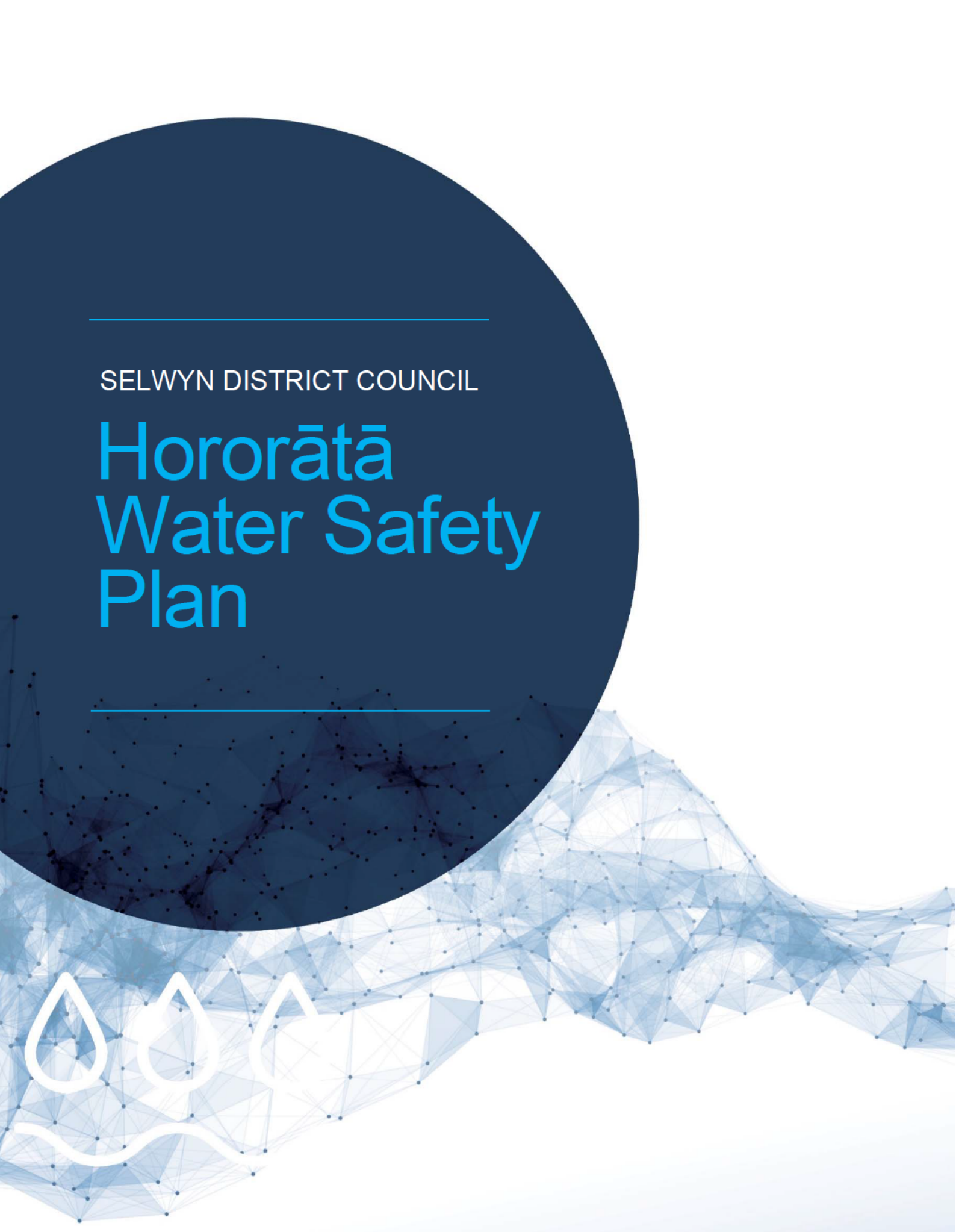
SELWYN DISTRICT COUNCIL

Hororātā Water Safety Plan



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The Selwyn District Council (SDC) **Water Services Delivery Manager** is responsible for this document.

Document history and status

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Acronyms

Acronym/Abbreviation	Details
ADD	Average Day Demand
AMIS	Asset Management Information System
AP	Annual Plan
BWN	Boil Water Notice
CCP	Critical Control Point
CDHB	Canterbury District Health Board
CAPEX	Capital Expenditure
CHA	Catchment Hazard Assessment
DHB	District Health Board
DORIS	Document Organisation and Record Information System
DWA	Drinking Water Assessor
DWSNZ	Drinking Water Standards for New Zealand 2005 (Revised 2018)
ECan	Environment Canterbury
GIS	Geographical Information Systems
H&S	Health and Safety
LTP	Long Term Plan
MoH	Ministry of Health
OPEX	Operational Expenditure
OMCP	Operational Monitoring Control Point

Acronym/Abbreviation	Details
PM	Project Manager
RMA	Resource Management Act 1991
SCADA	Supervisory Control and Data Acquisition
SDC	Selwyn District Council
SOP	Standard Operating Procedure
UPCP	Unit Process Control Procedure
USEPA	United States Environmental Protection Agency
UV	Ultraviolet
UVDGM	Ultraviolet Disinfection Guidance Manual
UVT	Ultraviolet Transmissivity
VSD	Variable Speed Drive
WHO	World Health Organisation
WSP	Water Safety Plan
WTP	Water Treatment Plant
WW	Wastewater

Executive Summary

This Water Safety Plan (WSP) has been prepared for the Hororātā Water Supply Scheme by Selwyn District Council (SDC), Canterbury, New Zealand.

As a drinking water supplier, SDC are required to have and implement a water safety plan in accordance with the *Health Act 1956*. The Act provides a flexible, risk management based, and outcome focused legislative framework for networked drinking water supplies. The Act requires compliance with the Drinking Water Standards for New Zealand (MoH, 2018a).

To support preparation of revised WSPs the Ministry of Health (MoH) has prepared the following guidance, Drinking Water Safety Plan Framework (MoH, 2018b), the Handbook for Preparing a Water Safety Plan (MoH, 2019). This documentation has been used as the basis to prepare this WSP.

The Hororātā Water Supply WSP refers to the scheme specific components, whilst the SDC Drinking Water Framework (DW-GEN-00-PLN-0001) provides the guidance and framework documentation of the SDC drinking water management system, and the methodology used in developing and implementing the WSP.

The SDC Drinking Water Framework (DW-GEN-00-PLN-0001) refers to a number of supporting documentations, these are summarised in Table 0-1, to provide ease of reference. The following supporting documentation should be read in conjunction with the WSP.

Table 0-1: Drinking Water Quality Management System

Document Number	Water Safety Document	WSP Component No.
DW-GEN-00-PLN-0001	SDC Drinking Water Framework	General
Available here	5-waters Activity Management Plan (Volume 1 and Volume 2 – Water)	General
Available here	Water Policy and Commitment Statement as documented to Council on 11 December 2019 (refer to page 204)	1 – Commitment to Drinking Water
DW-SEL-04-DST-0004	Hororātā - Unit Process Control Plans (UPCP) Covering the following requirements: • Operations & Maintenance Manual • Operational Monitoring and Inspection Plans • Critical Control Points • Operational Monitoring Points • Control Systems Manual Corrective Action Procedures	4 – Operational Procedures
DW-GEN-04-REG-0009	Standard Operating Procedures Master List	4 – Operational Procedures
DW-GEN-05-DST-0002	Drinking Water Quality Compliance Monitoring Plan	5 – Verification
DW-GEN-05-DST-0003	Drinking Water – Monitoring Schedule	5 – Verification
DW-GEN-07-DST-0007	Transgression Response Plan	5 – Verification
AMIS	Consumer Complaints Register	5 – Verification
DW-GEN-07-DST-0006	Drinking Water - Incident and Emergency Response Plan	7 – Management of incidents and emergencies
DW-GEN-00-DST-0000	Drinking Water Management System Document Register	8 – Documentation and Reporting

1. Commitment to drinking water quality management

1.1 Relationship of water safety plan to organisational policy and strategy

SDC's drinking water management system incorporates the relationship of the WSP to organisational policy and strategy across all drinking water schemes, details can be found by referring to Section 1.1 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001).

1.1.1 Drinking water quality statement

Refer to Section 1.1 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001) for details.

1.1.2 Commitment to implementation

Refer to Section 1.1 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001) for details.

1.2 Engaging stakeholders

SDC's drinking water management system incorporates the approach to engaging stakeholders undertaken across all drinking water schemes, details can be found by referring to Section 1.3 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001).

1.2.1 External stakeholders

External stakeholders affected by Hororātā Water Supply are detailed in Table 1-1 this includes:

- Industrial users of water supply;
- Community users' representatives; and
- High-risk users (hospitals, schools, aged-care facilities).

Table 1-1: Hororātā Drinking Water Supply – External Stakeholders List

Stakeholder Name	Location of Contact Details	Information
All water users	[redacted]	Water users contact information can be accessed through viewing MagiQ, AMIS and MapViewer
Dialysis patients	[redacted]	Information is provided to SDC by the District Health Board
Schools	School Directory	Register maintained by the SDC School Safety Officer
Early Childhood	Early Child Education Directory	Information stored on the Education Counts website
Aged Care Facilities	High Risk Users	Medical centre or hospital only
Health Care Facilities	High Risk Users	Medical Centres, hospitals and specialists
High Users	AMIS High Water Users	Commercial and Domestic users

Besides supply specific stakeholders, there are many stakeholders who have an interest across all of SDC drinking water schemes, a broader list of external stakeholders is provided in Section 1.3 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001).

1.2.2 Internal stakeholders

Refer to Section 1.3 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001) for details.

1.2.3 Water safety plan development

Refer to Section 1.3 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001) for details.

1.3 Engaging community

SDC's drinking water management system incorporates methods for engaging with the community undertaken across all drinking water schemes, details can be found by referring to Section 1.4 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001).

1.3.1 Consumer engagement plan

Refer to Section 1.4 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001) for details.

1.3.2 Communications plan

Refer to Section 1.4 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001) for details.

2. Assessment of the drinking water supply system

2.1 Water supply description and analysis

Hororātā is a small rural town in the Selwyn District, in the Canterbury region of New Zealand's South Island. Hororātā is located on the Canterbury Plains near the foothills, 60 km west of Christchurch. The Hororātā Water Supply Scheme is a fully restricted supply whereby the water units are allocated based on land area and dwelling. The supply serves an estimated population of 920 as of 1st of February 2020.

The water supply was installed in 1982 to replace the Snowden and Glenroy Water Race Schemes. The original scheme did not include the Harper Hills area, which was added after the main system was commissioned. There have been some minor extensions to serve small blocks on the outskirts of the original scheme boundary along with a major extension in 1999 to serve the area from Hororātā Township to the Selwyn River (covering the Selwyn water race area).

The Hororātā Water Supply Scheme currently comprises of 1 No. shallow well, 1 No. water treatment plant (WTP), 2 No. reservoirs and 1 No. pump station. The pump station pumps water from one reservoir to the other. The rural supplies, Selwyn No. 2 and Hororātā networks are all gravity fed. Refer to the map shown in Figure 2:1, the summary information in Table 2-1 and schematics provided in Appendix A – Hororātā Drinking Water Supply Schematics.

This section provides detailed description and analysis of each component of the Hororātā Water Supply system, including:

- Element 1: Catchment characteristics
- Element 2: Water sources and extraction
- Element 3: Treatment processes
- Element 4: Storage and reticulation network

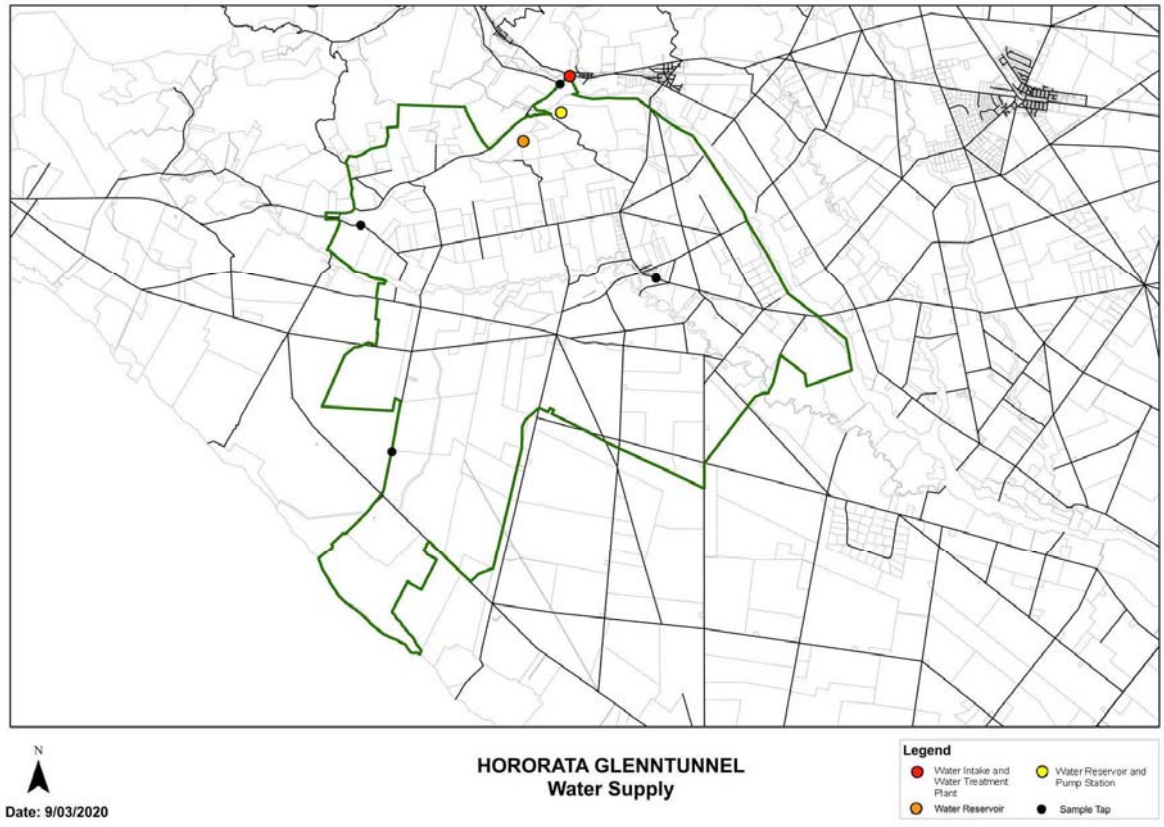


Figure 2:1: Hororātā Water Supply Network

Table 2-1: Scheme Summary - Hororātā Water Supply

Description		Quantity
Estimated Population Served (1 June 2020)	Population (No.)	920
Scheme Coverage (1 June 2020)	Full Charges	59
	Half Charges (supply available not connected)	0
	>1 Charges	47 (all restricted)
System Components	Bores/Intake (No.)	1
	Treatment Plants (No.)	1
	Reservoirs (No.)	2
	Pump Stations (No.)	1
	Piped – Water Lateral Pressure (m)	6,816
	Piped – Water Pipe Main (m)	104,226
	Piped – Water Pipe Rider (m)	30,564
	Piped – Total (m)	141,606
Demand (m^3) (1^{st} January 2019 – 31^{st} December 2019)	Average Daily (m^3)	1,137
	Peak Daily (m^3)	2,010
	Minimum Daily (m^3)	521
	Average daily per connection (m^3)	3.35

Some infill growth is expected but no significant development is underway. There is provision in the Regional Plans for community supply; however, any new groundwater or surface water takes to provide for growth will require resource consent from Environment Canterbury.

2.1.1 Water supply schematics

Schematic diagram/s provide a visual representation of the scheme from catchment to consumer, these are show in Appendix A – Hororātā Drinking Water Supply Schematics (DW-SEL-02-PFD-0006).

The schematics have been prepared as a representation of key aspects of the water supply system, including water sources, treatment components, reservoirs, and pump stations. The schematics include a representation of multiple barrier principle (as assessed in Section 3), Critical Control Points (CCP) and Operational Monitoring and Control Points (OMCPs) (as outlined in Section 4.3). For further detailed diagrams, refer to the Scheme Process Diagrams provided in Appendix E – Hororātā Drinking Water Supply Scheme Process Diagrams.

2.1.2 Description and analysis of each element of the drinking water supply

For each element of the Hororātā Water Supply Scheme, a description and analysis has been prepared, as follows:

- Element 1: Catchment characteristics
- Element 2: Water sources and extraction
- Element 3: Treatment process
- Element 4: Storage and reticulation network

2.1.2.1 Element 1: Catchment characteristics

A detailed Catchment Hazard Assessment (CHA) has been prepared for the Hororātā Water Supply Scheme, this can be found in Appendix C – Hororātā Drinking Water Supply Catchment Hazard Assessment (DW-SEL-02-RPT-0002).

The objective of this CHA is to delineate a series of source protection zones, based on spatial criterion, to identify hazards that could potentially impact individual supply wells within the Hororātā Water Supply scheme. These hazards include Priority 1 and Priority 2 determinands as defined in the DWSNZ (MoH, 2018a). The delineation of the source protection zones was undertaken in accordance with the Technical Guidelines for Drinking Water Source Protection Zones (PDP, 2018).

The catchment hazard assessment has been prepared in accordance with Section 2.1.2 of the Handbook for Preparing a Water Safety Plan, the requirements are as follows:

- Catchment characteristics, including:
  - Catchment area or groundwater recharge zone, including any designated catchment/recharge protection zones;
  - Hydrogeology;
  - Topography;
  - Main geological features; and
  - Land use, current and past, and likely land use change.
- Climatic features, including significant climate variability and expected longer-term changes.

The CHA is also used to determine the protozoal compliance criteria in Section 5 of the DWSNZ, and to inform potential preventative measures to be used in managing the hazards associated with the catchment and sources.

Table 2-2 provides a summary of catchment characteristics and climatic features, refer to Appendix C – Hororātā Drinking Water Supply Catchment Hazard Assessment (DW-SEL-02-RPT-0002) for more detailed information pertaining to each bore, including protection zones, land uses, and HAIL site information.

Table 2-2: Catchment Characteristics and Climatic Features

Catchment Characteristics	Summary
Topography	Flat to gently sloping land
Geology	Hororātā is located near the foothills of the Southern Alps.
Hydrogeology	The main river near Hororātā is the Hororātā River and the Cordys Stream. The Hororātā River begins in the high-country as a number of small streams which eventually merge to form the main channel of the Selwyn River which flows past Glentunnel onto the Canterbury Plains. It is noted that the Selwyn River is ephemeral in nature and generally runs dry after emerging onto the Canterbury Plains (Vincent, 2005).
Climatic features	Mean daily maximum temperature is 17.7 °C, although the daily maximum temperature can exceed 30 °C during the summer months. Mean daily temperature is 11.9 °C. Mean daily minimum temperature is 6.2 °C, although the daily minimum temperature can fall below 0°C during the winter months. Mean annual rainfall is 755.6 mm, although rainfall is likely to be variable across the surface water catchment, particularly in the foothills of the Southern Alps where the mean annual rainfall is likely to be significantly higher. MfE (2018) states that the climate change models generally predict increases in mean annual temperature and decreases in mean annual rainfall. This could have an impact on surface water flows in the area, and therefore have an effect on both surface water quality and quantity.
Historical land use[1]	A review of historical aerial imagery between 1940 and 1999 on Environment Canterbury's GIS database indicates that land use within the surface water catchment of the Glentunnel Intake source has predominantly been constant since at least 1940 (i.e., high-country land, high-country farm land, rural farm land), although the number of residential dwellings within the surface water catchment has increased over time and agricultural practices are likely to be more intensive given irrigation is now occurring within the surface water catchment.

2.1.2.2 Element 2: Water sources and extraction

The Hororātā Water Supply Scheme consists of 1 No. operational intake (as of June 2020). The well is located adjacent to the Selwyn River south of the Glentunnel township (refer to maps shown within Appendix F – Hororātā Drinking Water Supply Water Model Maps.

A summary of the water sources for the Hororātā Water Supply Scheme including source, consent (groundwater take), and well details (e.g. screen depth, aquifer type, depth) are provided is provided in Table 2-3.

[1] Historical aerial imagery obtained from Canterbury Maps (https://mapviewer.canterburymaps.govt.nz/, accessed 13 February 2020)

Table 2-3 : Hororātā Water Sources Summary

Source Name	Glentunnel Intake, Selwyn RWS
Source Details	
Source WINZ code	G00822
Location	[redacted]
Map reference NZTM 2000	[redacted]
Type of source	Groundwater hydraulically connected to surface water[2]
Consent Details[3]	
Consent number	CRC970985.1
Consent expiry date	11 Dec 2031
Max. instantaneous rate of take (l/s)	16.8
Daily volume (m^3)	1,450
Weekly volume (m^3)	N/A
Annual volume (m^3)	400,000 m^3 between 1 July and the following 30 June.
Well Details[4]	
Well ID	L35/0215
Well elevation (m AMSL[5])	261.08
Depth (m BGL[6])	6.00
Screen depth (m BGL)	No screen on intake
Aquifer type[7]	Unconfined

Security status – The well security status (as per Section 4.4 of DWSNZ (MoH, 2018a)) is noted in Table 2-4. Appendix C – Hororātā Drinking Water Supply Catchment Hazard Assessment (DW-SEL-02-RPT-0002) includes a summary of Hororātā Water Supply sources. This information is continually under review, refer to SDC DWSNZ Compliance Register (DW-GEN-05-DST-0011) for latest information.

[2] While listed as a groundwater take on ECan's resource consent database (https://www.ecan.govt.nz/data/consent-search/, accessed 23 March 2020), the supply well is located in close proximity to the Selwyn River being located approximately 30 to 50 m north of the stream bed (depending on river stage) and screened in river gravels, and therefore source water will predominantly be surface water.
[3] Consent details obtained from ECan's resource consent database (https://www.ecan.govt.nz/data/consent-search/, accessed 24 March 2020).
[4] Unless otherwise stated, all well details have been obtained from searching ECan's wells database (https://ecan.govt.nz/data/well-search/?WellNo=, accessed 30 December 2019).
[5] m AMSL = m above mean sea level.
[6] m BGL = m below ground level.
[7] Refer to Appendix C – Hororātā Drinking Water Supply Catchment Hazard Assessment for further information about aquifer type.

Table 2-4: Hororātā Water Supply – DWSNZ Bore Security

Source Name	Glentunnel Intake, Selwyn RWS
Well ID	L36/0215
Criterion 1 – Age Test Compliance	N/A
Criterion 2 (DWSNZ) – Wellhead security Compliance[8]	N/A
Criterion 3 (DWSNZ) – E.coli	No
Status (as of 20 June 2020)	Currently deemed to be **non-secure** (equivalent to surface water)

Pathway assessment – A pathway assessment has been completed for each water source against the potential pathways for surface water ingress into the groundwater, further details are provided in Appendix C – Hororātā Drinking Water Supply Catchment Hazard Assessment. Hazards associated with pathways present are addressed in the scheme risk assessment (Appendix B – Hororātā Drinking Water Supply Risk Assessment), including a review of existing preventative measures and the need for any improvement actions to be put in place.

Water source distribution – Water is sourced for Hororātā supply from 1 No. well.

Table 2-5 summarises the distribution of water supplied by source, based on volumes supplied from 1 January 2019 to 31 December 2019.

Table 2-5: Hororātā Water Supply – Distribution of Water Supplied by Source and WTP (2019)

WTP	WINZ Code	Source Name	Configuration	Annual Volume (m^3) Extracted by Bore	% Supply By Bore to Hororātā Water Scheme	Annual WTP Supply Volume (m^3)	% WTP Supply
Homebush Road WTP	G00822	Glentunnel Intake, Selwyn RWS	Submersible pump to WTP	387,605	100%	387,605	100%
		Total		**387,605**	**100%**	**387,605**	**100%**

2.1.2.3 Element 3: Treatment processes

The Hororātā Water Supply includes 1 No. WTP summarised in Table 2-6.

Table 2-6: Hororātā Water Supply Treatment Plant Infrastructure Summary

Treatment Plant Name	Treatment Plant ID	Reference to further details
Homebush Road WTP	TP01344	Table 2-8: Treatment plant infrastructure for Hororātā Water Supply – Homebush Road WTP

[8] The assessment against Criterion 2 – Wellhead security has been undertaken by SDC and provided to Jacobs on 3 December 2019 in a spreadsheet title "Compliance final Elaine".

Each WTP has a varying combination of treatment units (e.g. filtration, UV), and attributes (flow rates, set points, control points etc.), which are considered and presented throughout the WSP. Beyond this section, further information about WTPs can be found in the following parts of the WSP:

- Schematics presented in Section 2.1.1
- Treatment Plant Capacity and Loading, shown in Table 2-7
- Protozoa compliance (target and cumulative log credits) is presented in Section 2.1.3
- Multiple barrier principle, presented in Section 3.1

Table 2-7 shows a summary of Hororātā WTP capacity and loading. This shows how each element affects the system and also indicates any limitations in the system. The following flow rates in each system are summarised below:

- Instantaneous consent limit (l/s)
- Maximum operating flow (submersible pump capacity) (l/s)
- Validated filter capacity (based on validated flow of 9.33 l/s per cartridge) when operated with 1-micron units for validation purposes.
- UV disinfection unit maximum flow rate (l/s) at 90% UVT.

The % Treatment Capacity of each WTP within the Hororātā Water Supply is an indicative figure used to assess the constraints on the system, and whether constrained by the WTP pump capacity (<100%), (>100%) by UV disinfection unit or the filter unit. This shows that Homebush Road WTP is constrained by the submersible pump. Table 2-8 summarises the WTP infrastructure for Hororātā.

Table 2-7: Hororātā Water Supply – Treatment Plant Capacity and Loading

WTP	Source Name	Configuration	Consent Limit (Instantaneous) (l/s)	Max Submersible Pump Operating Flow (l/s)	Validated Filter Capacity (l/s)	Validated UV Capacity (l/s) (Max Flow at 90%UVT)	Max Pump to Network Operating Flow (l/s)	% UV Treatment Capacity versus Max Pump to Network Flow (Note 1)	Comments
Homebush Road WTP	Glentunnel Intake, Selwyn RWS	Two submersible pumps (duty-standby) pump to WTP and Atkins Road reservoir. Surface pump station pumps from Atkins Road reservoir to Harper Hills reservoir. Both reservoirs gravity feed to network.	16.8	15.9	28 (3HF40HB)	58.5 (D06)	15.9	368%	Limited by submersible pump capacity

Note 1: % Treatment capacity is calculated based on the UV validated capacity at 90%UVT divided by the max pump to network operating flow, this measure is used to assess whether the WTP is constrained by UV or by pumping capacity. This is only an indicative figure, as the water quality is often >90%UVT and the WTP pump capacity to network does not always operate at or near the maximum design rate. If the %Treatment Capacity is <100% this indicates constraint by UV, if >100% this indicates the scheme is constrained by the WTP pump capacity.

Table 2-8: Treatment plant infrastructure for Hororātā Water Supply – Homebush Road WTP

Treatment plant – Homebush WTP	
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

2.1.2.4 Element 4: Storage and reticulation network

The following information provides a summary of water storage and reticulation for the Hororātā Water Supply Scheme.

Storage – There are 2 No. reservoirs within the Hororātā water supply, these are summarised in Table 2-9.

Table 2-9: Hororātā Water Supply Reservoirs Summary

Reservoir Name	Reference
Atkins Road Reservoir	Table 2-10: Hororātā Water Supply – Atkins Road Reservoir Details
Harper Hills Reservoir	Table 2-11: Hororātā Water Supply – Harper Hills Reservoir Details

The reservoirs store treated water before the water is gravity fed into reticulation.. Hazards associated with the reservoirs are covered in the risk assessment (Appendix B – Hororātā Drinking Water Supply Risk Assessment (DW-SEL-02-REG-0003)). There are reservoir maintenance activities, scheduled tasks and SOPs, including reservoir cleaning and disinfection these activities are as per the Hororātā Water Supply Unit Process Control Procedure (DW-ROL-04-DST-0004).

Details of the Operational Monitoring Control Points (OMCPs) associated with the reservoirs can be found in Section 4.3 of this document.

Table 2-10: Hororātā Water Supply – Atkins Road Reservoir Details

Component	Details
Name	Atkins Road Reservoir
Asset tag	645962
Functionality	Balance and storage tank
Condition	Refer to inspection reports for condition details and recommendations.
Above or below ground	Above
Capacity (m^3)	490 m^3
Material	Steel (Tasman Tank)
Year of install	2015
Roofed	Yes
Vermin-proof	Yes
Run-off directed off roof	Yes

Figure 2:2 shows the Atkins Road Reservoir.

Figure 2:2: Atkins Road Reservoir

Table 2-11: Hororātā Water Supply – Harper Hills Reservoir Details

Component	Details
Name	Harper Hills Reservoir
Asset tag	542234
Functionality	Balance and storage tank
Condition	Refer to inspection reports for condition details and recommendations.
Above or below ground	Above
Capacity (m^3)	90 m^3
Material	Concrete
Year of install	1982
Roofed	Yes
Vermin-proof	Yes
Run-off directed off roof	Yes

Figure 2:3 shows the Harper Hills Reservoir.

Figure 2:3: Harper Hills Reservoir

Reticulated network – The Hororātā reticulated network is supplied by 1 No. WTP (outlined in Section 2.1.2.3). There are no defined pressure zones within the reticulation network. All supplies on this network are restricted.

Controls configuration – The scheme is operated on demand driven by maintaining a minimum level within each reservoir (refer to the Hororātā Network CCP in Hororātā Water Supply Unit Process Control Procedure (DW-SEL-04-DST-0004)). There is no pressure monitoring in the reticulated network. It should be noted that for periods of operation the operator may choose to vary the start and stop level of the reservoir. These changes are made using operator discretion and are based on system demand. For further details of the system configuration and controls, refer to Hororātā Water Supply Unit Process Control Procedure (DW-SEL-04-PCD-0004).

Condition – The age of the Hororātā network varies significantly with installations from 1973 to 2018, SDC have an ongoing renewals programme. The network has three pipe types and several material types these are summarised in Table 2-12 and Table 2-13. The network comprises (~74%) water-pipe-mains, (~22%) water-pipe-rider and (~5%) water-lateral-pressure.

The 2019 Water Balance and Review for Selwyn District Council's Water Supply Systems (Thomas Consultants Ltd., 2019) indicated the Infrastructure Leakage Index (ILI) to be 1.6 for the combined Hororātā and Acheron Water Supply Schemes. This equates to a Percentage Real Losses of 18.4%.

PVC-U is the predominant pipe material in this network, although there is also some sections with PE pipe. Network information is also shown in Appendix F – Hororātā Drinking Water Supply Water Model Maps.

Table 2-12: Hororātā Water Supply Total Pipe

Pipe Type	Asset Length (m)	% Pipe Type
Water-Lateral-Pressure	6,816	4.8 %
Water-Pipe-Main	104,226	73.6 %
Water-Pipe-Rider	30,564	21.6 %
Total	**141,606**	**100.0 %**

Table 2-13: Hororātā Water Supply Network – Material Type and Age

Material Type	Class-Combo	Min Age	Max Age	Total Length (m)	% Material Type
PE100	Water-Lateral-Pressure	14/01/2014	14/01/2014	2	0.0
PE80	Water-Lateral-Pressure/ Water-Pipe-Main/ Water-Pipe-Rider	01/02/2016	01/01/1980	23,560	16.7
HDPE	Water-Lateral-Pressure/ Water-Pipe-Main/ Water-Pipe-Rider	02/06/2011	31/12/1973	5,233	3.7

Material Type	Class-Combo	Min Age	Max Age	Total Length (m)	% Material Type
LDPR	Water-Pipe-Main	15/08/2000	15/08/2000	21	0.0
MDPE	Water-Lateral-Pressure/ Water-Pipe-Main/ Water-Pipe-Rider	12/04/2018	01/12/1980	13,978	9.9
PVC-U	Water-Lateral-Pressure/ Water-Pipe-Main/ Water-Pipe-Rider	01/01/2011	31/12/1975	98,705	69.8
ST-GL	Water-Pipe-Main	15/06/2017	15/06/2017	0	0.0
Total				**141,498**	**100%**

Data source: 5W asset data extract, report date 25/03/2020, note small discrepancy in totals between tables by pipe type and by material type due to some blank (unaccounted for) pipe data.

Network management strategy - SDC implement a range of items to demonstrate management of the reticulation network, these are being progressed into a developed Network Management Strategy. This will include detail on correlation between:

- Network modelling
- Demand management (including seasonal variability)
- Asset management (history, maintenance etc.)
- Renewals programme of works
- Water age assessments
- Asset criticality
- Pressure monitoring
- Critical Control Points
- Backflow prevention policy
- Pump station control descriptions

System vulnerabilities – Based on current operational experience, the following areas of vulnerability exist within the Hororātā Water Supply Scheme. These vulnerabilities have been reviewed in the preparation of the risk assessment, including consideration of preventive measures in place to manage the network, and where there are known vulnerabilities. Action items have been included in the Improvement Plan in Section 6.

- Catchment management - to encompass a holistic view of the drinking water supply improved liaison with ECan and study of ground water quality within the water supply protection zones are being investigated.
- Chlorine dosing – automate chlorine dosing and monitor concentration at WTP and throughout the network
- Access to infrastructure – improve access to Harper Hills reservoir and review access to water mains located through private properties
- Backflow – there is currently a district wide backflow prevention project underway
- Bulk water extraction – due to increasing construction across the district an update to the bulk water extraction policy and procedure is being investigated

- Pipe from intake to WTP – inspect and conduct a condition assessment of the pipe from the intake to the WTP, there is only one pipe and the condition is unknown

Planned improvements – planned improvements for the Hororātā Water Supply Scheme, currently approved with budget in accordance with the Selwyn District Council Long Term Plan (LTP) and Annual Plan (AP) are listed in Table 2-14.

Table 2-14: Planned Improvements to the Hororātā Drinking Water Supply Scheme

Account Label (Capital, Renewals, or OPEX)	Site	Description	CAPEX Value ($)	Timing
Capital	Atkins Road Reservoir	Storage Upgrade	$461,250	30/06/2021
Renewals	Hororātā	P&E (plant and equipment) Linear (pipes)	$18,931 $370,000	30/06/2020 30/06/2030
Renewals	Hororātā	Consent renewals	$61,000	30/06/2030

2.1.3 Microbiological log reduction values (LRV)

2.1.3.1 Target and cumulative log reduction value (LRV) approach

DWSNZ make use of the cumulative Log Reduction Values (LRV) approach for protozoal compliance. These LRV values can be extended for other microbiological classes (e.g. bacteria and viruses) but are not required as part of the current version of the drinking water standard (although this may be required in the future).

The target log reduction value for source waters has been developed on the basis of the catchment hazard assessment, and consideration of secure borewater status. The Target LRV is determined for each water source and must therefore be considered individually.

The following types of treatment processes can be used to gain log reduction credits:

- Pre-treatment (e.g. roughing filters, pre-treatment storage etc.);
- Coagulation, flocculation and sedimentation (e.g. clarifier, dissolved air flotation etc.);
- Filtration (e.g. cartridge, membrane filtration etc.); and
- Disinfection (e.g. Ultra Violet Disinfection or Chlorine Disinfection etc.).

SDC apply filtration and UV disinfection to meet treatment requirements based on water quality, with log reduction credits as outlined below.

Filtration log reduction credits: SDC utilise 3M cartridge filters with 1-micron and 5-micron cartridges. At present the 1-micron 3M is the only system validated against the requirements of the DWSNZ. This requires

each filter round to be set to a maximum flow of 9.33 l/s. For cartridge filters that are installed to meet this criteria, 2-protozoa log credits can be claimed.

The cartridge filters at the Homebush WTP are required for protozoal compliance therefore only 1-micron cartridges are used. These and the instrumentation and monitoring provide compliance with Section 5.12.1 of the DWSNZ.

Disinfection log reduction credits: SDC utilise Trojan and Wedeco ultraviolet disinfection systems, these are validated within a UVT% and flow range specific to each unit and its application. SDC have chosen UVDGM validation for UV systems. For details of the system used at Homebush WTP refer to Hororātā Water Supply Unit Process Control Procedure (DW-SEL-04-DST-0004).

2.1.3.2 Hororātā Water Supply microbiological log reduction credit (LRC) assessment

The Hororātā water supply LRC assessment is shown in Table 2-15. Sufficient log-credit are provided based on catchment target log-credit and validated UV systems. If changes within the catchment affect the target log credit or the water supply is operated outside filter or UV validation a review of treatment log credits will be required to ensure continued compliance.

