SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tātau

27 May 2026

[redacted]

Kia ora [redacted]

Official information Request: - Water pipe upgrade in Featherston - Ref# 2026/192

I am writing to you in response to your request received 5 May 2026 for the following information:

Please provide an updated list of all water pipes upgraded in Featherston since 2022 and the most recent copy of the Featherston Water pressure model output with pressure outputs at nodes similar to that presented by WWL during the hearing process on the appeal to RM230176.

We have assessed your request under the Local Government Official Information and Meetings Act 1987 (LGOIMA). I have received information to provide the following response:

Please see attached and below:

1. Geographical Information System (GIS) output showing all watermains in Featherston with an installed date of 2022 or later. (Fig 1 below)
2. Outline Layout from the in-progress C1275 Featherston Watermain Renewals project, commenced October 2025 (Fig 2 below)
3. Zone Management Plan document from Stantec, 2025 for Featherston, Greytown and Martinborough drinking water networks owned by SWDC. (attached)

Please note that it is our policy to proactively release our responses to official information requests where possible. If this request is selected it will be published at https://swdc.govt.nz/lgoima-proactive-release/, with your personal information removed.

You have a right to request a review by the Ombudsman on this response. Further information about this process can be found on https://www.ombudsman.parliament.nz/what-ombudsman-can-help/complaints-about-government-agencies/how-make-complaint or email info@ombudsman.parliament.nz

