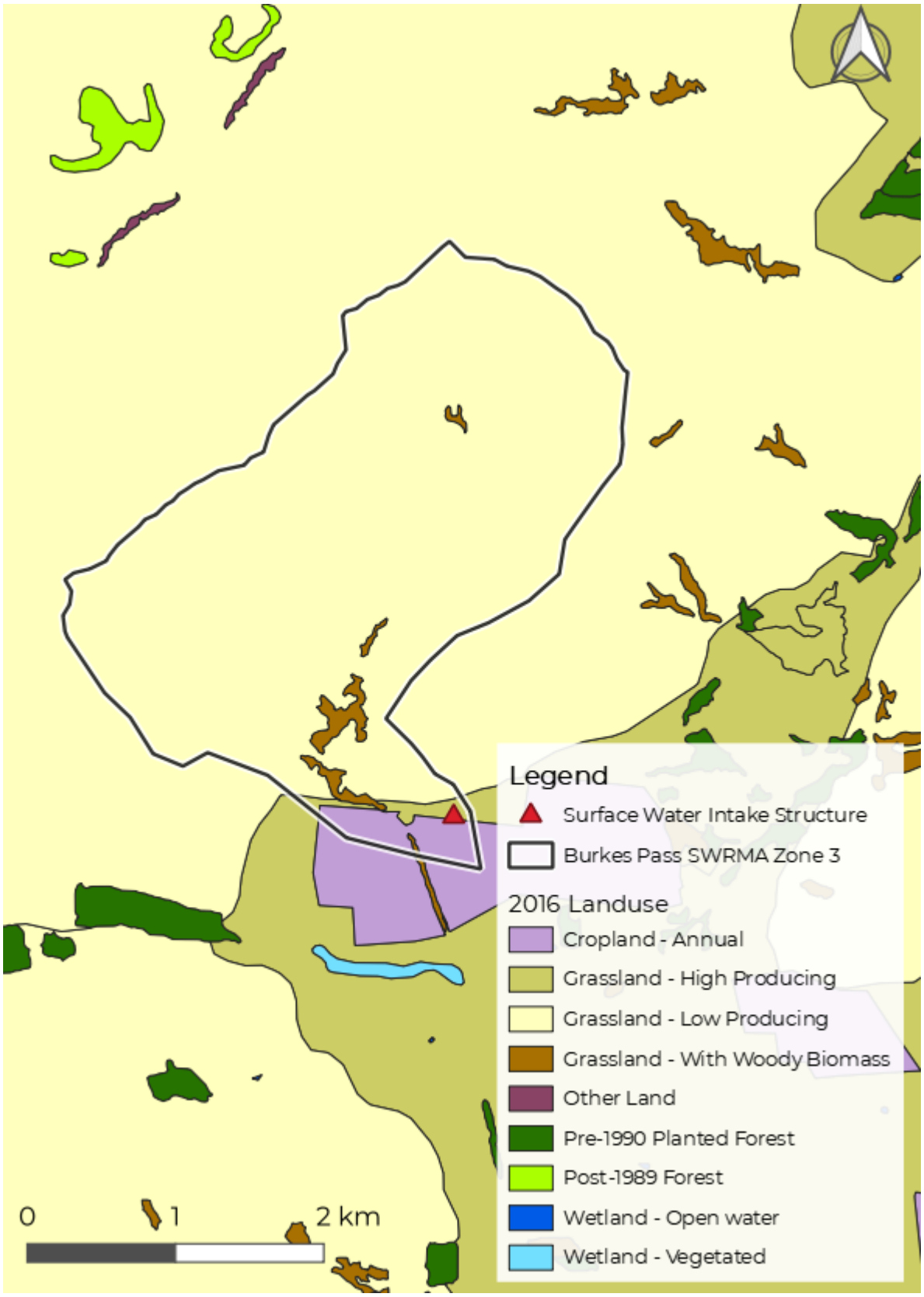


Figure 6-3 Burkes Pass surface water catchment land uses

Figure 6-4 Discharge consents in the vicinity of the Burkes Pass surface water catchment

Figure 6-5 Water take consents in the vicinity of the Burkes Pass surface water catchment

Figure 6-6 Contaminated sites within the vicinity of the catchment

6.3 Climatic Features

Climate related factors influencing catchment conditions and demand for water include rainfall and temperature. According to NIWA models (see Figure 6-7 and Figure 6-8) median annual total rainfall in the Burkes Pass catchment varies between 700 – 1000 mm/year and the median temperature ranges from 6 – 9 °C

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.

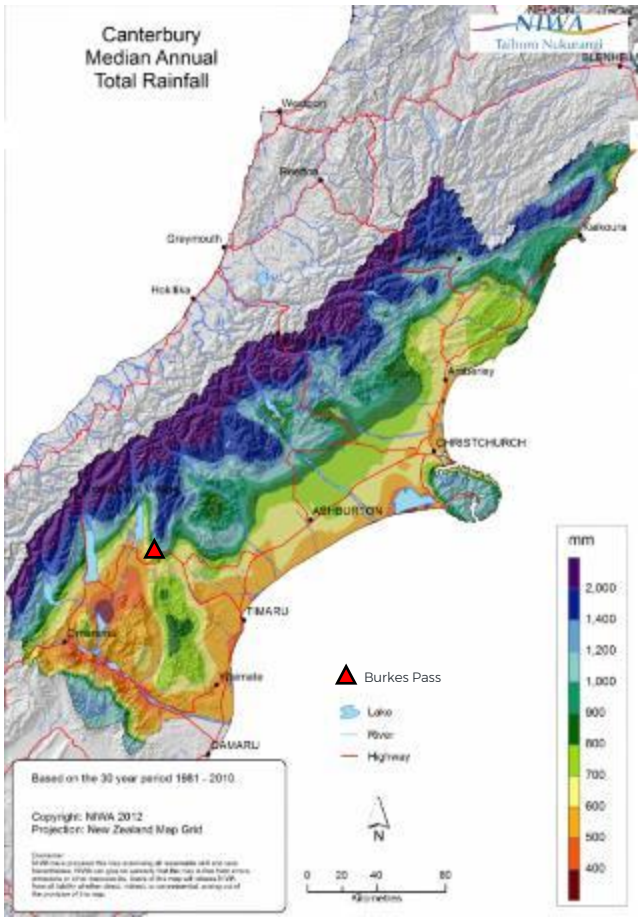


Figure 6-7 Canterbury region median annual total rainfall[6]