Table 2-15: Hororātā Water Supply – Cumulative Log Reduction Credits

Bore	Water Treatment Plant	Catchment Hazard Assessment Log Credit	Bore Water Security Status[9,10] (as of 14 February 2020)[11]	Target Log Reduction Value with Secure Status Applied	Filtration	Primary Disinfection[12]	Chlorination	Cumulative Log Reduction Value (LRV) Claimed	Log Credit Deficit / Comments
Glentunnel Intake, Selwyn RWS	Homebush Road WTP	Protozoa - 4	Currently deemed non-secure (surface water source – secure bore status is unachievable)	Protozoa – 4	Cartridge filtration Viruses – N/A Bacteria – 0 Protozoa – 2 Validated 1 µ cartridges used	Ultraviolet Disinfection Viruses - N/A Bacteria – 3 [13] Protozoa – 3 System is validated against UVDGM	Chlorine gas dosing Viruses – N/A Bacteria – 0 Protozoa – 0	Viruses – N/A Bacteria - 3 Protozoa - 5	Sufficient log-credits are provided based on the validated filter and UV systems. If changes in the catchment affect the target log credit or the water supply is operated outside filter and UV validation a review of treatment log credits will be required.

[9] Bore water security compliance as defined in Section 4.4 of the DWSNZ. Secure and interim are deemed to satisfy the protozoal compliance criteria.
[10] Non-secure status based on letter from Canterbury District Health Board to SDC titled "Bore Water Security Assessment Report – Drinking-water Standards for New Zealand (Revised 2018)
[11] Secure status based on comments provided by SDC to Jacobs in an email on 3 December 2019.
[12] UV systems have a 4-log virus removal, DWSNZ is silent on virus removal until further techniques are available and can be demonstrated effective.
[13] Bacterial 3-log removal shown in the UV Disinfection: Evidence of Validation and Issues Related to Compliance, 13 June 2019.

2.2 Assessment of water quality data

An assessment of raw water and treated water quality has been undertaken to understand historical source water characteristic and variability, especially related to treatability, hazards and system performance over time.

The SDC Drinking Water Compliance Monitoring Plan (DW-GEN-05-DST-0002) outlines details of the water quality assessment undertaken by SDC as part of their ongoing management of drinking water quality.

Source water quality has been assessed as part of the CHA, refer to Appendix C – Hororātā Drinking Water Supply Catchment Hazard Assessment for details. This includes, assessment of regional groundwater quality, and site-specific groundwater quality, as summarised below.

2.2.1 Regional groundwater quality

ECan undertakes monthly monitoring of groundwater quality in the Selwyn-Waihora Canterbury Water Management Strategy Zone (CWMSZ). ECan (2018) notes that the Selwyn-Waihora CWMSZ has:

- One of the highest proportion of sources with increasing nitrate-nitrogen (nitrate) trends;
- Three bores with nitrate concentrations greater than the health-based maximum acceptable value (MAV) in the DWSNZ (Note: these bores do not supply the Hororātā Drinking Water Supply Scheme); and
- Four wells with iron concentrations above the aesthetic-based guideline value (GV) in the DWSNZ, which is likely to be naturally occurring within the aquifer.

A nitrate risk map prepared for the Canterbury region indicates that the majority of the Selwyn-Waihora CWMSZ has a moderate nitrate risk (ECan, 2017), including with the protection zones identified for each supply source. A moderate nitrate risk is present in areas where it is unknown if a groundwater sample collected from a source will have nitrate concentrations exceeding the MAV.

In addition, surface water quality for the Selwyn River between 2004 and 2018, as measured at Whitecliffs Road (approximately 4.5 km upstream of the supply well) indicates the following:

- Five-year median *E.coli* count is 56.5 MPN/100 mL. Maximum *E.coli* count is >2,420 MPN/100ml;
- Five-year median total nitrogen concentration is 0.32 mg/L. Maximum nitrogen concentration is 2.0 mg/l;
- Five-year median ammoniacal nitrogen concentration is 0.005 mg/L. Maximum ammoniacal nitrogen concentration is 0.2 mg/l; and
- Five-year median dissolved reactive phosphorus (DRP) concentration is 0.002 mg/L. Maximum DRP concentration is 0.016 mg/l.

2.2.2 Site-specific groundwater quality

A summary of the specific water quality issues at the Hororātā intake is presented in to Appendix C – Hororātā Drinking Water Supply Catchment Hazard Assessment and in Table 2-16. There have been numerous *E.coli* transgressions but no chemical transgressions.

Table 2-16: Summary of groundwater quality at each supply well within the Hororātā Drinking Water Supply Scheme

Source Name	Glentunnel Intake, Selwyn RWS
Well ID	L35/0215
E.coli transgressions between 22 March 2012 and 29 June 2017[14]	779 samples and 285 *E.coli* transgressions reported *E.coli* counts, when transgressions were reported, ranged from 1 to 201 MPN/100 ml.
E.coli transgressions between 1 July 2017 and 17 June 2019[15]	Total of 305 transgressions between 1 July 2017 and 17 June 2019 *E.coli* counts ranged from 1 to ≥ 200 (cfu/100 mL).
Summary of chemical analysis between 2008 and 2019[16]	All chemical constituents analysed and reported were below GV and/or MAV in the DWSNZ for samples collected between 2008 and 2019. Nitrate concentrations ranged from 0.13 g/m^3 to 1.002 g/m^3.

2.2.3 Water quality analysis

2.2.3.1 Water quality data

The Hororātā Drinking Water Supply Scheme water quality analysis has been completed across a 12-month period and summarised in Table 2-17. The Hororātā water supply is considered a surface water source so there is some variability in the quality of the source water. The UV disinfection unit is rated to enable effective inactivation as low as 70 UVT% which is in line with the minimum UVT allowable in DWSNZ.

The data retrieved from complaints associated with the Hororātā Water Supply Scheme notes instances of chlorine smell or high chlorine concentration. It should also be noted that cyanobobacterial blooms have occurred in the Selwyn River. Monitoring of this in accordance with procedures adapted from the New Zealand Guidelines for Cyanobacteria in Recreational Waters refer to the Drinking Water Quality Compliance monitoring Plan (DW-GEN-05-DST-0002). The cyanobacteria data for 2019 shows a peak coverage of 34 % occurred in January. Observations were taken in January, November and December. The average coverage in January was 15 % and 2 % for November and December.

Table 2-17: Hororātā Water Supply Water Quality Summary

Location	Parameter	Units	Average	Minimum	Maximum
Glentunnel Intake, Selwyn RWS	*E.Coli* (1)	cfu/100ml	1.97	<1	36
	Total Coliforms (1)	cfu/100ml	7.8	<1	≥200

[14] Summary of *E.coli* transgressions provided in spreadsheet provided to Jacobs from SDC titled "R900_SampleWizDetail_source".
[15] Summary of *E.coli* transgressions provided to Jacobs by SDC in a spreadsheet titled 'All *E.coli* Transgressions – Since 1 July 2017. Only source data is reported.
[16] Summary of chemical analysis based on spreadsheets titled "Chemical Analysis (Ju 08, Jan11, jan13, Mar15)", "Full Chemical Analysis Feb 2017 – FHS", "Full Chemical Analysis Apr 2018 – FHS", and "Full Chemical Analysis Feb 2019 – FHS" containing water quality data provided to Jacobs by SDC in April, June, and December 2019.

Location	Parameter	Units	Average	Minimum	Maximum
G00822	Turbidity (1)	NTU	0.27	0.11	1.02
Homebush Road WTP TP01344	*E.Coli* (1)	cfu/100mL	<1	<1	<1
	Total Coliforms (1)	cfu/100mL	<1	<1	<1
	Turbidity (1)	NTU	0.23	0.10	0.80
	FAC (2)	mg/L	1.22	0.46	1.96
	pH (1)	N/A	6.97	6.62	7.30
Hororātā Reticulation SEL001HO	*E.Coli* (3)	cfu/100mL	<1	<1	<1
	Total Coliforms (3)	cfu/100mL	<1	<1	<1
	Turbidity (3)	NTU	0.33	0.14	2.61
	FAC (3)	mg/L	0.89	0.40	1.50

Note:
(1) 2nd January 2019 to 19th December 2019
(2) 4th June 2019 to 28th May 2020
(3) 3rd January 2019 to 16th December 2019

2.2.3.2 Chemical determinands

Chemical determinands testing is undertaken on a suite of chemical determinands for each of the SDC water sources. The frequency of testing has increased over time, from 3-yearly, to 2-yearly and annually since 2017. Chemical determinand test results for Hororātā Water Supply are provided in Appendix D – Hororātā Drinking Water Chemical Determinand Data.

Table 2-18 provides a list of chemical determinands that are tested for across all SDC schemes.

Table 2-18: List of Chemical Determinands

Chemical Determinand
Total Arsenic
Total Cadmium
Total Chromium
Total Lead
Total Nickel
pH
Total Alkalinity
Free Carbon Dioxide
Total Hardness
Electrical Conductivity
Electrical Conductivity
Approx. Dissolved Salts
Total Boron
Total Calcium
Total Copper
Total Iron
Total Magnesium
Total Manganese
Total Potassium
Total Sodium
Total Zinc
Chloride
Nitrate-N
Sulphate

Nitrate trends for the Hororātā Water scheme are shown in Figure 2:4 as Nitrate-N annual results (2008-2019) for all water supply sources. Annual chemical analysis is used to identify trends or exceedances in 50 % MAV which may trigger the requirement for more frequent testing.

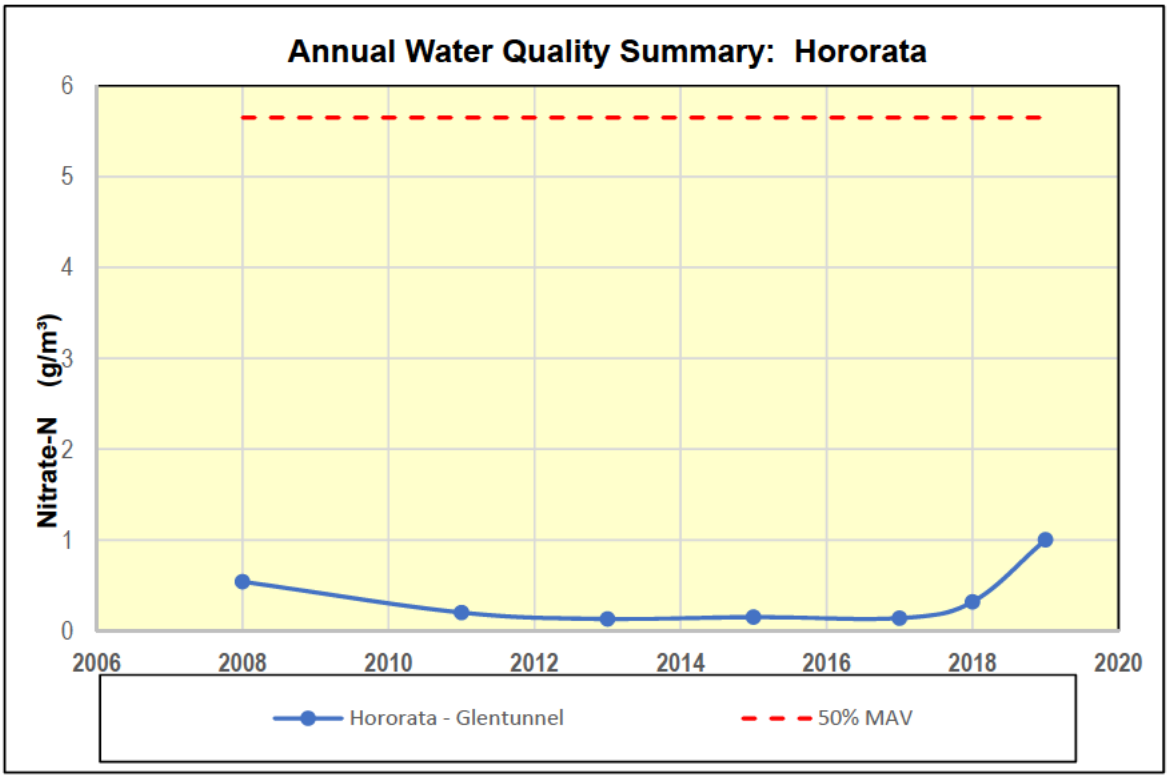


Figure 2:4 Hororātā Water Quality Summary Nitrate, 2008 – 2019

There are no particular contaminants of concern for Hororātā so no testing over and above the regular annual monitoring is conducted.

2.2.3.3 Water quality transgressions

The plant and network *E.coli* transgressions for the Hororātā Drinking Water Supply Scheme from 1st January 2015 to 31st December 2019 are summarised in Table 2-19. It should be noted that this is considered a surface water take and there have been 456 source *E.coli* transgressions over this period these are not listed individually as there is treatment in place to treat this source water.

Table 2-19: Summary of Water Quality Transgressions for Hororātā Drinking Water Supply Scheme

Sample Number	Component	Code	Type	Date	Purpose	Determinand	*E.coli* (cfu/100mL)
Unknown	Homebush Road WTP	TP01344	Plant	04-01-16	Monitoring	*Ecoli*	25
Unknown	Homebush Road WTP	TP01344	Plant	28-02-16	Monitoring	*Ecoli*	1

A review has been undertaken on water quality incidents over the past 5 years. The incidents are summarised in Table 2-20. Any outstanding incidents or actions are covered in Appendix B – Hororātā Drinking Water Supply Risk Assessment.

Table 2-20: Summary of Water Quality Incidents Hororātā Water Supply

Date	Time	Details of incident	Measures taken to rectify incident	Learnings	Corrective actions
2017	N/A	Chlorine smell and taste	Complaints of chlorine smell and taste. Chlorine residual measured at the relevant properties.	Issues related to household plumbing.	Household owners informed to contact a plumber to resolve the issues.

2.3 Hazard and hazardous event identification and risk assessment

An important component of the Water Safety Plan is the risk assessment methodology, which informs the allocation of risk levels (derived from the product of consequence and likelihood) and resulting identification of preventive measures and improvement plan items.

SDC's drinking water management system incorporates risk assessment methodology undertaken across all drinking water schemes, details can be found by referring to Section 5 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001).

2.3.1 Select risk assessment methodology

SDC have developed a risk assessment methodology in line with the Drinking Water Safety Plan Framework (MoH, 2018b), the Handbook for Preparing a Water Safety Plan (MoH, 2019) and World Health Organisation (WHO) Water Safety Plan Manual (WHO, 2019).

The Hororātā Drinking Water Supply Scheme Risk Assessment was developed through:

- Risk Assessment Workshop - 2 March 2020 attendees included:
  - Murray England (Asset Manager Water Services)
  - Leila Dadian (SDC Water Quality Engineering Officer)
  - Dave Maccoll (SDC Asset Systems Officer)
  - Marcia Jones (SDC Water Engineer)
  - David Potts (SDC Water Engineer)
  - Daniel Crequer (Water Services Supervisor – SICON)
  - Jim Beresford (Water Services Contract Manager – SICON)
  - Becky Macdonald (Principal Water Engineer – Jacobs NZ Ltd)
  - Jessica Hamilton (Graduate Water Engineer – Jacobs NZ Ltd)
  - Elaine McLaren (Water Engineer – Jacobs NZ Ltd)
- Follow-up conversations with SDC Water Services Team and Operations & Maintenance Contractor (SICON)

SDC's drinking water management system incorporates risk assessment methodology undertaken across all drinking water schemes, details can be found by referring to Section 5 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001). A summary of the likelihood and consequence descriptors are in found in Appendix B – Hororātā Drinking Water Supply Risk Assessment.

SDC have chosen to make use of the risk matrix provided by Ministry of Health (2019) with an additional likelihood category, of 'Very Rare'. SDC's adopted risk matrix is shown in Appendix B –

Hororātā Drinking Water Supply Risk Assessment and detailed in the SDC Drinking Water Framework (DW-GEN-00-PLN-0001).

3. Preventive measures for drinking water quality management

3.1 Hororātā Water Supply - Multiple barrier assessment

An assessment of the water supply scheme has been undertaken, this assessment has included identifying and reviewing existing barriers for their effectiveness. Each barrier is considered to be effective, partially-effective or non-effective. For each barrier type, a definition of effectiveness has been developed to enable an objective assessment and comparison of each. These definitions can be found in Section 6.1 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001).

For each water supply source, the multiple barrier principal has been reviewed and considered within the scheme risk assessment, and if required further preventative measures have been included in the risk assessment table alongside the hazards and hazardous events they address. Refer to Appendix B – Hororātā Drinking Water Supply Risk Assessment.

The Hororātā Drinking Water Supply Scheme consists of 1 No. shallow groundwater intake, and 1 No. water treatment plant feeding into the same interconnected network. There is a need to assess the system as a whole and consider its component parts to understand whether there are vulnerabilities within the system.

Table 3-1 summarises the multiple barrier assessment for Hororātā Water Supply Scheme.

For each water supply source within the scheme, an assessment has been undertaken against the multiple barrier principle, Table 3-2 details this assessment. This assessment has been undertaken based on the current water supply configuration (as of March 2020), and should be read in conjunction with the water supply schematics for the scheme (refer to Appendix A – Hororātā Drinking Water Supply Schematics).

Table 3-1: Assessment of Hororātā Water Supply Scheme Multiple Barriers

Barrier No.	Barrier Type	Assessment	Status
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]

Recommendation – The assessment of the Hororātā Water Supply Scheme has concluded that each of the barrier types (excluding prevention) are present. However, the status of the maintain barrier is partially effective. As this is a surface water source it is not possible to implement an improvement which would achieve barrier 1 (source protection).

To raise the status of barrier types to "effective" or to add additional barriers the following actions would be required:

- Install additional chlorine and pressure monitoring within the network and complete documentation of the network management strategy.

Table 3-2: Multiple Barrier Assessment – Hororātā Water Supply Scheme

WINZ Code	Source – Groundwater Well/Bore	Treatment Plant	Barrier 1 PREVENTION	Barrier 2 PHYSICAL REMOVAL		Barrier 3 INACTIVATION			Barrier 4 MAINTAIN	Recommendations to be considered in preventative measures assessment
			Borehead Protection	Selective Abstraction	Cartridge Filtration	UV Disinfection	Chlorine Disinfection	Chlorine Residual	Network Management	
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

3.1.1 Calculation of residual risk

The residual risk has been calculated for the combination of preventive measures associated with each hazard and hazardous event using the documented risk assessment methodology as outlined in Section 5 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001). Residual risk has been determined for the combination of preventive measures.

The failure of preventative measures will trigger an emergency response plan to be initiated (refer to Section 7 of this document and Section 8 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001).

The residual risk for each combination of hazards/hazardous events is shown in the risk assessment, presented in Appendix B – Hororātā Drinking Water Supply Risk Assessment.

3.2 Identification of additional preventive measures

The residual risk for each hazard and hazardous event is assessed against their predetermined level of acceptable risk. All residual risks medium or greater are deemed as unacceptable.

An assessment of additional preventative measures to manage and reduce these risks to an acceptable level has been undertaken. This includes short-term, measures for managing the risk until long-term (permanent) measures are in place.

Refer to Section 6 Improvement Plan for details of the improvement actions, including timing, responsibility and financial cost. The risk assessment refers to relevant improvement actions associated with mitigating each hazardous event further.

4. Operational procedures

SDC have established a consistent approach across all drinking water schemes to operations and maintenance this includes, asset information, standardisation (where practicable) of procedures, operational staff training and contract requirements.

4.1 Operational procedures

For each scheme a UPCP has been prepared, the UPCP provides the operations and maintenance teams with full information on the elements of the water scheme, including:

- Scheme information;
- Operational Monitoring Control Points (OMCPs) and Critical Control Points (CCPs);
- Control Systems Details (including alarms and set-points);
- Corrective actions and troubleshooting details;
- Equipment information and maintenance details;
- Equipment inspection and validation details; and
- Links to relevant SOPs.

The Hororātā Water Supply Unit Process Control Procedure (DW-SEL-04-DST-0004) should be referred to for all scheme specific information relating to operations and maintenance of the scheme assets. The Standard Operating Procedure Master List provides a list of standard operational procedures relevant all SDC drinking water schemes. This list is indicative as it is always under review, for live version refer to Standard Operating Procedures Master List (DW-GEN-04-REG-0009).

Training records – Training is provided to all staff members involved in the operations and maintenance of drinking water supply scheme. For more information refer to SDC Drinking Water Framework (DW-GEN-00-PLN-0001).

4.2 Operational monitoring and inspection

Operational monitoring and inspection plans for assessing the plant, including satisfactory operation of preventive measures, are covered in the Hororātā Water Supply Unit Process Control Procedure (DW-SEL-04-PCD-0004) and Standard Operating Procedures Master List (DW-GEN-04-REG-0009).

The maintenance schedule task and frequency for the water equipment, WTP and reservoir facility checks is also briefly summarised in C1241 (Part E Technical Specifications for water). All tasks are programmed into AMIS for allocation to operations staff.

A log of the operational monitoring/inspection undertaken, is kept with sign-off by the person responsible when each action is complete, with records maintained on-site and associated with tasks in AMIS. The Hororātā Water Supply Unit Process Control Procedure (DW-SEL-04-PCD-0004) provides a summary of maintenance schedule including task and frequency for the water equipment, WTP and reservoir facility checks.

SDC also undertake routine spot check site inspections across the district on an ongoing basis.

4.2.1 Operational parameter selection

The Hororātā Water Supply Unit Process Control Procedure (DW-SEL-04-PCD-0004) should be referred to for all scheme specific information relating to operations and maintenance of the scheme assets, this includes details of operational parameter selection and critical control points.

4.2.2 Sampling/observation frequency

The SCADA system monitors and records water scheme performance on an on-going continuous basis, including:

- Daily water usage;
- Pump hours and starts;
- Reservoir levels;
- Well levels;
- Network pressure;
- Alarm status; and
- Chemical dosing.

SMS alerts are sent to on-call operators for critical alarms to ensure a timely response.

4.2.3 Target criteria, triggers and critical limits

The Hororātā Water Supply Unit Process Control Procedure (DW-SEL-04-DST-0004) should be referred to for all scheme specific information relating to operations and maintenance of the scheme assets this includes details of operational parameter selection. This includes target criteria and critical limits triggering corrective or emergency action.

Note: Excursion of an operational parameter up to or outside the critical limits indicates that control of a preventive measure has been lost and an immediate corrective action is needed.

4.2.4 Result analysis

The SCADA system is used for continuous monitoring of the drinking water supply and providing alerts to the Water Operations team to warn of any issues 24 hour a day seven days a week. The SCADA system is monitored by the both the Water Engineer and the Asset Systems Officer, to ensure trends and changes in system performance are identified and modified as required. Operational monitoring feeds into long-term evaluation results.

Operational monitoring feeds into long-term evaluation results as outlined in Section 11 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001) and SDC Drinking Water Quality Compliance Monitoring Plan (DW-GEN-05-DST-0002).

4.3 Critical control points

The functioning of the water supply system requires ongoing monitoring, Table 4-1 summarises the Critical Control Points (CCPs) and Operational Monitoring Control Points (OMCPs) within the Hororātā Water Supply Scheme. A definition for a CCP and OMCP is provided in Section 4.3 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001) Document-controlled version is maintained in

Hororātā Water Supply Unit Process Control Procedure (DW-SEL-04-DST-0004). These CCPs and OMCPs are also shown in the drinking water supply schematics (Section 2.1).

Table 4-1: Critical Control Point and Operational Monitoring Control Point Summary

WINZ Code	Source	Treatment Plant	Critical Control Points (CCP)	Operational Monitoring Control Points (OMCP)
G00822	Glentunnel Intake, Selwyn RWS	Homebush Road WTP	• Auto-Flushing Turbidity • Filter Differential Pressure • UV Disinfection (UVT%, UV Dose, Turbidity) • Chlorine Dosing Control (High/Low Dose)	• Raw Water Sample Point • Post-UV Sample Point • Post-Reservoir Sample Point • Reservoir Level Gauge
Hororātā Water Supply Network			• Network Chlorine Monitoring Points • Network Water Sample Points	

CCPs and OMCPs, for each of the WTPs are maintained within the Hororātā Water Supply Unit Process Control Procedure (DW-SEL-04-DST-0004), this includes reference to Corrective Action Plans. For each CCP and OMCP, details are provided for each parameter including target criteria, action limits and critical limits, linked to predefined corrective actions and relevant SOPs.

4.4 Additional monitoring

The following are in place to ensure that the CCPs and OMCPs are monitored and managed:

1. On-call Operations Team – any alarms or alerts are issued to the operations team 24 hours a day, seven days a week.

2. Laboratory sampling – sampling for *E.coli*, Total Coliforms (T.C) and Turbidity (with pH and Free Available Chlorine (F.A.C) monitoring as required) with Transgression reporting to the Operations Team for consultation with the Drinking Water Assessor as per the following procedures:

    - SDC Drinking Water Compliance Monitoring Plan (DW-GEN-05-DST-0002)
    - SDC Drinking Water Incident and Emergency Management Plan (DW-GEN-07-DST-0006)
    - SDC Drinking Water Transgression Response Plan (DW-GEN-07-DST-0007)

4.5 Corrective actions

SDC have a set of drinking water SOPs (as outlined in Section 4.1 Operational procedures). A number of these SOPs, relate specifically to corrective actions.

The Hororātā Water Supply Unit Process Control Procedure (DW-SEL-04-DST-0004) provides details of the corrective actions to be taken if CCP or OMCP's action or target limits are out of range/specification. The corrective action are linked to SOPs where applicable. When these corrective actions are unable to return the system to within the acceptable target ranges, an emergency response plan will be activated. For more information on emergency escalation refer to Section 7 Management of incidents and emergencies.

A review of corrective actions is undertaken following a drinking water incident or emergency, as outlined in SDC Drinking Water Incident and Emergency Management Plan (DW-GEN-07-DST-0006). This includes review of why the corrective action was needed, how effective the monitoring and inspection plan and corrective action were, and whether the WSP needs to be updated as a result.

Table 4-2 provides a list of procedures for corrective actions that are triggered by exceeding target criteria or critical limits. These procedures can be found in the Standard Operating Procedures Master List (DW-GEN-04-REG-0009).

Table 4-2: Corrective action procedures list

Equipment	CCP/OMCP	SOP Reference
Auto-Flushing: Turbidity	CCP/OMCP	SOP-305 Corrective action (auto-flushing) for turbidity alert and critical alarms
Filtration: Differential Pressure	CCP	SOP-306 Corrective actions for filter differential pressure alarms
UV Disinfection: (Turbidity, UV dose, UVT%)	CCP	SOP-304 Corrective actions for UV disinfection out of target range
Chlorine Dosing	CCP	SOP-307 Chlorine feed flow corrective actions
Storage Reservoir	OMCP	SOP-311 Corrective actions for reservoir level out of target range
Network	OMCP	SOP-301 Corrective actions for contaminated water in the reticulation network SOP-312 Corrective actions for low network pressure

5. Verification monitoring programme

5.1 Drinking water quality monitoring

Refer to Section 3 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001).

5.2 Short-term evaluation of results

Refer to Section 3.1 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001)

6. Improvement plan

6.1 Drinking water quality management improvement plan

Inclusion of an improvement plan in a WSP is a statutory requirement. Section 69Z(2)(a)(v) of the Health Act 1956 requires that a WSP 'set out a timetable for managing the public health risks that have been identified as being associated with the drinking water supply'. The Improvement Plan for the Hororātā Water Supply Scheme is shown in Appendix G – Hororātā Drinking Water Supply Improvement Plan and has been derived from Appendix B – Hororātā Drinking Water Supply Risk Assessment. A master Improvement Plan Register is maintained which covers scheme specific and general actions. For information on the improvement action types and prioritisation refer to Section 7 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001).

7. Management of incidents and emergencies

7.1 Incident and emergency response plans

SDC's drinking water management system incorporates management of incidents and emergencies undertaken across all drinking water schemes, details can be found by referring to Section 8 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001) and SDC Drinking Water Incident and Emergency Plan (DW-GEN-07-DST-0006).

The SDC Drinking Water Incident and Emergency Plan (DW-GEN-07-DST-0006) sets out the emergency and incident management planning processes and response plans as they relate to all drinking water schemes managed by SDC. This plan does not cover non-drinking water services, such as wastewater, stormwater, or water races.

The plan is complementary to existing lifelines utilities and civil defence protocols and integrates with existing management planning, roles and responsibilities according to the Civil Defence Emergency Management Act (2002) and Selwyn District Council Lifeline Utilities Response Plan (Selwyn District Council, 2016). The plan is intended to supplement these protocols and systems, to enable focused preparation and response specifically to drinking water related emergencies and incidents.

7.1.1 Communication

SDC's drinking water management system incorporates management of incidents and emergencies undertaken across all drinking water schemes, details can be found by referring to Section 8 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001) and SDC Drinking Water Incident and Emergency Plan (DW-GEN-07-DST-0006).

8. Documenting and reporting

8.1 Management of documentation and records

SDC's drinking water management system incorporates management of documentation and records undertaken across all drinking water schemes, details can be found by referring to Section 10.1 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001).

8.2 Reporting

SDC's drinking water management system incorporates reporting requirements undertaken across all drinking water schemes, details can be found by referring to Section 10.2 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001).

8.2.1 Internal reporting

Refer to Section 10.2 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001).

8.2.2 External reporting

Refer to Section 10.2 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001).

8.2.3 Annual reports

Refer to Section 10.2 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001).

9. Investigations

9.1 Investigative studies

Investigative studies are required when there is evidence of unsatisfactory performance of an aspect of the drinking water supply (known as problem-targeted), or strategic investigations required to gather information about the supply that allow the supplier to maintain and improve drinking water quality.

Investigations should be used as a means to validate unknown issues, identify options for remediating issues and to plan long term supply solutions for the drinking water supply.

Table 9-1 lists the investigations that are currently planned for Hororātā Water Supply Scheme.

Table 9-1: Hororātā Water Supply - Investigation Activities

Activity	Criteria for investigation	Accountability	Investigation required	Actions taken	Reported to
Nitrate levels	>50% MAV, trending upwards	Water Quality Officer	Review trending of nitrate levels in bores	Report trends annually	Water Services Delivery Manager
Water Conservation	Sustainable water use	Water Engineer	Review success of summer initiatives against agreed level of service (LoS)	Monitored weekly all year round Consideration of restrictions vs. education made through summer high demand periods Educational messages issued as required during that period	Water Services Delivery Manager
Water supply capacity master planning	Ensure funding of assets to meet growth demand	Asset Manager	Review population growth predictions for Hororātā, develop hydraulic water models and run / test future growth predictions	Incorporate findings into 3 yearly AMP review	AMP leads into LTP and consultation documents
Impact of climatic cycles and trends on water supplies	Resilience and sustainable water supplies	Asset Manager	Review of the Impact of climatic cycles and trends on water supplies on a district wide basis	Incorporate findings into 3 yearly AMP review	AMP leads into LTP and consultation documents

9.2 Validation of equipment, processes and practice

Validation takes on many forms, frequencies and methods to ensure continued effectiveness of each as a preventative measure.

SDC have in place a number of systems and practices to ensure validation of each, these are summarised in Section 9.2 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001).

10. Oversight review and continual improvement

10.1 Long-term evaluation of results

SDC's drinking water management system incorporates long-term evaluation of results and trends across all drinking water schemes, details can be found by referring to Section 11.1 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001).

10.2 Audit of drinking water quality management

SDC's drinking water management system incorporates auditing and continuous improvement initiatives across all drinking water schemes, details can be found by referring to Section 11.2 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001).

10.2.1 Internal audit

Refer to Section 11.2 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001).

10.2.2 External audit

Refer to Section 11.2 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001).

10.3 Review by senior leadership

SDC's drinking water management system incorporates processes for review by senior leadership undertaken across all drinking water schemes, details can be found by referring to Section 11.3 of SDC Drinking Water Framework (DW-GEN-00-PLN-0001).

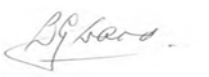
Prior to submitting this Water Safety Plan for Hororātā Water Scheme, the following senior leadership have reviewed the contents, and endorsed Improvement Plan as outlined in Section 6 of this document.

Selwyn District Council – Group Manager Infrastructure

Name: Murray Washington

Date: 25.06.2020

Selwyn District Council – Chief Executive Officer



Name: David Ward

Date: 25.06.2020

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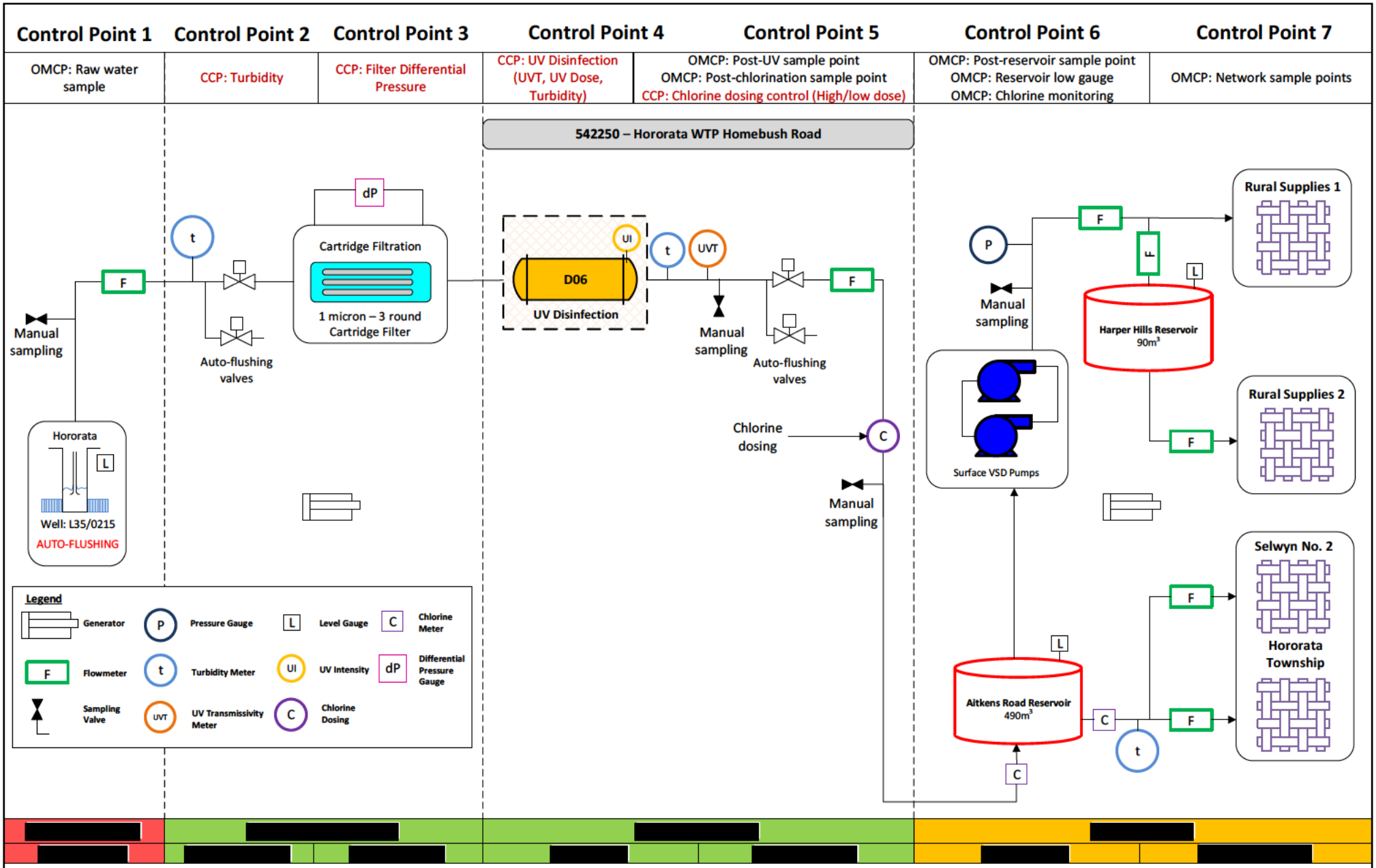
Appendix A – Hororātā Drinking Water Supply Schematics



Note 1: Barrier assessment colours relate to effectiveness (red = non-effective, green = effective, orange = partially effective, white = not applicable). The highest effectiveness is used where there are multiple elements within the one barrier. For a detailed breakdown of barrier effectiveness for each source and treatment unit refer to WSP.
Note 2: One micron filter cartridges must be used.