Nāku noa, nā

James O'Connor
Group Manager, Infrastructure & Community Operations

SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tātau

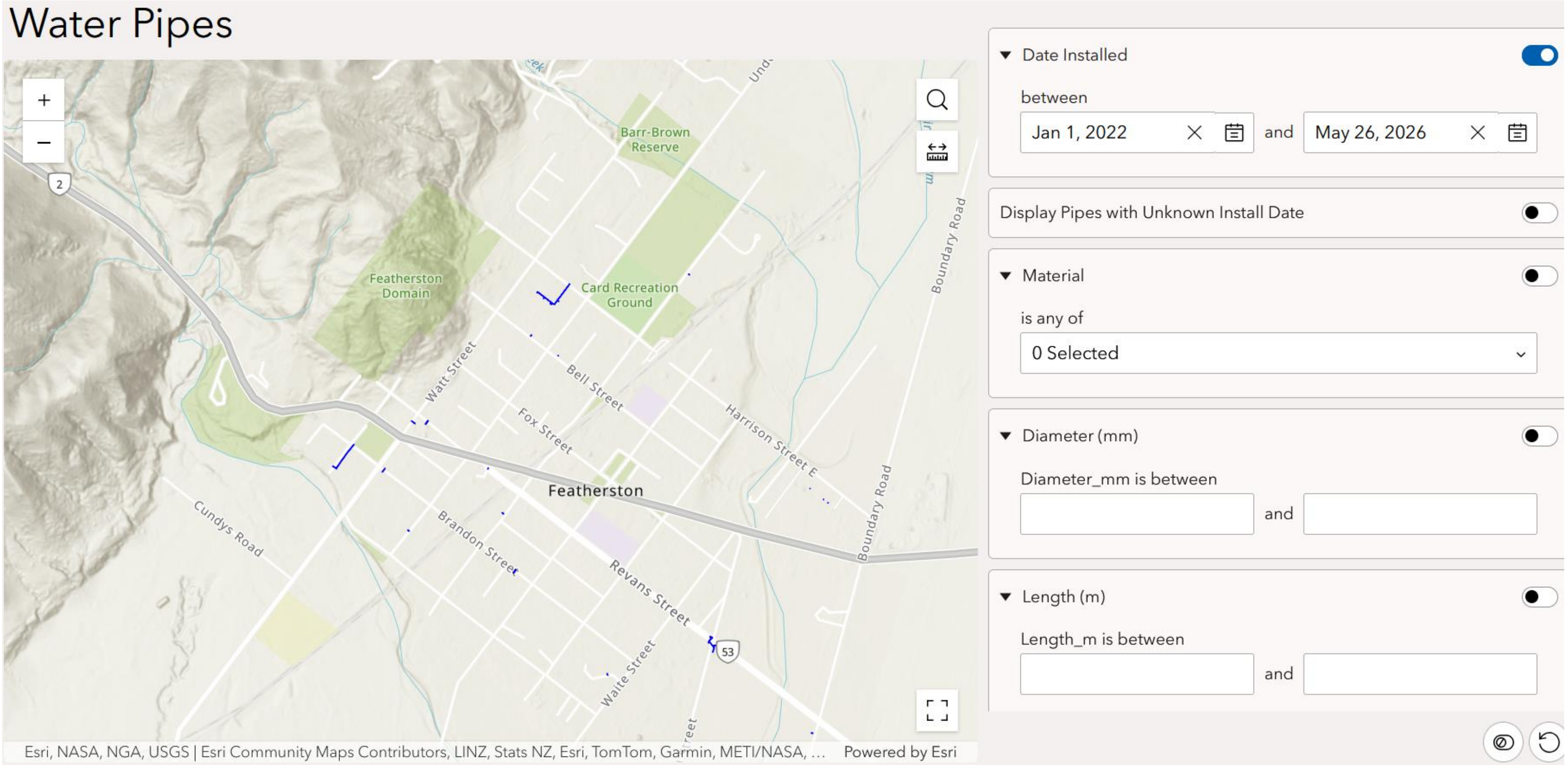


Fig. 1

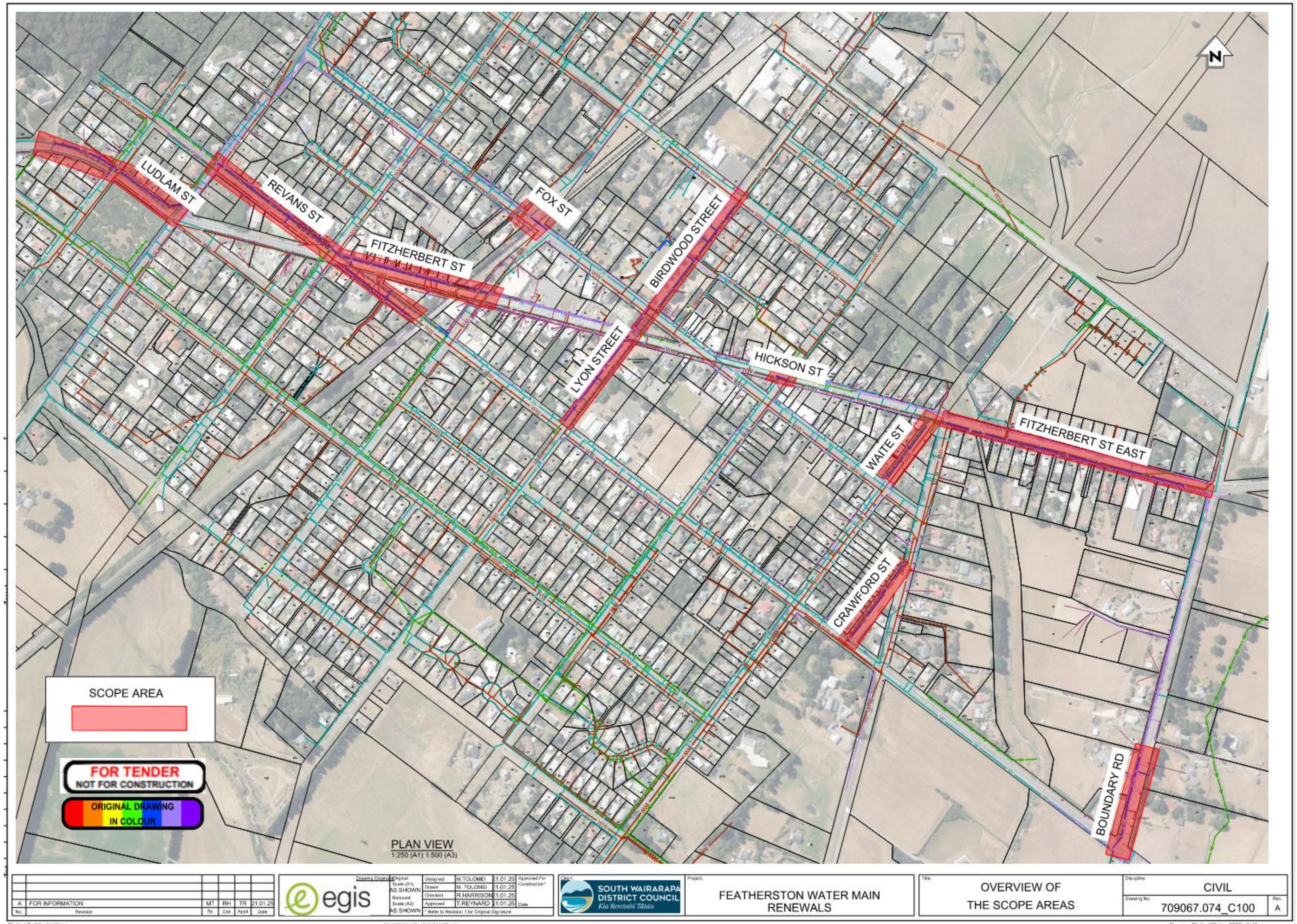

N
LUDLAM ST
REVANS ST
FOX ST
FITZHERBERT ST
BIRDWOOD STREET
LYON STREET
HICKSON ST
WAITE ST
FITZHERBERT ST EAST
CRAWFORD ST
BOUNDARY RD
SCOPE AREA
FOR TENDER
NOT FOR CONSTRUCTION
ORIGINAL DRAWING IN COLOUR
PLAN VIEW
1:250 (A1) 1:500 (A3)
A FOR INFORMATION MT RH TR 21.01.25
No. Revision By Chk Appd Date
egis
Drawing Originator
Original Scale (A1) AS SHOWN
Reduced Scale (A3) AS SHOWN
Designed M.TOLOMEI 21.01.25
Drawn M. TOLOMEI 21.01.25
Checked R.HARRISON 21.01.25
Approved T.REYNARD 21.01.25
Approved For Construction*
Date
* Refer to Revision 1 for Original Signature
Client:
SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tātau
Project:
FEATHERSTON WATER MAIN RENEWALS
Title:
OVERVIEW OF THE SCOPE AREAS
Discipline
CIVIL
Drawing No.
709067.074_C100
Rev.
A

Fig. 2

South Wairarapa

Model Build, Calibration and Zone Management Report

PREPARED FOR Wellington Water | March 2025

We design with community in mind

Stantec

Revision Schedule

Rev No.	Date	Description	Signature or Typed Name (documentation on file)			
			Prepared by	Checked by	Reviewed by	Approved by
1	01/03/21	Model Build	AB	CP	CP	AB
2	18/05/21	Model Calibration	AB	CP	BD	AB
3	29/06/21	WWL Calibration Comments	AB	CP	AB	AB
4	07/09/21	Working Model	AB	CP	BD	AB
5	15/06/23	Zone Management Plan – Featherson and Greytown	KW	AB	CP	AB
6	7/07/23	Zone Management Plan – Featherson and Greytown - WWL Comments addressed	KW	CP	AB	AB