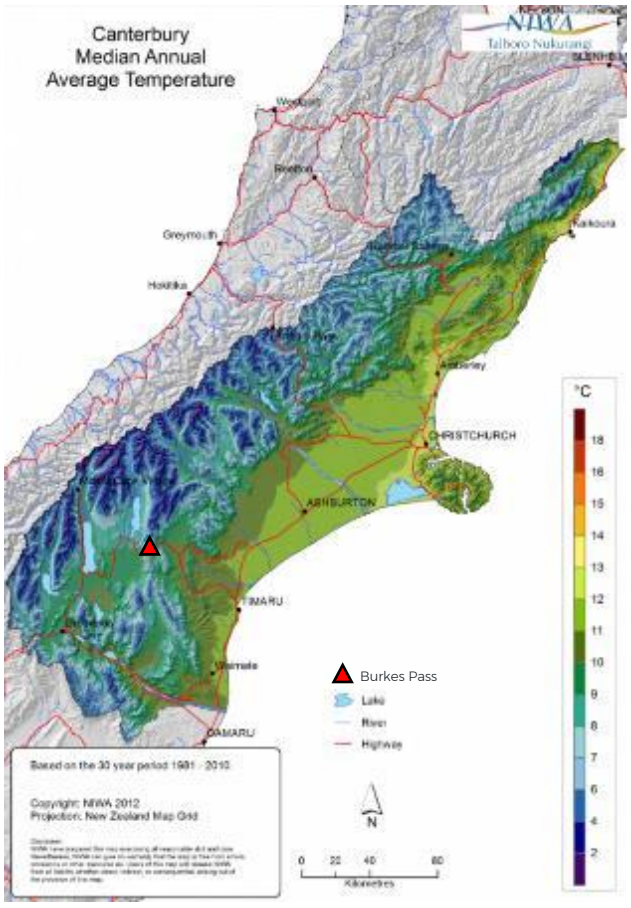


Figure 6-8 Canterbury region median annual temperature[7]

[6] Median annual rainfall for the period 1981 – 2010 from NIWA: https://niwa.co.nz/climate/national-and-regional-climate-maps/canterbury
[7] 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 6-1.

Table 6-1 Catchment impact

Land Use	Percentage	Comment
Low Producing Grassland	94%	Low producing grassland is likely to be lightly to moderately grazed and represents a low to moderate risk to the source water. This is due to the low to medium density of domestic and feral animals which will produce faecal contamination.
High Producing Grassland	1%	The high producing grassland surrounding the source water is moderately grazed (currently sheep) and represents a high risk to the source water. This is due to the medium density of domestic and feral animals which will produce a moderate level of faecal contamination in the catchment. The level of risk will increase during lambing season. There are no fences to prevent stock access to the stream. Stock within the catchment have access to the stream around and upstream of the intake. There is evidence of livestock both accessing and crossing the stream.
Grassland with Woody Biomass	2%	Grassland with woody biomass presents a low risk to the source water, with low levels of faecal contamination expected from catchment wildlife.
Cropland Annual	3%	Cropland presents a low to moderate risk to the source water due to nutrients from fertilizers or pesticides potentially leaching through the soil or into surface runoff that may enter the source.

6.5 Cyanobacteria

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

- Consider implementing riparian management or upstream waste discharge management / control to at least 1 km upstream of the intake.
- 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 Paddys Market Stream upstream of the intake over the period from October to May.

Rule S1.4 says that if there is evidence of cyanobacterial growth, steps must be taken to evaluate the cyanotoxin risk to consumers. If there is a risk of supplying water with cyanotoxins that exceed MAVs, abstraction of water must be discontinued until the risk is no longer present.

MDC is arranging an easement from the landowners and will put up fencing for SWRMA1 to prevent animal access. This is expected to be completed by the end of 2022.

6.6 Protozoa Log Removal Level

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

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 Opihi River Regional Plan (ORRP) as they relate to this water supply are included in Appendix A.

6.7.1 Burkes Pass Surface Water

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

- Schedule 1: Community Drinking-water Protection Zone
- Fairlie Basin groundwater quality zone
- The tributary flows into the Opihi River, both of which the surface water bodies are an Hill-fed Upland Water Quality Management Class.

6.7.2 Arowhenua Engagement

A meeting was held with Arowhenua on 22 June 2022 to discuss the values of the water bodies that Mackenzie District Council uses for its water supply. Arowhenua advised there was not any information available in literature that was specific to Kāti Huirapa on this Paddys Market Stream; however, it is recorded that tuna (eels), āruhe (fernroot) and kauru (cabbage tree root) were gathered in the immediate area.

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. No notable values have been identified for the Burkes Pass community drinking water supply, as summarised in Table 6-2.

Table 6-2 Values Identified for the Fairlie drinking water source

	Cultural	Contact Recreation	Biodiversity Values	Ecosystem Values	Trout Fishery and Spawning	Wetlands
Burkes Pass						

'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 CRC971594 for the water take was granted in 1997 (see Figure 6-9).