Appendix B – Hororātā Drinking Water Supply Risk Assessment

Hororātā WTP					Maximum Risk			Residual Risk											
	A	B		C	D	E	F	G		H	I	J	K	L	M	N	O	P	
Hazard Group	Supply element	No.	Hazardous event	Hazards reasonably expected to be associated with hazardous event	Consequence of the hazardous event	Likelihood of hazardous event occurring	Maximum (unmitigated risk (D x E)		Preventative measures	Modified consequences	Overall modified consequence	Modified likelihood of hazardous event occurring	Overall modified likelihood	Residual (mitigated risk) (I x k)	Risk managed	Priority	Uncertainty	Comment	Improvement Plan Actions
		C.01	Presence of various HAIL sites within majority of protection zones causing contamination of shallow groundwater and surface water.	Bacteria/viruses	Major	Unlikely	Medium	PM 51	Sharing of consenting and building information, relating to any new business or potential contamination, within SDC and from external organisations. Corrective actions taken should appropriate MAV trigger levels be reached	Major	Major	Unlikely	Unlikely	Medium	Yes		Reliable	This risk is managed through the following actions - Monitor source water at minimum twice weekly intervals, as per the SDC Drinking Water Quality Compliance Monitoring Plan (DW-GEN-05-DST-0002) to identify potential contaminants (Turbidity, E.coli, UVT) . - A catchment hazard assessment has been completed, this includes modelling of the catchment and potential contamination sources. This shows in relation to bacteria/viruses/protozoa all zones are potentially impacted. The justification for the assigned likelihood and consequence is summarised below There are six HAIL sites identified in PZ2 and PZ3. The HAIL sites identified consist of the following activities/industries - Livestock dip or spray operations - Persistent pesticide bulk storage or use - Mining industries - Engine reconditioning workshops - Landfill site Consequence of this event has been assessed as major. Contamination of the aquifer/river will impact the entirety of the network. The impact will be significant, with the potential for acute illness. Would require the bore or WTP or reservoir to be removed from service while the event is resolved. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence.	
				Protozoa	Major	Unlikely	Medium	PM 51	Sharing of consenting and building information, relating to any new business or potential contamination, within SDC and from external organisations. Corrective actions taken should appropriate MAV trigger levels be reached	Major	Major	Unlikely	Unlikely	Medium	Yes		Estimate	This risk is managed through the following actions - Monitor source water at minimum twice weekly intervals, as per the SDC Drinking Water Quality Compliance Monitoring Plan (DW-GEN-05-DST-0002) to identify potential contaminants (Turbidity, E.coli, UVT). Testing for protozoa is not conducted. The Guidelines for Drinking-water Quality Management for New Zealand (May 2019) shows that for streams or rivers the Cryptosporidium concentration can vary between 2 - 480. Additionally DWSNZ (2017) showed that 1 - 42% of the samples taken in a study contained Cryptosporidium. - A catchment hazard assessment has been completed, this includes modelling of the catchment and potential contamination sources. This shows in relation to bacteria/viruses/protozoa all zones are potentially impacted. The justification for the assigned likelihood and consequence is summarised below There are six HAIL sites identified in PZ2 and PZ3. The HAIL sites identified consist of the following activities/industries - Livestock dip or spray operations - Persistent pesticide bulk storage or use - Mining industries - Engine reconditioning workshops - Landfill site Consequence of this event has been assessed as major. Contamination of the aquifer/river will impact the entirety of the network. The impact will be significant, with the potential for acute illness. Would require the bore or WTP or reservoir to be removed from service while the event is resolved. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The risk of consuming contaminated water is covered within the abstraction section of the risk assessment.	
				Chemical	Moderate	Unlikely	Medium	PM 51	Sharing of consenting and building information, relating to any new business or potential contamination, within SDC and from external organisations. Corrective actions taken should appropriate MAV trigger levels be reached	Moderate	Moderate	Unlikely	Unlikely	Medium	Yes		Reliable	This risk is managed through the following actions - Annual chemical testing. - A catchment hazard assessment has been completed, this includes modelling of the catchment and potential contamination sources. This shows in relation to chemicals all zones are potentially impacted. The justification for the assigned likelihood and consequence is summarised below There are six HAIL sites identified in PZ2 and PZ3. The HAIL sites identified consist of the following activities/industries - Livestock dip or spray operations - Persistent pesticide bulk storage or use - Mining industries - Engine reconditioning workshops - Landfill site No chemical transgressions have been recorded. Consequence has been assessed as moderate. Contamination will impact the entirety of the network. The impact will be significant with the potential for widespread aesthetic issues, or repeated breach of the MAVs.	

Hororātā WTP					Maximum Risk				Residual Risk										
	A	B		C	D	E	F	G		H	I	J	K	L	M	N	O	P	
Hazard Group	Supply element	No.	Hazardous event	Hazards reasonably expected to be associated with hazardous event	Consequence of the hazardous event	Likelihood of hazardous event occurring	Maximum (unmitigated risk (D x E)		Preventative measures	Modified consequences	Overall modified consequence	Modified likelihood of hazardous event occurring	Overall modified likelihood	Residual (mitigated risk) (I x k)	Risk managed	Priority	Uncertainty	Comment	Improvement Plan Actions
		C.02	Contamination through surface water ingress as a result of poor bore security in existing wells and abandoned or incorrectly decommissioned wells (result of an earthquake) and/or through shallow groundwater hydraulically connected to the Selwyn River and receiving contaminants.	Bacteria/viruses	Major	Likely	High	PM 51	Sharing of consenting and building information, relating to any new business or potential contamination, within SDC and from external organisations. Corrective actions taken should appropriate MAV trigger levels be reached	Major	Major	Likely	Likely	High	Yes		Reliable	This risk is managed through the following actions - Monitor source water at minimum twice weekly intervals, as per the SDC Drinking Water Quality Compliance Monitoring Plan (DW-GEN-05-DST-0002) to identify potential contaminants (Turbidity, E.coli, UVT) . - A catchment hazard assessment has been completed, this includes modelling of the catchment and potential contamination sources. This shows in relation to bacteria/viruses/protozoa PZ1 and PZ2 could be impacted. The likelihood and consequence are assigned due to the following reasons - There are other known wells and bores in the catchment, it is also possible that there are additional unknown wells/bores. Consequence of this event has been assessed as major. Contamination of the aquifer/river will impact the entirety of the network. The impact will be significant, with the potential for acute illness. Would require the bore or WTP or reservoir to be removed from service while the event is resolved. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The risk of consuming contaminated water is covered within the abstraction section of the risk assessment.	
				Protozoa	Major	Likely	High	PM 51	Sharing of consenting and building information, relating to any new business or potential contamination, within SDC and from external organisations. Corrective actions taken should appropriate MAV trigger levels be reached	Major	Major	Likely	Likely	High	Yes		Estimate	This risk is managed through the following actions - Monitor source water at minimum twice weekly intervals, as per the SDC Drinking Water Quality Compliance Monitoring Plan (DW-GEN-05-DST-0002) to identify potential contaminants (Turbidity, E.coli, UVT). Testing for protozoa is not conducted. The Guidelines for Drinking-water Quality Management for New Zealand (May 2019) shows that for streams or rivers the Cryptosporidium concentration can vary between 2 - 480. Additionally DWSNZ (2017) showed that 1 - 42% of the samples taken in a study contained Cryptosporidium. - A catchment hazard assessment has been completed, this includes modelling of the catchment and potential contamination sources. This shows in relation to bacteria/viruses/protozoa PZ1 and PZ2 could be impacted. The likelihood and consequence are assigned due to the following reasons There are other known wells and bores in the catchment, it is also possible that there are additional unknown wells/bores. Consequence of this event has been assessed as major. Contamination of the aquifer/river will impact the entirety of the network. The impact will be significant, with the potential for acute illness. Would require the bore or WTP or reservoir to be removed from service while the event is resolved. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The risk of consuming contaminated water is covered within the abstraction section of the risk assessment.	
				Chemical	Moderate	Unlikely	Medium	PM 51	Sharing of consenting and building information, relating to any new business or potential contamination, within SDC and from external organisations. Corrective actions taken should appropriate MAV trigger levels be reached	Moderate	Moderate	Unlikely	Unlikely	Medium	Yes		Reliable	This risk is managed through the following actions - Annual chemical testing. - A catchment hazard assessment has been completed, this includes modelling of the catchment and potential contamination sources. This shows in relation to chemicals all zones are potentially impacted. The likelihood and consequence are assigned due to the following reasons There are other known wells and bores in the catchment, it is also possible that there are additional unknown wells/bores. No chemical transgressions have been recorded. Consequence has been assessed as moderate. Contamination will impact the entirety of the network. The impact will be significant with the potential for widespread aesthetic issues, or repeated breach of the MAVs.	
		C.03	Short- or long-term changes in surface water flows as a result of a reduction in base flow driven by decreases in monthly or annual rainfall (e.g., drought/climate change) and/or reduction in available surface water from upstream surface water abstractions leading to insufficient surface water available to meet demand.	Water demand may not be met	Major	Rare	Medium	PM 51	Sharing of consenting and building information, relating to any new business or potential contamination, within SDC and from external organisations. Corrective actions taken should appropriate MAV trigger levels be reached	Major	Moderate	Rare	Rare	Low	Yes		Confident	This risk is managed through the following actions - Controls and limits placed on units sold - Monitoring of river levels and education to conserve water - Control of water take consents granted - Monitoring of climate patterns and predicted changes The likelihood and consequence are assigned due to the following reasons On one occasion diversion works in the river were required to reinstate this source. This was following a flood in 2015. Consequence has been assessed as major as the population affected would be less than 5,000 and this event would cause a significant compromise of systems and abnormal operation with a requirement for high level monitoring and incident management.	
								HOPM 2	Perform emergency works in the Selwyn River to re-divert flow to well	Moderate		Rare							

Hororātā WTP					Maximum Risk			Residual Risk											
	A	B		C	D	E	F	G		H	I	J	K	L	M	N	O	P	
Hazard Group	Supply element	No.	Hazardous event	Hazards reasonably expected to be associated with hazardous event	Consequence of the hazardous event	Likelihood of hazardous event occurring	Maximum (unmitigated risk (D x E)		Preventative measures	Modified consequences	Overall modified consequence	Modified likelihood of hazardous event occurring	Overall modified likelihood	Residual (mitigated risk) (I x k)	Risk managed	Priority	Uncertainty	Comment	Improvement Plan Actions
Catchment	Shallow aquifer/surface water	C.04	Presence of livestock and agricultural activities in the catchment zones PZ2 and PZ3 could result in contamination of shallow groundwater and surface water through bacterial contamination, an increase in nitrate concentrations and/or spills or leaks associated with storage or use of petroleum products, fertilisers, or other hazardous chemicals used to support agriculture operations.	Bacteria/viruses	Major	Likely	High	PM 51	Sharing of consenting and building information, relating to any new business or potential contamination, within SDC and from external organisations. Corrective actions taken should appropriate MAV trigger levels be reached	Major	Major	Likely	Likely	High	Yes		Reliable	This risk is managed through the following actions - Monitor source water at minimum twice weekly intervals, as per the SDC Drinking Water Quality Compliance Monitoring Plan (DW-GEN-05-DST-0002) to identify potential contaminants (Turbidity, E.coli, UVT) . - A catchment hazard assessment has been completed, this includes modelling of the catchment and potential contamination sources. This shows in relation to bacteria/viruses/protozoa all zones are potentially impacted. The likelihood and consequence are assigned due to the following reasons Agricultural activities are present in PZ2 and PZ3. Consequence of this event has been assessed as major. Contamination of the aquifer/river will impact the entirety of the network. The impact will be significant, with the potential for acute illness. Would require the bore or WTP or reservoir to be removed from service while the event is resolved. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The risk of consuming contaminated water is covered within the abstraction section of the risk assessment.	
				Protozoa	Major	Likely	High	PM 51	Sharing of consenting and building information, relating to any new business or potential contamination, within SDC and from external organisations. Corrective actions taken should appropriate MAV trigger levels be reached	Major	Major	Likely	Likely	High	Yes		Estimate	This risk is managed through the following actions - Monitor source water at minimum twice weekly intervals, as per the SDC Drinking Water Quality Compliance Monitoring Plan (DW-GEN-05-DST-0002) to identify potential contaminants (Turbidity, E.coli, UVT). Testing for protozoa is not conducted. The Guidelines for Drinking-water Quality Management for New Zealand (May 2019) shows that for streams or rivers the Cryptosporidium concentration can vary between 2 - 480. Additionally DWSNZ (2017) showed that 1 - 42% of the samples taken in a study contained Cryptosporidium. - A catchment hazard assessment has been completed, this includes modelling of the catchment and potential contamination sources. This shows in relation to bacteria/viruses/protozoa PZ1 and PZ2 could be impacted. The likelihood and consequence are assigned due to the following reasons Agricultural activities are present in PZ2 and PZ3. Consequence of this event has been assessed as major. Contamination of the aquifer/river will impact the entirety of the network. The impact will be significant, with the potential for acute illness. Would require the bore or WTP or reservoir to be removed from service while the event is resolved. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The risk of consuming contaminated water is covered within the abstraction section of the risk assessment.	
				Chemical	Moderate	Unlikely	Medium	PM 51	Sharing of consenting and building information, relating to any new business or potential contamination, within SDC and from external organisations. Corrective actions taken should appropriate MAV trigger levels be reached	Moderate	Moderate	Unlikely	Unlikely	Medium	Yes		Reliable	This risk is managed through the following actions - Annual chemical testing. - A catchment hazard assessment has been completed, this includes modelling of the catchment and potential contamination sources. This shows in relation to chemicals all zones are potentially impacted. The likelihood and consequence are assigned due to the following reasons Agricultural activities are present in PZ2 and PZ3. No chemical transgressions have been recorded. Consequence has been assessed as moderate. Contamination will impact the entirety of the network. The impact will be significant with the potential for widespread aesthetic issues, or repeated breach of the MAVs.	
		C.05	Presence of horticultural activities within PZ2 and PZ3 causing contamination of shallow groundwater and surface water. Use of fertiliser likely to lead to an increase in nitrate concentrations in groundwater and surface water.	Bacteria/viruses	Major	Possible	High	PM 51	Sharing of consenting and building information, relating to any new business or potential contamination, within SDC and from external organisations. Corrective actions taken should appropriate MAV trigger levels be reached	Major	Major	Possible	Possible	High	Yes		Reliable	This risk is managed through the following actions - Monitor source water at minimum twice weekly intervals, as per the SDC Drinking Water Quality Compliance Monitoring Plan (DW-GEN-05-DST-0002) to identify potential contaminants (Turbidity, E.coli, UVT) . - A catchment hazard assessment has been completed, this includes modelling of the catchment and potential contamination sources. This shows in relation to bacteria/viruses/protozoa all zones are potentially impacted. The likelihood and consequence are assigned due to the following reasons Horticultural activities are present in PZ2 and PZ3. Consequence of this event has been assessed as major. Contamination of the aquifer/river will impact the entirety of the network. The impact will be significant, with the potential for acute illness. Would require the bore or WTP or reservoir to be removed from service while the event is resolved. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The risk of consuming contaminated water is covered within the abstraction section of the risk assessment.	
				Protozoa	Major	Possible	High	PM 51	Sharing of consenting and building information, relating to any new business or potential contamination, within SDC and from external organisations. Corrective actions taken should appropriate MAV trigger levels be reached	Major	Major	Possible	Possible	High	Yes		Estimate	This risk is managed through the following actions - Monitor source water at minimum twice weekly intervals, as per the SDC Drinking Water Quality Compliance Monitoring Plan (DW-GEN-05-DST-0002) to identify potential contaminants (Turbidity, E.coli, UVT). Testing for protozoa is not conducted. The Guidelines for Drinking-water Quality Management for New Zealand (May 2019) shows that for streams or rivers the Cryptosporidium concentration can vary between 2 - 480. Additionally DWSNZ (2017) showed that 1 - 42% of the samples taken in a study contained Cryptosporidium. - A catchment hazard assessment has been completed, this includes modelling of the catchment and potential contamination sources. This shows in relation to bacteria/viruses/protozoa PZ1 and PZ2 could be impacted. The likelihood and consequence are assigned due to the following reasons Horticultural activities are present in PZ2 and PZ3. Consequence of this event has been assessed as major. Contamination of the aquifer/river will impact the entirety of the network. The impact will be significant, with the potential for acute illness. Would require the bore or WTP or reservoir to be removed from service while the event is resolved. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The risk of consuming contaminated water is covered within the abstraction section of the risk assessment.	
				Chemical	Moderate	Unlikely	Medium	PM 51	Sharing of consenting and building information, relating to any new business or potential contamination, within SDC and from external organisations. Corrective actions taken should appropriate MAV trigger levels be reached	Moderate	Moderate	Unlikely	Unlikely	Medium	Yes		Reliable	This risk is managed through the following actions - Annual chemical testing. - A catchment hazard assessment has been completed, this includes modelling of the catchment and potential contamination sources. This shows in relation to chemicals all zones are potentially impacted. Horticultural activities are present in PZ2 and PZ3. No chemical transgressions have been recorded. Consequence has been assessed as moderate. Contamination will impact the entirety of the network. The impact will be significant with the potential for widespread aesthetic issues, or repeated breach of the MAVs.	

Hororātā WTP					Maximum Risk			Residual Risk											
	A	B		C	D	E	F	G		H	I	J	K	L	M	N	O	P	
Hazard Group	Supply element	No.	Hazardous event	Hazards reasonably expected to be associated with hazardous event	Consequence of the hazardous event	Likelihood of hazardous event occurring	Maximum (unmitigated risk (D x E)		Preventative measures	Modified consequences	Overall modified consequence	Modified likelihood of hazardous event occurring	Overall modified likelihood	Residual (mitigated risk) (I x k)	Risk managed	Priority	Uncertainty	Comment	Improvement Plan Actions
		C.06	Presence of engine reconditioning workshop within PZ2 and PZ3 causing contamination through spills/leaks or petroleum products associated with construction activities or storage and of hazardous chemicals.	Chemical	Moderate	Very Rare	Low	PM 51	Sharing of consenting and building information, relating to any new business or potential contamination, within SDC and from external organisations. Corrective actions taken should appropriate MAV trigger levels be reached	Moderate	Moderate	Very Rare	Very Rare	Low	Yes		Reliable	This risk is managed through the following actions - Annual chemical testing. - A catchment hazard assessment has been completed, this includes modelling of the catchment and potential contamination sources. This shows in relation to chemicals all zones are potentially impacted. The likelihood and consequence are assigned due to the following reasons No chemical transgressions have been recorded. Consequence has been assessed as moderate. Contamination will impact the entirety of the network. The impact will be significant with the potential for widespread aesthetic issues, or repeated breach of the MAVs.	
		C.07	Presence of active discharges of human effluent (e.g. septic tank discharges within the capture zone) causing contamination of shallow groundwater and surface water.	Bacteria/viruses	Major	Likely	High	PM 51	Sharing of consenting and building information, relating to any new business or potential contamination, within SDC and from external organisations. Corrective actions taken should appropriate MAV trigger levels be reached	Major	Major	Likely	Likely	High	Yes		Reliable	This risk is managed through the following actions - Monitor source water at minimum twice weekly intervals, as per the SDC Drinking Water Quality Compliance Monitoring Plan (DW-GEN-05-DST-0002) to identify potential contaminants (Turbidity, E.coli, UVT) . - A catchment hazard assessment has been completed, this includes modelling of the catchment and potential contamination sources. This shows in relation to bacteria/viruses/protozoa PZ1 and PZ2 could be impacted. The likelihood and consequence are assigned due to the following reasons There are two consented effluent discharges in PZ1, 34 in PZ2 and 62 in PZ3. Consequence of this event has been assessed as major. Contamination of the aquifer/river will impact the entirety of the network. The impact will be significant, with the potential for acute illness. Would require the bore or WTP or reservoir to be removed from service while the event is resolved. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The risk of consuming contaminated water is covered within the abstraction section of the risk assessment.	
				Protozoa	Major	Likely	High	PM 51	Sharing of consenting and building information, relating to any new business or potential contamination, within SDC and from external organisations. Corrective actions taken should appropriate MAV trigger levels be reached	Major	Major	Likely	Likely	High	Yes		Estimate	This risk is managed through the following actions - Monitor source water at minimum twice weekly intervals, as per the SDC Drinking Water Quality Compliance Monitoring Plan (DW-GEN-05-DST-0002) to identify potential contaminants (Turbidity, E.coli, UVT). Testing for protozoa is not conducted. The Guidelines for Drinking-water Quality Management for New Zealand (May 2019) shows that for streams or rivers the Cryptosporidium concentration can vary between 2 - 480. Additionally DWSNZ (2017) showed that 1 - 42% of the samples taken in a study contained Cryptosporidium. - A catchment hazard assessment has been completed, this includes modelling of the catchment and potential contamination sources. This shows in relation to bacteria/viruses/protozoa PZ1 and PZ2 could be impacted. The likelihood and consequence are assigned due to the following reasons There are two consented effluent discharges in PZ1, 34 in PZ2 and 62 in PZ3. Consequence of this event has been assessed as major. Contamination of the aquifer/river will impact the entirety of the network. The impact will be significant, with the potential for acute illness. Would require the bore or WTP or reservoir to be removed from service while the event is resolved. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The risk of consuming contaminated water is covered within the abstraction section of the risk assessment.	
		C.08	Stormwater discharges within the protection zones, discharge of road drainage from the village adjacent to the WTP, stormwater from Whitecliffs discharges into the river causing contamination of shallow groundwater and surface water.	Bacteria/viruses	Major	Likely	High	PM 51	Sharing of consenting and building information, relating to any new business or potential contamination, within SDC and from external organisations. Corrective actions taken should appropriate MAV trigger levels be reached	Major	Major	Likely	Likely	High	Yes		Reliable	This risk is managed through the following actions - Monitor source water at minimum twice weekly intervals, as per the SDC Drinking Water Quality Compliance Monitoring Plan (DW-GEN-05-DST-0002) to identify potential contaminants (Turbidity, E.coli, UVT) . - A catchment hazard assessment has been completed, this includes modelling of the catchment and potential contamination sources. This shows in relation to bacteria/viruses/protozoa PZ1 and PZ2 could be impacted. The likelihood and consequence are assigned due to the following reasons There is one consented (residential) stormwater discharge in PZ2 and PZ3. Consequence of this event has been assessed as major. Contamination of the aquifer/river will impact the entirety of the network. The impact will be significant, with the potential for acute illness. Would require the bore or WTP or reservoir to be removed from service while the event is resolved. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The risk of consuming contaminated water is covered within the abstraction section of the risk assessment.	
				Protozoa	Major	Likely	High	PM 51	Sharing of consenting and building information, relating to any new business or potential contamination, within SDC and from external organisations. Corrective actions taken should appropriate MAV trigger levels be reached	Major	Major	Likely	Likely	High	Yes		Estimate	This risk is managed through the following actions - Monitor source water at minimum twice weekly intervals, as per the SDC Drinking Water Quality Compliance Monitoring Plan (DW-GEN-05-DST-0002) to identify potential contaminants (Turbidity, E.coli, UVT). Testing for protozoa is not conducted. The Guidelines for Drinking-water Quality Management for New Zealand (May 2019) shows that for streams or rivers the Cryptosporidium concentration can vary between 2 - 480. Additionally DWSNZ (2017) showed that 1 - 42% of the samples taken in a study contained Cryptosporidium. - A catchment hazard assessment has been completed, this includes modelling of the catchment and potential contamination sources. This shows in relation to bacteria/viruses/protozoa PZ1 and PZ2 could be impacted. The likelihood and consequence are assigned due to the following reasons There is one consented (residential) stormwater discharge in PZ2 and PZ3. Consequence of this event has been assessed as major. Contamination of the aquifer/river will impact the entirety of the network. The impact will be significant, with the potential for acute illness. Would require the bore or WTP or reservoir to be removed from service while the event is resolved. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The risk of consuming contaminated water is covered within the abstraction section of the risk assessment.	
				Chemical	Moderate	Unlikely	Medium	PM 51	Sharing of consenting and building information, relating to any new business or potential contamination, within SDC and from external organisations. Corrective actions taken should appropriate MAV trigger levels be reached	Moderate	Moderate	Unlikely	Unlikely	Medium	Yes		Reliable	This risk is managed through the following actions - Annual chemical testing. - A catchment hazard assessment has been completed, this includes modelling of the catchment and potential contamination sources. This shows in relation to chemicals all zones are potentially impacted. The likelihood and consequence are assigned due to the following reasons There is one consented (residential) stormwater discharge in PZ2 and PZ3. No chemical transgressions have been recorded. Consequence has been assessed as moderate. Contamination will impact the entirety of the network. The impact will be significant with the potential for widespread aesthetic issues, or repeated breach of the MAVs.	

Hororātā WTP					Maximum Risk																
	A	B		C	D	E	F	G		H	I	J	K	L	M	N	O	P			
Hazard Group	Supply element	No.	Hazardous event	Hazards reasonably expected to be associated with hazardous event	Consequence of the hazardous event	Likelihood of hazardous event occurring	Maximum (unmitigated risk (D x E)		Preventative measures	Modified consequences	Overall modified consequence	Modified likelihood of hazardous event occurring	Overall modified likelihood	Residual (mitigated risk) (I x k)	Risk managed	Priority	Uncertainty	Comment		Improvement Plan Actions	
		C.09	Contaminants within the Selwyn River from point or non-point sources migrating to the shallow aquifer and contaminating shallow groundwater due to groundwater recharge.	Bacteria/viruses	Major	Likely	High	PM 51	Sharing of consenting and building information, relating to any new business or potential contamination, within SDC and from external organisations. Corrective actions taken should appropriate MAV trigger levels be reached	Major	Major	Likely	Likely	High	Yes		Reliable	This risk is managed through the following actions - Monitor source water at minimum twice weekly intervals, as per the SDC Drinking Water Quality Compliance Monitoring Plan (DW-GEN-05-DST-0002) to identify potential contaminants (Turbidity, E.coli, UVT) . - A catchment hazard assessment has been completed, this includes modelling of the catchment and potential contamination sources. This shows in relation to bacteria/viruses/protozoa PZ1 and PZ2 could be impacted. The likelihood and consequence are assigned due to the following reasons Groundwater recharge occurs through percolation of surface water through soils to the aquifer. Consequence of this event has been assessed as major. Contamination of the aquifer/river will impact the entirety of the network. The impact will be significant, with the potential for acute illness. Would require the bore or WTP or reservoir to be removed from service while the event is resolved. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The risk of consuming contaminated water is covered within the abstraction section of the risk assessment.		
				Protozoa	Major	Likely	High	PM 51	Sharing of consenting and building information, relating to any new business or potential contamination, within SDC and from external organisations. Corrective actions taken should appropriate MAV trigger levels be reached	Major	Major	Likely	Likely	High	Yes		Estimate	This risk is managed through the following actions - Monitor source water at minimum twice weekly intervals, as per the SDC Drinking Water Quality Compliance Monitoring Plan (DW-GEN-05-DST-0002) to identify potential contaminants (Turbidity, E.coli, UVT). Testing for protozoa is not conducted. The Guidelines for Drinking-water Quality Management for New Zealand (May 2019) shows that for streams or rivers the Cryptosporidium concentration can vary between 2 - 480. Additionally DWSNZ (2017) showed that 1 - 42% of the samples taken in a study contained Cryptosporidium. - A catchment hazard assessment has been completed, this includes modelling of the catchment and potential contamination sources. This shows in relation to bacteria/viruses/protozoa PZ1 and PZ2 could be impacted. The likelihood and consequence are assigned due to the following reasons Groundwater recharge occur through percolation of surface water through soils to the aquifer. Consequence of this event has been assessed as major. Contamination of the aquifer/river will impact the entirety of the network. The impact will be significant, with the potential for acute illness. Would require the bore or WTP or reservoir to be removed from service while the event is resolved. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The risk of consuming contaminated water is covered within the abstraction section of the risk assessment.		
		C.10	Contamination from water getting into shallow groundwater and/or Selwyn River from the ground surface or overland flow. Pathways are through contamination sources in close proximity to the well head, the wellhead not being properly sealed, the wellhead being damaged or the wellhead being inundated with water.	Protozoa	Major	Likely	High	PM 75	Condition assessment of bore/wellhead/intake - Visual assessment of the bore/wellhead/intake undertaken by a SICON staff member every 3 months. - Annual inspections are undertaken by an experienced member of SICON staff.	Major	Major	Likely	Likely	High	Yes		Estimate	This risk is managed through the following actions - Monitor source water at minimum twice weekly intervals, as per the SDC Drinking Water Quality Compliance Monitoring Plan (DW-GEN-05-DST-0002) to identify potential contaminants (Turbidity, E.coli, UVT). Testing for protozoa is not conducted. The Guidelines for Drinking-water Quality Management for New Zealand (May 2019) shows that for streams or rivers the Cryptosporidium concentration can vary between 2 - 480. Additionally DWSNZ (2017) showed that 1 - 42% of the samples taken in a study contained Cryptosporidium. - A catchment hazard assessment has been completed, this includes modelling of the catchment and potential contamination sources. This shows in relation to bacteria/viruses/protozoa PZ1 and PZ2 could be impacted. The likelihood and consequence are assigned due to the following reasons This is a shallow well located next to the river, there are also other wells/bores in the surrounding area. Consequence of this event has been assessed as major. Contamination of the aquifer/river will impact the entirety of the network. The impact will be significant, with the potential for acute illness. Would require the bore or WTP or reservoir to be removed from service while the event is resolved. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The risk of consuming contaminated water is covered within the abstraction section of the risk assessment.		
		C.11	Contamination of water supply through Cyanobacterial blooms (>50% PMAV) occurring in the Selwyn River.	Bacteria/viruses	Major	Unlikely	Medium	PM 73	Cyanobacterial levels monitored by Food and Health. If >50% PMAV is observed the supply will be removed from service and alternative water supplied.	Major	Major	Unlikely	Unlikely	Medium	No	2	Estimate	The management of this risk requires improvements to improve the uncertainty and management. See the improvement action plan. The following contingencies are currently applied - Use quantitative survey field sheet for benthic cyanobacteria (from NZ guidelines of Cyanobacteria in recreational waters) to quantify mat coverage. This with the existing SDC Cyanotoxin and Cyanobacterial Management Protocol sets out the current operative and management approach for water supply schemes. The likelihood and consequence are assigned due to the following reasons Historic monitoring results have demonstrated seasonal contamination of the source by cyanobacteria. Consequence of this event has been assessed as major. Contamination of the aquifer/river will impact the entirety of the network. The impact will be significant, with the potential for acute illness. Would require the bore or WTP or reservoir to be removed from service while the event is resolved. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence.		IA.CM.11

Hororātā WTP					Maximum Risk																	
	A	B		C	D	E	F	G		H	I	J	K	L	M	N	O	P				
Hazard Group	Supply element	No.	Hazardous event	Hazards reasonably expected to be associated with hazardous event	Consequence of the hazardous event	Likelihood of hazardous event occurring	Maximum (unmitigated risk (D x E)		Preventative measures	Modified consequences	Overall modified consequence	Modified likelihood of hazardous event occurring	Overall modified likelihood	Residual (mitigated risk) (I x k)	Risk managed	Priority	Uncertainty	Comment		Improvement Plan Actions		
Abstraction	Surface Water Well	A.01	Contaminated water being abstracted from the aquifer and supplied to consumers.	Bacteria/viruses	Major	Likely	High	PM 19	Pump shutdown/lockout and automatic or manual flushing in place to enable selective abstraction of groundwater to meet CCP setpoints for disinfection.	Moderate	Insignificant	Likely	Likely	Medium	Yes		Confident	This risk is managed through the following actions - Monitor source water at minimum twice weekly intervals, as per the SDC Drinking Water Quality Compliance Monitoring Plan (DW-GEN-05-DST-0002) to identify potential contaminants (Turbidity, E.coli, UVT) . Historic monitoring results have demonstrated seasonal contamination of the source by cyanobacteria. - Selective abstraction, cartridge filtration, UV treatment and chlorine dosing associated with CCPs. Monitored through SCADA and automatic shutdown/lockout occurs if any of the critical CCP limits are reached. The likelihood and consequence are assigned due to the following reasons This is a surface water source and source water quality shows that contamination does occur. Consequence of this event has been assessed as major. Contamination of the aquifer/river will impact the entirety of the network. The impact will be significant, with the potential for acute illness. Would require the bore or WTP or reservoir to be removed from service while the event is resolved. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence.		
								PM 50	1 micron cartridge filtration is validated for log reduction credits and operational with active CCPs	Minor		Likely										
								PM 1	Ultraviolet disinfection is validated and functioning with active CCPs	Insignificant		Likely										
								PM 52	Continuous permanent chlorine dosing	Insignificant		Likely										
				Protozoa	Major	Likely	High	PM 19	Pump shutdown/lockout and automatic or manual flushing in place to enable selective abstraction of groundwater to meet CCP setpoints for disinfection.	Moderate	Insignificant	Likely	Likely	Medium	Yes		Estimate	This risk is managed through the following actions - Monitor source water at minimum twice weekly intervals, as per the SDC Drinking Water Quality Compliance Monitoring Plan DW-GEN-05-DST-0002 to identify potential contaminants (Turbidity, E.coli, UVT). Testing for protozoa is not conducted. The Guidelines for Drinking-water Quality Management for New Zealand (May 2019) shows that for streams or rivers the Cryptosporidium concentration can vary between 2 - 480. Additionally DWSNZ (2017) showed that 1 - 42% of the samples taken in a study contained Cryptosporidium. - Selective abstraction, cartridge filtration, UV treatment and chlorine dosing associated with CCPs. Monitored through SCADA and automatic shutdown/lockdown occurs it any of the critical CCP limits are reached. The likelihood and consequence are assigned due to the following reasons This is a surface water source and source water quality shows that contamination may occur. Consequence of this event has been assessed as major. Contamination of the aquifer/river will impact the entirety of the network. The impact will be significant, with the potential for acute illness. Would require the bore or WTP or reservoir to be removed from service while the event is resolved. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence.		
								PM 50	1 micron cartridge filtration is validated for log reduction credits and operational with active CCPs	Minor		Likely										
								PM 1	Ultraviolet disinfection is validated and functioning with active CCPs	Insignificant		Likely										
				Chemical	Moderate	Rare	Low	PM 51	Sharing of consenting and building information, relating to any new business or potential contamination, within SDC and from external organisations. Corrective actions taken should appropriate MAV trigger levels be reached	Moderate	Moderate	Rare	Rare	Low	Yes		Reliable	This risk is managed through the following actions - Annual chemical testing. The likelihood and consequence are assigned due to the following reasons No chemical transgressions have been recorded. Consequence has been assessed as moderate. Contamination will impact the entirety of the network. The impact will be significant with the potential for widespread aesthetic issues, or repeated breach of the MAVs.		
		A.02	Well pump failure causing there to be insufficient surface water available to meet demand.	Water demand may not be met	Major	Unlikely	Medium	PM 6	Reservoir level remotely monitored with a SCADA alarm to provide an alert and allow time to put contingency measures in place	Moderate	Minor	Unlikely	Unlikely	Low	Yes		Confident	This risk is managed through the following actions - Water storage in the reticulation and on private properties - There are two pumps and they are in a shallow well so easily accessible for maintenance or replacement -SCADA alerts the Water Operator that a pump failure has occurred to allow time to implement the necessary contingencies (as per UCPC of Emergency Response Plans) - Routine visual inspection of well The likelihood and consequence are assigned due to the following reasons The well pumps do not currently fail regularly and fit for purpose pumps have been selected and installed. Consequence has been assessed as major as the population affected would be less than 5,000 and this event would cause a significant compromise of systems and abnormal operation with a requirement for high level monitoring and incident management.		
								PM 57	For restricted schemes all consumers are advised to have three days storage on their own properties	Minor		Unlikely										
		A.03	Willow roots restricting incoming water to the intake causing there to be insufficient surface water available to meet demand.	Water demand may not be met	Major	Rare	Medium	PM 6	Reservoir level remotely monitored with a SCADA alarm to provide an alert and allow time to put contingency measures in place	Moderate	Minor	Rare	Rare	Low	Yes		Confident	This risk is managed through the following actions - Water storage in the reticulation and on private properties - There are two pumps and they are in a shallow well so easily accessible for maintenance or replacement -SCADA alerts the Water Operator that a pump failure has occurred to allow time to implement the necessary contingencies (as per UCPC of Emergency Response Plans) - Routine visual inspection of well The likelihood and consequence are assigned due to the following reasons This event has occurred once, divers were brought into clear the intake. Consequence has been assessed as major as the population affected would be less than 5,000 and this event would cause a significant compromise of systems and abnormal operation with a requirement for high level monitoring and incident management.		
								PM 57	For restricted schemes all consumers are advised to have three days storage on their own properties	Minor		Rare										
								HOPM 1	Clean-out of intake by divers, when required	Major		Rare										
		A.04	Deterioration of intake condition causing there to be insufficient water available to meet demand.	Water demand may not be met	Major	Rare	Medium	PM 75	Condition assessment of bore/wellhead/intake - Visual assessment of the bore/wellhead/intake undertaken by a SICON staff member every 3 months. - Annual inspections are undertaken by an experienced member of SICON staff.	Major	Major	Very Rare	Very Rare	Low	Yes		Confident	This risk is managed through the following actions - Water storage in the reticulation and on private properties - Any bore deterioration is highlighted through the inspection. If necessary a maintenance task is raised through AMS. The likelihood and consequence are assigned due to the following reasons The wells are designed and constructed to a high design standard and failure is not frequently observed. Consequence has been assessed as major as the population affected would be less than 5,000 and this event would cause a significant compromise of systems and abnormal operation with a requirement for high level monitoring and incident management.		
		A.05	Aged infrastructure and a high pressure system (approx. 14 bar from the pump) causing failure of pipe between headworks and treatment plant.	Water demand may not be met	Major	Unlikely	Medium	PM 6	Reservoir level remotely monitored with a SCADA alarm to provide an alert and allow time to put contingency measures in place	Moderate	Minor	Unlikely	Unlikely	Low	Yes		Uncertain	This risk is managed through the following actions - Asset management information - If necessary implement the Emergency Response Plan The likelihood and consequence are assigned due to the following reasons The pipe has not previously failed however with the aging the likelihood has increased. Consequence has been assessed as major as the population affected would be less than 5,000 and this event would cause a significant compromise of systems and abnormal operation with a requirement for high level monitoring and incident management.		
								PM 57	For restricted schemes all consumers are advised to have three days storage on their own properties	Minor		Unlikely										