7	17/07/23	Zone Management Plan – Featherston and Greytown - further WWL Comments addressed	KW	CP	AB	AB
8	04/10/24	Draft Zone Management Plan – Martinborough	LH	AB	CP	AB
9	21/10/24	Zone Management Plan – Martinborough - WWL comments addressed	LH	AB		AB
10	10/03/2025	Zone Management Plan – Martinborough – PDD revised	LH	AB		AB
11	20/03/2025	Zone Management Plan – Martinborough – Storage revised	LH	AB		AB

Quality Statement

This document has been prepared for the benefit of Wellington Water. No liability is accepted by this company or any employee or sub-consultant of this company with respect to its use by any other person.

This disclaimer shall apply notwithstanding that the report may be made available to Wellington Water and other persons for an application for permission or approval to fulfil a legal requirement.

PROJECT MANAGER	PROJECT TECHNICAL LEAD (Greytown/Featherston)	PROJECT TECHNICAL LEAD (Martinborough)
[redacted]	[redacted]	[redacted]

PREPARED BY

[redacted]

CHECKED BY

[redacted]

REVIEWED BY

[redacted]

APPROVED FOR ISSUE BY

[redacted]

[redacted]

Level 15, 10 Brandon Street, Wellington, 6010

PO Box 13-052, Armagh, Christchurch 8141

TEL +64 3 816 7000

STATUS FINAL | Project No 310103463

Table of Contents

Executive Summary

South Wairarapa District Council requires a model of their water supply network and a master plan for future infrastructure development. This report sets out the build and calibration of the water supply model, Master Plan and the Zonal Management Plan for Martinborough, Featherston and Greytown. Featherston and Greytown forms a connected network, but Martinborough is a separate system.