1 The rate at which water is diverted shall not exceed six litres per second, with a volume not exceeding 520 cubic metres per day.

2 A fish screen shall be operated and maintained on the intakes to ensure that fish are prevented from passing into the intakes.

3 This consent shall not be exercised concurrently with consent SCY700186.

4 When requested in writing by the Canterbury Regional Council, the hours and rate at which water is taken shall be recorded to within an accuracy of 10 percent. A copy of the records shall be provided to the Canterbury Regional Council when requested.

5 The Canterbury Regional Council may annually, on the last working day of October, serve notice of its intention to review the conditions of this consent for the purposes of:(a) dealing with any adverse effect on the environment which may arise from the exercise of the consent and which is appropriate to deal with at a later stage; or(b) complying with the requirements of a relevant rule in an operative regional plan.

6 Charges, set in accordance with section 36 of the Resource Management Act 1991, shall be paid to the Regional Council for the carrying out of its functions in relation to the administration, monitoring and supervision of resource consents and for the carrying out of its functions under section 35 of the Act.

Figure 6-9 Burkes Pass water take resource consent conditions. Resource Consent: CRC971594

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 an infiltration gallery in a stream located in a paddock on private property. The intake is discrete and its location on private property means that it is very unlikely to be tampered with.

The location of the intake in an unfenced stream in a sheep paddock means that there is no barrier to prevent microbiological hazards entering the source water.

There are no chemical contaminants of concern found in annual monitoring, and no known activities in the catchment which would result in chemical contamination.

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

The Burkes Pass water treatment plant uses cartridge filtration to remove particles from the water and improve the efficiency of the UV disinfection and chlorination process. This is considered a complete barrier to particles, and once filtered water turbidity is monitored, this will provide 2-log inactivation of protozoa.

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

UV disinfection is used to reduce the risk of bacteria and viruses contaminating the water supply. The water supply is disinfected with UV light. This provides 3-log inactivation of protozoa. The water is then chlorinated.

This is considered to provide a complete barrier to bacteria, protozoa and viruses in the water.

7.5 Maintaining the Quality of the Water in the Distribution System

The treated water storage tanks are in excellent condition which prevents ingress of rainwater or contaminants. All entry hatches are secured and locked against unauthorised access.

Sodium hypochlorite is dosed following UV disinfection. The target free available chlorine residual is 0.8 mg/L and this provides a partial barrier to microbiological re-contamination.

Backflow prevention is a crucial part of maintaining the quality of water in the distribution system. There are no high and medium backflow hazard activities in the Burkes Pass water supply scheme.

It is considered that the chlorine residual, the good condition of the infrastructure, continuous positive pressure in the reticulation and lack of hazardous activities provides a complete barrier to maintain the quality of water in the distribution system.

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 engage Temuka Transport or Cone Peak Farms Ltd for water delivery services in case of emergencies, who deliver potable waterand 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 there are adequate preventive measures in place that contribute to the effectiveness of each of the four 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	The stream is unfenced and the intake is in a sheep paddock. Turbidity levels are known to increase following rain events. Source water quality monitoring shows no chemical contaminants of major concern. No monitoring of *E. coli* or total coliforms has been undertaken in source water. There is no barrier to microbial contamination.
Removing particles and hazardous chemicals from the water	Cartridge filtration demonstrates an effective barrier to particles is in place.
Killing or inactivating pathogens in the water	UV disinfection and no *E. coli* detected at the treatment plant since the upgrade in March 2021 demonstrates an effective treatment barrier is in place.
Maintaining the quality of the water in the distribution system	FAC levels are generally within the specified range, although drop below target in daily monitoring at times. *E coli* has not been detected in the distribution system since treatment plant upgrades. There are no high or medium hazard activities in Burkes Pass. It is considered there is a complete barrier to contamination in the reticulation.

Notwithstanding the above statement Council has identified several areas for improvement which are outlined in Section 8.1.

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	Install continuous treated water turbidity monitoring	1.05	3 Waters Manager	$1,000	End December 2022	2
2	Monitor disinfection by-products (6 monthly monitoring has commenced)	2.06	3 Waters Manager	$5,000	End December 2022 (in progress)	2
3	Add UV alarms to SCADA.	2.10 2.11	3 Waters Manager	Staff time	End June 2023 (in progress)	2
4	• Undertake a survey of commercial customers to determine backflow hazard (complete). • Undertake assessment of backflow risk for residential connections • Install backflow prevention devices on medium hazard connections. Alternatively, revert Burkes Pass scheme to a restricted supply with air gaps on tanks. • Test all testable backflow prevention devices annually. • Create and maintain a backflow register.	4.08	3 Waters Manager	$5,000	End June 2023	2

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 (3) 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
5	Fence the area around and upstream of the infiltration gallery to exclude stock	1.01	3 Waters Manager / landowner	TBC	2024	3
6	• Consider implementing riparian management or upstream waste discharge management / control to at least 1 km upstream of the intake. • 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 Paddys Market Stream upstream of the intake over the period from October to May.	1.06	3 Waters Manager	$10,000	End 2023	2
7	Install water meters on customer connections or revert back to a restricted supply with air gaps at connections	4.02 4.08	Engineering Manager	$10,000	2025 / 2026	3

Improvement Number	Improvement Action	Mitigates Risk No(s)	Person Responsible	Estimated Cost	Timeframe	Priority 1 = High 2 = Medium 3 = Low
8	Review operations and maintenance manuals, develop SoPs for cartridge filter maintenance, UV unit maintenance and calibration, reticulation maintenance, contamination event response, and backflow prevention device installation.	All treatment risks	3 Waters Manager	Staff Time	End 2022	3
9	Develop emergency response plans and business continuity plan	5.10	Engineering Manager	Staff Time	June 2023	3
10	Implement alkalinity correction to meet guideline values	1.03	3 Waters Manager	$5,000	End 2023	3

9 Operational Procedures

9.1 Operational Staff Training

MDC and Whitestone Contracting Ltd staff managing and operating the Burkes Pass 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 Burkes Pass Water Operational Manual describes how the Burkes Pass 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 Burkes Pass 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 Burkes Pass water treatment plant is provided in Table 9-2.