Hororātā WTP					Maximum Risk			Residual Risk											
	A	B		C	D	E	F	G		H	I	J	K	L	M	N	O	P	
Hazard Group	Supply element	No.	Hazardous event	Hazards reasonably expected to be associated with hazardous event	Consequence of the hazardous event	Likelihood of hazardous event occurring	Maximum (unmitigated risk (D x E)		Preventative measures	Modified consequences	Overall modified consequence	Modified likelihood of hazardous event occurring	Overall modified likelihood	Residual (mitigated risk) (I x k)	Risk managed	Priority	Uncertainty	Comment	Improvement Plan Actions
		A.06	Unplanned mains power supply interruption causing there to be insufficient water available to meet demand.	Water demand may not be met	Major	Unlikely	Medium	PM 9	Conserve water notification can be issued with water restrictions implemented if the treated water storage drops below 50% during any power supply interruption, conserve water notification or water restrictions can be put in place	Moderate	Minor	Unlikely	Unlikely	Low	Yes		Confident	This risk is managed through the following actions - Standby generator on-site which is tested routinely - Ability to issue Conserve Water Notices - Refer to SDC Drinking Water - Incident and Emergency Management Plan DW-GEN-07-DST-0006 The likelihood and consequence are assigned due to the following reasons This event does not occur frequently. Consequence has been assessed as major as the population affected would be less than 5,000 and this event would cause a significant compromise of systems and abnormal operation with a requirement for high level monitoring and incident management.	
								PM 8	Provision of standby generator onsite with auto-change over (tested monthly)	Minor		Unlikely							
		T.HB.01	Treatment system does not target chemicals and chemical contamination of the source water has occurred.	Chemical	Moderate	Rare	Low	PM 51	Sharing of consenting and building information, relating to any new business or potential contamination, within SDC and from external organisations. Corrective actions taken should appropriate MAV trigger levels be reached	Moderate	Moderate	Rare	Rare	Low	Yes		Reliable	This risk is managed through the following actions - Annual chemical testing - Transgression and Emergency Response Plans provide guidance on contingency measures if this occurs The likelihood and consequences are assigned due to the following reasons No chemical transgressions have been recorded. Consequence has been assessed as moderate. Contamination will impact the entirety of the network. The impact will be significant with the potential for widespread aesthetic issues, or repeated breach of the MAVs.	
		T.HB.02	Failure to flush highly turbid water to waste due to a mechanical or turbidity monitoring failure.	Bacteria/viruses	Major	Possible	High	PM 50	1 micron cartridge filtration is validated for log reduction credits and operational with active CCPs	Insignificant	Insignificant	Possible	Possible	Low	Yes		Confident	This risk is managed through the following actions - Continuous online turbidity monitoring. - Cartridge filtration, UV treatment and chlorine dosing associated with CCPs. Monitored through SCADA and automatic shutdown/lockout occurs if any of the critical CCP limits are reached. The likelihood and consequences are assigned due to the following reasons Mechanical and monitoring failures have been observed in the past. Consequence of this event has been assessed as major. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The impact would be significant with the potential for acute harm or widespread outbreak of illness. Would require the treatment plant to be removed from service while the event is resolved.	
								PM 52	Continuous permanent chlorine dosing	Insignificant		Possible							
								PM 53	Post filtration turbidity alarm (CCP) in place with corrective action plan - high turbidity alarm stops supply through UV	Insignificant		Possible							
				Protozoa	Major	Possible	High	PM 50	1 micron cartridge filtration is validated for log reduction credits and operational with active CCPs	Insignificant	Insignificant	Possible	Possible	Low	Yes		Estimate	This risk is managed through the following actions - Continuous online turbidity monitoring. - Cartridge filtration, UV treatment and chlorine dosing associated with CCPs. Monitored through SCADA and automatic shutdown/lockout occurs if any of the critical CCP limits are reached. The likelihood and consequences are assigned due to the following reasons Mechanical and monitoring failures have been observed in the past. Consequence of this event has been assessed as major. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The impact would be significant with the potential for acute harm or widespread outbreak of illness. Would require the treatment plant to be removed from service while the event is resolved.	
								PM 53	Post filtration turbidity alarm (CCP) in place with corrective action plan - high turbidity alarm stops supply through UV	Insignificant		Possible							
		T.HB.03	Failure to remove protozoal contaminants due to the following - Filter system operating outside of the validated range - Filter system malfunction - Control system malfunction - Power supply interruption - Communications failure - Differential pressure gauge malfunction	Protozoa	Major	Possible	High	PM 19	Pump shutdown/lockout and automatic or manual flushing in place to enable selective abstraction of groundwater to meet CCP setpoints for disinfection.	Moderate	Insignificant	Possible	Possible	Low	Yes		Estimate	This risk is managed through the following actions - Selective abstraction, cartridge filtration, UV treatment and chlorine dosing associated with CCPs. Monitored through SCADA and automatic shutdown/lockdown occurs it any of the critical CCP limits are reached. - Routine maintenance and calibration of equipment The likelihood and consequences are assigned due to the following reasons Mechanical and monitoring failures have been observed in the past. Consequence of this event has been assessed as major. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The impact would be significant with the potential for acute harm or widespread outbreak of illness. Would require the treatment plant to be removed from service while the event is resolved. For operation parameters refer to Hororātā UPCP (DW-SEL-04-DST-0004) including SOP list.	
								PM 53	Post filtration turbidity alarm (CCP) in place with corrective action plan - high turbidity alarm stops supply through UV	Insignificant		Possible							
								PM 1	Ultraviolet disinfection is validated and functioning with active CCPs	Insignificant		Possible							
		T.HB.04	Failure to remove bacterial and/or protozoal contaminants, inadequate disinfection and/or ineffective UV treatment - UV system operating outside of the validated range - UV system malfunction - Control system malfunction - Power supply interruption - Communications failure - Turbidity, UVT and UV intensity monitoring equipment failure	Bacteria/viruses	Major	Possible	High	PM 11	UV Major Fault Alarm stops supply (including dose low or <80% UVT, or blown lamp, or ballast) and prompts operator intervention (CCP) with corrective action plan in place	Insignificant	Insignificant	Possible	Unlikely	Low	Yes		Confident	This risk is managed through the following actions - Selective abstraction, cartridge filtration, UV treatment and chlorine dosing associated with CCPs. Monitored through SCADA and automatic shutdown/lockdown occurs it any of the critical CCP limits are reached. - Routine maintenance and calibration of equipment The likelihood and consequences are assigned due to the following reasons Mechanical and monitoring failures have been observed in the past. Consequence of this event has been assessed as major. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The impact would be significant with the potential for acute harm or widespread outbreak of illness. Would require the treatment plant to be removed from service while the event is resolved. For operation parameters refer to Hororātā UPCP (DW-SEL-04-DST-0004) including SOP list.	
								PM 12	Preventative maintenance undertaken on UV plant - lamp hours metered, and alert at 12,500 hours, preventative item to change out lamp	Major		Unlikely							
								PM 13	SCADA alarms are monitored, with communications to on-call operator to action (notes either Urgent or Routine). Any instrumentation tied to CCPs will cause shutdown of the system in the event of an equipment failure.	Minor		Possible							
								PM 15	Major fault alarm connected to loss of power stops flow, prompts Operator intervention and corrective action plan (Operator fault finding and on-call electrician)	Minor		Possible							
								PM 52	Continuous permanent chlorine dosing	Insignificant		Possible							
				Protozoa	Major	Possible	High	PM 11	UV Major Fault Alarm stops supply (including dose low or <80% UVT, or blown lamp, or ballast) and prompts operator intervention (CCP) with corrective action plan in place	Insignificant	Insignificant	Possible	Unlikely	Low	Yes		Estimate	This risk is managed through the following actions - Selective abstraction, cartridge filtration, UV treatment and chlorine dosing associated with CCPs. Monitored through SCADA and automatic shutdown/lockdown occurs it any of the critical CCP limits are reached. - Routine maintenance and calibration of equipment The likelihood and consequences are assigned due to the following reasons Mechanical and monitoring failures have been observed in the past. Consequence of this event has been assessed as major. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The impact would be significant with the potential for acute harm or widespread outbreak of illness. Would require the treatment plant to be removed from service while the event is resolved. For operation parameters refer to Hororātā UPCP (DW-SEL-04-DST-0004) including SOP list.	
								PM 12	Preventative maintenance undertaken on UV plant - lamp hours metered, and alert at 12,500 hours, preventative item to change out lamp	Major		Unlikely							
								PM 13	SCADA alarms are monitored, with communications to on-call operator to action (notes either Urgent or Routine). Any instrumentation tied to CCPs will cause shutdown of the system in the event of an equipment failure.	Minor		Possible							
								PM 15	Major fault alarm connected to loss of power stops flow, prompts Operator intervention and corrective action plan (Operator fault finding and on-call electrician)	Insignificant		Possible							
								PM 19	Pump shutdown/lockout and automatic or manual flushing in place to enable selective abstraction of	Moderate		Possible							

Hororātā WTP					Maximum Risk			Residual Risk											
	A	B		C	D	E	F	G		H	I	J	K	L	M	N	O	P	
Hazard Group	Supply element	No.	Hazardous event	Hazards reasonably expected to be associated with hazardous event	Consequence of the hazardous event	Likelihood of hazardous event occurring	Maximum (unmitigated risk (D x E)		Preventative measures	Modified consequences	Overall modified consequence	Modified likelihood of hazardous event occurring	Overall modified likelihood	Residual (mitigated risk) (I x k)	Risk managed	Priority	Uncertainty	Comment	Improvement Plan Actions
HOMEBUSH WATER TREATMENT PLANT	Treatment	T.HB.05	Failure to remove bacterial and/or protozoal contaminants - Incorrect Operation and Maintenance of the UV system - Incorrect or missed cleaning of the sensor (this is not cleared by autowiper) - Incorrect/missed verification of turbidity meters	Bacteria/viruses	Major	Possible	High	PM 11	UV Major Fault Alarm stops supply (including dose low or <80% UVT, or blown lamp, or ballast) and prompts operator intervention (CCP) with corrective action plan in place	Insignificant	Insignificant	Possible	Rare	Low	Yes		Confident	This risk is managed through the following actions - Operator training including alarm responses for CCP's UV system operations and maintenance (SICON Training Register). - SOPs - Selective abstraction, cartridge filtration, UV treatment and chlorine dosing associated with CCPs. Monitored through SCADA and automatic shutdown/lockdown occurs it any of the critical CCP limits are reached. The likelihood and consequences are assigned due to the following reasons Operators attend site regularly so there is a chance for this to occur. Consequence of this event has been assessed as major. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The impact would be significant with the potential for acute harm or widespread outbreak of illness. Would require the treatment plant to be removed from service while the event is resolved. For operation parameters refer to Hororātā UPCP (DW-SEL-04-DST-0004) including SOP list.	
								PM 13	SCADA alarms are monitored, with communications to on-call operator to action (notes either Urgent or Routine). Any instrumentation tied to CCPs will cause shutdown of the system in the event of an equipment failure.	Minor		Possible							
								PM 14	Operations staff are trained, have a sound knowledge of systems and access to experienced operators on-call	Major		Rare							
								PM 52	Continuous permanent chlorine dosing	Insignificant		Possible							
				Protozoa	Major	Possible	High	PM 11	UV Major Fault Alarm stops supply (including dose low or <80% UVT, or blown lamp, or ballast) and prompts operator intervention (CCP) with corrective action plan in place	Insignificant	Insignificant	Possible	Rare	Low	Yes		Estimate	This risk is managed through the following actions - Operator training including alarm responses for CCP's UV system operations and maintenance (SICON Training Register). - SOPs - Selective abstraction, cartridge filtration, UV treatment and chlorine dosing associated with CCPs. Monitored through SCADA and automatic shutdown/lockdown occurs it any of the critical CCP limits are reached. The likelihood and consequences are assigned due to the following reasons Operators attend site regularly so there is a chance for this to occur. Consequence of this event has been assessed as major. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The impact would be significant with the potential for acute harm or widespread outbreak of illness. Would require the treatment plant to be removed from service while the event is resolved. For operation parameters refer to Hororātā UPCP (DW-SEL-04-DST-0004) including SOP list.	
								PM 13	SCADA alarms are monitored, with communications to on-call operator to action (notes either Urgent or Routine). Any instrumentation tied to CCPs will cause shutdown of the system in the event of an equipment failure.	Minor		Possible							
								PM 14	Operations staff are trained, have a sound knowledge of systems and access to experienced operators on-call	Major		Rare							
		T.HB.06	Chlorine dosing failure - Dosing pump fails to start - Dosing valve closed - Chlorine bottles empty - Insufficient dosing	Bacteria/viruses	Major	Possible	High	PM 54	High/low chlorine (FAC) sensors and alarms. Triggering Operator response when necessary.	Moderate	Insignificant	Possible	Possible	Low	Yes		Confident	This risk is managed through the following - Levels alarmed and FAC measured continuously online at the Homebush Road WTP and Atkins Road reservoir inlet and outlet. The likelihood and consequences are assigned due to the following reasons Mechanical and monitoring failures have been observed in the past. Consequence of this event has been assessed as major. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The impact would be significant with the potential for acute harm or widespread outbreak of illness. Would require the treatment plant to be removed from service while the event is resolved.	
								PM 68	Chlorine residual monitored at WTP, functioning with active CCPs/OMCPs	Insignificant		Possible							
		T.HB.07	High chlorine dosing - Chlorine concentration exceeds MAV value - Dosing instrument fault/failure	Chemical	Moderate	Possible	Medium	PM 68	Chlorine residual monitored at WTP, functioning with active CCPs/OMCPs	Insignificant	Insignificant	Possible	Possible	Low	Yes		Confident	This risk is managed through the following - FAC measured continuously online at the Homebush WTP and Atkins Road reservoir inlet and outlet The likelihood and consequences are assigned due to the following reasons Mechanical and monitoring failures have been observed in the past. Consequence has been assessed as moderate. Contamination will impact the entirety of the network. The impact will be significant with the potential for widespread aesthetic issues, or repeated breach of the MAVs.	
		T.HB.08	Electrical failure due to loss of power to WTP	Water demand may not be met	Major	Unlikely	Medium	PM 15	Major fault alarm connected to loss of power stops flow, prompts Operator intervention and corrective action plan (Operator fault finding and on-call electrician)	Moderate	Minor	Unlikely	Unlikely	Low	Yes		Reliable	This risk is managed through the following actions - Standby generator on-site which is tested routinely - Refer to SDC Drinking Water - Incident and Emergency Management Plan DW-GEN-07-DST-0006 - Fault alarms to inform operators and get contingency responses underway The likelihood and consequence are assigned due to the following reasons This event does not occur frequently. Consequence has been assessed as major as the population affected would be less than 5,000 and this event would cause a significant compromise of systems and abnormal operation with a requirement for high level monitoring and incident management.	
								PM 8	Provision of standby generator onsite with auto-change over (tested monthly)	Minor		Unlikely							
		T.HB.09	Electrical failure, mains failure due to lightning or network spikes	Water demand may not be met	Major	Unlikely	Medium	PM 16	Surge diverters installed at site	Minor	Minor	Unlikely	Unlikely	Low	Yes		Reliable	This risk is managed through the following actions - Standby generator on-site which is tested routinely - Refer to SDC Drinking Water - Incident and Emergency Management Plan DW-GEN-07-DST-0006 - Fault alarms to inform operators and get contingency responses underway - Surge diverters installed The likelihood and consequence are assigned due to the following reasons This event does not occur frequently. Consequence has been assessed as major as the population affected would be less than 5,000 and this event would cause a significant compromise of systems and abnormal operation with a requirement for high level monitoring and incident management.	
								PM 8	Provision of standby generator onsite with auto-change over (tested monthly)	Minor		Unlikely							

Hororātā WTP					Maximum Risk																
	A	B		C	D	E	F	G		H	I	J	K	L	M	N	O	P			
Hazard Group	Supply element	No.	Hazardous event	Hazards reasonably expected to be associated with hazardous event	Consequence of the hazardous event	Likelihood of hazardous event occurring	Maximum (unmitigated risk (D x E)		Preventative measures	Modified consequences	Overall modified consequence	Modified likelihood of hazardous event occurring	Overall modified likelihood	Residual (mitigated risk) (I x k)	Risk managed	Priority	Uncertainty	Comment		Improvement Plan Actions	
		T.HB.10	Turbidity spikes in source water	High turbidity	Major	Possible	High	PM 19	Pump shutdown/lockout and automatic or manual flushing in place to enable selective abstraction of groundwater to meet CCP setpoints for disinfection.	Moderate	Insignificant	Possible	Possible	Low	Yes		Confident	This risk is managed through the following actions - Selective abstraction, cartridge filtration, UV treatment and chlorine dosing associated with CCPs. Monitored through SCADA and automatic shutdown/lockdown occurs it any of the critical CCP limits are reached. The likelihood and consequence are assigned due to the following reasons Water quality data shows that during high rainfall events the source water turbidity does increase. Consequence of this event has been assessed as major. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The impact would be significant with the potential for acute harm or widespread outbreak of illness. Would require the treatment plant to be removed from service while the event is resolved.		
								PM 50	1 micron cartridge filtration is validated for log reduction credits and operational with active CCPs	Minor		Possible									
								PM 52	Continuous permanent chlorine dosing	Insignificant		Possible									
				Water demand may not be met	Major	Unlikely	Medium	PM 6	Reservoir level remotely monitored with a SCADA alarm to provide an alert and allow time to put contingency measures in place	Moderate	Minor	Unlikely	Unlikely	Low	Yes		Confident	This risk is managed through the following actions - Water storage in the reticulation and on private properties - If the turbidity event persists the Emergency Response Plan can be activated The likelihood and consequence are assigned due to the following reasons Water quality data shows that during high rainfall events the source water turbidity does increase. Consequence has been assessed as major as the population affected would be less than 5,000 and this event would cause a significant compromise of systems and abnormal operation with a requirement for high level monitoring and incident management.		
								PM 22	Conserve water notice can be issued via the 'Boil Water Notice Portal' during periods of high demand or when there is a water supply issue.	Moderate		Unlikely									
								PM 57	For restricted schemes all consumers are advised to have three days storage on their own properties	Minor		Unlikely									
								PM 74	Storage reservoirs to provide a buffer in water supply capacity.	Minor		Unlikely									
		T.HB.11	Treatment unit and pipe pressure ratings exceeded during a high pressure event	Water demand may not be met	Major	Unlikely	Medium	PM 58	Pressure relief valve installed at WTP to prevent water hammer	Minor	Minor	Unlikely	Rare	Low	Yes		Uncertain	This risk is managed through the following actions - No pressure monitoring in the network but there are PRVs and pressure sustaining valves installed to protect the treatment plant equipment The likelihood and consequence are assigned due to the following reasons Pipes and equipment installed are designed to withstand the expected pressure from the system. Consequence has been assessed as major as the population affected would be less than 5,000 and this event would cause a significant compromise of systems and abnormal operation with a requirement for high level monitoring and incident management.		
								HOPM 7	Pressure sustaining valve installed to protect pipeline between WTP and reservoir	Major		Rare									
		T.HB.12	Monitoring equipment fails resulting in an inability to control/monitor system	Contamination of treated water supply	Major	Unlikely	Medium	PM 13	SCADA alarms are monitored, with communications to on-call operator to action (notes either Urgent or Routine). Any instrumentation tied to CCPs will cause shutdown of the system in the event of an equipment failure.	Minor	Minor	Unlikely	Unlikely	Low	Yes		Confident	This risk is managed through the following actions - All information from SCADA system is available. This shows any instances where the monitoring equipment has been unavailable. - Instrumentation tied to active CCPs will have regular maintenance, trigger alarms and shutdown of the system if any failure occurs. The likelihood and consequence are assigned due to the following reasons All data related to monitoring and instrumentation is recorded . Consequence of this event has been assessed as major. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The impact would be significant with the potential for acute harm or widespread outbreak of illness. Would require the treatment plant to be removed from service while the event is resolved.		
								PM 17	Routine calibration and maintenance conducted on any instrumentation associated with CCPs. This is programmed as a recurring task in AMS.	Major		Unlikely									
Reservoir **(Atkins Road 490 m^3)**		S.AT.01	Contamination of treated water storage caused by - Bird/vermin entry - Roof runoff - Unauthorised access - Weather event	Bacteria/viruses	Major	Unlikely	Medium	PM 20	Condition assessments every 3 months used to determine asset replacement including preventative maintenance, replacement and critical spares. There is also a detailed annual scheme review which involves a full condition assessment.	Major	Insignificant	Rare	Unlikely	Low	Yes		Confident	The risk is managed through the following actions - Facilities inspection undertaken weekly, reservoir inspections undertaken 3 monthly and scheme review undertaken annually. - Data stored on AMIS and issued to the Water Engineer and Engineers Representative. The likelihood and consequence are assigned due to the following reasons Data on the reservoirs is stored on AMIS. Consequence of this event has been assessed as major. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The impact would be significant with the potential for acute harm or widespread outbreak of illness. Would require the reservoir to be removed from service while the event is resolved.		
								PM 45	Locked reservoirs, hatches, access points, valves etc.	Major		Rare									
								PM 52	Continuous permanent chlorine dosing	Insignificant		Unlikely									
								HOPM 3	Reservoir lid is sealed, this is shown on the tank as-built drawings	Major		Rare									
				Protozoa	Major	Unlikely	Medium	PM 20	Condition assessments every 3 months used to determine asset replacement including preventative maintenance, replacement and critical spares. There is also a detailed annual scheme review which involves a full condition assessment.	Major	Major	Unlikely	Unlikely	Medium	Yes		Estimate	This risk is managed through the following activities - Facilities inspection undertaken weekly, reservoir inspections undertaken 3 monthly and scheme review undertaken annually. - Data stored on AMIS and issued to the Water Engineer and Engineers Representative. - Contingency measures required in the event of contamination occurring are covered in the Transgression Response Plans. This provides guidance on the measures required according to the level of contamination detected. The likelihood and consequence are assigned due to the following reasons Data on the reservoirs is stored on AMIS. Consequence of this event has been assessed as major. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The impact would be significant with the potential for acute harm or widespread outbreak of illness. Would require the reservoir to be removed from service while the event is resolved.		
								PM 45	Locked reservoirs, hatches, access points, valves etc.	Major		Unlikely									
								HOPM 3	Reservoir lid is sealed, this is shown on the tank as-built drawings	Major		Unlikely									
				Chemical	Moderate	Very Rare	Low	PM 20	Condition assessments every 3 months used to determine asset replacement including preventative maintenance, replacement and critical spares. There is also a detailed annual scheme review which involves a full condition assessment.	Moderate	Moderate	Very Rare	Very Rare	Low	Yes		Reliable	This risk is managed through the following activities - Facilities inspection undertaken weekly, reservoir inspections undertaken 3 monthly and scheme review undertaken annually. - Data stored on AMIS and issued to the Water Engineer and Engineers Representative. - Contingency measures required in the event of contamination occurring are covered in the Transgression Response Plans. This provides guidance on the measures required according to the level of contamination detected. The likelihood and consequence are assigned due to the following reasons Data on the reservoirs is stored on AMIS. Consequence has been assessed as moderate. Contamination will impact the entirety of the network. The impact will be significant with the potential for widespread aesthetic issues, or repeated breach of the MAVs.		
								PM 45	Locked reservoirs, hatches, access points, valves etc.	Moderate		Very Rare									
								HOPM 3	Reservoir lid is sealed, this is shown on the tank as-built drawings	Moderate		Very Rare									

Hororātā WTP					Maximum Risk			Residual Risk											
	A	B		C	D	E	F	G		H	I	J	K	L	M	N	O	P	
Hazard Group	Supply element	No.	Hazardous event	Hazards reasonably expected to be associated with hazardous event	Consequence of the hazardous event	Likelihood of hazardous event occurring	Maximum (unmitigated risk (D x E)		Preventative measures	Modified consequences	Overall modified consequence	Modified likelihood of hazardous event occurring	Overall modified likelihood	Residual (mitigated risk) (I x k)	Risk managed	Priority	Uncertainty	Comment	Improvement Plan Actions
		S.AT.02	Insufficient turnover of treated water storage.	Water age	Moderate	Rare	Low			Moderate	Moderate	Rare	Rare	Low	Yes		Confident	The risk is managed through the following activities - Flow to and from the Atkins Road reservoir is monitored data available in SCADA. The likelihood and consequence are assigned due to the following reasons Data on the reservoirs is stored on AMIS. Consequence of this event has been assessed as major. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The impact would be significant with the potential for acute harm or widespread outbreak of illness. Would require the reservoir to be removed from service while the event is resolved. For operation parameters refer to Hororātā UPCP (DW-SEL-04-DST-0004) including SOP list	
		S.AT.03	Power supply interruption to just surface water pump or pump failure causing there to be Insufficient water available.	Water demand may not be met	Major	Unlikely	Medium	PM 13	SCADA alarms are monitored, with communications to on-call operator to action (notes either Urgent or Routine). Any instrumentation tied to CCPs will cause shutdown of the system in the event of an equipment failure.	Minor	Minor	Unlikely	Unlikely	Low	Yes		Confident	This risk is managed through the following actions - Standby generator on-site which is tested routinely - Ability to issue Conserve Water Notices - Refer to SDC Drinking Water - Incident and Emergency Management Plan DW-GEN-07-DST-0006 The likelihood and consequence are assigned due to the following reasons This event does not occur frequently. Consequence has been assessed as major as the population affected would be less than 5,000 and this event would cause a significant compromise of systems and abnormal operation with a requirement for high level monitoring and incident management.	
								PM 8	Provision of standby generator onsite with auto-change over (tested monthly)	Minor		Unlikely							
								PM 22	Conserve water notice can be issued via the 'Boil Water Notice Portal' during periods of high demand or when there is a water supply issue.	Moderate		Unlikely							
		S.AT.04	Reservoir outflow exceeds inflow causing there to be insufficient treated water available	Water demand may not be met	Major	Unlikely	Medium	PM 21	Outflow from surface water pumps limited by reservoir level set point	Major	Moderate	Rare	Rare	Low	Yes		Confident	This risk is managed through the following actions - Controls and alarms on the reservoir and surface pumps - Ability to issue Conserve Water Notices - Refer to SDC Drinking Water - Incident and Emergency Management Plan DW-GEN-07-DST-0006 The likelihood and consequence are assigned due to the following reasons This event does not occur frequently. Consequence has been assessed as major as the population affected would be less than 5,000 and this event would cause a significant compromise of systems and abnormal operation with a requirement for high level monitoring and incident management.	
								PM 22	Conserve water notice can be issued via the 'Boil Water Notice Portal' during periods of high demand or when there is a water supply issue.	Moderate		Unlikely							
			[redacted]																
		S.HA.01	Contamination of treated water storage - Bird/vermin entry - Roof runoff - Unauthorised access - Weather event																
	Reservoir **(Harper Hills, 75 m3)**	S.HA.02	Insufficient turnover of treated water storage.	Water age	Moderate	Rare	Low			Moderate	Moderate	Rare	Rare	Low	Yes		Confident	The risk is managed through the following activities - Flow to and from the Atkins Road reservoir is monitored data available in SCADA. The likelihood and consequence are assigned due to the following reasons Data on the reservoirs is stored on AMIS. Consequence of this event has been assessed as major. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The impact would be significant with the potential for acute harm or widespread outbreak of illness. Would require the reservoir to be removed from service while the event is resolved. For operation parameters refer to Hororātā UPCP (DW-SEL-04-DST-0004) including SOP list	

Hororātā WTP					Maximum Risk			Residual Risk												
	A	B		C	D	E	F	G		H	I	J	K	L	M	N	O	P		
Hazard Group	Supply element	No.	Hazardous event	Hazards reasonably expected to be associated with hazardous event	Consequence of the hazardous event	Likelihood of hazardous event occurring	Maximum (unmitigated risk (D x E)		Preventative measures	Modified consequences	Overall modified consequence	Modified likelihood of hazardous event occurring	Overall modified likelihood	Residual (mitigated risk) (l x k)	Risk managed	Priority	Uncertainty	Comment		Improvement Plan Actions
		S.HA.03	Reservoir outflow exceeds inflow causing there to be insufficient treated water available	Water demand may not be met	Major	Unlikely	Medium	PM 13	SCADA alarms are monitored, with communications to on-call operator to action (notes either Urgent or Routine). Any instrumentation tied to CCPs will cause shutdown of the system in the event of an equipment failure.	Minor	Minor	Unlikely	Unlikely	Low	Yes		Confident	This risk is managed through the following actions - Controls and alarms on the reservoir and surface pumps - Ability to issue Conserve Water Notices - Refer to SDC Drinking Water - Incident and Emergency Management Plan DW-GEN-07-DST-0006 The likelihood and consequence are assigned due to the following reasons This event does not occur frequently. Consequence has been assessed as major as the population affected would be less than 5,000 and this event would cause a significant compromise of systems and abnormal operation with a requirement for high level monitoring and incident management.	
								PM 22	Conserve water notice can be issued via the 'Boil Water Notice Portal' during periods of high demand or when there is a water supply issue.	Moderate		Unlikely							
		S.HA.04	Poor road condition (small farm track) causing an inability to access reservoir for reactive maintenance activities.	Water demand may not be met	Moderate	Unlikely	Medium	PM 22	Conserve water notice can be issued via the 'Boil Water Notice Portal' during periods of high demand or when there is a water supply issue.	Moderate	Moderate	Unlikely	Unlikely	Medium	No	3	Reliable	The management of this risk requires improvements to improve the uncertainty and management. See the improvement action plan. The following contingencies are currently applied - Reactive maintenance The likelihood and consequence are assigned due to the following reasons The reservoir in it's current state is in need of repair and there have been occasions when access is difficult. Consequence has been assessed as moderate as the population affected would be the sub-population supplied by Harper Hills Reservoir and this event would cause a significant compromise of systems and abnormal operation with a requirement for high level monitoring and incident management.	IA.H.RR.01
				Contamination of treated water supply	Major	Unlikely	Medium	PM 52	Continuous permanent chlorine dosing	Insignificant	Insignificant	Unlikely	Unlikely	Low	Yes		Reliable	The management of this risk requires improvements to improve the uncertainty and management. See the improvement action plan. The following contingencies are currently applied - Reactive maintenance The likelihood and consequence are assigned due to the following reasons The reservoir in it's current state is in need of repair and there have been occasions when access is difficult. Consequence has been assessed as moderate as the population affected would be the sub-population supplied by Harper Hills Reservoir and this event would cause a significant compromise of systems and abnormal operation with a requirement for high level monitoring and incident management.	
		R.01	Backflow from customer connections causing introduction of contaminants into the distribution system (residential).	[redacted]																

Hororātā WTP					Maximum Risk			Residual Risk											
	A	B		C	D	E	F	G		H	I	J	K	L	M	N	O	P	
Hazard Group	Supply element	No.	Hazardous event	Hazards reasonably expected to be associated with hazardous event	Consequence of the hazardous event	Likelihood of hazardous event occurring	Maximum (unmitigated risk (D x E)		Preventative measures	Modified consequences	Overall modified consequence	Modified likelihood of hazardous event occurring	Overall modified likelihood	Residual (mitigated risk) (I x k)	Risk managed	Priority	Uncertainty	Comment	Improvement Plan Actions
Reticulation & Storage		R.02	Backflow from customer connections (industrial and commercial) introduction of contaminants into the distribution system.																
		R.03	Contamination of supply due to unapproved hydrant access																