The build and calibration have been done for all areas jointly, but the master plan was split into two phases: Featherston and Greytown in 2023 and Martinborough in 2024.

Model Build

The South Wairarapa District Council water supply network has been modelled using InfoWorks WS Pro 2021.5. The asset, customer and flow data was compiled in 2020/2021 and was found to be sufficient for development of a model suitable for a Zone Management Plan.

Model Calibration

A model calibration has been undertaken against measurements taken in the field test conducted in March 2021. The model provides a good representation of the observed network operation, with one outstanding unexplained discrepancy in pressure near the Greytown Memorial Park Water Treatment Plant. This was found to have no significant impact on the system performance or recommended upgrades and is therefore not considered to be an issue for the Master Plan.

Working Model

Scenarios have been developed to simulate the operation of the water network under current Average Day and Peak Day demand for Featherston, Greytown and Martinborough.

Growth – Featherston and Greytown

Scenarios were developed to simulate the expected population growth in these two localities, up to the 2072 planning horizon.

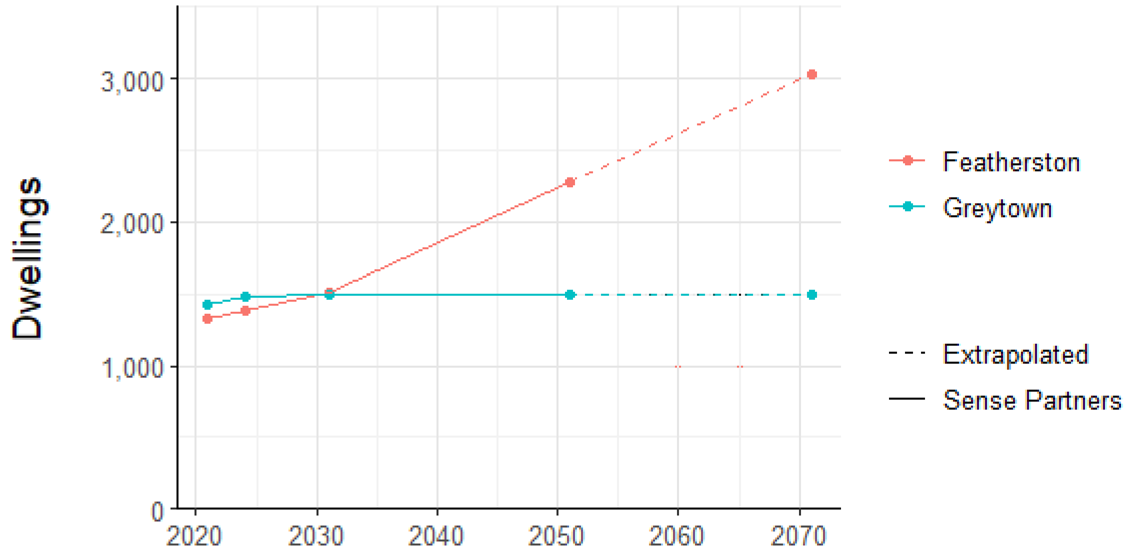


Figure 0-1: Featherston/Greytown Population projection

The scenarios developed are summarised in Table 0-1.

Table 0-1: Featherston/Greytown Current and Future peak day demand summary

	Horizon	Residential (m3/day)	Non-Residential (m3/day)	Leakage (m3/day)	Total (m3/day)
Featherston	**2021**	1,146	40	804	1,990
	2024	1,359	40	804	2,203
	2031	1,528	40	804	2,371
	2051	2,338	40	804	3,181
	2071	3,067	40	804	3,910
Greytown	**2021**	1,520	126	659	2,305
	2024	1,764	126	659	2,550
	2031	1,777	126	659	2,563
	2051	1,777	126	659	2,563
	2071	1,777	126	659	2,563

System Performance and ZMP – Featherston and Greytown

An analysis of the system performance under current and future demand conditions has identified several deficiencies.

The bore capacity, raw water pumping and Waiohine Treatment Plant capacity will need to be increased in the future. This report only covered the hydraulic capacity aspects: the hydrology and treatment implications should be investigated in a separate study.