Table 9-2 Burkes Pass 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 Shed 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:

- Maintenance of cartridge filter
- Maintenance of UV disinfection unit
- UV sensor calibration
- 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 Burkes Pass Water Operational Manual. Maintenance tasks that need to be undertaken bi-monthly, six-monthly and annually are also listed. The Burkes Pass 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 Burkes Pass 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.

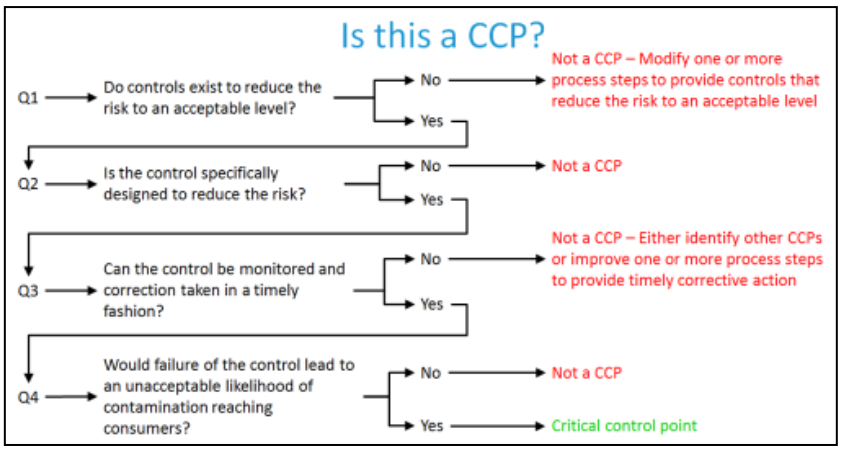


Figure 9-1 Flowchart to help distinguish a CCP, taken from the Handbook for Preparing Drinking Water Safety Plans

The Burkes Pass water supply has cartridge filtration, UV disinfection and chlorination as critical control points over which process controls can be made.

Table 9-3 Critical points and critical control points

	Critical Point	Description
1	Infiltration gallery	Possible access point for contamination due to source water contamination.
3	*Critical Control Point* Cartridge filtration	Cartridge filtration removes particulate material and failure may affect protozoa removal, the performance of the UV reactors and chlorination treatment processes.
4	*Critical Control Point* UV disinfection	UV reactors disinfect the water of all micro-organisms and failure removes a protozoa barrier in the treatment process.
5	*Critical Control Point* Chlorine dosing	Chlorination controls bacterial and viral pathogens and failure reduces the number of treatment barriers and removes the residual disinfectant provided in the distribution zone. Overdosing may exceed the chemical MAV.
6	Distribution system	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.

9.6.1 Cartridge Filtration – CCP1

Cartridge filtration provides the **primary particle removal CCP** to separate material that will compromise the efficacy of subsequent disinfection barriers. It also provides a protozoa barrier.

Table 9-4 Burkes Pass filtration critical control point process objectives

OPERATIONAL DAY-TO-DAY MONITORING OF CONTROL PROCESSES		
What	Turbidity	
When	Continuously monitored	
Where	In the main plant building, after water is filtered and prior to disinfection	
How	Continuous online monitoring analyser.	
Who	Results are telemetered to the duty operator.	
Records	All data is recorded digitally to the Mackenzie District Council SCADA system.	
Process performance criteria at the operational monitoring point.		Correction required if performance criteria are not met.
Target Range	Turbidity < 1.0 NTU	Perform routine plant/supply assessment and maintenance
Action Limits	Turbidity 1.0 NTU – 2.0 NTU	• Operator to assess and dial in to review SCADA. • Visit site and conduct the following checks and remedial actions: • Check raw water turbidity/condition using portable HACH meter. • Check differential pressure across filter. • Replace cartridge filters if necessary. • If raw water turbidity is high, inspect source to determine possible cause. • Record cause of failure and corrective steps taken. • Once situation corrected, monitor turbidity until it is below 1.0 NTU consistently.
Critical Limits	Turbidity ≥ 2.0 NTU	• Continue with Action Limit response and: • Operator to change filter cartridges. • Operator notifies MDC 3 Waters Manager • Follow the relevant procedures in DWSNZ Fig 5.1 (plant). • 3 Waters Manager discusses with Taumata Arowai Compliance Officer if inadequately treated water needs to be supplied or has been supplied to the community and determines with the Taumata Arowai Compliance Officer the need to issue a boil water notice and/or provide tankered water. • Operator to complete an investigation into the failure and record the results of the investigation and any improvement actions.

9.6.2 UV Disinfection – CCP2

UV treatment provides the primary **disinfection CCP** to inactivate bacterial, viral and protozoan pathogens that may have entered the water supply upstream of the system.