Hororātā WTP					Maximum Risk			Residual Risk											
	A	B		C	D	E	F	G		H	I	J	K	L	M	N	O	P	
Hazard Group	Supply element	No.	Hazardous event	Hazards reasonably expected to be associated with hazardous event	Consequence of the hazardous event	Likelihood of hazardous event occurring	Maximum (unmitigated risk (D x E)		Preventative measures	Modified consequences	Overall modified consequence	Modified likelihood of hazardous event occurring	Overall modified likelihood	Residual (mitigated risk) (I x k)	Risk managed	Priority	Uncertainty	Comment	Improvement Plan Actions
	Reticulation	R.04	Operation and maintenance activities (hygiene) causing introduction of contaminants into the distribution system.	Bacteria/viruses	Major	Possible	High	PM 14	Operations staff are trained, have a sound knowledge of systems and access to experienced operators on-call	Major	Insignificant	Rare	Rare	Low	Yes		Confident	This risk is managed through the following activities - Disinfecting and Hygiene procedures stored in DORIS, update required 2020. - Education and training of operations staff - Residual disinfectant The likelihood and consequence are assigned due to the following reasons Possible as Operations and Maintenance staff regularly attend site and perform operational activities. Consequence of this event has been assessed as major. Hororātā has an interconnected network. Thus, any part of the network impacted by contamination can be isolated. The impact will be significant, with the potential for acute illness. It may take time to locate the source of contamination in the network.	
								PM 29	Hygiene Procedure in place for all O&M activities	Major		Rare							
								PM 52	Continuous permanent chlorine dosing	Insignificant		Possible							
				Protozoa	Major	Possible	High	PM 14	Operations staff are trained, have a sound knowledge of systems and access to experienced operators on-call	Major	Major	Rare	Rare	Medium	Yes		Estimate	The risk is managed through the following actions - Disinfecting and Hygiene procedures stored in DORIS, update required 2020. - Education and training of operations staff - Contingency measures required in the event of contamination occurring are covered in the Transgression Response Plans. This provides guidance on the measures required according to the level of contamination detected. The likelihood and consequence are assigned due to the following reasons Possible as Operations and Maintenance staff regularly attend site and perform operational activities. Consequence of this event has been assessed as major. Hororātā has an interconnected network. Thus, any part of the network impacted by contamination can be isolated. The impact will be significant, with the potential for acute illness. It may take time to locate the source of contamination in the network.	
								PM 29	Hygiene Procedure in place for all O&M activities	Major		Rare							
				Chemical	Moderate	Unlikely	Medium	PM 14	Operations staff are trained, have a sound knowledge of systems and access to experienced operators on-call	Moderate	Moderate	Rare	Rare	Low	Yes		Estimate	The risk is managed through the following actions - Disinfecting and Hygiene procedures stored in DORIS, update required 2020. - Education and training of operations staff - Contingency measures required in the event of contamination occurring are covered in the Transgression Response Plans. This provides guidance on the measures required according to the level of contamination detected. The likelihood and consequence are assigned due to the following reasons Possible as Operations and Maintenance staff regularly attend site and perform operational activities. Consequence has been assessed as moderate. The impact will be significant with the potential for widespread aesthetic issues, or repeated breach of the MAVs. Would require part of the network to be isolated. It may take some time to locate the source of contamination in the network.	
								PM 29	Hygiene Procedure in place for all O&M activities	Moderate		Rare							
		R.05	Introduction of contaminants into the distribution system through pipe materials, age and condition and plumbosolvency.	Bacteria/viruses	Major	Unlikely	Medium	PM 20	Condition assessments every 3 months used to determine asset replacement including preventative maintenance, replacement and critical spares. There is also a detailed annual scheme review which involves a full condition assessment.	Major	Insignificant	Rare	Rare	Low	Yes		Estimate	This risk is managed through the following activities - Residual disinfectant - Annual review procedure as per SDC Activity Management Plan 2015 Figure 7-26, update due 2021. The likelihood and consequence are assigned due to the following reasons Unlikely as pipe material is selected to be unreactive, age and condition of infrastructure is monitored and consumers are advised about plumbosolvency. Consequence of this event has been assessed as major. Hororātā has an interconnected network. Thus, any part of the network impacted by contamination can be isolated. The impact will be significant, with the potential for acute illness. It may take time to locate the source of contamination in the network.	
								PM 30	Notify consumers of plumbosolvency twice per year as required by DWSNZ	Major		Unlikely							
								PM 31	Pipe renewals are reviewed annually based on asset data including age, pipe material, previous number of repairs	Major		Rare							
								PM 69	Continual monitoring of trends in network water quality data allowing for a response to any changes.	Major		Rare							
								PM 52	Continuous permanent chlorine dosing	Insignificant		Rare							
				Chemical	Moderate	Unlikely	Medium	PM 20	Condition assessments every 3 months used to determine asset replacement including preventative maintenance, replacement and critical spares. There is also a detailed annual scheme review which involves a full condition assessment.	Moderate	Moderate	Rare	Rare	Low	Yes		Estimate	This risk is managed through the following activities - Annual review procedure as per SDC Activity Management Plan 2015 Figure 7-26, update due 2021. The likelihood and consequence are assigned due to the following reasons Unlikely as pipe material is selected to be unreactive, age and condition of infrastructure is monitored and consumers are advised about plumbosolvency. Consequence has been assessed as moderate. The impact will be significant with the potential for widespread aesthetic issues, or repeated breach of the MAVs. Would require part of the network to be isolated. It may take some time to locate the source of contamination in the network..	
								PM 30	Notify consumers of plumbosolvency twice per year as required by DWSNZ	Moderate		Unlikely							
								PM 69	Continual monitoring of trends in network water quality data allowing for a response to any changes.	Moderate		Rare							
								PM 31	Pipe renewals are reviewed annually based on asset data including age, pipe material, previous number of repairs	Moderate		Rare							
		R.06	Insufficient water available due to water main failure.	Water demand may not be met	Moderate	Possible	Medium	PM 6	Reservoir level remotely monitored with a SCADA alarm to provide an alert and allow time to put contingency measures in place	Moderate	Moderate	Possible	Rare	Low	Yes		Estimate	This risk is managed through the following activities - Annual review procedure as per SDC Activity Management Plan 2015 Figure 7-26, update due 2021 - Data from previous bursts recorded and available, informing annual review - Annual scheme reviews including reticulation review, data stored on AMIS and issued to the Water Engineer and Engineers Representative The likelihood and consequence are assigned due to the following reasons Possible as there are many water mains and these can break due to age and/or can be ruptured by other activities (i.e. construction). Consequence of this event has been assessed as major. Hororātā has an interconnected network. Thus, any part of the network impacted by contamination can be isolated. The impact will be significant, with the potential for acute illness. It may take time to locate the source of contamination in the network.	
								PM 20	Condition assessments every 3 months used to determine asset replacement including preventative maintenance, replacement and critical spares. There is also a detailed annual scheme review which involves a full condition assessment.	Moderate		Unlikely							
								PM 31	Pipe renewals are reviewed annually based on asset data including age, pipe material, previous number of repairs	Moderate		Rare							
								PM 32	Isolate section of pipe via network valves, operational contract includes response time required for major failures	Moderate		Possible							

Hororātā WTP					Maximum Risk			Residual Risk											
	A	B		C	D	E	F	G		H	I	J	K	L	M	N	O	P	
Hazard Group	Supply element	No.	Hazardous event	Hazards reasonably expected to be associated with hazardous event	Consequence of the hazardous event	Likelihood of hazardous event occurring	Maximum (unmitigated risk (D x E)		Preventative measures	Modified consequences	Overall modified consequence	Modified likelihood of hazardous event occurring	Overall modified likelihood	Residual (mitigated risk) (I x k)	Risk managed	Priority	Uncertainty	Comment	Improvement Plan Actions
		R.07	Insufficient water available due to demand exceeding supply.	Water demand may not be met	Moderate	Unlikely	Medium	PM 6	Reservoir level remotely monitored with a SCADA alarm to provide an alert and allow time to put contingency measures in place	Moderate	Minor	Unlikely	Unlikely	Low	Yes		Confident	This risk is managed through the following activities - Demand data stored and available on SCADA - Demand management plan in place and available here https //www.selwyn.govt.nz/__data/assets/pdf_file/0005/194270/Water-Conservation-and-Demand-Management-Plan.pdf The likelihood and consequence are assigned due to the following reasons The amount of connections to a water supply scheme is controlled based on the amount of water available. Consequence has been assessed as moderate as the population affected would be the sub-population supplied by and this event would cause a significant compromise of systems and abnormal operation with a requirement for high level monitoring and incident management.	
								PM 13	SCADA alarms are monitored, with communications to on-call operator to action (notes either Urgent or Routine). Any instrumentation tied to CCPs will cause shutdown of the system in the event of an equipment failure.	Moderate		Unlikely							
								PM 22	Conserve water notice can be issued via the 'Boil Water Notice Portal' during periods of high demand or when there is a water supply issue.	Minor		Unlikely							
		R.08	Insufficient chlorine contact time causing a compromised water supply to house between Homebush WTP and Atkins Road reservoir.	Bacteria/viruses	Moderate	Possible	Medium			Moderate	Moderate	Possible	Possible	Medium	No	2	Uncertain	The management of this risk requires improvements to improve the uncertainty and management. See the improvement action plan. The following contingencies are currently applied - Online FAC monitoring at Atkins Road reservoir inlet and outlet. - Twice weekly E.coli manual sampling. - Filtration and UV in place as well as being a high pressure system, chlorine is used as secondary disinfection. The likelihood and consequence are assigned due to the following reasons There is little chlorine data for this particular connection. Consequence has been assessed as moderate as the population affected would be the sub-population supplied by and this event would cause a significant compromise of systems and abnormal operation with a requirement for high level monitoring and incident management.	IA.H.HB.02
		R.09	High FAC chlorine experienced by house between Homebush WTP and Atkins Road reservoir.	Chemical	Moderate	Possible	Medium	PM 68	Chlorine residual monitored at WTP, functioning with active CCPs/OMCPs	Moderate	Moderate	Rare	Rare	Low	Yes		Reliable	This risk is managed through the following activities FAC measured continuously online at the Homebush WTP and Atkins Road reservoir inlet and outlet, there is one supply point before the reservoir. The likelihood and consequence are assigned due to the following reasons The house is in close proximity to the WTP so any higher dosing may be experienced by them. Consequence has been assessed as moderate. The impact will be significant with the potential for widespread aesthetic issues, or repeated breach of the MAVs. Would require part of the network to be isolated. It may take some time to locate the source of contamination in the network..	
		R.10	Pipe failure Homebush WTP to Atkins Road reservoir due to - Bridge failure - Damage due to vehicle incident	Water demand may not be met	Major	Rare	Medium	HOPM 4	More resilient pipe installed across the bridge	Major	Moderate	Very Rare	Very Rare	Low	Yes		Reliable	This risk is managed through the following actions - Galvanised pipe installed across the bridge The likelihood and consequence are assigned due to the following reasons The event of a vehicle crash or damage that is significant enough to damage the pipe is rare. Consequence has been assessed as major as the population affected would be less than 5,000 and this event would cause a significant compromise of systems and abnormal operation with a requirement for high level monitoring and incident management.	
								HOPM 5	Non-return valve installed on the reservoir side of the bridge	Moderate		Rare							
								PM 22	Conserve water notice can be issued via the 'Boil Water Notice Portal' during periods of high demand or when there is a water supply issue.	Moderate		Rare							
		R.11	Maintenance required or water main failure of pipes which are difficult access due to being in remote locations and on private land.	Water demand may not be met	Major	Possible	High	PM 9	Conserve water notification can be issued with water restrictions implemented if the treated water storage drops below 50% during any power supply interruption, conserve water notification or water restrictions can be put in place	Moderate	Moderate	Possible	Unlikely	Medium	No	3	Estimate	The management of this risk requires improvements to improve the uncertainty and management. See the improvement action plan. The following contingencies are currently applied - Reactive maintenance - Transgression and Emergency Response Plans - Asset management The likelihood and consequence are assigned due to the following reasons The current condition of the pipes is tracked the same way as for all other pipes so there is asset management in place Consequence has been assessed as major as the population affected would be less than 5,000 and this event would cause a significant compromise of systems and abnormal operation with a requirement for high level monitoring and incident management.	IA.S.07
								PM 31	Pipe renewals are reviewed annually based on asset data including age, pipe material, previous number of repairs	Major		Unlikely							
		R.12	Pressure surges in the network impacting mechanical equipment	Water demand may not be met	Major	Rare	Medium			Major	Major	Rare	Rare	Medium	No	3	Estimate	The management of this risk requires improvements to improve the uncertainty and management. See the improvement action plan. The following contingencies are currently applied - A pressure vessel is installed at the Atkins Road pump station, however this is not stamped or certified. - A PRV and pressure sustaining valve are installed downstream of the WTP to protect mechanical equipment. The likelihood and consequence are assigned due to the following reasons The pumps are run on VSDs or soft start/stop motors to reduce the risk of surges, there is also a pressure vessel which is not certified but provides some protection. Consequence has been assessed as major as the population affected would be less than 5,000 and this event would cause a significant compromise of systems and abnormal operation with a requirement for high level monitoring and incident management.	IA.S.03
		R.13	Water supply compromised due to the following - Insufficient chlorine residual - Pressure and chlorine monitoring equipment failure	Bacteria/viruses	Major	Possible	High	PM 68	Chlorine residual monitored at WTP, functioning with active CCPs/OMCPs	Insignificant	Insignificant	Possible	Possible	Low	Yes		Reliable	This risk is managed through the following - Levels alarmed and FAC measured continuously online at the Homebush Road WTP and Atkins Road reservoir inlet and outlet. The likelihood and consequences are assigned due to the following reasons It is possible for there to be a failure in chlorine dosing or residual if a contamination event has occurred. Consequence of this event has been assessed as major. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The impact would be significant with the potential for acute harm or widespread outbreak of illness. Would require the treatment plant to be removed from service while the event is resolved.	

Hororātā WTP					Maximum Risk			Residual Risk											
	A	B		C	D	E	F	G		H	I	J	K	L	M	N	O	P	
Hazard Group	Supply element	No.	Hazardous event	Hazards reasonably expected to be associated with hazardous event	Consequence of the hazardous event	Likelihood of hazardous event occurring	Maximum (unmitigated risk (D x E)		Preventative measures	Modified consequences	Overall modified consequence	Modified likelihood of hazardous event occurring	Overall modified likelihood	Residual (mitigated risk) (I x k)	Risk managed	Priority	Uncertainty	Comment	Improvement Plan Actions
		R.14	Compromised water supply - High FAC chlorine	Chemical	Minor	Unlikely	Low	PM 68	Chlorine residual monitored at WTP, functioning with active CCPs/OMCPs	Insignificant	Insignificant	Unlikely	Unlikely	Low	Yes		Reliable	This risk is managed through the following - Levels alarmed and FAC measured continuously online at the Homebush Road WTP and Atkins Road reservoir inlet and outlet. The likelihood and consequences are assigned due to the following reasons It is possible for there to be a failure in chlorine dosing if there is a mechanical or controls fault. Consequence of this event has been assessed as major. Hororātā has approx. 900 residents which is less than the threshold of 5000 residents required to meet criteria for "catastrophic" consequence. The impact would be significant with the potential for acute harm or widespread outbreak of illness. Would require the treatment plant to be removed from service while the event is resolved.	
Other	Overall system	O.01	Inappropriate/ inadequate/ incorrect sampling leading to incorrect water quality data used for supply management.	Unsafe water distributed to customers	Major	Rare	Medium	PM 61	DW-GEN-07-DST-0007 Drinking Water - Transgression Response Plans in place, including requirements to undertake immediate resampling of the source, post-treatment and retic in the event of a transgression post-treatment	Minor	Minor	Rare	Rare	Low	Yes		Confident	This risk is managed through the following actions - Transgression Response Plan is implemented when required - Sample records checked weekly to confirmed the required level of sampling has been undertaken. - Sampling contract in progress, including requirement for staff who undertake water quality samples to be trained in taking and handling water samples with records of SOPs and training kept up to date and document controlled. The likelihood and consequence are assigned due to the following The sampling and monitoring is conducted by verified and calibrated instrumentation or trained individuals, there are multiple safeguards in place. Consequence of this event has been assessed as major. Hororātā has an interconnected network. Thus, any part of the network impacted by contamination can be isolated. The impact will be significant, with the potential for acute illness. It may take time to locate the source of contamination in the network.	
								PM 34	DW-GEN-05-DST-0001 Drinking Water Quality Compliance Monitoring Plan developed in consultation with DWA	Moderate		Rare							
								PM 33	Sampling arrangement in place including requirement for staff and Food and Health staff who undertake water quality samples be trained in taking and handling water samples with records of SOPs and training kept up to date and document controlled	Major		Rare							
								PM 17	Routine calibration and maintenance conducted on any instrumentation associated with CCPs. This is programmed as a recurring task in AMS.	Minor		Rare							
		O.02	Incorrect analysis of sample and/or inadequate/inaccurate reporting of results leading to a failure to identify adverse water quality.	Unsafe water distributed to customers	Major	Rare	Medium	PM 35	IANZ accredited laboratory; chain of custody process	Major	Moderate	Rare	Rare	Low	Yes		Confident	This risk is managed through the following actions - Transgression Response Plan is implemented when required - Sample records checked weekly to confirmed the required level of sampling has been undertaken. - Sampling contract in progress, including requirement for staff who undertake water quality samples to be trained in taking and handling water samples with records of SOPs and training kept up to date and document controlled. The likelihood and consequence are assigned due to the following The sampling and monitoring is conducted by verified and calibrated instrumentation or trained individuals, there are multiple safeguards in place. Consequence of this event has been assessed as major. Hororātā has an interconnected network. Thus, any part of the network impacted by contamination can be isolated. The impact will be significant, with the potential for acute illness. It may take time to locate the source of contamination in the network.	
								PM 36	Transgressions results provided via text message in advance of full results email	Moderate		Rare							
		O.03	System does not perform as intended due to inadequate skills or training.	Unsafe water distributed to customers	Major	Unlikely	Medium	PM 14	Operations staff are trained, have a sound knowledge of systems and access to experienced operators on-call	Major	Moderate	Rare	Rare	Low	Yes		Confident	This risk is managed through the following actions - For operation parameters refer to Hororātā UPCP (DW-SEL-04-DST-0004) including SOP list - Water Operator Training including alarm responses for CCPs, UV system operations and maintenance (SICON Training Register) The likelihood and consequence are assigned due to the following It is unlikely that the system not performing is due to inadequate skills or training. This can and does occur but is not regular. Consequence of this event has been assessed as major. Hororātā has an interconnected network. Thus, any part of the network impacted by contamination can be isolated. The impact will be significant, with the potential for acute illness. It may take time to locate the source of contamination in the network.	
								PM 37	A copy of relevant all drawings, manuals and reference material are kept on site, available to Operations Staff, and updated as required	Moderate		Unlikely							
								PM 38	Basic visual inspections are programmed weekly and detailed inspection 3 monthly	Major		Rare							
								PM 39	SDC Asset Management System (AMS) used for programming and monitoring regular maintenance and inspection/monitoring tasks	Major		Rare							
		O.04	Inadequate controls on construction and maintenance work resulting in system damage during construction/maintenance work.	Water demand may not be met	Moderate	Unlikely	Medium	PM 40	All maintenance is undertaken by trained/authorised SDC staff or contractors	Moderate	Moderate	Rare	Rare	Low	Yes		Reliable	This risk is managed through the following actions - Water Operator Training including undertaking maintenance in the reticulation (SICON Training Register) - As-built records are maintained through the AMIS system and as per the AMIS SOPs and Code of Practice - SICON undertake supervision of all new water connections and third party work as per SDC policy and stated when applying for a new connection https //www.selwyn.govt.nz/services/water/water-supplies/water-connections/new-water-connection-approval-and-declaration The likelihood and consequence are assigned due to the following There is not a significant amount of construction around this scheme and this event has not occurred regularly in the past. Consequence has been assessed as moderate as the population affected would be the sub-population supplied by and this event would cause a significant compromise of systems and abnormal operation with a requirement for high level monitoring and incident management.	
								PM 41	SDC construction work is appropriately supervised	Moderate		Rare							
								PM 42	As-constructed records are maintained, up to date and made available to all parties working on or in vicinity of system	Moderate		Rare							
								PM 43	Third party work is supervised to ensure no damage to water services	Moderate		Rare							
		O.05	Inadequate controls on construction and maintenance work resulting in system damage during construction/maintenance work.	Bacteria/viruses	Major	Unlikely	High	PM 40	All maintenance is undertaken by trained/authorised SDC staff or contractors	Major	Insignificant	Rare	Rare	Low	Yes		Reliable	This risk is managed through the following actions - Water Operator Training including undertaking maintenance in the reticulation (SICON Training Register) - As-built records are maintained through the AMIS system and as per the AMIS SOPs and Code of Practice - SICON undertake supervision of all new water connections and third party work as per SDC policy and stated when applying for a new connection https //www.selwyn.govt.nz/services/water/water-supplies/water-connections/new-water-connection-approval-and-declaration The likelihood and consequence are assigned due to the following There is not a significant amount of construction around this scheme and this event has not occurred regularly in the past. Consequence of this event has been assessed as major. Hororātā has an interconnected network. Thus, any part of the network impacted by contamination can be isolated. The impact will be significant, with the potential for acute illness. It may take time to locate the source of contamination in the network.	
								PM 41	SDC construction work is appropriately supervised	Major		Rare							
								PM 42	As-constructed records are maintained, up to date and made available to all parties working on or in vicinity of system	Major		Rare							
								PM 52	Continuous permanent chlorine dosing	Insignificant		Unlikely							
								PM 43	Third party work is supervised to ensure no damage to water services	Major		Rare							

Hororātā WTP					Maximum Risk			Residual Risk											
	A	B		C	D	E	F	G		H	I	J	K	L	M	N	O	P	
Hazard Group	Supply element	No.	Hazardous event	Hazards reasonably expected to be associated with hazardous event	Consequence of the hazardous event	Likelihood of hazardous event occurring	Maximum (unmitigated risk (D x E)		Preventative measures	Modified consequences	Overall modified consequence	Modified likelihood of hazardous event occurring	Overall modified likelihood	Residual (mitigated risk) (I x k)	Risk managed	Priority	Uncertainty	Comment	Improvement Plan Actions
		O.06	Bore unable to be used due to catastrophic failure (natural disaster e.g. earthquake).	Water demand may not be met	Major	Very Rare	Low	PM 22	Conserve water notice can be issued via the 'Boil Water Notice Portal' during periods of high demand or when there is a water supply issue.	Moderate	Moderate	Very Rare	Very Rare	Low	Yes		Reliable	This risk is managed through the following actions - Emergency Response Plans for these events The likelihood and consequence are assigned due to the following Significant natural disasters are very rare. Consequence has been assessed as major as the population affected would be less than 5,000 and this event would cause a significant compromise of systems and abnormal operation with a requirement for high level monitoring and incident management.	
								PM 56	Deliver tankers of water for consumers to fill	Moderate		Very Rare							
								PM 57	For restricted schemes all consumers are advised to have three days storage on their own properties	Moderate		Very Rare							
		O.07	Vandalism/sabotage or accidental damage (e.g. vehicle) to water supply infrastructure (i.e. surface pumps, reservoir, or headworks etc.)	[redacted]															

Appendix C – Hororātā Drinking Water Supply Catchment Hazard Assessment

Selwyn District Council Water Safety Plans

Hororata Catchment Hazard Assessment

IZ122400-A.CS.CI.5.WSP-NW-RPT-9 | 0

17 April 2020

Selwyn District Council

Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved
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Selwyn District Council Water Safety Plans

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Contents

Important note about your report

This sole purposed of this report prepared by Jacobs New Zealand Limited (Jacobs) for Selwyn District Council (the Client) is to Hororata water supply scheme. The contents of this report are in accordance with the scope of services detailed in the terms of engagement between Jacobs and the client. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report (or any part of it) for any other purpose.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change. Jacobs derived the data in this report from information sourced from the Client (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re- evaluation of the data, findings, observations and conclusions expressed in this report.

Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report may also describe specific limitations and/or uncertainties which qualify its findings. Accordingly, this report should be read in full and no excerpts are to be taken as representative of the findings unless any such excerpt and the context in which it is intended to be used have been approved by Jacobs in writing.

1. Introduction

1.1 Terms of Reference

This report has been prepared by Jacobs New Zealand Limited (Jacobs) to support the development of the Water Safety Plan (WSP) for the Hororata water supply scheme for Selwyn District Council (SDC). This report documents the catchment hazard assessment undertaken in accordance with the Handbook for Preparing a Water Safety Plan (MoH, 2019a) and the New Zealand Drinking-water Safety Plan Framework (MoH, 2018a).

1.2 Background

SDC operate 27 water supply schemes across the Selwyn District. These 27 water supply schemes provide potable drinking water to 82% of the population of the Selwyn District, equivalent to approximately 50,000 people. WSPs have been prepared for each of the 27 water supply schemes. The purpose of these WSPs are to document, assess, and manage the risks associated with each water supply scheme, thus protecting public health.

SDC has engaged Jacobs to support the five-yearly review requirements in the *Health (Drinking Water) Amendment Act 2007* and to meet the requirements of the New Zealand Drinking-water Safety Plan Framework (MoH, 2018a). As part of this support, Jacobs is preparing catchment hazard assessments for the majority of SDCs water supply schemes as per the water safety plan review process. The catchment hazard assessments are being undertaken to identify hazards which could potentially impact individual supply sources within each water supply scheme. Subsequently, each catchment hazard assessment will be used to develop the risk assessment documented in each WSP.

1.3 Objective

The objective of this catchment hazard assessment is to delineate a series of source protection zones, based on spatial criterion, to identify hazards that could potentially impact the existing supply gallery within the Hororata water supply scheme. These hazards include Priority 1 and Priority 2 determinands as defined in the Drinking-water Standards for New Zealand 2005 (revised 2018) (DWSNZ) (MoH, 2018b). The delineation of the source protection zones was undertaken in accordance with the Technical Guidelines for Drinking Water Source Protection Zones (PDP, 2018).

This catchment hazard assessment has been prepared in accordance with the requirements of Section 2.1.2 of the Handbook for Preparing a Water Safety Plan (MoH, 2019a), which are as follows:

- Catchment characteristics, including:
  - Catchment area or groundwater recharge zone, including any designated catchment/recharge protection zone;
  - Topography;
  - Main geological features; and
  - Land use, current and past, and likely land use change.
- Climatic features, including significant climate variability and expected longer-term changes.

This catchment hazard assessment is also used to determine the protozoal compliance criteria in Section 5 of the DWSNZ (MoH, 2018b).

1.4 Limitations

In preparing this catchment hazard assessment, Jacobs has relied upon, and presumed accurate, data and reports obtained from publicly available sources (e.g., Cliflo[1], Environment Canterbury (ECan), and Ministry of Health (MoH) etc.) and SDC. If the data or reports are subsequently determined to be inaccurate, then it is possible that the conclusions expressed in this catchment hazard assessment would change.

It is noted that the passage of time and impacts of future events (e.g., land use changes, natural events such as earthquakes, and regulatory changes etc.) may result in changes to the number or types of hazards present within the protection zones developed as part of this catchment hazard assessment or treatment required at specific water treatment plants. Therefore, this catchment hazard assessment should be considered a living document and updated as required, including when additional sources of supply are connected to the Hororata water supply scheme.

This catchment hazard assessment does not describe the risks associated with each hazard identified. The risks associated with the various hazards identified are provided in the WSP prepared for the Hororata water supply scheme. This catchment hazard assessment should therefore be read in conjunction with the WSP for the Hororata water supply scheme.

[1] National Climate Database for New Zealand (https://cliflo.niwa.co.nz).

2. Hororata Water Supply Scheme Overview

The sole source of water in the Hororata water supply scheme is a supply gallery located on a river terrace near the true left bank of the Selwyn River in close proximity to the State Highway (SH) 77 bridge. A high-level summary of the supply gallery is outlined in **Table 2.1**. The location of the supply gallery is shown in **Figure 2-1**.

Table 2.1 : Summary of the supply gallery within the Hororata water supply scheme.

Source Name	Source WO Code	Gallery ID
Glentunnel Intake, Selwyn RWS	G00822	L35/0215

Figure 2-1 : Location of Glentunnel Intake, Selwyn RWS – L35/0215 (See **Appendix A**).

It is noted that the Hororata water supply scheme is part of the Selwyn Rural Water Scheme (Selwyn RWS) which provides treated surface water to an area of over 20,000 ha. The Selwyn RWS also includes the Acheron water supply scheme. The hazards associated with the Acheron water supply scheme are documented in a separate catchment hazard assessment.

3. Source, Consent, & Well Details

A detailed summary of the source, associated resource consent (groundwater take[2]), and supply gallery (well) details for the Hororata supply scheme is provided in **Table 3.1**.

Table 3.1 : Summary of source, consent, and supply gallery details for the Hororata water supply scheme.

Source Name	**Glentunnel Intake, Selwyn RWS**
Source Details	
Source WO code	G00822
Location	[redacted]
Map reference NZTM	[redacted]
Type of source	Groundwater hydraulically connected to surface water[2]
Consent Details[3]	
Consent number	CRC970985.1
Consent expiry date	11 December 2031
Max. instantaneous rate of take (L/s)	16.8
Daily volume (m^3)	1,450
Weekly volume (m^3)	N/A
Annual volume (m^3)	400,000 between 1 July and the following 30 June
Well Details[4]	
Well ID	L35/0215
Elevation (m AMSL[5])	261.08
Diameter (mm)	1,000
Depth (m BGL[6])	6.00
Screen depth (m BGL)	Unknown
Aquifer type[7]	Unconfined
Borelog	Yes – Refer to **Appendix B**
Aquifer test	No
Concrete well pad	Sicon (2019) state that intake is in a concrete chamber that is covered by a lockable lid that is in good condition but not bolted down.

[2] While listed as a groundwater take on ECan's resource consent database (https://www.ecan.govt.nz/data/consent-search/, accessed 11 February 2020), the supply gallery is located in close proximity to the Selwyn River being located approximately 30 to 50 m north of the stream bed (depending on river stage) and screened in river gravels, and therefore source water will predominantly be surface water.

[3] Consent details obtained from ECan's resource consent database (https://www.ecan.govt.nz/data/consent-search/, accessed 11 February 2020).

[4] Unless otherwise stated, all well details have been obtained ECan's wells database (https://ecan.govt.nz/data/well-search/?WellNo=, accessed 11 February 2020).

[5] m AMSL = m above mean sea level.

[6] m BGL = m below ground level.

[7] Refer to Error! Reference source not found. in **Section** Error! Reference source not found. for further information about aquifer type.

4. Community Drinking Water Supply Protection Zones

4.1 Provisional Community Drinking Water Supply Protection Zones

The provisional community drinking water supply protection zone (CDWSPZ) for the Hororata water supply scheme, as delineated by ECan using the methodology outlined in Schedule 1 of the Canterbury Land and Water Regional Plan (CLWRP), is summarised in **Table 4.1** and shown in **Figure 2-1**.

Table 4.1 : Summary of provisional community drinking water supply protection zones for the Hororata water supply scheme.

Source Name	Well ID	Provisional Community Drinking Water Supply Protection Zone[8]
Glentunnel Intake, Selwyn RWS	L35/0215	Extends: ▪ 100 m downstream of supply gallery ▪ 1,000 m upstream of supply gallery ▪ Across the full width and within 50 m of the bed of the Selwyn River

For the purposes of this catchment hazard assessment, the primary concern associated with the provisional CDWSPZ, relate to the fact that it is not representative of the actual surface water catchment. It is therefore considered that the hazards associated with the supply gallery will not be adequately assessed by solely analysing the provisional CDWSPZ.

4.2 Delineation of New Protection Zones

4.2.1 Introduction to the New Protection Zones

Given the aforementioned concern with regard to the provisional CDWSPZ, three new community drinking water protection zones in relation to surface water have been delineated in accordance with the Technical Guidelines for Drinking Water Source Protection Zones (PDP, 2018). Surface water protection zones have been applied for the Hororata water supply scheme given the supply gallery is screened in river gravels in close proximity to the Selwyn River. The three protection zones are outlined in more detail below.

Protection Zone 1 – Intake Protection Zone

Protection Zone 1 (PZ1) is the area extending 50 m landward from the water's edge for a distance of 1,000 m upstream and 100 downstream from the supply gallery[9]. It is noted that this encompasses the area within a five metre radius of the supply gallery.

The purpose of PZ1 is to reduce the:

- Risk of contamination via the gallery casing; and
- Likelihood of a direct discharge of contaminants into the Selwyn River by allowing a mixing zone upstream (and immediately downstream) of the supply gallery.

[8] Provisional CDWSPZ obtained from ECan's GIS database (https://mapviewer.canterburymaps.govt.nz/, accessed 11 February 2020). It is noted that the provisional CDWSPZ appears to have been assigned to the incorrect gallery.

[9] PDP (2018) note that PZ1 could extend as little as five m landward from the water's edge or a larger distance (e.g., 50 m or greater) if it could be achieved in a practical manner. A distance of 50 m land from the water's edge was considered to be practical and achievable for the Dry Acheron Stream as this distance is consistent with the provisional CDWSPZ.

It is noted that PZ1 provides a limited response time buffer, although this requires immediate reporting of incidents by those involved.

The supply gallery wellhead itself should also be fenced off (minimum of a five metre radius) to prevent access by animals and unauthorised access. In addition, direct sources of contamination within the fenced off area such as fuel or chemical storage or discharges of contaminants should be prohibited.

Protection Zone 2 – Intermediate Zone (Microbial Source Protection Zone)

Protection Zone 2 (PZ2) is the area extending 100 m landwards from the water's edge and upstream for a distance equivalent to eight hours travel time based on flow velocity data and 100 m downstream of the supply gallery. The purpose of this is to allow for considerable attenuation by dilution and dispersion within the flowing channel of the Selwyn River, and some attenuation within the unsaturated zone adjacent to the Selwyn River.

It is noted that a travel time of eight hours should allow sufficient time for SDC to be notified and implement appropriate actions should a discharge or other event (e.g., flooding) occur outside of PZ2. However, it is noted that contaminants could potentially reach the supply gallery, indirectly, at concentrations exceeding the guideline value (GV) or maximum acceptable value (MAV) in the DWSNZ as a result of agricultural activities, large point source discharges (e.g., stormwater or wastewater), and spills and/or leaks from chemical storage facilities from within PZ2.

Protection Zone 3 – Capture Zone (Upstream Surface Water Catchment)

Protection Zone 3 (PZ3) extends upstream of the point 100 m downstream of the supply gallery and encompasses the entire surface water catchment. The purpose of PZ3 is to identify the surface water catchment so that appropriate controls can be put in place to manage land uses within it.

4.2.2 Methodology for Delineating New Protection Zones

Protection Zone 1 – Intake Protection Zone

PZ1 was delineated by identifying the area within 50 m landward from the water's edge for a distance of 1,000 m upstream and 100 m downstream of the supply gallery. It is noted that this encompasses the area within a five metre radius of the supply gallery.

Protection Zone 2 – Intermediate Zone (Microbial Source Protection Zone)

PZ2 was delineated by identifying the area within 100 m landward from the water's edge from the water's edge and upstream for a distance equivalent to eight hours travel time, which was calculated using the Mannings equation, and 100 m downstream of the supply gallery.

Protection Zone 3 – Capture Zone (Upstream Surface Water Catchment)

PZ3 was delineated using NIWA REC2[10] (i.e., the existing river line data was applied to identify the surface water catchment extending upstream from a point 100 m downstream of the supply gallery).

The three protection zones for the supply gallery are shown in **Figure 2-1**.

[10] National Institute of Water and Atmospheric Research - River Environmental Classification, Version 2.0 (downloaded 12 June 2019).

5. Environmental Setting

The supply gallery in the Hororata water supply scheme is located on a river terrace near the true left bank of the Selwyn River in close proximity to the SH 77 bridge. Assessing the environmental setting allows the identification of (historical, current, or future) land uses present within each protection zone which could potentially impact water quality.

The current land cover, discharges, and HAIL[11] sites within the three protection zones for the supply gallery are shown in **Table 5.1**.

Table 5.1 : Summary of the environmental setting within the protection zones of the supply gallery within the Hororata water supply scheme.

Source Name	Glentunnel Intake, Selwyn RWS
Well ID	L35/0215
Surface water catchment area (ha)	20,326.2
Location	Located on river terrace near the true left bank of the Selwyn River in close proximity to the SH 77 bridge
Topography	Flat-to-gently sloping land
Hydrology	Hororata is located near the foothills of the Southern Alps. The main river near Hororata is the Selwyn River. The Selwyn River begins in the high-country as a number of small streams which eventually merge to form the main channel of the Selwyn River which flows past Glentunnel onto the Canterbury Plains. It is noted that the Selwyn River is ephemeral in nature and generally runs dry after emerging onto the Canterbury Plains (Vincent, 2005).
Climatic features	Mean daily maximum temperature is 17.7 °C, although the daily maximum temperature can exceed 30 °C during the summer months. Mean daily temperature is 11.9 °C. Mean daily minimum temperature is 6.2 °C. although the daily minimum temperature can fall below 0 °C during the winter months. Mean annual rainfall is 755.6 mm, although rainfall is likely to be variable across the surface water catchment, particularly in the foothills of the Southern Alps where the mean annual rainfall is likely to be significantly higher. MfE (2018) states that the climate change models generally predict increases in mean annual temperature and decreases in mean annual rainfall. This could have an impact on surface water flows in the area, and therefore have an effect on both surface water quality and quantity.
Historical land use[12]	A review of historical aerial imagery between 1940 and 1999 on Environment Canterbury's GIS database indicates that land use within the surface water catchment of the Glentunnel Intake source has predominantly been constant since at least 1940 (i.e., high-country land, high-country farm land, rural farm land), although the number of residential dwellings within the surface water catchment has increased over time and agricultural practices are likely to be more intensive given irrigation is now occurring within the surface water catchment.
Current land use[13] – PZ1	Sicon (2019) state that supply gallery is a concrete chamber that is covered by a lockable lid that is in good condition but not bolted down (Version 4.1 of the Land Cover Database (LCDB) indicates that land cover is deciduous hardwoods).
Current land use[13] – PZ2	Version 4.1 of the LCDB indicates that the following land covers are present within PZ2: ▪ Forest – 34.4%; ▪ Built-up area (settlement) – <1.0%; ▪ Scrub – 3.3%;

[11] HAIL = Hazardous activities and industries list.
[12] Historical aerial imagery obtained from Canterbury Maps (https://mapviewer.canterburymaps.govt.nz/, accessed 13 February 2020).
[13] Current land cover identified using the Version 4.1 of the Land Cover Database developed by Landcare Research and obtained from the Land Resource Information System portal (https://lris.scinfo.org.nz/layer/48423-lcdb-v41-land-cover-database-version-41-mainland-new-zealand/, accessed 13 June 2019).