Water is conveyed from the Waiohine Treatment Plant, via a large Treated Water Reservoir (TWR) and into the Greytown Reservoir. The limited capacity between the TWR and Greytown Reservoir causes the reservoir to drop to a low level during high demand periods, creating concerns for the continuity of supply to Greytown. Water is also conveyed from the TWR to the Featherston Boar Bush Reservoir. In the future, the capacity of the pipeline to the Boar Bush Reservoir is predicted to be insufficient.

Upgrades to maintain the water level in both the Greytown and Boar Bush reservoirs were considered jointly. Several options were considered with a preferred option tentatively retained. This consists in installing two new pump stations from the TWR, one to each reservoir. There are, however, several unknowns around the pipework of the Waiohine complex and further investigation is required to confirm a preferred solution.

The hydraulic requirements of the distribution network are in part guided by the Fire Code, which indicates what flow should be available from hydrants based on the nature of the buildings' fire hazard rating. Some buildings in Featherston and Greytown could be classified as FW6, requiring 200 l/s from hydrants. This is immensely greater than what could reasonably be achieved by the existing network, even with local upgrades. Following discussions with Fire and Emergency NZ as well as Wellington Water Operations and Planning staff, upgrades were identified to achieve a FW3 (50 l/s) level of service as a starting point. The Memorial Park Water Treatment Plant pumps directly into the Greytown reticulation and contributes significantly to the flow available for fire-fighting. While an extended outage was considered for maintenance, we recommend maintaining the Memorial Park WTP at least on stand-by for emergencies.

Distribution pipe upgrades were identified to accommodate the projected population growth. All strategic upgrades, Featherston upgrades and Greytown upgrades are shown in Figure 0-2, Figure 0-3, and Figure 0-4.