Table 9-5 Burkes Pass UV critical control point process objectives

OPERATIONAL DAY-TODAY MONITORING OF CONTROL PROCESSES		
What	UV intensity and UV transmittance	
When	UV intensity is continuously monitored. UV transmittance is measured weekly	
Where	In the treatment plant, after water is filtered and prior to chlorine disinfection	
How	Continuous online monitoring analysers.	
Who	Results are telemetered to the duty operator.	
Records	All data is recorded digitally to the Mackenzie District Council SCADA system.	
Process performance criteria at the operational monitoring point.		Correction required if performance criteria are not met.
Target Range	UV intensity 48 mJ/cm^2 UV transmittance > 95%	• Normal operating range for UV disinfection. • Conduct normal checks, maintenance and calibrations on UV unit.
Action Limits	UV intensity 40 mJ/cm^2 – 48 mJ/cm^2 UV transmittance 80% – 95%	• Operator to visit the plant to check situation and repair/rectify. UV visual alarms at plant, lights are displayed to diagnose the fault type. • Record cause of failure and corrective steps taken.
Critical Limits	UV intensity <40 mJ/cm^2 UV transmittance < 80%	• Continue with Action Limit response and: • Duty Supervisor notifies MDC 3 Waters Manager • Follow the relevant procedures in DWSNZ Fig 5.2 (plant). • MDC 3 Waters Manager notifies Taumata Arowai if inadequately treated water needs to be supplied or has been supplied to the community and considers with the Taumata Arowai Compliance Officer the need to issue a boil water notice and/or provide tankered water. • Operator to complete an investigation into the failure and record the results of the investigation and any improvement actions.

9.6.3 Chlorine Disinfection – CCP3

Chlorine disinfection provides secondary **disinfection CCP** to inactivate bacterial, viral and protozoan pathogens that may have entered upstream in the system.

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

Table 9-6 Burkes Pass chlorine disinfection critical control point process objectives

OPERATIONAL DAY-TODAY MONITORING OF CONTROL PROCESSES		
What	FAC concentration	
When	Monitored weekly at the treatment plant and monthly in the distribution zone. Continuously monitored online at the treatment plant.	
Where	Post UV disinfection.	
How	Portable spectrophotometer for sampling. Continuous online monitoring analysers.	
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	> 0.3 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, in proportion to flow, set by the Operator. • Operator to check turbidity and 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 – 0.3 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 hypochlorite and dosing systems. • Operator to adjust sodium hypochlorite 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. • 3 Waters Manager to notify Taumata Arowai if FAC >5 mg/L in the distribution zone. • If FAC in water from treated water storage reservoir < 0.2 mg/L, 3 Waters Manager to 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 Burkes Pass 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), Infrastructure Data 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

Protozoal inactivation is achieved through cartridge filtration and UV disinfection (4-log protozoa inactivation). Bacterial compliance is achieved throughout the treatment process.

As Burkes Pass supplies fewer than 500 people, it is a small supply under DWSNZ and so section 10 of DWSNZ applies.

The water in the distribution system is monitored in accordance with section 10 of the DWSNZ and is in compliance.

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
UV intensity	Target > 40 mJ/cm^2	WTP post treatment
UV transmittance	Target > 80%	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 Burkes Pass 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. Compliance with section 10 of DWSNZ is summarised in Table 10-2.

Table 10-2 DWSNZ compliance assessment[8]

Standards Compliance Assessed Against	DWSNZ 2005 (revised 2018)
Water safety plan prepared, approved and implemented	Did not comply. Water safety plan was prepared but not approved by the Drinking Water Assessor.
Treatment process	Complied. Cartridge filtration and UV unit which meets the NSF/ANSI 55 Class A standard.
Monitoring	Complied. *E. coli* samples collected at least three monthly (maximum interval of 135 days between samples with zero permitted exceedances) and no *E. coli* detected.

Compliance for the Burkes Pass water supply are stored in Hinekōrako. Compliance survey results with the Health Act for the past 5 years are shown in Table 10-3.

Table 10-3 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)	Yes	Yes	Yes	Yes	Yes
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

* 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.

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.

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

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

E. coli has been detected in three samples monitored at the treatment plant in the last five years. Details of *E. coli* transgressions are provided in Table 11-1. Since the treatment plant was upgraded in 2021, there have been no *E. coli* detected.

Table 11-1 E. coli transgressions and investigative actions

Sample Date	*E. coli* Transgression	Investigation Notes	Actions Taken
6/07/2017	1 MPN/100 mL	Heavy rain preceded sampling. Chlorine dosing had also lost its charge	3 consecutive clear Corrective Action samples taken on 11, 12, 13 July 2017
20/02/2018	5 MPN/100 mL	Chlorine dosing pump failure	Resolved by the maintenance contractor
29/06/2020	18 MPN/100 mL	Chlorine dosing system was not dosing enough chlorine to the supply to cope	Install analyser, cartridge filter, UV unit and different chlorine dosing pump with process control programming

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 11-2 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 11-2 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

Incident/emergency level	Description of level
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 is 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 Burkes Pass drinking water supply. There is a potential improvement action in Section 8.1 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 11-2).

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 11-3.

Table 11-3 Burkes Pass 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 surface water catchment 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 the surface water 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.

Type of Event	Required Actions
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.
Chemical contamination of source water Indicators: • A contamination event in the surface water catchment 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 river 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 8.1 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.

Type of Event	Required Actions
	• 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.
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

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.

12.1 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.