Source Name	Glentunnel Intake, Selwyn RWS
	▪ Gravel, sand, and rock – 1.4%; ▪ Grassland – 58.9%; ▪ Orchard, vineyard or other perennial crop – <1.0%; ▪ Water – <1.0%; ▪ Shrubland – 1.5%; and ▪ Urban parkland/open space – <1.0%. As per Table A3 in the Handbook for Preparing a Water Safety Plan, based on the above land cover and review of recent aerial imagery, the following land use categories are present within PZ2: ▪ Agriculture – all activities; ▪ Forestry – all activities; ▪ Mining – all activities; ▪ Industry and commerce (heavy and light industry) – fertilise/agrichemical production and wood processing; ▪ Open space – disposal of stormwater run-off; and ▪ Residential (urban, lifestyle, and rural) – all activities. Additional land uses not captured in Table A3 present within PZ2 include: ▪ Livestock dip or spray operations; and ▪ Engine reconditioning workshops.
Current land use[13] – PZ3	Version 4.1 of the LCDB indicates that the following land covers are present within PZ2: ▪ Forest – 27.8%; ▪ Built-up area (settlement) – <1.0%; ▪ Scrub – 4.1%; ▪ Gravel, sand, and rock – <1.0%; ▪ Grassland – 60.3%; ▪ Tussock grassland – 4.3%; ▪ Orchard, vineyard or other perennial crop – <1.0%; ▪ Water – <1.0%; ▪ Shrubland – 2.9%; and ▪ Urban parkland/open space – <1.0%. As per Table A3 in the Handbook for Preparing a Water Safety Plan, based on the above land cover and review of recent aerial imagery, the following land use categories are present within PZ2: ▪ Agriculture – all activities; ▪ Forestry – all activities; ▪ Mining – all activities; ▪ Industry and commerce (heavy and light industry) – fertilise/agrichemical production and wood processing; ▪ Open space – disposal of stormwater run-off; ▪ Residential (urban, lifestyle, and rural) – all activities; and ▪ Landfill – all activities. Additional land uses not captured in Table A3 present within PZ2 include: ▪ Livestock dip or spray operations; and ▪ Engine reconditioning workshops.
Future land use	District Plan zoning maps indicate that the surface water catchment covers two different rural zones; high country and Malvern Hills. It is likely that the majority the surface water catchment will remain in its current state (e.g., high-country land, high-country farm land, rural farm land), but may be subject to more intensive agricultural practices in certain areas of the surface water catchment.

Source Name	Glentunnel Intake, Selwyn RWS
Discharges[14] – PZ1	Within PZ1 there are two consented human effluent discharges.
Discharges[14] – PZ2	Within PZ2 there are: ▪ 34 consented human effluent point discharges. In addition, there are likely to be multiple permitted and/or unconsented discharges of human effluent given the presence of residential dwellings which do not appear to have a consented discharge of human effluent; and ▪ One consented discharge of stormwater (residential).
Discharges[14] – PZ3	Within PZ3 there are: ▪ 62 consented human effluent point discharges. In addition, there are likely to be multiple permitted and/or unconsented discharges of human effluent given the presence of residential dwellings which do not appear to have a consented discharge of human effluent; and ▪ One consented discharge of stormwater (residential). It is noted that there are no discharges of dairy effluent within the surface water catchment of supply gallery.
HAIL sites[15] – PZ1	No HAIL sites are present within PZ1.
HAIL sites[15] – PZ2	Within PZ2 there are six identified HAIL sites which consist of the following activities/industries: ▪ One site consisting of livestock dip or spray operations; • One site consisting of persistent pesticide bulk storage or use; • One site consisting of mining industries; and • One site consisting of engine reconditioning workshops.
HAIL sites[15] – PZ3	Within PZ3 there are six identified HAIL sites which consist of the following activities/industries: ▪ Two sites consisting of livestock dip or spray operations; • One site consisting of persistent pesticide bulk storage or use; • One site consisting of mining industries; • One site consisting of engine reconditioning workshops; and • One landfill site.

Figure 5-1 : Land cover, discharges, and HAIL sites within the three protection zones for the Glentunnel intake, Selwyn RWS – L35/0215 (See **Appendix A**).

[14] Discharge consent data obtained from Canterbury Maps (http://opendata.canterburymaps.govt.nz/search?page=2&tags=Environment, accessed on 5 February 2020). It is noted that there may be discharges occurring within the three protection zones for the supply gallery which either permitted under ECan's Land and Water Regional Plan (LWRP) or currently unauthorised, and therefore may not have been captured in the discharge analysis.

[15] Data pertaining to HAIL sites within the Canterbury region was provided by ECan on 15 July 2019.

6. Pathway Assessment

As outlined in Appendix 4 of the Handbook for Preparing a Water Safety Plan (MoH, 2019a), a hazard (source) within a protection zone only presents a threat to the safety of a water supply if there is a pathway by which the hazard can enter the water supply up-gradient of the supply gallery (receptor). Potential pathways in relation to the existing supply gallery within the Hororata water supply scheme include the following:

- Ingress of surface water via the gallery wellhead. A supply gallery, or other wells or galleries within the surface water catchment, that do not comply with NZS 4411:2001 (Environmental Standard for Drilling of Soil and Rock) represent a direct pathway for contaminants to enter the target aquifer (i.e., shallow groundwater hydraulically connected to the Selwyn River);
- Ingress of surface water via wells or galleries (aside from wellhead security) that have been inadequately maintained post-construction or incorrectly abandoned. Similar to wellhead security, wells or galleries that have been inadequately maintained post-construction or incorrectly abandoned represent a direct pathway if the well or gallery in question targets a similar depth to the supply gallery. Some examples of inadequately maintained or abandoned wells or galleries that could provide a direct pathway for contaminants to enter the target aquifer include:
    - Wells or galleries where the seal around the casing degrades over time, thus providing a preferential pathway;
    - Wells or galleries where surface drainage does not direct surface flow away from the casing;
    - Wells or galleries where the casing has been subject to corrosion to such a degree that it allows shallow groundwater to enter the well;
    - Wells or galleries that have been damaged by an earthquake; and
    - Abandoned wells or galleries that have not been decommissioned in accordance with NZS 4411:2001 (Environmental Standard for Drilling of Soil and Rock).
- Point source discharges (e.g., human effluent, stormwater etc.) to the Selwyn River. Point source discharges represent a direct pathway if they occur in close proximity to the supply gallery;
- Groundwater recharge (i.e., baseflow from groundwater in the Selwyn River). Groundwater recharge is an indirect pathway given the recharged water has to migrate vertically through the vadose zone to the water table and horizontally to the Selwyn River (or tributaries); and
- Overland flow mobilising contaminants at the ground surface which subsequently enter the Selwyn River (or tributaries). Overland flow represents an indirect pathway for contaminants to enter the supply gallery.

7. Existing Water Quality Data

7.1 Regional Water Quality

ECan undertakes monthly monitoring of groundwater quality in the Selwyn-Waihora Canterbury Water Management Strategy Zone (CWMSZ). ECan (2018) notes that the Selwyn-Waihora CWMSZ has:

- One of the highest proportion of wells with increasing nitrate-nitrogen (nitrate) trends;
- Three wells with nitrate concentrations greater than the health-based MAV in the DWSNZ; and
- Four wells with iron concentrations above the aesthetic-based GV in the DWSNZ which is likely to be naturally occurring within the aquifer.

A nitrate risk map prepared for the Canterbury region indicates that the majority of the Selwyn-Waihora CWMSZ has a moderate nitrate risk (ECan, 2017), including within the three protection zones identified for the supply gallery. A moderate nitrate risk is present in areas where it is unknown if a groundwater sample collected from a well will have nitrate concentrations exceeding the MAV.

In addition, surface water quality for the Selwyn River between 2004 and 2018, as measured at Whitecliffs Road (approximately 4.5 km upstream of the supply gallery) indicates the following:

- Five-year median *E. coli* count is 56.5 MPN/100 mL. Maximum *E. coli* count is >2,420 MPN/100 mL;
- Five-year median total nitrogen concentration is 0.32 mg/L. Maximum total nitrogen concentration is 2.0 mg/L;
- Five-year median ammoniacal nitrogen concentration is 0.005 mg/L. Maximum ammoniacal nitrogen concentration is 0.2 mg/L; and
- Five-year median dissolved reactive phosphorus (DRP) concentration is 0.002 mg/L. Maximum DRP concentration is 0.016 mg/L.

7.2 Site-Specific Water Quality

A summary of the water quality at the supply gallery of the Hororata water supply scheme is presented in **Table 7.1**.

Table 7.1 : Summary of water quality at each supply gallery within the Hororata water supply scheme.

Source Name	Glentunnel Intake, Selwyn RWS
Well ID	L35/0215
E. coli transgressions (2012 to 2017) as reported in Volume 2 of 5Waters Activity Management Plan (SDC, 2018)	There were 282 source, nine treatment, and nine zone transgressions between 2012 and 2017. *E. coli* counts associated with the 282 source transgressions are not reported.
E. coli transgressions between 22 March 2012 and 29 June 2017[16]	779 samples and 285 *E. coli* transgressions reported. *E. coli* counts, when transgressions were reported, ranged from 1 to 201 MPN/100 mL.
E. coli transgressions between 1 July 2017 and 17 June 2019[17]	Total of 305 transgressions between 1 July 2017 and 17 June 2019. *E. coli* counts ranged from 1 to >=200 cfu/100 mL.

[16] Summary of *E. coli* transgressions provided in spreadsheet provided to Jacobs from SDC titled "R900_SampleWizDetail_source".
[17] Summary of *E. coli* transgressions provided to Jacobs by SDC in a spreadsheet titled 'All E. Coli Transgressions – Since 1 July 2017. Only source data is reported.

Source Name	Glentunnel Intake, Selwyn RWS
Summary of chemical analysis between 2008 and 2019[18]	All chemical constituents analysed and reported were below GV and/or MAV in the DWSNZ for samples collected between 2008 and 2019. Nitrate concentrations ranged from 0.13 g/m^3 to 1.002 g/m^3.

[18] Summary of chemical analysis based on spreadsheets titled "Chemical Analysis (Jul08, Jan11, Jan13, Mar15)", "Full Chemical Analysis Feb 2017 – FHS", "Full Chemical Analysis Apr 2018 – FHS", and "Full Chemical Analysis Feb 2019 – FHS" containing water quality data provided to Jacobs by SDC in April, June, and December 2019.

8. Protozoal Compliance

8.1 Background

Protozoal compliance for the Hororata water supply scheme has been assessed as per the requirements of Section 5.2.1 (Procedures for determining protozoal log credit requirements) of the DWSNZ, which are as follows:

- Secure and interim secure bore water (Section 4.4.4) is deemed to satisfy the protozoal compliance criteria (i.e., no protozoal log credits are required); and
- Non-secure bore water (springs, and groundwater that does not produce secure bore water) is considered equivalent to surface water so need to meet protozoal compliance. The default requirement for protozoa in surface water is 3-log inactivation or removal. However, it is possible that 4-log inactivation or removal may be required based on an assessment of land uses within the groundwater catchment (for the purposes of this catchment hazard assessment the groundwater catchment is considered to be PZ3). If bacterial compliance is met by chlorination, and these waters meet bore water security criterion 2, acknowledgement of underground attenuation processes reduces the protozoa log credit requirement to two.

In relation to non-secure bore water, where an assessment of land uses within a groundwater catchment identifies that 4-log credits may be required, *Cryptosporidium* monitoring is required. If the *Cryptosporidium* monitoring is then subsequently undertaken in accordance with Section 5.2.1.2 of the DWSNZ and demonstrates that the *Cryptosporidium* count (as measured as mean oocysts per 10 litres) is less than 0.75, then a 3-log credit is required (refer to Table 5.1 in the DWSNZ)[19]. Conversely, if the *Cryptosporidium* count is 0.75 of more, then 4-log credits is required (refer to Table 5.1 in the DWSNZ).

8.2 Assessments

The assessment of land uses in accordance with protozoal compliance assessment has been undertaken using the following information:

- Our conceptual understanding of the groundwater system underlying Hororata, particularly the target aquifer, and wider surface water catchment;
- **Sections 3** through **7** of this report; and
- Guidance provided in Chapter 3 (Water Sources) and Chapter 8 (Protozoal Compliance) of the Guidelines for Drinking-water Quality Management for New Zealand (MoH, 2019b), particularly:
  - Section 3.2 (Groundwater);
  - Section 3.3 (Surface Water);
  - Section 8.2.2 (Approach to Categorisation); and
  - Chapter 8 – Appendix: Guidance Notes: Interpretation of Catchment Protozoal Risk Category.

Using the above information, the log-credit requirement for the supply gallery in the Hororata water supply scheme is 4-log credits based on the following:

- Existing water quality data provided by SDC (see **Section 7**) generally indicates that the water abstracted from the supply gallery is subject to frequent (i.e., weekly) *E. coli* transgressions up to counts >= 200 cfu/100 mL. Jacobs understand that the source of these transgressions has not been investigated. The frequent nature of the *E. coli* transgressions and the relatively high counts observed suggest that the 4-log

[19] As noted in the DWSNZ, *Cryptosporidium* is the most infectious and difficult protozoan to remove or inactivate, and therefore the protozoal compliance criteria are structured on the principle that if the treatment process deals successfully with the *Cryptosporidium*, it will also successfully treat other protozoa

credit removal is required based on the current land uses within PZ2 and PZ3. However, it is noted that this assessment should be reviewed if changes in land uses within PZ1, PZ2, or PZ3 indicate a likely increase in oocysts or an outbreak of waterborne protozoal infection (see **Section 8.3**).

A summary of the log credit requirement for the supply gallery of the Hororata water supply scheme is provided in Table 8.1.

Table 8.1 : Protozoal compliance criteria assessments for the Hororata water supply scheme.

Source Name	Well ID	Log Credit Required
Glentunnel Intake, Selwyn RWS	L35/0215	4

8.3 Updates

As outlined in Section 5.2.1.2 (Source water from surface catchments) of the DWSNZ the log credit assessment in relation to protozoal compliance must be repeated in response to any of the following:

- Catchment activities that indicate a likely increase in oocyst numbers;
- An intention by the water supplier to employ treatment with a reduced protozoal log removal rating; and
- An outbreak of waterborne protozoal infection linked to the water that is not explained by a lapse in protozoal treatment.

9. Cyanotoxin Compliance

9.1 Background

SDC's Cyanotoxin and Cyanobacteria Management Protocol sets out the current operative monitoring and management approach for the Hororata Water Supply (Opus, 2012). This protocol refers to the Drinking-water Standards for New Zealand 2005 (Revised 2008) (MoH, 2008), and the draft Guidelines for Drinking-water Quality Management for New Zealand, subsequently published in 2017 and updated in 2019 (MoH, 2019b).

9.2 Assessments

The current monitoring schedule for cyanotoxins indicates that this is a seasonal focus only: October through to March each year (inclusive), and results of field surveys and analytical data, collected in accordance with the SDC's Cyanotoxin and Cyanobacteria Management Protocol (Opus, 2012) and the SDC's Drinking Water Compliance Monitoring Plan (SDC in prep.).

SDC has supplied a limit amount of monitoring data in relation to cyanobacteria for the Hororata water supply scheme, namely a summary letter for the 2018/19 monitoring season[20] and field observations relating to the 2019/20 monitoring season up to 22 January 2020.

The summary letter indicates that the coverage of cyanobacteria algal mats on the river bed along the transects monitored reached a maximum of 34.25% on 26 January 2019. The second highest observed coverage was 20.5% on 5 February 2019. Both of these coverages exceeded the 'vigilance' trigger level in SDC's Cyanotoxin and Cyanobacteria Management Protocol of 20% (Opus, 2012), meaning twice weekly monitoring of cyanobacteria algal mats is required and the DWA is required to be informed.

Field observations from the 2019/20 monitoring season (up to 22 January 2020) indicate that coverage of cyanobacteria algal mats on the river bed along the transects monitored have not exceeded 16.75% during the 2019/20 monitoring season to date. This indicates that the 'vigilance' trigger level in SDC's Cyanotoxin and Cyanobacteria Management Protocol of 20% coverage has not been exceeded during the current monitoring season (Opus, 2012).

9.3 Conclusions

The monitoring data provided by SDC to assess cyanotoxin compliance is limited but suggests that the coverage of cyanobacterial algal mats is typically limited. However, it is noted that coverage of cyanobacteria algal mats could vary widely on a year-to-year basis, and therefore monitoring and management actions should continue to be undertaken in accordance SDC's Cyanotoxin and Cyanobacteria Management Protocol (Opus, 2012).

[20] Letter from Lisa Shaw (Team Leader, Water Services at Food and Health Services Ltd) to Amit Chauhan (Water Engineer at Selwyn District Council) date 1 May 2019.

10. Summary of Potential Hazards for the Hororata Water Supply Scheme

This section has been prepared to provide a summary of the potential hazards to the Hororata water supply scheme, as identified in **Sections 3** through **9**. A summary of the potential hazards is provided in **Table 10.1**. Also provided in **Table 10.1** is a list in preventative measures which could be adopted by SDC to address some of the potential hazards identified. However, it is noted that the preventative measures listed in **Table 10.1** are considered to be relatively high-level. For example, further work, which is outside the scope of this catchment hazard assessment, is required to identify alternative sources of water and develop appropriate water quality monitoring plans within PZ2 and PZ3 to provide early warning signs with regard to emerging water quality issues which could impact the Hororata water supply scheme.

Table 10.1 : Summary of potential hazards and preventative measures for the Hororata water supply scheme.

Event Reference	Supply Element	Hazardous Event	Potential Cause of Hazardous Event	Impacts Reasonably Expected to be Associated with Event	Potentially Impacted Protection Zones	Potential Preventative Measures
S1	▪ Surface water – supply gallery	▪ Insufficient surface water available to meet demand (e.g., drought, climate change, competing surface water users etc.)	▪ Short- or long-term changes in surface water flows as a result of a reduction in base flow driven by decreases in monthly or annual rainfall (e.g., drought/climate change)	▪ Water demand may not be met	▪ All three protection zones considered to be potentially impacted given widespread nature of impacts	▪ PM1 – Identify and utilise, if required, alternative sources of water (e.g., groundwater wells or other surface water bodies). Identification of alternative sources of water would improve security of supply ▪ PM2 – In the event that a surface water consent is applied for that could potentially impact the supply gallery, SDC should liaise with ECan to identify appropriate consent conditions
			▪ Reduction in available surface water from upstream surface water abstractions	▪ Water demand may not be met	▪ PZ1 and PZ2 considered to be potentially impacted given impacts of surface water abstractions are likely to be relatively localised (i.e., surface water abstractions within PZ3 are unlikely to have a direct impact on the supply gallery)	
S2	▪ Surface water – supply gallery	▪ Inability to abstract sufficient surface water to meet demand	▪ Damage to supply gallery ▪ Pump failure ▪ Clogged screens ▪ Deterioration of supply gallery condition ▪ Gallery vandalism/sabotage	▪ Water demand may not be met	▪ Failure linked directly to the existing supply gallery, and therefore potential impacts limited to PZ1	▪ PM3 – Continue to undertake three-monthly and annual supply gallery wellhead condition inspections and remediate any issues that are identified as soon as reasonably practicable. It is noted that the supply gallery wellhead condition inspections should be undertaken in accordance with SDC approved and industry-standard protocols
S3	▪ Surface water – supply gallery	▪ Supply gallery unable to be used	▪ Catastrophic failure (e.g., natural disaster such as an earthquake)	▪ Water demand may not be met	▪ Failure linked directly to the existing supply gallery, and therefore potential impacts limited to PZ1	▪ PM1 ▪ PM3
S4	▪ Surface water – supply gallery	▪ Shallow groundwater hydraulically connected to the Selwyn River receiving contaminants via existing, abandoned, or decommissioned wells (e.g., surface water ingress at the wellhead)	▪ Surface water ingress as a result of poor wellhead security in existing wells and abandoned or incorrectly decommissioned wells remaining open. This includes damage to wells as a result of an earthquake	▪ All contaminants (see **Appendix C** for detailed summary of potential contaminants)	▪ In relation to bacteria/viruses/protozoa, potentially impacted protection zones include PZ1 and PZ2. Likely to be sufficient microbial attenuation in PZ3 ▪ In relation to all other contaminants, potentially impacted zones include PZ1, PZ2, and PZ3[21]	▪ PM4 – Delineation of protection zones and restriction of activities which could potentially result in contaminants (microbiological and chemical) entering the supply gallery ▪ PM5 – Continue monitoring source water quality at the supply gallery in accordance SDC approved monitoring plan ▪ PM6 – Review (and, if necessary, collect[22]) catchment-specific water quality data in accordance with SDC approved monitoring plan to inform long-term source protection measures ▪ PM7 – Liaise with ECan to improve wellhead security, where required, in wells within PZ2 and PZ3
S5	▪ Surface water – supply gallery	▪ Shallow groundwater receiving contaminants from the Selwyn River via groundwater recharge	▪ Contaminants within the Selwyn River from point or non-point sources migrating to the shallow aquifer due to groundwater recharge	▪ All contaminants (see **Appendix C** for detailed summary of potential contaminants)	▪ In relation to bacteria/viruses/protozoa, potentially impacted protection zones include PZ1 and PZ2. Likely to be sufficient microbial attenuation in PZ3 ▪ In relation to all other contaminants, potentially impacted zones include PZ1, PZ2, and PZ3[21]	▪ PM4 ▪ PM5 ▪ PM6
		▪ Cyanobacteria growth during warmer months and release of cyanotoxins	▪ Cyanotoxins exceeding MAV in DWSNZ and associated potential impact to human and animal health	▪ Cyanotoxins	▪ All three protection zones considered to be potentially impacted given the surface water catchment is relatively small	▪ PM8 – Enact mitigation measures in SDC's Cyanotoxin and Cyanobacteria Management Protocol

[21] Whether a protection zone will be impacted by contamination (excluding bacteria/viruses/protozoa) is dependent on a number of factors including existing contaminant concentrations in surface water, source contaminant concentrations, advection, dispersion, adsorption, and aerobic decay.
[22] It is noted that SDC should liaise with ECan to determine appropriate and catchment-specific water quality monitoring locations and data and to establish suitable notification and reporting mechanisms.

Event Reference	Supply Element	Hazardous Event	Potential Cause of Hazardous Event	Impacts Reasonably Expected to be Associated with Event	Potentially Impacted Protection Zones	Potential Preventative Measures
S6	▪ Surface water – supply gallery	▪ Contaminated water getting into shallow groundwater and/or Selwyn River from the ground surface or overland flow. This includes discharges to the ground surface or preferential pathways	▪ Contamination sources in close proximity to the supply gallery ▪ Wellhead not properly sealed ▪ Wellhead or casing damage ▪ Water inundates wellhead	▪ All contaminants (see **Appendix C** for detailed summary of potential contaminants)	▪ In relation to bacteria/viruses/protozoa, potentially impacted protection zones include PZ1 and PZ2. Likely to be sufficient microbial attenuation in PZ3 ▪ In relation to all other contaminants, potentially impacted zones include PZ1, PZ2, and PZ3[21]	▪ PM4 ▪ PM5 ▪ PM6 ▪ PM7
S7	▪ Surface water – supply gallery	▪ Contamination of shallow groundwater and surface water caused by agricultural activities	▪ Presence of livestock within PZ2 and PZ3 could result in bacterial contamination in combination with event reference S4, S5, and S6	▪ Bacteria/viruses/protozoa	▪ In relation to bacteria/viruses/protozoa, potentially impacted protection zones include PZ1 and PZ2	▪ PM4 ▪ PM5 ▪ PM6 ▪ PM7
			▪ Presence of livestock with PZ2 and PZ3 could result in increase in nitrate concentrations in combination with event reference S4, S5, and S6	▪ Nitrate	▪ All three protection zones potentially impacted given diffuse nature of nitrate sources	▪ PM4 ▪ PM5 ▪ PM6 ▪ PM7
			▪ Spills or leaks associated with storage or use of petroleum products, fertilisers, or other hazardous chemicals used to support agricultural operations	▪ All contaminants (see **Appendix C** for detailed summary of potential contaminants)	▪ All three protection zones potentially impacted	▪ PM4 ▪ PM5 ▪ PM6
S8	▪ Surface water – supply gallery	▪ Contamination of shallow groundwater and surface water as a result of discharges of human effluent	▪ Presence of active discharges of human effluent ▪ Contamination may occur due to S4, S5, and S6	▪ Bacteria/viruses ▪ Protozoa	▪ In relation to bacteria/viruses/protozoa, potentially impacted protection zones include PZ1 and PZ2	▪ PM4 ▪ PM5 ▪ PM6 ▪ PM7
S9	▪ Surface water – supply gallery	▪ Contamination of shallow groundwater and surface water as a result of discharges of stormwater within the protection zones	▪ Presence of active discharges of stormwater ▪ Contamination may occur due to S4, S5, and S6	▪ Heavy metals	▪ Potentially impacted protection zones likely to be limited to PZ1 and PZ2 given heavy metal concentrations in stormwater, whilst elevated, are unlikely to result in exceedances of the GV or MAV	▪ PM4 ▪ PM5 ▪ PM6 ▪ PM7
S10	▪ Surface water – supply gallery	▪ Contamination of shallow groundwater and surface water as a result of HAIL sites within the protection zones	▪ Presence of various HAIL sites within majority of protection zones ▪ Contamination may occur due to event S4, S5, and S6	▪ All contaminants (see **Appendix C** for detailed summary of potential contaminants)	▪ All three protection zones potentially impacted	▪ PM4 ▪ PM5 ▪ PM6 ▪ PM7
S11	▪ Surface water – supply gallery	▪ Contamination of shallow groundwater and surface water as a result of horticultural activities within the protection zones	▪ Presence of horticultural activities within PZ2 and PZ3. Use of fertiliser likely to lead to an increase in nitrate concentrations in groundwater and surface water ▪ Contamination may occur due to event S4, S5, and S6 outlined above	▪ Pesticides ▪ Heavy metals ▪ Nitrate	▪ All three protection zones potentially impacted, although it is noted that horticultural activities are not present within PZ1 and only comprise a small percentage of the total land cover within PZ2 and PZ3	▪ PM4 ▪ PM5 ▪ PM6 ▪ PM7
S12	▪ Surface water – supply gallery	▪ Spill/leaks or petroleum products associated with construction activities or storage of hazardous chemicals in the protection zones	▪ Presence of engine reconditioning workshop within PZ2 and PZ3 ▪ Contamination may occur due to event S4, S5, and S6 outlined above	▪ All contaminants (see **Appendix C** for detailed summary of potential contaminants)	▪ All three protection zones potentially impacted	▪ PM4 ▪ PM5 ▪ PM6 ▪ PM7

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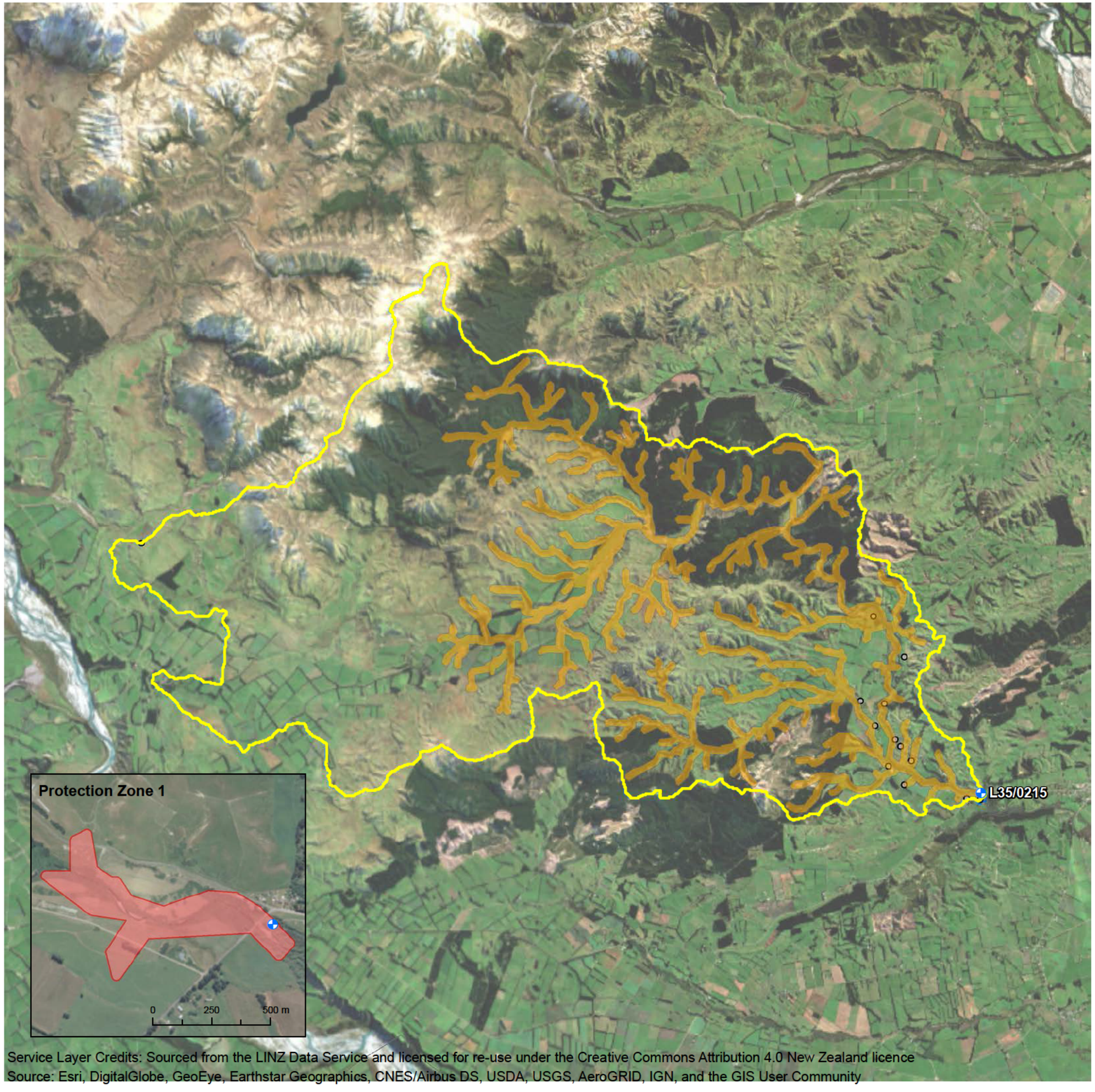
Appendix A. Figures



Service Layer Credits: Sourced from the LINZ Data Service and licensed for re-use under the Creative Commons Attribution 4.0 New Zealand licence
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Bore & Capture Zone Overview

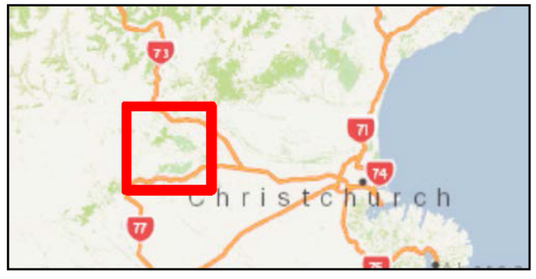
Figure 2-1 : Glentunnel Intake, Selwyn RWS - L35/0215

Well No.	L35/0215	Source Type	Surface water
Screen Depth	N/A	WINZ Code	G00674
Well Depth	6	Elevation	261.08
Screen Length	N/A	Aquifer Type	Unconfined
Consent No. 1	CRC970985.1	Easting	1513227
Consent No. 2	N/A	Northing	5185178
Daily Vol.	1,450	Consent Exp.	11-Dec-31
Weekly Vol.	N/A	Max Rate of Take	16.8
Yearly Vol.	400,000		

Notes

The wells and bores were downloaded from Canterbury Maps on 28/08/2019. The location of these bores has not been verified.

Further information regarding the delineation of Protection Zone 1 (5m radius), Protection Zone 2 (1-year TOT) and Protection Zone 3 (5-year TOT) is provided in the Catchment Hazard Assessment prepared by Jacobs.



Legend

- Protection Zone 1 (50m radius)
- Protection Zone 2 (1 year TOT)
- Protection Zone 3 (5 year TOT)
- Supply bore

Wells & Bores depth (m)

- 0 - 50
- 51 - 100
- 101 - 150
- 151 - 200
- 200 +

N

1:110,000 @ A3

1,500 750 0 1,500 Meters

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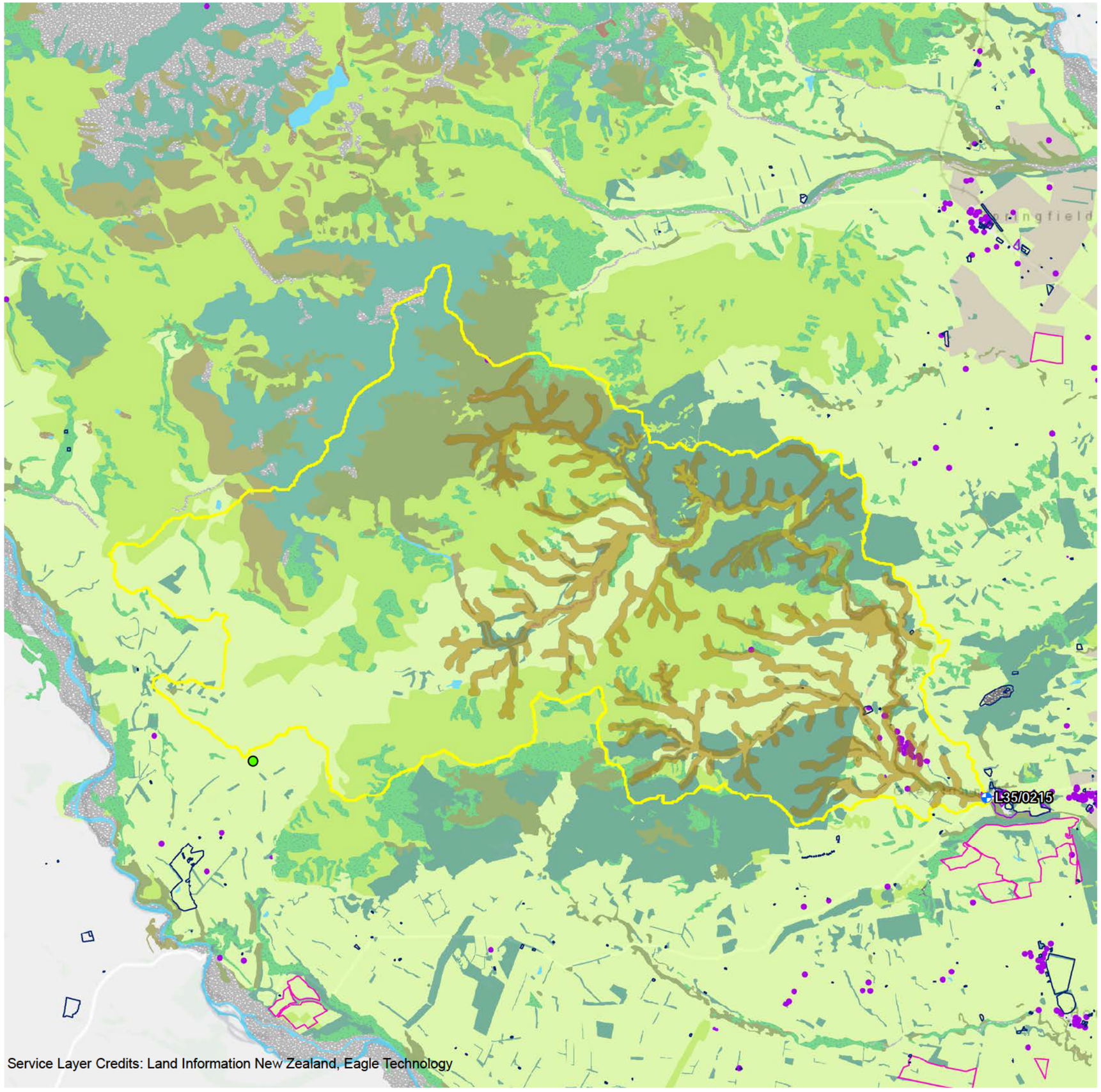
Figure 5-1 : Land cover, discharges, and **HAIL** sites **within** the three **protection zones** for the **Glentunnel Intake, Selwyn RWS** (L35/0215)



Land Cover Database (2012)

- Forest
- Built-up Area (settlement)
- Water
- Exotic Forest
- Scrub
- Gravel, rock, sand
- Herbaceous Vegetation
- High Producing Exotic Grassland
- Landslide
- Low Producing Grassland
- Shrubland
- Orchard, Vineyard or Other Perennial Crop
- Short-rotation Cropland
- Surface Mine or Dump
- Tussock Grassland
- Transport Infrastructure
- Urban Parkland/Open Space

Legend

- Effluent Dairy Discharges Consented Activities
- Effluent Human Discharge Consented Activities
- LLUR HAIL - Activities
- Effluent Human Discharge Consented Activities (Point)
- Supply bore
- Protection Zone 3 (5 year TOT)
- Protection Zone 2 (1 year TOT)

N

1:110,000 @ A3

1,500 750 0 1,500 Meters

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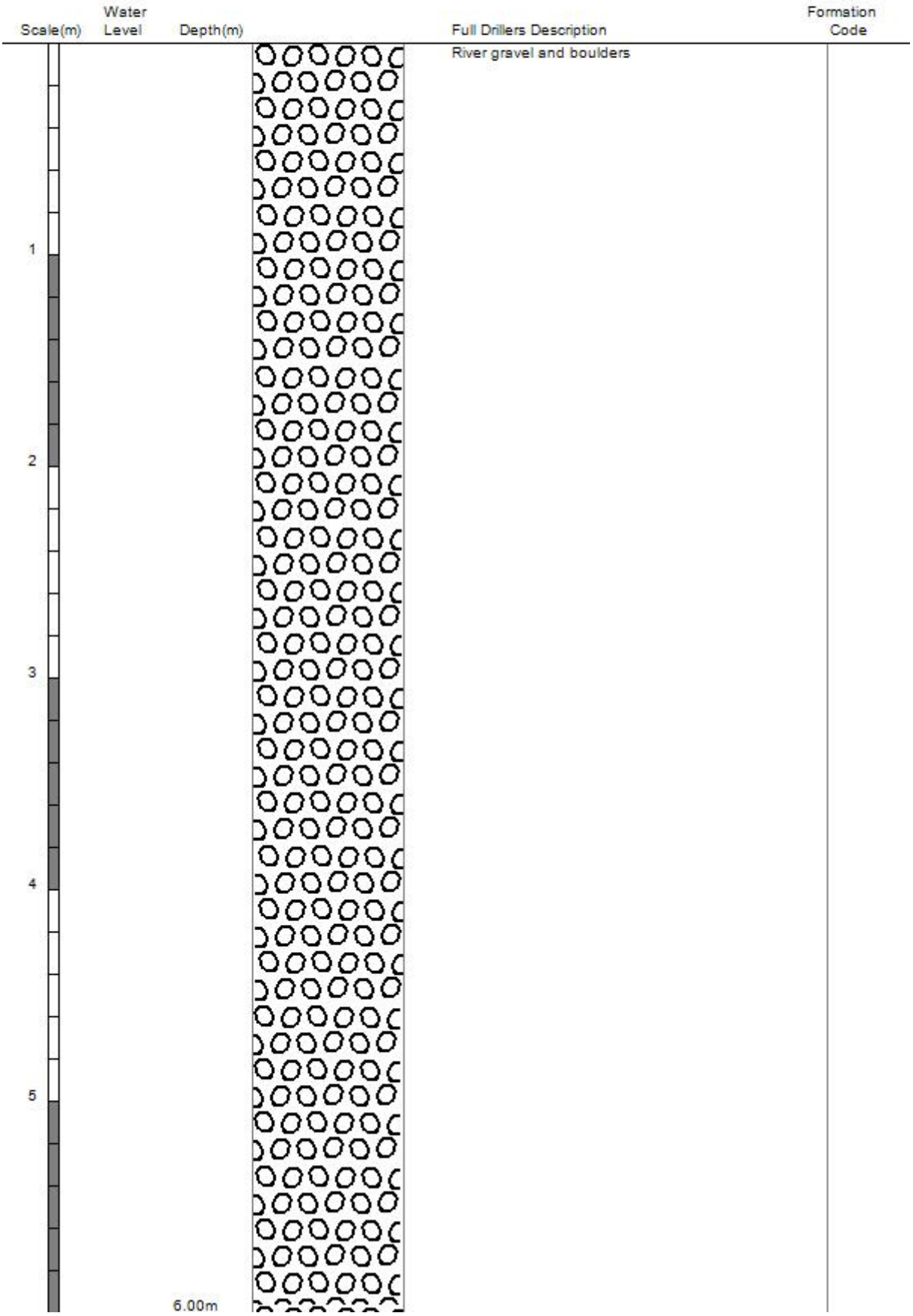
Appendix B. Borelog

L35/0215 details

Borelog for well L35/0215

Grid Reference (NZTM): 1513228 mE, 5185177 mN
Location Accuracy: 1 - 2m
Ground Level Altitude: 261.1 m +MSD Accuracy: < 0.5 m
Driller: Briggs Bros
Drill Method: Unknown
Borelog Depth: 6.0 m Drill Date:

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha



Appendix C. Chemical Determinands within Discrete Land Use Categories

A summary of the chemical determinands within discrete land use categories, as provided Table A3 of the Handbook for Preparing a Water Safety Plan (MoH, 2019a), is provided in **Table A.1**. The land uses and particular chemical determinands relevant to the Hororata water supply scheme have been highlighted in yellow. The land uses within each protection zone for the supply gallery is provided in **Table 5.1**.