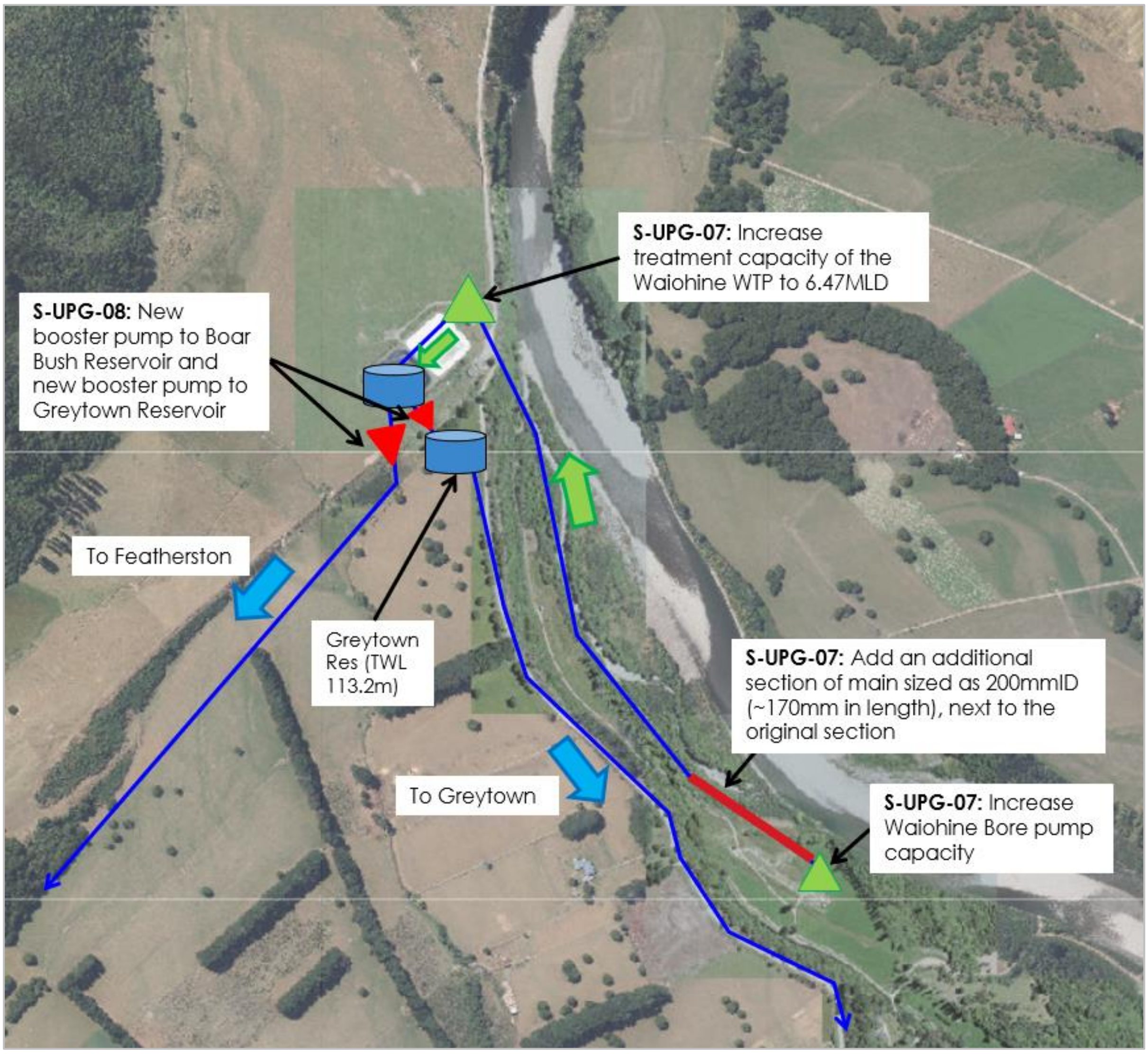


Figure 0-2: Featherston/Greytown Strategic Upgrades

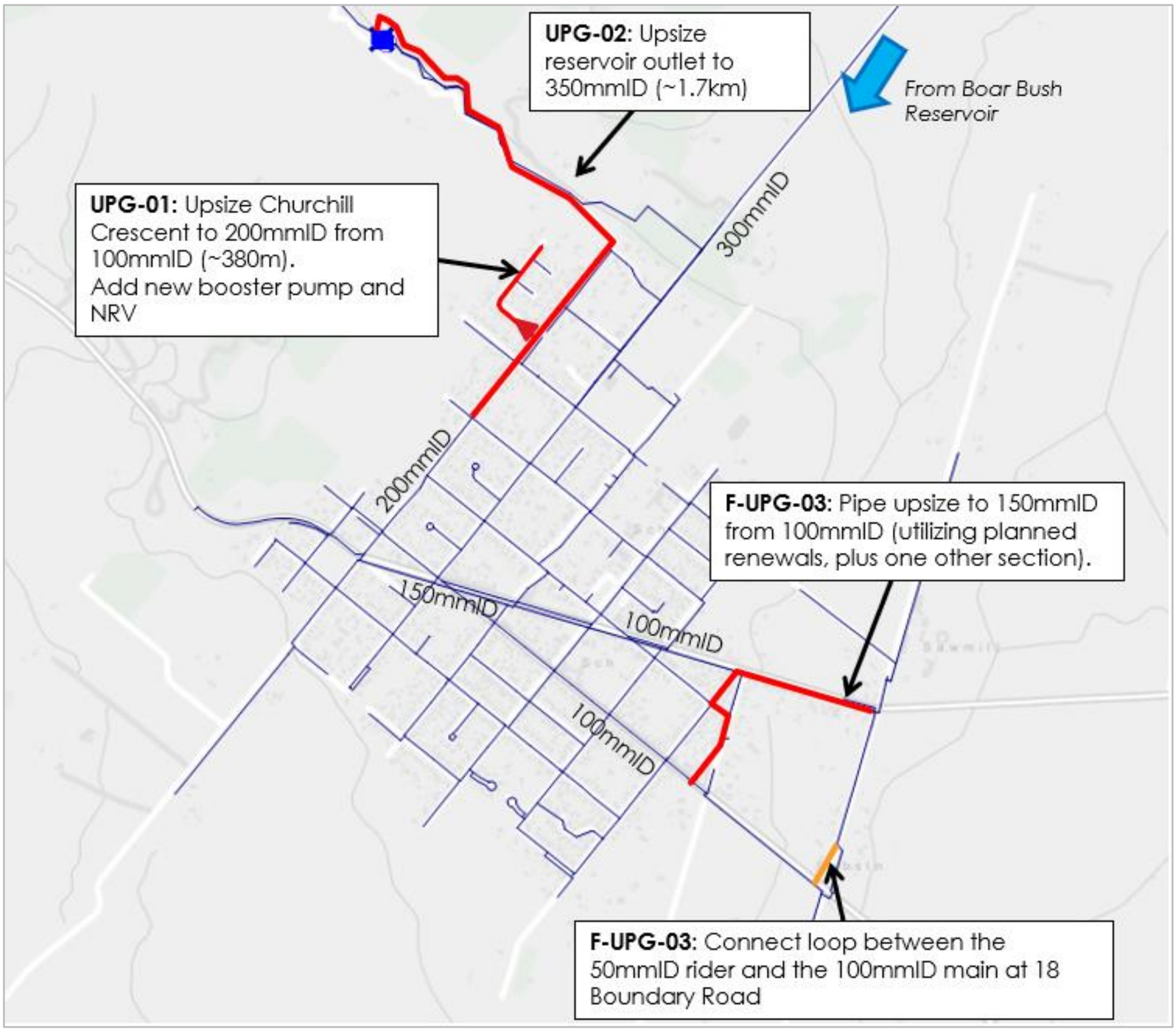


Figure 0-3: All upgrades for Featherston