MDC 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 Burkes Pass 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 Burkes Pass 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[9]. 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 Burkes Pass 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

[9] 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
Burkes Pass Drinking Water Supply – Risk Assessment Table

Burkes Pass 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?
Source - Catchment	Microbiological contamination due to surface runoff from catchment, 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 • E. coli and FAC monitoring in distribution system • Illness in community	• Community Drinking Water Protection Zone • Multistage treatment plant (sand filter, disc filter, cartridge filter, UV disinfection and chlorination) • Limited natural filtration by infiltration gallery (~0.5 m deep) • Treated water storage • Use of tankered water	Almost Certain	Intake in actively farmed paddock, 46% of catchment is low production grassland (2017 CRA)	Insignificant	Treatment reduces consequence	5	1	Medium	Reliable	5	Acceptable	No
Source - Catchment	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	• Farmer is aware of drinking water catchment • Community drinking water protection zone in Land and Water Regional Plan • Treated water storage • Use of tankered water	Rare	No known activities in catchment which would result in contamination (2017 CRA)	Major	PMs don't reduce consequence	1	4	Medium	Reliable	4	Acceptable	No
Source - Catchment	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 fournd in annual monitoring	Possible	raw water has low alkalinity	Moderate	PMs don't reduce consequence	3	3	Medium	Reliable	9	Acceptable	No
Source - Catchment	Chemical contamination	1.04	Chemical spill in water upstream of infiltration gallery			☑		Unlikely		Major	Potential repeated exceedance of MAV	2	4	Medium	• Taste and/or odour complaints • Chemical spill is reported	• Infiltration gallery is distant from any road and there is no bulk storage of chemicals • Community drinking water protection zone in Land and Water Regional Plan • Treated water storage • Use of tankered water	Rare	No known activities in catchment which would result in contamination (2017 CRA)	Major	PMs don't reduce consequence	1	4	Medium	Reliable	4	Acceptable	No
Source - Catchment	Increased sediment load in source water	1.05	Heavy rainfall, fire in catchment			☑		Almost Certain	The average daily raw water turbidity is above the GV of 2.5 NTU for 15% of the time (SCADA data 1/10/21 – 23/1/22)	Moderate	Potential widespread aesthetic issues	5	3	High	• Continuous turbidity, pH and FAC monitoring in treated water • SCADA controls and alarms • Visual observation	• Multistage treatment plant (sand filter, disc filter, cartridge filter, UV disinfection and chlorination) • Limited natural filtration by infiltration gallery (~0.5 m deep) • Treated water storage • Use of tankered water	Unlikely	Turbidity increases after rainfall	Moderate	Treatment reduces consequence	2	3	Medium	Estimate	6	**Unacceptable**	No
Source - Catchment	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	• Low nutrient catchment • Flowing stream • Use of tankered water	Rare	Low nutrient catchment reduces likelihood	Moderate	PMs don't reduce consequence	1	3	Low	Estimate	3	Acceptable	No
Source - Catchment	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	• SCADA controls and alarms • Water level gauge in Paddys Market Stream • Prolonged drought or low rainfall conditions	• Water restrictions • Treated water storage • Use of tankered water	Rare	No issues with low flows to date but it could happen	Moderate	PMs don't reduce consequence	1	3	Low	Estimate	3	Acceptable	No
Source - Catchment	Loss of supply	1.08	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 2032 • NPS Freshwater Management prioritises drinking water over other consumptive uses	Rare		Major	PMs don't reduce consequence	1	4	Medium	Reliable	4	Acceptable	No
Source - Infiltration Gallery	Loss of supply	1.09	Intentional vandalism or accidental damage to infiltration gallery 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	• Infiltration gallery is below stream bed and is inaccessible • Infiltration gallery is well away from public areas, access is through private land with the farmers home at the entrance • Regular assessment of condition of infiltration gallery	Rare		Moderate		1	3	Low	Reliable	3	Acceptable	No
Source - Infiltration Gallery	Loss of supply due to blocking of infiltration gallery	1.10	Blocking of infiltration gallery with debris, sediment, shifting of river bed after flooding				☑	Likely		Major	Significant compromise of systems and abnormal operation	4	4	High	• Flow meter • Reservoir level indicator • SCADA controls and alarms	• Infiltration gallery can be exposed and gravel reinstalled • Treated water storage • Use of tankered water	Rare	Mostly gravel stream bed, unlikely to shift	Minor	Manageable disruption to normal operation if unblocked or alternative intake with reservoir storage	1	2	Low	Estimate	2	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 PE 2020 and in excellent condition • On private land location known by farmer • 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 • Treated water storage • 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 • New main was upsized from DN 50 to DN 75 • Treated water storage	Rare	No issues meeting peak demand	Moderate		1	3	Low	Estimate	3	Acceptable	No
Treatment - Sand Filter	Contamination due to particulate material not removed by filtration	2.01	Filter blockage	☑	☑		☑	Almost Certain		Moderate		5	3	High	• Flow to treatment plant	• Media planned for replacement • UV disinfection and chlorination • Treated water storage	Unlikely		Moderate		2	3	Medium	Reliable	6	Acceptable	No