Table A.1 : Chemical determinands within discreet land use categories as provided in Table A3 of the Handbook for Preparing a Water Safety Plan (MoH, 2019a). The activities relevant to the Hororata water supply scheme are highlighted in yellow.

Land use category	Activity	Contaminating material	Possible health-significant determinands for which there are MAVs	Comment
1. Agriculture	Use of pesticides	Range of pesticides, metals	Pesticides, copper	
	Use of artificial fertilisers	Range of artificial fertilisers	Nitrate, cadmium, arsenic	Cadmium is a contaminant of superphosphate
	Use of manure as fertiliser	Manure	Nitrate, copper, pathogens	
	Fuel storage and use	Petrol, diesel	Benzene, toluene, xylene, ethylbenzene, lead	
	Land farming	Oil industry waste	Benzene, toluene, xylene, ethylbenzene, benzo(α)pyrene, lead, nickel, copper, cadmium, chromium	
	Silage production	Silage leachate	Nitrate	
	Sewage sludge application	Sewage	Nitrate, antimony, cadmium, chromium, copper, lead, nickel, mercury, pathogens	
	Compost application	Compost	Arsenic, antimony, cadmium, chromium, copper, lead, nickel, nitrate, pesticides	The nature of the contaminants depends on the materials used to produce the compost
	Dairy shed operation	Washwater	Nitrate, pathogens	Chlorine and monochloramine may also be present
	Spray irrigation of effluent	Effluent	Nitrate, copper, pathogens	Levels of contaminants from well-operated effluent ponds should be low
	Effluent pond operation	Effluent		
	Grazing animals	Manure deposited in pasture		
2. Forestry	Sewage sludge application	Sewage	Nitrate, antimony, cadmium, chromium, copper, lead, nickel, mercury, pathogens	
	Use of pesticides	Range of pesticides	Pesticides	
	Use of poisons (feral animal control)	Poisoned baits	Cyanide, 1080	Determine which poisons are in use before selecting determinands to monitor Events involving 1080 should be treated as a chemical spillage. Preventive measures need to be taken as soon as contamination is believed to have occurred, and sampling for 1080 needs to be undertaken as soon as

Land use category	Activity	Contaminating material	Possible health-significant determinands for which there are MAVs	Comment
				possible after the contamination event. 1080[23] decomposes relatively rapidly – its half-life in water is about 24 hours Forestry slash presents a possible physical hazard to supply infrastructure during heavy rain events
2. Forestry (continued)	Use and maintenance of vehicles	Petrol, diesel, oil	Benzene, toluene, xylene, ethylbenzene	
	Fuel storage	Petrol, diesel		
3. Mining and quarrying	Use and maintenance of vehicles	Petrol, diesel, oil	Benzene, toluene, xylene, ethylbenzene	
	Fracking			These contaminants can be found near fracking sites from activities associated with fracking. Suppliers should make checks for other chemicals in use if fracking is carried out in the catchment or capture zone
	Fuel storage	Petrol, diesel		
	Ore extraction	Extraction chemicals	Cyanide, arsenic, antimony, cadmium, chromium, copper, lead, nickel, mercury	The metals of concern will depend on the composition of the ore. The presence of cyanide will depend on the nature of the extraction process(es) in use. Find out from the mine operator what chemicals are in use
	Backfilling	Backfill	Arsenic, chromium, nickel, lead, benzo(α)pyrene	A wide range of contaminants may arise, depending on the source of the backfill and the geochemistry of surrounding geology
	Collection and treatment of acid mine drainage	Mine drainage	Antimony, cadmium, chromium, copper, lead, nickel, mercury	The metals of concern will depend on the composition of the ore and extraction processes
4. Industry and commerce (heavy and light industry)	Ceramics	Glazes	Antimony, cadmium, copper, lead, nickel, mercury, boron	
	Cold storage	Refrigerants	Nitrate	Possibly formed from the oxidation of ammonia

[23] The primary route of degradation is microbiological defluoridation. Laboratory studies of 1080 have shown half-lives from very much less than 24 hours to eight days: see Appendix C of the ERMA review of 1080 (2007). (Application for the Reassessment of a Hazardous Substance under Section 63 of the Hazardous Substances and New Organisms Act 1996. Application Number: HRE05002). URL: www.epa.govt.nz/assets/FileAPI/hsno-ar/HRE05002/HRE05002-059.pdf (accessed 31 January 2019).

Land use category	Activity	Contaminating material	Possible health-significant determinands for which there are MAVs	Comment
4. Industry and commerce (heavy and light industry) (continued)	Drum reconditioning	Range of organic and inorganic chemicals, degreasers, detergents	Benzene, toluene, xylene, ethylbenzene, antimony, cadmium, chromium, copper, lead, nickel, mercury	
	Electronics	Alkalis, acids, cyanides, solvents, metals	Cyanide, antimony, cadmium, chromium, copper, lead, nickel, mercury, barium, selenium, tetrachloroethene, trichloroethene, toluene, dichloromethane	
	Fertiliser/ agrichemical production	Fertilisers and pesticides	Nitrate, pesticides	
	Foundries	Acids, metals, fluxes	Antimony, cadmium, chromium, copper, lead, nickel, mercury	Nitric acid may give rise to nitrate
	Furniture production	Glues, polishes, paints	Toluene, dichloromethane, formaldehyde	
	Gas works	Product, solid residues and tar	Cyanide, nitrate, antimony, arsenic, barium, boron, cadmium, chromium, copper, lead, manganese, mercury, nickel, selenium, benzo(α)pyrene, benzene, ethyl benzene, toluene xylenes	
	Meat and milk processing	Processing effluent including cleaning chemicals	Nitrate, chlorine, monochloramine, pathogens	
	Metal cleaning/ electroplating	Cleaning and plating chemicals, metals, acids	Cyanide, antimony, cadmium, chromium, copper, lead, nickel, mercury, nitrate, ethylenediaminetetraacetic acid (EDTA), carbon tetrachloride, tetrachloroethene, trichloroethene	Nitric acid may give rise to nitrate
	Paper making	Bleaching chemicals, caustic soda	Barium, chlorite, chlorate, Trihalomethanes (THMs), haloacetic acids, EDTA nitrilotriacetic acid	In this situation, DBPs may be formed in the source water before chlorine at the water treatment plant comes in contact with the water. The quantities of chlorinated organic compounds (e.g., DBPs) should be small in a well-run plant
	Printing	Solvents, inks, dyes	Dichloromethane, toluene, xylene, antimony, cadmium, chromium, lead, mercury	
	Product storage	Fumigants	1,3-dichloropropene, cyanide	The nature of the fumigation will determine which fumigants are a concern

Land use category	Activity	Contaminating material	Possible health-significant determinands for which there are MAVs	Comment
4. Industry and commerce (heavy and light industry) (continued)	Resins	Range of organic chemicals	Formaldehyde, THMs, di(2-ethylhexyl)phthalate, epichlorohydrin, styrene, toluene	Members of the THM family can be used as solvents for resins
	Rubbers and plastics	Solvents, plasticisers, paints and other organic substances	Formaldehyde, di(2-ethylhexyl)phthalate), cyanide	
	Tanning	Tanning chemicals	Arsenic, chromium, pentachlorophenol, organochlorine pesticides	
	Wood processing	Preservatives and other treatment chemicals	Pentachlorophenol, copper, chromium, arsenic, boron, chlorpyriphos, benzo(α)pyrene	
	Wool scouring	Degreasing agents, pesticides	Pesticides (including chlorpyriphos, diazinon), pentachlorophenol, copper	The classes of pesticides likely to be derived from wool are organophosphates, synthetic pyrethroids and insect growth regulators
4. Industry and commerce (commerce and community)	Car washes	Soaps, detergents, waxes, oil	Benzo(α)pyrene, nitrilotriacetic acid, EDTA	
	Cemeteries	Embalming fluids, bodies, coffin construction materials, fertilisers	Formaldehyde, arsenic, mercury, lead, copper, nitrate	The properties of the soil and age of the cemetery, among other things, will influence the nature of contaminants in the groundwater
	Dental clinics	Filling materials	Mercury	
	Defence establishments	Disinfectants, human waste, chemical dumps, fuel and oil, fire-fighting foams	Chlorine, benzene, toluene, xylene, ethylbenzene, benzo(α)pyrene, lead, cadmium, poly-fluoroalkyl substances (PFAS), perfluorooctanesulfonic acid (PFOS), pesticides, pathogens Chemical dumps may contain a wide range of chemicals. Ask defence authorities for a list of chemicals disposed of in the greatest quantity. Use these as markers of contamination. Once it is confirmed that there is contamination, consider testing for other specific contaminants	
	Dry cleaning	Dry cleaning chemicals	Tetrachloroethene, trichloroethene	
	Hospital	Disinfectants, biological waste, radiological waste, other miscellaneous chemicals	Formaldehyde, chlorine, mercury, pathogens A wide range of contaminants may arise from hospital sources. Identify the most-used chemical contaminants, and use these are markers of contamination. Once it is	

Land use category	Activity	Contaminating material	Possible health-significant determinands for which there are MAVs	Comment
			confirmed that there is contamination, consider testing for other specific contaminants	
4. Industry and commerce (commerce and community) (continued)	Laboratories (school, medical and research)	Disinfectants, biological waste, other miscellaneous chemicals	A wide range of contaminants may arise from laboratory sources. Identify the most-used chemical contaminants, and use these are markers of contamination. Once it is confirmed that there is contamination, consider testing for other specific contaminants	Chlorine and monochloramine may be present Reticulated waste disposal should reduce the likelihood of contamination with hazards associated with this activity
	Laundromats	Detergents, bleaches, dyes	Nitrilotriacetic acid, EDTA, chlorine, monochloramine	
	Offices	Detergents, solvents	Dichloromethane, toluene, xylene, 1,2 dichloroethane	
	Photographic processing	Photographic processing chemicals	Cyanide, selenium, chromium, copper, nitrilotriacetic acid, EDTA, nitrate	Cyanide was used in an early photographic process and is unlikely to be a concern in modern photographic laboratories. Ammonium salts may be oxidised to nitrate
	Prisons	Disinfectants, human waste	Chlorine, monochloramine, nitrate, pathogens	This is only a possible concern if sewage is treated and discharged on-site
	Scrap yards	Petroleum products, solvents, metals, acids, alkalis	Benzene, toluene, xylene, ethylbenzene, benzo(α)pyrene, antimony, cadmium, chromium, copper, lead, nickel, mercury, tetrachloroethene, trichloroethene, carbon tetrachloride	
	Swimming pools	Disinfectants, other pool treatment chemicals, human waste	THMs, haloacetic acids, chlorine, monochloramine	In this situation, DBPs may be formed in the source water before chlorine at the water treatment plant comes in contact with the water. The quantities of chlorinated organic compounds (e.g., DBPs) should be small in a well-run plant Disposal of backwash water to a reticulated sewer will minimise the likelihood of contamination from this source
4. Industry and commerce (transport, storage and utilities)	Airport operation	Fuels, fire-fighting foams, solvents, de-icing substances, fumigants	Benzo(α)pyrene, cyanide, formaldehyde, antimony, cadmium, chromium, copper, lead, nickel, PFAS, PFOS, tetrachloroethene, trichloroethene, carbon tetrachloride	The range of contaminants will depend on whether the airport has maintenance facilities
	Fuel storage and sale	Fuel storage and sale	Benzene, toluene, xylene, ethylbenzene, benzo(α)pyrene	

Land use category	Activity	Contaminating material	Possible health-significant determinands for which there are MAVs	Comment
4. Industry and commerce (transport, storage and utilities) (continued)	Railway operation	Spraying of tracks, diesel and oil leaks, human waste (if toilet effluent is vented onto tracks)	Pesticides (herbicides), benzo(α)pyrene, nitrate, arsenic, pathogens	Spills of cargo carried by rail may result in a wide range of contaminants being introduced into water if there is a pathway to the source water
	Road transport	Asphalt, fuel and oil leaks, chemicals for roadside weed control, tyre and brake wear	Benzo(α)pyrene, benzene, toluene, xylene, ethylbenzene, herbicides, antimony, cadmium, chromium, copper, lead, nickel	Spills of cargo carried by road may result in a wide range of contaminants being introduced into water if there is a pathway to the source water
	Sewerage reticulation	Sewage (human waste, trade waste)	Nitrate, antimony, cadmium, chromium, copper, lead, nickel, mercury, pathogens	A wide range (in addition to what is listed) of industrial and domestic contaminants may be present in sewage
	Sewage treatment			
	Stock effluent and camper van effluent disposal facilities	Animal and human waste	Nitrate, antimony, cadmium, chromium, copper, lead, nickel, mercury, pathogens	
	Tyre storage	Tyres	Benzo(α)pyrene	
5. Open space	Car parks	Fuel and oil leaks, asphalt surface	Benzene, toluene, xylene, ethylbenzene, benzo(α)pyrene, antimony, cadmium, chromium, copper, lead, nickel, pathogens	
	Clay target clubs	Lead shot	Arsenic, antimony, lead, benzo(α)pyrene	
	Disposal of stormwater run-off	Fuel and oil spills and other contaminants on asphalt road surfaces, faecal material from animals, weed and pest control chemicals, fertilisers, metals	Nitrate, pesticides, industrial solvents (benzene, toluene, xylene, ethylbenzene), antimony, cadmium, chromium, copper, lead, nickel, mercury, pathogens	
	Golf courses	Chemicals used for course upkeep (fertiliser, pesticides), fuel storage	Nitrate, pesticides, benzene, toluene, xylene, ethylbenzene, benzo(α)pyrene, lead, arsenic, cadmium, copper	
	Recreational parks	Fertilisers, weed control chemicals, fuel and oil from vehicles		
	Sports fields	Fertilisers, weed control chemicals, fuel and oil from vehicles		
6. Residential (urban, lifestyle block, rural)	Disposal of household waste	Household chemicals, garden chemicals, petrol, diesel and oil	Arsenic, antimony, cadmium, chromium, copper, lead, nickel, mercury, benzene, toluene, xylene, ethylbenzene, nitrate, pesticides, benzo(α)pyrene	The contamination risk associated with this activity is likely to be small because of the small scale
	Use of fertilisers	Fertilisers	Nitrate, cadmium	

Land use category	Activity	Contaminating material	Possible health-significant determinands for which there are MAVs	Comment
6. Residential (urban, lifestyle block, rural) (continued)	Keeping pets or livestock (lifestyle blocks)	Animal waste, pest control chemicals	Nitrate, pesticides, pathogens	
	Fuel storage	Petrol, diesel, oils	Benzene, toluene, xylene, ethylbenzene, benzo(α)pyrene	
	On-site disposal of sewage	Human waste, detergents	Nitrate, pathogens	
	Weed and pest control	Pesticides	Pesticides	
7. Vacant land	Illegal dumping	Wide range of possible chemicals	Arsenic, antimony, cadmium, chromium, copper, lead, nickel, mercury. In addition to these metals, a screen for semi-volatile organic compounds may be the best check on possible contamination.	Measurement of water conductivity in the vicinity of the activity and comparison with groundwater from the area known not be contaminated
8. Landfill	Disposal of industrial waste	Leachate containing a wide range of possible chemicals	Arsenic, antimony, cadmium, chromium, copper, lead, nickel, mercury, nitrate pesticides, cyanide. In addition to these determinands, a screen for semi-volatile organic compounds may be the best check on possible contamination.	
	Disposal of waste from water and wastewater treatment systems	Leachate from waste sludge (which includes treatment chemicals)	Antimony, cadmium, chromium, copper, lead, nickel, mercury, acrylamide, epichlorohydrin, nitrate (derived from ammonia which may be high), pathogens	
	Disposal of household waste	Household chemicals, garden chemicals, petrol, diesel and oil	Arsenic, antimony, cadmium, chromium, copper, lead, nickel, nitrate, pesticides. In addition to these metals, a screen for semi-volatile organic compounds may be the best check on possible contamination	Which contaminants are present will depend on how well the landfill system is controlled
9. Fishing	Onshore aquaculture	Faecal matter, pesticides	Pesticides, nitrate	
10. Conservation land	On-site sewage disposal	Human waste	Nitrate, pathogens	
	Feral animal control	Poisons	Cyanide, 1080	Check to determine which poisons are in use before selecting determinands to monitor Events involving 1080 should be treated as a chemical spillage. Preventive measures need to be taken as soon as contamination is believed to have occurred, and sampling for

Land use category	Activity	Contaminating material	Possible health-significant determinands for which there are MAVs	Comment
				1080 needs to be undertaken as soon as possible after the contamination event 1080 decomposes relatively rapidly[24]

[24] The primary route of degradation is microbiological defluoridation. Laboratory studies of 1080 have shown half-lives from very much less than 24 hours to eight days: see Appendix C of the ERMA review of 1080 (2007). (Application for the Reassessment of a Hazardous Substance under Section 63 of the Hazardous Substances and New Organisms Act 1996. Application Number: HRE05002). URL: www.epa.govt.nz/assets/FileAPI/hsno-ar/HRE05002/HRE05002-059.pdf (accessed 31 January 2019).

Additional determinands not captured in Table A.1, as summarised by Ministry for the Environment (MFE), are provided in Table A.2.

Table A.2 : Summary of HAIL contaminants as listed by MFE. The activities relevant to the Hororata water supply scheme are highlighted in yellow.

Activity or industry on the HAIL	Hazardous substances likely to be
Corrosives including formulation or bulk storage	Mercury, sulphuric, phosphoric, hydrochloric and nitric acids, sodium and calcium hydroxide, ammonia and ammonium hydroxide
Livestock dip or spray race operations	Arsenic, organochlorines (e.g., aldrin, dieldrin, DDT, lindane) and organophosphates, carbamates, and synthetic pyrethroids
Commercial concrete manufacture or commercial cement storage	Cement, calcium hydroxide, alkalis, and ammonia
Coal or coke yards	Hydrocarbons (particularly PAHs), boron, and arsenic
Engine reconditioning workshops	Hydrocarbons including solvents, and metals contained in waste oil
Motor vehicle workshops	Hydrocarbons including PAHs, solvents, and metals contained in waste oil

Appendix D – Hororātā Drinking Water Chemical Determinand Data

Hororata Chemical Determinand Summary (Annual)

Hororata

Glentunnel Intake, Selwyn RWS

		GV	MAV	2008	2011	2013	2015	2017	2018	2019
Total Arsenic	**(g/m³)**		0.01	<0.0010	<0.0011	<0.0011	<0.0011	< 0.0011	<0.0011 ± 0.00074	<0.0011 ± 0.00074
Total Cadmium	**(g/m³)**		0.004				<0.000053	< 0.000053	<0.000053 ± 0.000036	<0.000053 ± 0.000036
Total Chromium	**(g/m³)**		0.05	<0.0050	<0.00053	<0.00053	<0.00053	< 0.00053	<0.00053 ± 0.00036	0.00066 ± 0.00036
Total Lead	**(g/m³)**		0.01	<0.00010	0.00014	0.0006	0.00062	0.000477	0.000116 ± 0.000074	0.001097 ± 0.000099
Total Nickel	**(g/m³)**		0.08	<0.00050	<0.00053	<0.00053	<0.00053	< 0.00053	<0.00053 ± 0.00036	<0.00053 ± 0.00036
pH	**(-) log (H+)** [3]	7.0-8.5		7.2	7.4	7	7.6	7.3	7.3 ± 0.2	7.6 ± 0.2
Total Alkalinity	**(g/m³ as CaCO)**			32	40	42	43	45.1	38.9 ± 1.7	40.8 ± 1.8
Free Carbon Dioxide	**(g/m³ at 25°C)** [3]				3.2	8.4	2.3	4.30	3.6 ± 1.7	2.03 ± 0.95
Total Hardness	**(g/m³ as CaCO)**	200		32	37	37	41	41.0	35.9 ± 1.4	40.6 ± 1.5
Electrical Conductivity	**(mS/m)**			9.5	9.8	9.9	10.2	10.6	9.5 ± 0.3	11.0 ± 0.3
Electrical Conductivity	**(µS/cm)**				98	99	102	106	95 ± 3	110 ± 3
Approx Total Dissolved Salts	**(g/m³)**	1000			66	66	68	70.9	63.4 ± 1.4	73.8 ± 1.6
Total Boron	**(g/m³)**		1.4	0.02	0.036	0.034	0.035	0.0325	0.0296 ± 0.0054	0.0293 ± 0.0054
Total Calcium	**(g/m³)**			9.1	10.6	10.8	11.8	12.06	10.49 ± 0.43	11.98 ± 0.49
Total Copper	**(g/m³)**	1	2	0.002	0.00125	0.0049	0.0025	0.00404	0.00204 ± 0.00041	0.00094 ± 0.00037
Total Iron	**(g/m³)**	0.2		<0.020	<0.021	<0.021	<0.021	< 0.021	<0.021 ± 0.014	<0.021 ± 0.014
Total Magnesium	**(g/m³)**	100		2.2	2.4	2.4	2.8	2.64	2.34 ± 0.19	2.60 ± 0.21
Total Manganese	**(g/m³)**	<0.04 (staining) <0.02 (taste)	0.4	<0.00050	<0.00053	<0.00053	<0.00053	< 0.00053	<0.00053 ± 0.00036	<0.00053 ± 0.00036
Total Potassium	**(g/m³)**	N/A		0.54	0.77	0.73	0.74	0.744	0.712 ± 0.056	0.817 ± 0.061
Total Sodium	**(g/m³)**	200		5.2	5	5	5.2	5.40	5.10 ± 0.31	5.45 ± 0.33
Total Zinc	**(g/m³)**	1.5		0.0025	0.003	0.0058	0.0037	0.00406	0.0357 ± 0.0079	0.00507 ± 0.00084
Chloride	**(g/m³)**	250		5.3	2.9	2.6	3.1	3.82	3.09 ± 0.37	4.02 ± 0.39
Nitrate-N	**(g/m³)**		11.3	0.54	0.2	0.13	0.15	0.139	0.318 ± 0.041	1.002 ± 0.083
Sulphate	**(g/m³)**	250		4.3	3.2	2.9	3.3	2.93	2.83 ± 0.36	3.66 ± 0.42

Appendix E – Hororātā Drinking Water Supply Scheme Process Diagrams

VALVES

GENERAL
GATE
DIAPHRAGM
BUTTERFLY
BALL
CLOSED
HYDRANT

ACTUATORS

FLOAT
MOTORISED
SOLENOID
HYDRAULIC
PNEUMATIC

PIPE JOINTS

FLANGE
SOCKET
FLEXIBLE
PIPE END
DISCONNETED

PIPING AND CONNECTIONS

PRIMARY PIPE (NORMAL FLOW)
ELECTRICAL (COMM. / CONTROL)
MAJOR PIPE (TRANSFER / FLOW)
FLOW DIRECTION
MINOR PIPE (LOCAL / INST. FEED)
RETICULATION

GENERAL MECHANICAL

FLOW RESTRICTOR (FIXED)
PRESSURE REDUCING VALVE
INJECTOR (LIQUID CHLORINE)
FLOW RESTRICTOR (VARIABLE)
PRESSURE RELIEF VALVE
INJECTOR (CHLORINE GAS)
NON RETURN VALVE
AIR RELEASE VALVE
GAS TANK (CHLORINE)
REDUCED PRESSURE ZONE (RPZ)
STRAINER
UV REACTOR
TESTABLE DOUBLE CHECK (TDC)
FILTER
INTAKE
WEIR
INLET SCREEN
PRESSURE TANK

1500 L
TANK (OPEN)

2 M3
TANK (COVERED)

1500 L
TANK (CONTAINED)

VOLUME
TOP WATER LEVEL
INVERT
RESERVOIR

PUMPS

PUMP
CENTRIFUGAL PUMP
SUBMERSIBLE PUMP
WELL
DISPLACEMENT PUMP
DIRECT ONLINE DRIVE
SOFT STARTER
VARIABLE SPEED DRIVE

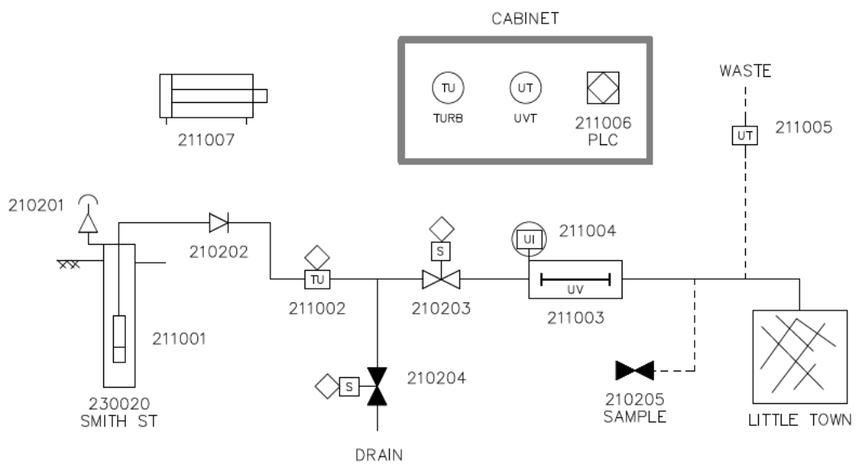
INSTRUMENTATION

ANALYSER xx – TYPE
ANALYSER WITH FIELD DISPLAY
ANALYSER CONNECTED TO LOGIC CONTROL
LOGIC CONTROL (PLC/RTU) x – CONTROLLER ID
INDICATOR SEPARATE / PANEL
INDICATOR SHARED DISPLAY
INDICATOR COMPUTER / HMI
AUDIBLE ALARM
VISUAL ALARM
RADIO DATA LINK
GENERATOR SOCKET
BATTERY / UPS
RADIO + RTU
FIELD SWITCH
SOLAR POWER
SWITCHBOARD
GENERATOR

ANALYSER TYPES

TYPE	DESCRIPTION
C	DISSOLVED CHLORINE
CG	CHLORINE GAS
DO	DISSOLVED OXYGEN
F	FLOW
FM	FLOW (MAGNETIC)
L	LEVEL
P	PRESSURE
T	TEMPERATURE
TU	TURBIDITY
UI	UV INTENSITY
UT	UV TRANSMITTANCE

EXAMPLE COMBINATION



REV	DATE	REVISION	DES	DRN	CHK
F	21.04.2020	ADDED TANKS	KN	KN	SR
E	13.03.2020	REVISED INSTRUMENTATION LEGEND	KN	KN	SR
D	11.04.2018	REVISED EXAMPLE LAYOUT, MINOR EDITS	KN	KN	SR
C	16.12.2017	ADDITIONAL ASSET TYPES	KN	KN	
B	01.11.2017	REVISED DRAFT FOR REVIEW	KN	KN	
A	30.10.2017	INITIAL DRAFT FOR DISCUSSION	KN	KN	SR

DESIGN SURVEY
AS–BUILT SURVEY
COORD SYS –
V. DATUM –
NORTH

Selwyn DISTRICT COUNCIL

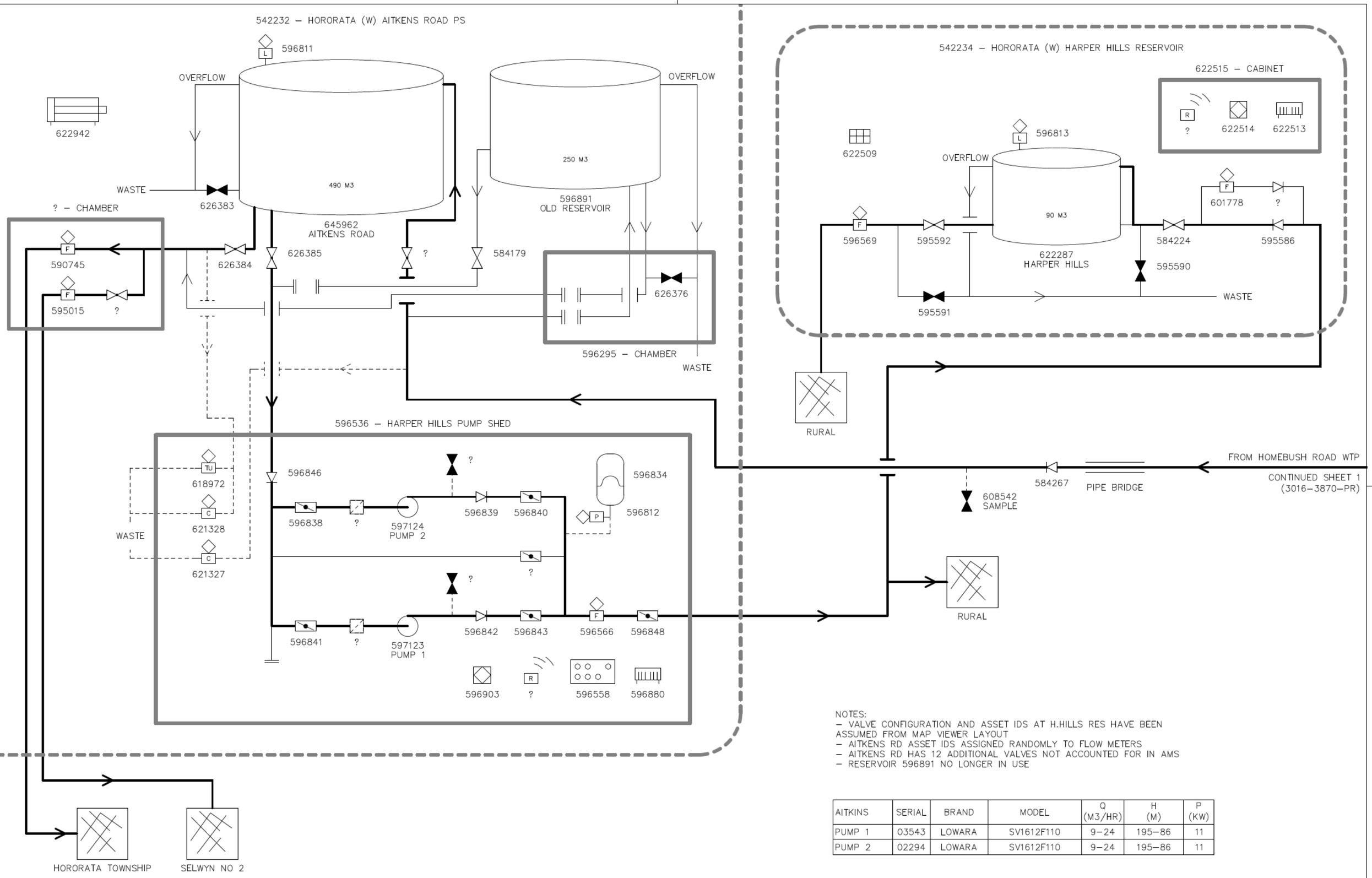
DWG BY: MAPPAZZO
DRAWN: K. NORRIS
CHECKED: S. RISI
CLIENT: D. POTTS

mappazzo

WATER NETWORKS
GENERAL
PROCESS & INSTRUMENTATION LEGEND

ORG. SCALE A1

DWG NO 3007–4000–PR
REV F
21–04–2020



NOTES:
– VALVE CONFIGURATION AND ASSET IDS AT H.HILLS RES HAVE BEEN ASSUMED FROM MAP VIEWER LAYOUT
– AITKENS RD ASSET IDS ASSIGNED RANDOMLY TO FLOW METERS
– AITKENS RD HAS 12 ADDITIONAL VALVES NOT ACCOUNTED FOR IN AMS
– RESERVOIR 596891 NO LONGER IN USE

AITKINS	SERIAL	BRAND	MODEL	Q (M3/HR)	H (M)	P (KW)
PUMP 1	03543	LOWARA	SV1612F110	9–24	195–86	11
PUMP 2	02294	LOWARA	SV1612F110	9–24	195–86	11