Burkes Pass 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?
Treatment - Chlorination	Inadequate Chlorination	2.02	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	• Sufficient contact time in pipeline and reservoir • Chlorine dose is always above 0.2mg/L • UV disinfection	Rare		Moderate	UV treatment reduces consequence	1	3	Low	Reliable	3	Acceptable	No
Treatment - Chlorination	Inadequate Chlorination	2.03	• Sodium hypochlorite 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 • 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 weekly, Whitestone tops up chlorine supply as required • Chlorine dose rate automatically adjusted based on FAC and flow • Spare tubing and fittings held by contractor • Chlorine dosing system serviced annually by Whitestone • Operations and maintenance manual • Standard operating procedures • Solar powered WTP • Small petrol generator on site (automatically tops up batteries if required) • Trained and experienced operations staff • UV disinfection • Heaters in shed and checked weekly in winter	Unlikely	O&M procedures and trained staff reduce likelihood	Moderate	UV treatment reduces consequence	2	3	Medium	Reliable	6	Acceptable	No
Treatment - Chlorination	Inadequate Chlorination	2.04	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	• UV disinfection • pH historically <8	Unlikely		Moderate	UV treatment reduces consequence	2	3	Medium	Reliable	6	Acceptable	Yes
Treatment - Chlorination	Over-chlorination	2.05	• Dosing system failure • Chlorine dosage rate is too high due to equipment malfunction or reduction in demand for chlorine in the source water			☑		Likely	Assumes inexperienced operators and no O&M procedures	Moderate	Repeated breach of MAV	4	3	High	• 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 adjusted based on FAC and flow • Operator visits the plant at least weekly to check operation of chlorination system • Chlorine dosing system serviced annually by Whitestone • Operations and maintenance manual • Standard operating procedures • Trained and experienced operations staff	Unlikely		Moderate	PMs don't reduce consequence	2	3	Medium	Reliable	6	Acceptable	No
Treatment - Chlorination	Production of disinfection by-products	2.06	Organic material in raw water results in the production of disinfection by-products			☑		Almost Certain		Moderate	Repeated breach of MAV	5	3	High	• High organic loading in source water without a filtration process prior to chlorination	• Multistage treatment plant (sand filter, disc filter, cartridge filter, UV disinfection and chlorination)	Possible	DBPs have not been measured in distribution system	Moderate	PMs don't reduce consequence	3	3	Medium	Estimate	9	**Unacceptable**	Yes
Treatment - UV disinfection	Inadequate disinfection	2.07	UV intensity insufficient due to build-up of deposits on sleeve	☑	☑			Possible		Major	Potential acute harm to people, declared outbreak or widespread illness and possible deaths expected	3	4	High	• Visible build-up of deposits on sleeve • UV intensity sensor • SCADA controls and alarms	• Sleeve in manually cleaned by the operator • Multistage treatment plant (sand filter, disc filter, cartridge filter, UV disinfection and chlorination) • Regular servicing of UV unit by Whitestone • Weekly site visits by operator • Operations and maintenance manual • Standard operating procedures • Trained and experienced operations staff • Treated water storage • Use of tankered water	Unlikely		Major	Chlorination reduces consequence of bacterial or viral contamination but not protozoal	2	4	Medium	Reliable	8	Acceptable	No
Treatment - UV disinfection	Inadequate disinfection	2.08	Excessive turbidity in water decreases the effectiveness of the treatment	☑	☑			Possible		Major	Potential acute harm to people, declared outbreak or widespread illness and possible deaths expected	3	4	High	• Continuous turbidity and FAC monitoring in treated water • FAC and E. coli monitoring in distribution system • SCADA controls and alarms • Illness in the community	• Multistage treatment plant (sand filter, disc filter, cartridge filter, UV disinfection and chlorination) • Treated water storage • Use of tankered water	Unlikely	Turbidity increases after rainfall	Major		2	4	Medium	Reliable	8	Acceptable	No
Treatment - UV disinfection	Inadequate disinfection	2.09	Flow rate through UV unit too rapid for effective treatment	☑	☑			Possible		Major	Potential acute harm to people, declared outbreak or widespread illness and possible deaths expected	3	4	High	• Flow rate through plant greater than UV unit maximum	• UV reactor is sized to treat maximum flow through inlet pipe (Filtec calculations) • Multistage treatment plant (sand filter, disc filter, cartridge filter, UV disinfection and chlorination) • Chlorination	Rare		Major	Chlorination reduces consequence of bacterial or viral contamination but not protozoal	1	4	Medium	Estimate	4	Acceptable	No
Treatment - UV disinfection	Inadequate disinfection	2.10	UV lamp failure	☑	☑			Possible		Major	Potential acute harm to people, declared outbreak or widespread illness and possible deaths expected	3	4	High	• Local alarms for UV lamp failure • Lamp hour meter • SCADA controls and alarms	• UV system is maintained at regular intervals and lamps replaced annually • Spare UV lamps and sleeves kept on-site • Weekly site visits by operator • Operations and maintenance manual • Standard operating procedures • Maintenance contract KPIs • Trained and experienced operations staff • Multistage treatment plant (sand filter, disc filter, cartridge filter, UV disinfection and chlorination) • Treated water storage • Use of tankered water	Unlikely		Moderate	Filtration and chlorination reduces consequence	2	3	Medium	Estimate	6	**Unacceptable**	Yes

Burkes Pass 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?
Treatment - UV disinfection	Inadequate disinfection	2.11	UV intensity sensor failure	☑	☑			Possible		Major	Potential acute harm to people, declared outbreak or widespread illness and possible deaths expected	3	4	High	• UV intensity alarm • SCADA controls and alarms	• UV systems are maintained at regular intervals with sensor checked or replaced annually • Spare UVI sensor kept on-site • Weekly site visits by operator • Operations and maintenance manual • Standard operating procedures • Maintenance contract KPIs • Trained and experienced operations staff • Multistage treatment plant (sand filter, disc filter, cartridge filter, UV disinfection and chlorination) • Treated water storage • Use of tankered water	Unlikely		Major	Filtration and chlorination reduces consequence	2	4	Medium	Reliable	8	Acceptable	Yes
Treatment - UV disinfection	Inadequate disinfection	2.12	Power failure resulting in UV unit being unable to operate	☑	☑			Likely		Major	Potential acute harm to people, declared outbreak or widespread illness and possible deaths expected	4	4	High	• Notice of power failure • SCADA controls and alarms	• Solar powered WTP • Backup petrol generator on site • Chlorination • Manual shutdown of plant • Treated water storage • Use of tankered water	Rare		Major	Chlorination reduces consequence of bacterial or viral contamination but not protozoal	1	4	Medium	Reliable	4	Acceptable	No
Treatment	Fire within treatment plant building	2.13	• Faulty switchboard or other malfunction • Vandalism or sabotage				☑	Possible		Major		3	4	High	• Obvious signs of damage to structure • Reported by residents	• 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 • Monthly inspection of reservoir by Contractor	• Chlorine residual • Reservoir is covered and all entry hatches are secured and locked against unauthorised access • No overflow pipes • Two plastic PE reservoirs installed in 2020 • Tanks are fenced off	Unlikely	New reservoirs in excellent condition	Moderate	Chlorine residual reduces consequence	2	3	Medium	Reliable	6	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 • Reservoir is covered and all entry hatches are secured and locked against unauthorised access • Reservoirs are on private land with multiple closed gates • Tanks are fenced off	Unlikely	Reservoir security reduces likelihood	Moderate	Chlorine residual reduces consequence	2	3	Medium	Reliable	6	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	• Multistage treatment plant (sand filter, disc filter, cartridge filter, UV disinfection and chlorination) • Minimum operating level in reservoir is maintained. Reservoir level drops to ≈50% overnight • Reservoirs can be bypassed and cleaned out if required • New reservoirs	Likely		Minor	Treatment reduces consequence	4	2	Medium	Reliable	8	Acceptable	No
Post-Treatment - Storage	Loss of Supply	3.04	Failure of reservoir e.g. due to structural failure or earthquake damage				☑	Unlikely		Catastrophic	Major impact on most of the population, complete failure of systems, requirement for high level of monitoring and incident management	2	5	High	• Customer complaints • Obvious signs of leakage or failure at reservoir site • Monthly inspection of reservoir by Contractor • Reservoir level indicator • SCADA controls and alarms	• 2 plastic PE reservoirs installed in 2020 • Reservoirs can be bypassed and water supplied directly to reticulation • Replacement tanks available with short turnaround • Water restrictions • Use of tankered water	Unlikely	Reservoir condition reduces likelihood	Moderate	Reservoir bypass reduces consequence	2	3	Medium	Reliable	6	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	• 1 - 1 1/2 days of stored treated water at peak demand • Water restrictions • Use of tankered water	Possible	No issues meeting peak demand	Moderate		3	3	Medium	Reliable	9	Acceptable	No
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	• New PE bulk supply main installed in 2020 • 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	Rare	New pipe reduces likelihood	Catastrophic	PMs don't reduce consequence	1	5	Medium	Reliable	5	Acceptable	No
Reticulation	Loss of Supply	4.02	• Excessive demand in the network • Inadequate distribution system capacity				☑	Possible		Moderate		3	3	Medium	• Customer complaints • Reservoir level indicator • SCADA controls and alarms	• Pipe renewals programme • Water restrictions • Use of tankered water • Treated water storage	Unlikely	No issues meeting peak demand	Moderate		2	3	Medium	Reliable	6	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
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

Burkes Pass 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?
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 • Mostly new PE network • Failures, maintenance and renewals are recorded in Council asset management system • Pipeline renewals programme • Treated water storage • Water restrictions • Use of tankered water	Unlikely	Contractor processes and audits, and mostly new PE 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 separately 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 • A backflow survey in 2022 found no high or medium risk backflow risk activities in Burkes Pass	Possible	Continuous positive pressure reduces likelihood	Minor	Lack of high risk activities reduces consequence	3	2	Medium	Estimate	6	**Unacceptable**	Yes
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	Possible		Minor	No issues meeting peak demand redues consequence	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 • Multistage treatment plant (sand filter, disc filter, cartridge filter, UV disinfection and chlorination) • Treated storage	Rare	No complaints	Minor		1	2	Low	Estimate	2	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	Chemical Contamination	4.12	low alkalinity or pH causes leaching of metals from pipes and fittings into the treated water supply				☑	Possible		Moderate	Significant disruption to normal operation	3	3	Medium	• Rate of pipe failures is higher than expected • Complaints about hot water cylinder failures • pH, alkalinity and hardness Langelier saturation index of water • pH of water is analysed bi-annually		Possible		Moderate		3	3	Medium	Reliable	9	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
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

Burkes Pass 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?
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	• Treatment plant complies with section 10 of DWSNZ (cartridge filtration and validated UV) • E. coli monitoring complies with section 10 of DWSNZ (at least 3-monthly in distribution system)	Rare		Major		1	4	Medium	Certain	4	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 • Chlorination and UV • Chlorine residual • Water restrictions • Treated water storage • Use of tankered water	Rare		Major		1	4	Medium	Reliable	4	Acceptable	No
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 Burkes Pass 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[10]

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

[10] 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 Burkes Pass 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 3.16	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 4.3	Surface water bodies are managed so that: (a) toxin producing cyanobacteria do not render rivers or lakes unsuitable for recreation or human and animal drinking-water; (b) fish are not rendered unsuitable for human consumption by contaminants; (c) the natural colour of the water in a river is not altered; (d) the natural frequency of hāpua, coastal lakes, lagoons and river openings is not altered; (e) the passage for migratory fish species is maintained unless restrictions are required to protect populations of native fish; (f) reaches of rivers are not induced to run dry, thereby maintaining the natural continuity of river flow from source to sea, (g) variability of flow, including floods and freshes, is maintained to avoid prolonged "flatlining" of rivers; to facilitate fish passage; and to mobilise bed material; and (h) 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.
Policies 14.4.6-6C	Seeks to protect surface water flows 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.

Opihi River Regional Plan

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

Objective 1 – SW Quantity	Achieve sufficient quantities of water in the Opihi 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 Opihi 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 Opihi 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 Opihi 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 Opihi 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 Opihi 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 Opihi River or its tributaries; or
		(ii) onto or into land in circumstances which may result in that sewage entering the Opihi River or its tributaries.
	(b)	Existing discharges of treated or untreated human sewage into the Opihi River or its tributaries, or onto or into land in circumstances which may result in that sewage entering the Opihi 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 Opihi River or its tributaries, after passing through soil.
	(d)	Set and maintain water quality standards for the Opihi 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 Opihi 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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