REV	DATE	REVISION	DES	DRN	CHK
B	16.06.2020	ADD ASSET IDS, UPDATED INSTRUMENT SYMBOLOGY		KN	SR
A	01.04.2019	WTP UPGRADE, ASSETS MOVED FROM DWG 3016		KN	SR

DESIGN SURVEY | COORD SYS: – | NORTH
AS–BUILT SURVEY | V. DATUM: –

Selwyn DISTRICT COUNCIL

DWG BY: MAPPAZZO
DRAWN: K. NORRIS
CHECKED: S. RISI
CLIENT: A. CHAUHAN

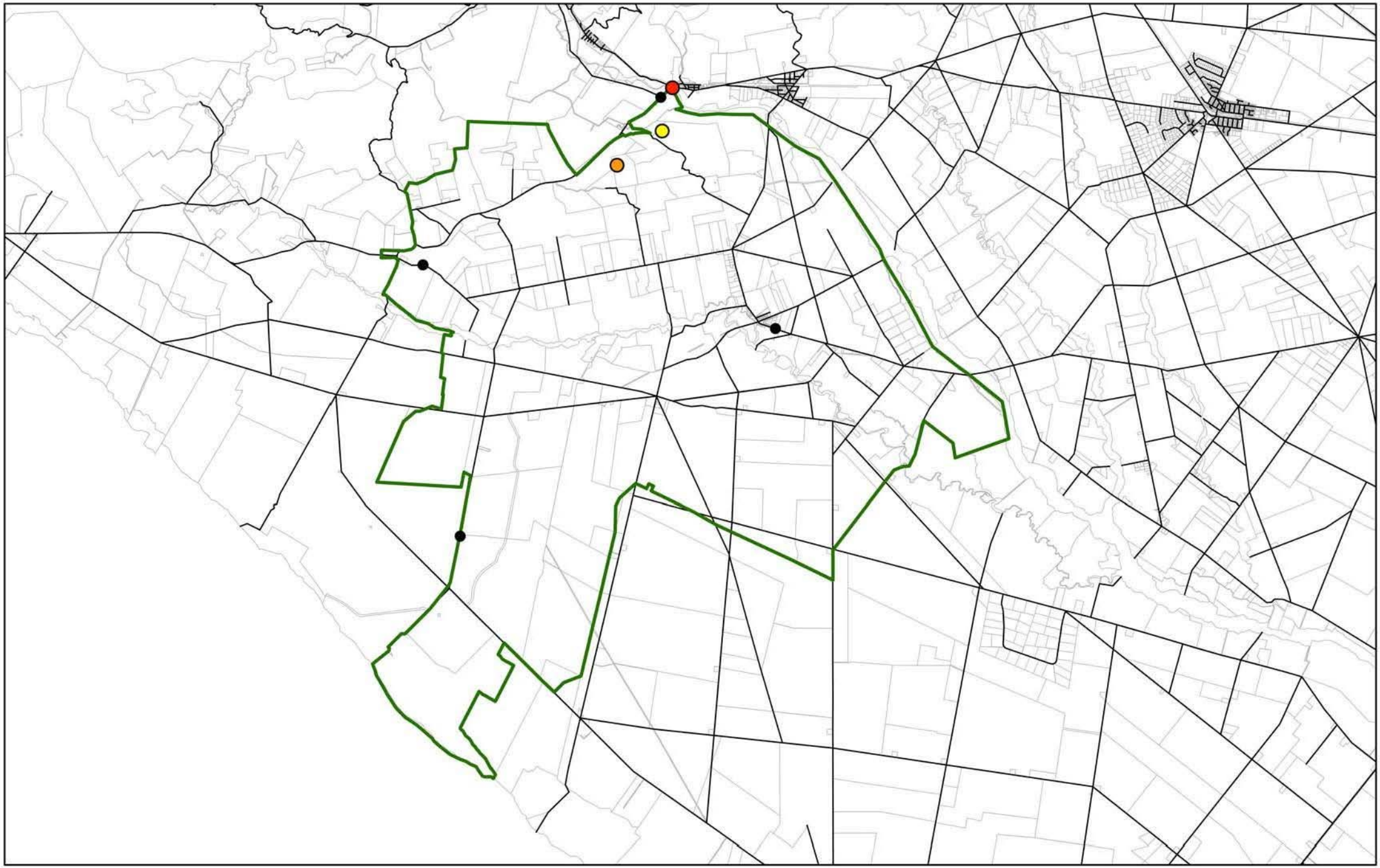
mappazzo

WATER NETWORKS
HORORATA
SCHEME PROCESS, SHEET 2 OF 2

ORG. SCALE: A1

DWG NO: 3044–3870–PR | REV: B | 16–06–2020

Appendix F – Hororātā Drinking Water Supply Water Model Maps



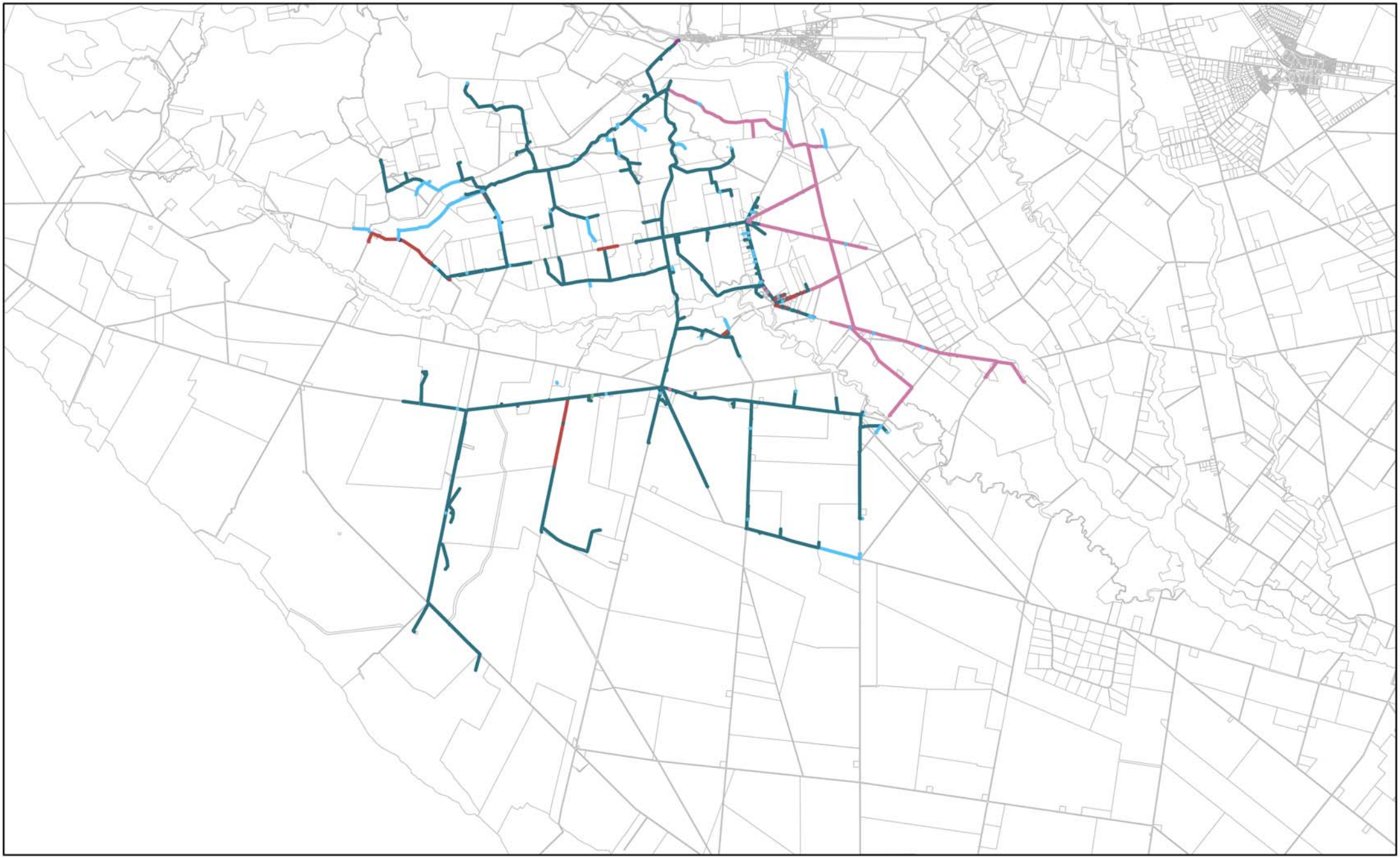
N

Date: 9/03/2020

HORORATA GLENNTUNNEL
Water Supply

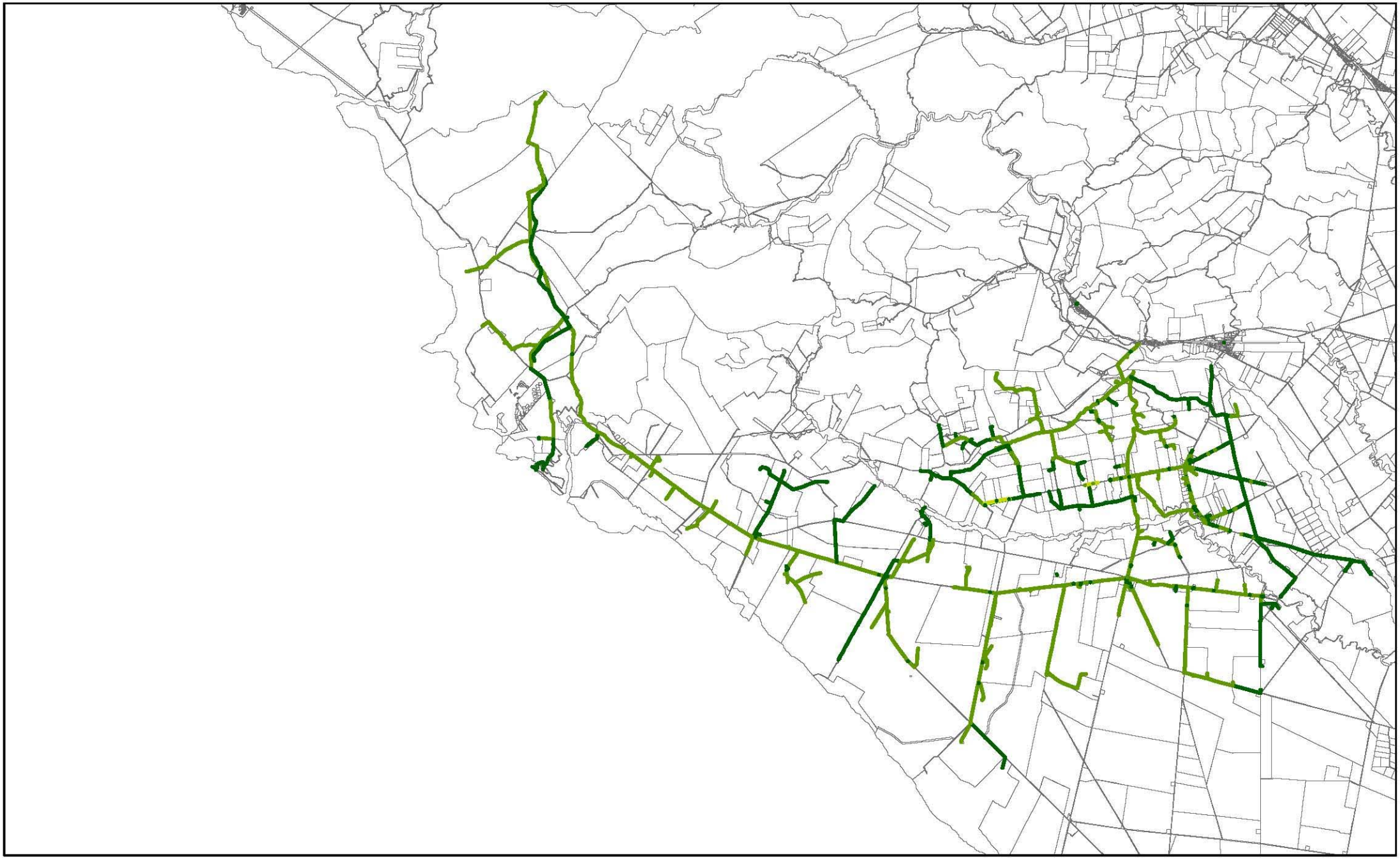
Legend

- Water Intake and Water Treatment Plant
- Water Reservoir and Pump Station
- Water Reservoir
- Sample Tap



HORORATA GLENNTUNNEL
Pipe Material

Date: 2/03/2020



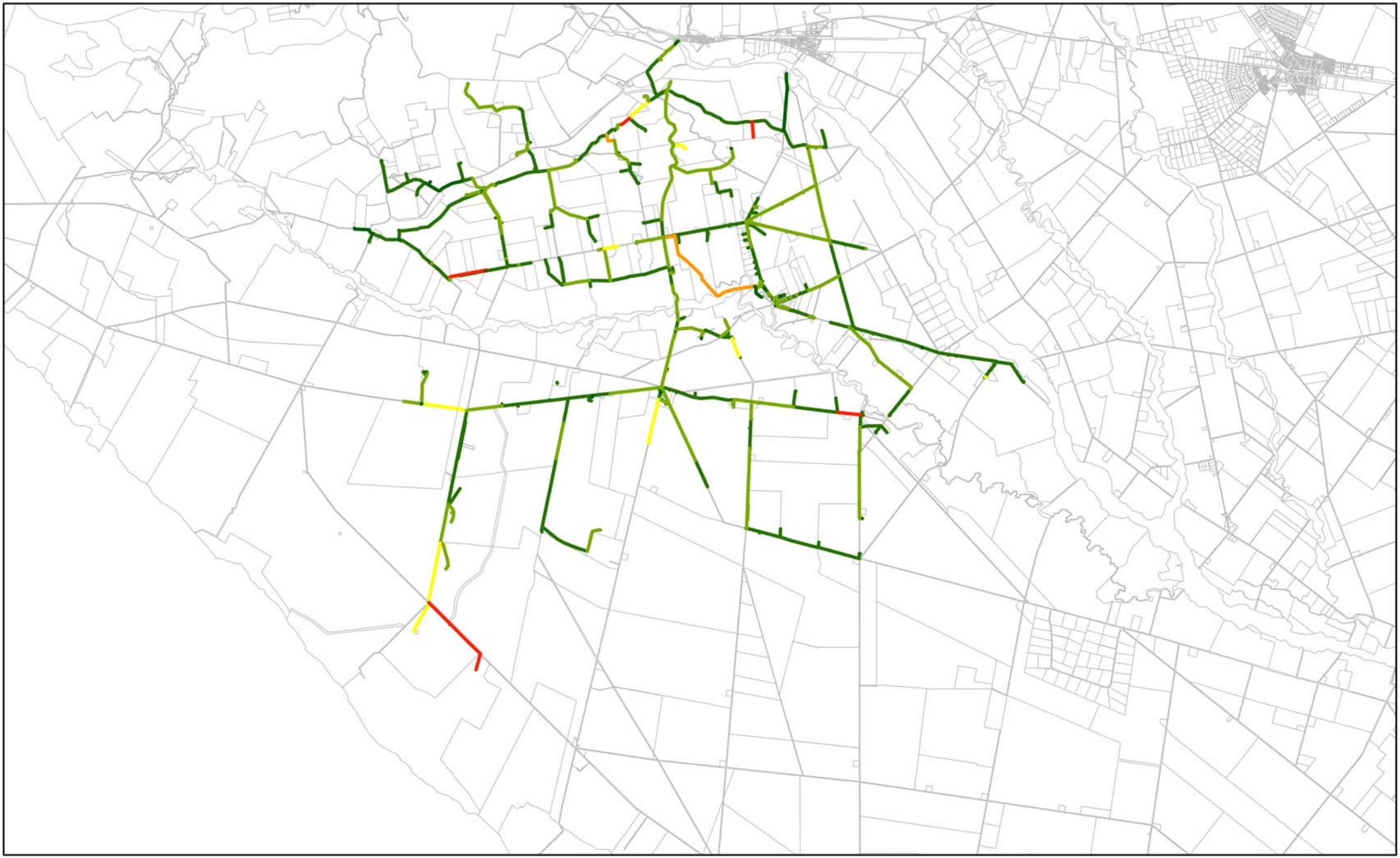
N

Date: 12/02/2020

HORORATA ACHERON
Age of Pipes

Legend

- 0 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 100



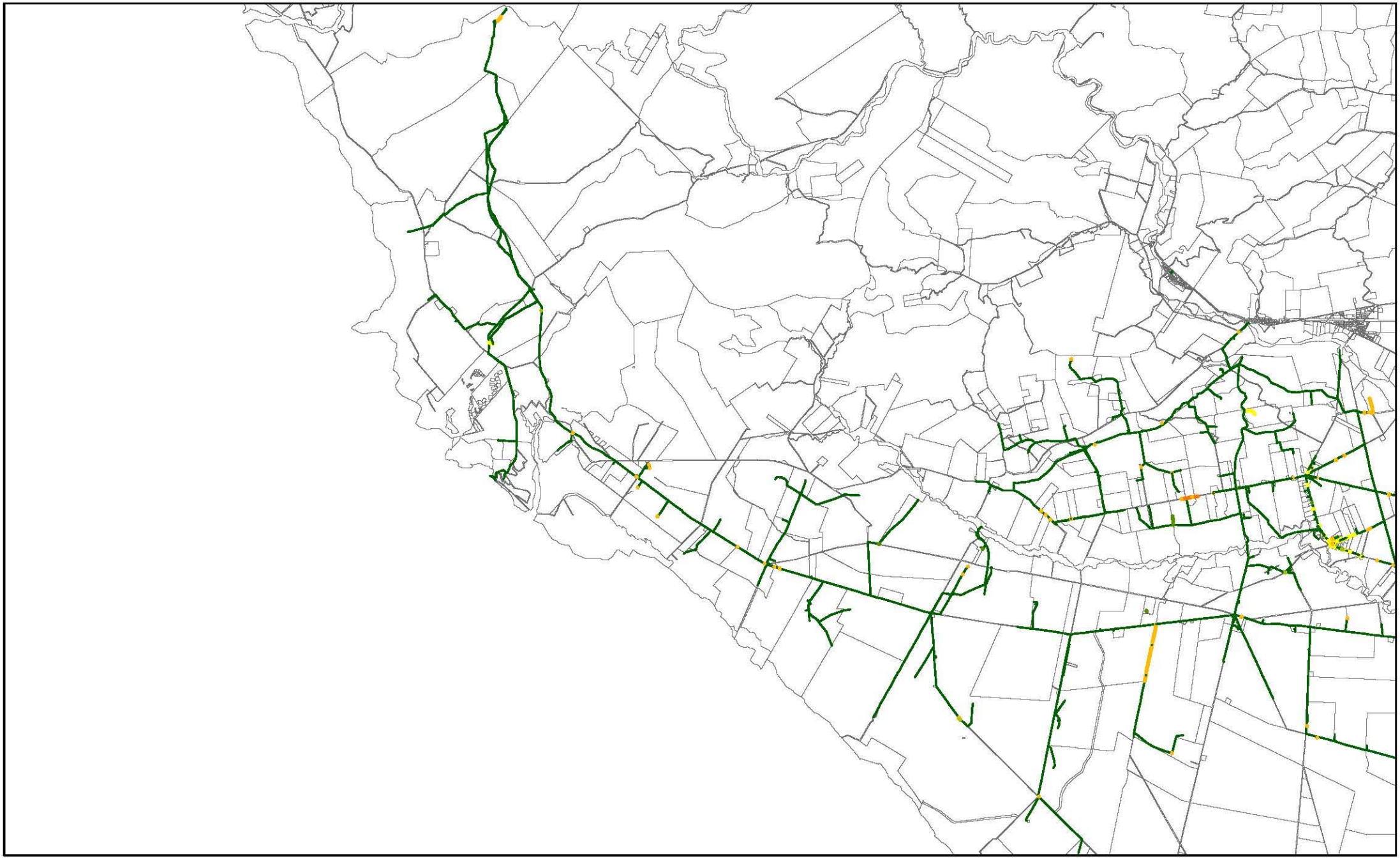
N

Date: 2/03/2020

HORORATA GLENNTUNNEL
Pipe Material

Legend

- 0
- 1 - 2
- 3 - 4
- 5 - 6
- 7 +



HORORATA ACHERON
Renewal Period

Date: 12/02/2020

Appendix G – Hororātā Drinking Water Supply Improvement Plan

SDC General Improvement Actions 09 February 2021								
Code	**Category (CAPEX, OPEX, INVST, MGMTSYS)**	**Proposed Improvement**	**Objective of Improvement**	**Priority Level**	**Accountability**	**Timeframe**	**Temporary Action**	**Cost Estimate**
Management								
IA.GN.001	MGMTSYS	Implement the updated Water Services Team structure	Supply Management	1	Service Delivery Manager	30 June 2021		$1,000
IA.GN.002	MGMTSYS	Review and implement updated Water Services Team roles and accountabilities	Supply Management	1	Service Delivery Manager	30 June 2021		$1,000
IA.GN.003	MGMTSYS	Establish WSP Adoption and Change Forum	Supply Management	1	Water Services Delivery Manager	30 June 2021		$3,000
IA.GN.004	MGMTSYS	Develop and implement annual target for customer complaints, endorsed by ELT, including: - Establish report to communicate customer complaints target vs. actual (monthly basis) to Service Delivery Manager	Supply Management	2	Asset Manager Water Service	31 December 2021		$1,500
IA.GN.005	MGMTSYS	Develop and implement annual target for Water Quality compliance, endorsed by ELT, including: - Establish monthly reporting to communicate Water Quality Strategy compliance target vs. actual to Service Delivery Manager	Supply Management	2	Asset Manager Water Service	31 December 2021		$1,000
IA.GN.006	MGMTSYS	Further develop and implement annual target for Operation & Maintenance (O&M) compliance, endorsed by ELT: - Establish monthly reporting to communicate O&M compliance target vs. actual to Service Delivery Manager	Supply Management	2	Service Delivery Manager	31 December 2021		$1,000
IA.GN.007	MGMTSYS	Develop and implement annual target for water capacity, endorsed by ELT, including: - Establish monthly reporting to communicate water capacity target vs. actual to Service Delivery Manager	Supply Management	2	Asset Manager Water Service	31 December 2021		$2,500
IA.GN.008	MGMTSYS	Develop and implement annual target for capital delivery program, endorsed by ELT: - Establish monthly reporting to communicate capital delivery program target vs. actual to Service Delivery Manager	Supply Management	2	Service Delivery Manager	31 December 2021		$1,500
IA.GN.009	MGMTSYS	Develop reporting template and responsibilities for Water Safety Reporting and implement monthly reporting procedure to SDC councillors	Supply Management	2	Water Services Delivery Manager	31 December 2021		$1,000
IA.GN.010	MGMTSYS	Develop and implement annual target for WSP adoption program, endorsed by ELT: - Establish monthly reporting to communicate WSP adoption program target vs. actual (monthly basis) to Service Delivery Manager	Supply Management	2	Service Delivery Manager	31 December 2021		$1,000
IA.GN.011	MGMTSYS	Formalise Water Services Communications and Engagement Strategy, inclusive of an engagement plan for consumers (including participation of any elected officials) on awareness and involvement in safe and secure drinking-water, including annual review ability to track process including: - Review LTP Stakeholder Engagement Process to ensure objectives for long-term consumer engagement plan on awareness of and involvement in maintaining safe and secure drinking-water are met	Supply Management	3	Water Services Delivery Manager	30 June 2022		$2,000
IA.GN.012	MGMTSYS	Consolidate targets vs. actuals into overall Water Services Performance Report to Group Manager - Infrastructure	Supply Management	1	Water Services Delivery Manager	31 July 2021		$1,000
IA.GN.013	MGMTSYS	Develop and implement customer complaints SOP	Supply Management	1	Water Services Delivery Manager	31 July 2021		$2,000

Code	Category (CAPEX, OPEX, INVST, MGMTSYS)	Proposed Improvement	Objective of Improvement	Priority Level	Accountability	Timeframe	Temporary Action	Cost Estimate
Management								
IA.GN.014	MGMTSYS	Develop and implement Planned and Emergency Water Shutdown SOP	Supply Management	1	Water Services Delivery Manager	30 June 2021		$2,000
IA.GN.015	MGMTSYS	Implement Incident and Emergency Management Plan: - Refine and test detailed Emergency Response Plans within Incident and Emergency Response Plan - Conduct training for staff in use of Incident and Emergency Response Plans.	Security of Supply	2	Water Services Delivery Manager	31 December 2021		$10,000
IA.GN.016	MGMTSYS	Initiate and undertake annual quality audits of routine and emergency procedures, including management tracking system	Supply Management	2	Water Engineer	31 December 2021		$2,000
IA.GN.017	MGMTSYS	Implement Transgression Response Plan including annual review process and tracking	Supply Management	1	Water Services Delivery Manager	30 June 2021		$2,000
IA.GN.018	MGMTSYS	Water Operator training procedures for SOP Master List (DW-GEN-04-REG-0009) written and SOPs implemented into operation.	Scheme Operation	2	SICON	31 December 2021	Use existing operation and maintenance procedures until IA.GN.018 is complete.	Within SICON Contract
IA.GN.019	MGMTSYS	Implement annual review of CCPs and corrective actions to ensure they are up-to-date and being followed	Scheme Operation	2	Water Engineer	31 December 2021		$1,000
IA.GN.020	MGMTSYS	Formalise process for activating, planning and carrying out investigations and document in Water Investigations Procedure	Water Quality	2	Water Services Delivery Manager	30 September 2021		$2,000
IA.GN.021	MGMTSYS	Develop and implement a Water Quality Strategy to specify the interconnection between planning, financing, monitoring, training and communication systems relating to water quality management.	Supply Management	3	Water Services Delivery Manager	31 December 2022		$10,000
IA.GN.022	MGMTSYS	Develop and implement an training plan (for all relevant parties) inclusive of on boarding plan, annual skills training and monitoring system	Supply Management	2	Water Services Delivery Manager	31 December 2021		$10,000
IA.GN.023	MGMTSYS	Determine a procedure for the evaluation of performance results (to guide those undertaking evaluation of performance results), inclusive of the evaluation of daily water quality results, monthly or quarterly reviews and long-term evaluation of results. Define responsibility for undertaking the review and disseminating the results.	Supply Management	2	Water Quality Engineering Officer	31 December 2021		$10,000
IA.GN.024	MGMTSYS	Undertake a review by SDC's Audit & Risk Subcommittee and define the appropriate auditing mechanisms including: - Triggers which would initiate the requirement for an external audit - Methodology to conduct an internal audit	Supply Management	3	Group Manager - Infrastructure	31 December 2022		$5,000
IA.GN.025	MGMTSYS	Specify the triggers which would initiate the need for an external audit including the responsibility for identifying these triggers, initiating the audit and reporting audit outcomes.	Supply Management	3	Group Manager - Infrastructure	31 December 2022		$1,000
IA.GN.026	MGMTSYS	Develop an internal audit process and template which can be used to audit all systems. This needs to include what should be covered in the audit.	Supply Management	3	Water Services Delivery Manager	31 December 2022		$1,000

Code	Category (CAPEX, OPEX, INVST, MGMTSYS)	Proposed Improvement	Objective of Improvement	Priority Level	Accountability	Timeframe	Temporary Action	Cost Estimate
Management								
Catchment								
IA.CM.01	INVST	Review revised protection zones, from the Catchment Hazard Assessment, in conjunction with ECan and confirm any potential restriction of activities required to prevent contaminants (microbiological and chemical) entering a bore, as well as liaising with ECAN to identify appropriate consent conditions for new groundwater consents.	Catchment Management	3	Water Quality Engineering Officer	30 June 2022	IA.CM 05	$5,000
IA.CM.02	INVST	Liaise with ECAN to improve bore security of wells within PZ2 and PZ3, including abandoned bores, review future management plans with ECAN.	Catchment Management	2	Water Engineer	31 December 2021	IA.CM 05	$2,000
IA.CM.03	INVST	Undertake feasibility study of ground water quality monitoring in up gradient bores to give early warning of water quality issues in the protection zone, consider outcomes from study	Catchment Management	3	Asset Manager Water Service	31 December 2022	IA.CM 05	Plan $20,000 Annual $10,000
IA.CM.04	INVST	Develop review chemical water quality data in relation to HAIL and land use data. Implement this as an on-going process.	Water Quality	2	Water Quality Engineering Officer	31 December 2021	IA.CM 05	$10,000
IA.CM.05	MGMTSYS	Undertake educational letter drop highlighting the causes and effects of ground water contamination to local land owners	Consumer Education	2	Water Quality Engineering Officer	31 October 2021		$5,000
IA.CM.06	INVST	Consider protozoa testing to gauge whether this is present in water sources across the district	Water Quality	2	Water Quality Engineering Officer	31 December 2021		TBC
IA.CM.07	INVST	Investigate catchment modelling techniques and enhance modelling accuracy over time	Water Quality	3	Asset Manager Water Service	31 December 2022		$5,000
IA.CM.08	INVST	Investigate modelling of contamination of the aquifer, quantity of contaminant that would need to be discharged within the catchment to exceed the MAV at the point of abstraction.	Water Quality	3	Asset Manager Water Service	31 December 2022		$2,000
IA.CM 09	MGMTSYS	Finalise sampling Contract with Food & Health Ltd.	Water Quality	1	Water Quality Engineering Officer	30 June 2021		$2,000
IA.CM.10	INVST	Review of emerging contaminants and disinfection byproducts (where applicable) within the water supply catchments	Water Quality	2	Water Quality Engineering Officer	31 December 2021		$5,000
IA.CM.11	MGMTSYS/OPEX	Finalise and implement an updated Selwyn District Council Cyanobacteria and Cyanotoxin Management Protocol.	Water Quality	2	Water Quality Engineering Officer	30 November 2021		$5,000
Scheme								

Code	Category (CAPEX, OPEX, INVST, MGMTSYS)	Proposed Improvement	Objective of Improvement	Priority Level	Accountability	Timeframe	Temporary Action	Cost Estimate
Management								
IA S.01	MGMTSYS	Continue to develop SOP for routine operation procedures, preventative maintenance task, inspections, monitoring, record keeping, and instrument calibration as per SOP Master List (DW-GEN-04-REG-0009)	Supply Management	1	Water Engineer SICON	30 August 2021	Use existing operation and maintenance procedures until IA.GN.018 is complete.	$60,000
IA S.02	INVST	Undertake review of security requirement (i.e. fencing) at all sites and implement recommendations	Scheme Operation	2	Water Engineer SICON	30 September 2021		$60,000
IA S.03	INVST	District wide review of pressure vessels to confirm certify or requirement for replacement pressure vessels	Security of Supply	2	Water Engineer	31 December 2021		$5,000
IA S.04	MGMTSYS	Review spare pump and instrumentation requirement for all sites, produce database of available spares and where they can be used and confirm additional spares that are required district wide	Security of supply	2	Water Engineer	31 December 2021		$4,000
IA S.05	MGMTSYS / OPEX	Develop district wide preventative maintenance programme for submersible pumps and implement the programme of works	Security of supply	2	Water Engineer	31 December 2021		$2,000
IA S.06	CAPEX	Review emergency water supply arrangements for each site, provide plan for each scheme and (i.e. addition of a pre-treatment tie-in point for water to be pumped into the system from a tanker in the event that the source is offline)	Supply Management	3	Water Engineer	30 June 2022		$2,000
IA S.07	INVST	Investigate and confirm current access agreements to all water infrastructure	Security of Supply	3	Water Engineer	31 December 2025		$5,000
IA S.08	CAPEX/OPEX	Review chlorine readiness of all schemes e.g. review contact times, potential for disinfection by-products, dead-ends, dosing requirements, monitoring/control etc.	Scheme Operation	1	Water Engineer	31 August 2021		$5,000
IA S.09	OPEX	Inspection of bore casing on a fifteen yearly basis or when pump maintenance occurs to be added to the operation and maintenance schedule.	Supply Management	1	Water Engineer	31 August 2021		$20,000/bore
IA S.10	CAPEX/OPEX	Design, construct and install chlorination across the district.	Water Quality	3	Water Engineer	30 June 2022		
Reservoirs and Reticulation								
IA.RR 01	INVST	Completion of district wide project to review existing connections and ensure suitable backflow prevention is in place. This includes identification of all high hazard properties within council and private properties	Water Engineer	3	Water Engineer	30 June 2022		$100,000
IA.RR.02	INVST/CAPEX	Review of bulk water extraction process across the district and provide recommendation for updated procedure for feasibility review and implementation. This may include a review of consequences for not complying with council hydrant use (e.g. fines)	Water Quality	2	Service Delivery Manager	31 December 2021		$300,000
IA.RR.03	OPEX	Addition of an alarm for rapid change in reservoir level (i.e. to recognise issues in the network) where network pressure is not available	Supply Management	3	Water Engineer	30 November 2022		-

Code	Category (CAPEX, OPEX, INVST, MGMTSYS)	Proposed Improvement	Objective of Improvement	Priority Level	Accountability	Timeframe	Temporary Action	Cost Estimate
Management								
IA.RR 04	INVST	Undertake a district wide review of reservoir sites and investigate any improvements to be implemented to allow reservoirs to be taken offline for the 7-year cleaning cycle as specified in the C1284 Maintenance Contract and/or if contaminated or in need of repair	Supply Management	3	Water Engineer	30 June 2022		$10,000

Code	Category (CAPEX, OPEX, INVST, MGMTSYS)	Proposed Improvement	Objective of Improvement	Priority Level	Accountability	Timeframe	Temporary Action	Cost Estimate
Management								
IA.RR 05	CAPEX	Implement any improvements found in the district wide review of reservoirs to ensure that they can be taken offline for the 7-year cleaning cycle and/or if contaminated or in need of repair.	Supply Management	3	Water Engineer	30 June 2023		TBC
IA.RR 06	MGMTSYS	Further develop SDC Network Strategy including target Pressure Plan and review pressure zone management	Scheme Operation	3	Water Engineer	30 June 2023		$10,000
IA.RR 07	MGMTSYS	Updated existing Reservoir Disinfection SOP and provide training to Water Operations staff	Water Quality	1	Water Engineer	31 August 2021		$10,000
IA.RR 08	MGMTSYS	Update existing Disinfection and Hygiene of Water Reticulation SOP and provide training to Water Operations staff	Water Quality	1	Water Engineer	31 August 2021		$10,000
IA.RR 09	MGMTSYS	Addition of an alarm for reservoir mass balance (i.e. to recognise when reservoir turnover rate has been insufficient)	Water Quality	2	Water Engineer	30 September 2021		$5,000
IA.RR.10	INVST/MGMTSYS	Develop SDC Network Strategy including Target Pressure Plan and review pressure zone management	Scheme Operation	3	Water Engineer	30 June 2022		$20,000

SDC Hororātā Improvement Actions 01 February 2021							
Code	**Category (CAPEX, OPEX, INVST, MGMTSYS)**	**Proposed Improvement**	**Objective of Improvement**	**Priority**	**Accountability**	**Timeframe**	**Cost Estimate**
Hororātā - Homebush WTP							
IA.H.HB.01	CAPEX/OPEX	Add pipe between the well pump and Homebush WTP to the renewal schedule.	Security of Supply	2	Water Engineer	31 December 2021	$100,000
IA.H.HB.02	OPEX	Automate chlorination and install a chlorine analyser at the Homebush WTP	Water quality	1	Water Engineer	30 June 2021	$30,000
Hororātā - Reservoirs and Reticulation							
IA.H.RR.01	INVST/OPEX	Assess the current condition of the Harper Hills access road and implement an Access Road Management Plan.	Security of Supply	3	Water Engineer	30 June 2022	Staff Time
IA.H.RR.02	INVST/OPEX/CAPEX	Additional chlorine analysers to be added in the network, investigate optimal network location, provide additional analysers and update CCPs.	Water Quality	3	Water Engineer	30 June 2023	$100,000
IA.H.RR.03	INVST/OPEX/CAPEX	Additional pressure sensors to be added into the network, investigated optimal network location and provide additional sensors	Water Quality	3	Water Engineer	30 June 2023	$20,000
IA.H.RR.04	INVST	Investigate options to connect the first house downstream of the Homebush WTP (upstream of Atkins Road reservoir) to a different nearby water scheme	Water Quality	3	Water Engineer	30 June 2022	Staff Time
IA.H.RR.05	CAPEX	Harper Hills reservoir to be renewed.	Water Quality	3	Water Engineer	30 June 2022	$150,000