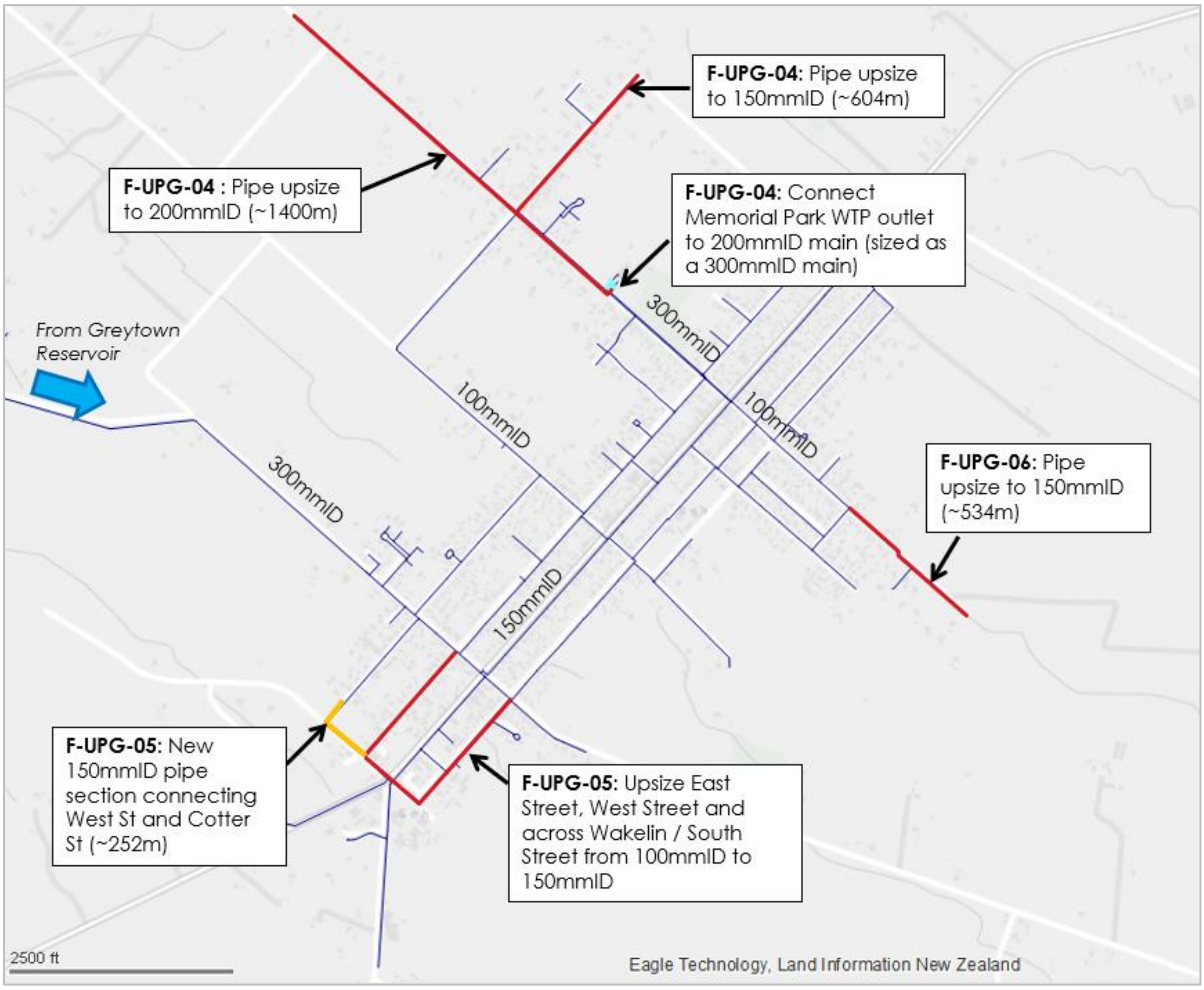


Figure 0-4: All upgrades for Greytown

These upgrades are estimated to cost a total of $32.5M, and a breakdown can be seen below:

Table 0-2: Featherston/Greytown Cost summary ($M)

Upgrade category	2021	2031	2051	2071	Total
Fire	$16.0				$16.0
Pressure (including growth) and Fire	$12.3				$12.3
Strategic (maintain reservoir replenishment)			$4.2		$4.2
Total	**$28.2**	**$0.0**	**$4.2**	**$0.0**	**$32.5**

Possible upgrades to the Waiohine Treatment Plant are not included in this estimate.

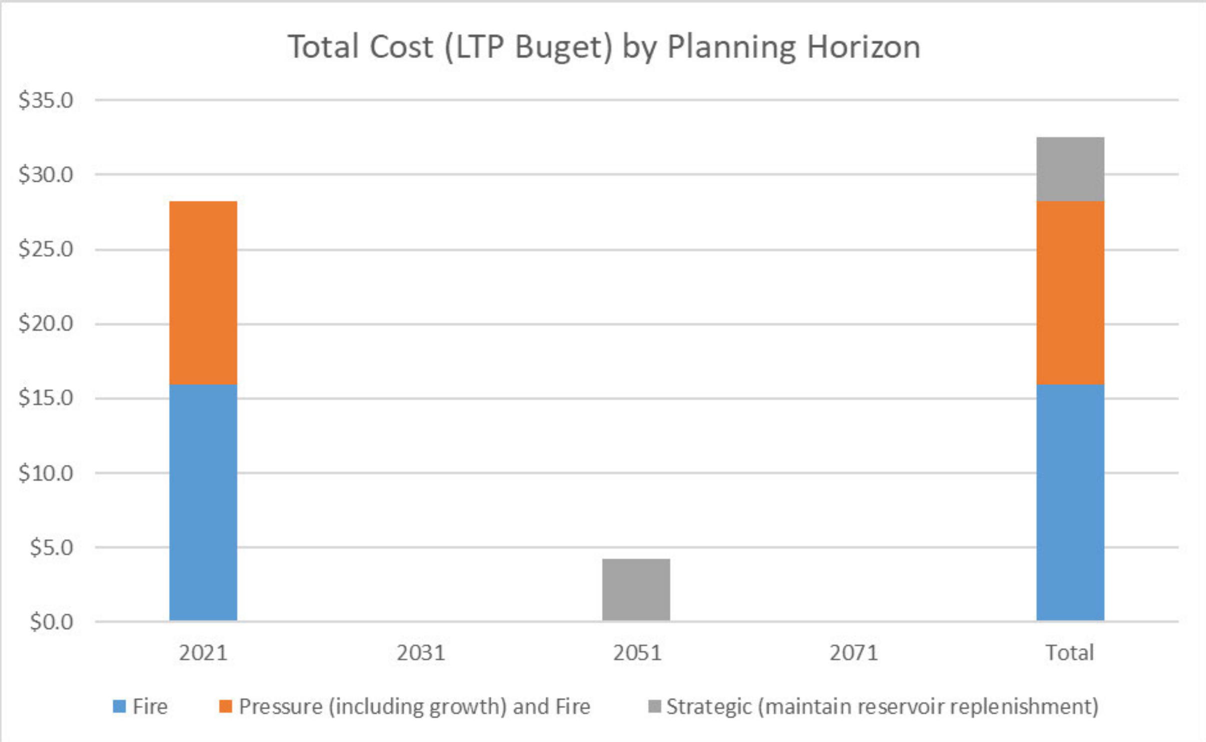


Figure 0-5: Featherston/Greytown Cost Summary

Growth – Martinborough

Scenarios were developed to simulate the expected population growth in Martinborough, up to the 2071 planning horizon. Aorangi Forest is a statistical area, used for growth estimates that part of the Martinborough DMA is located in.

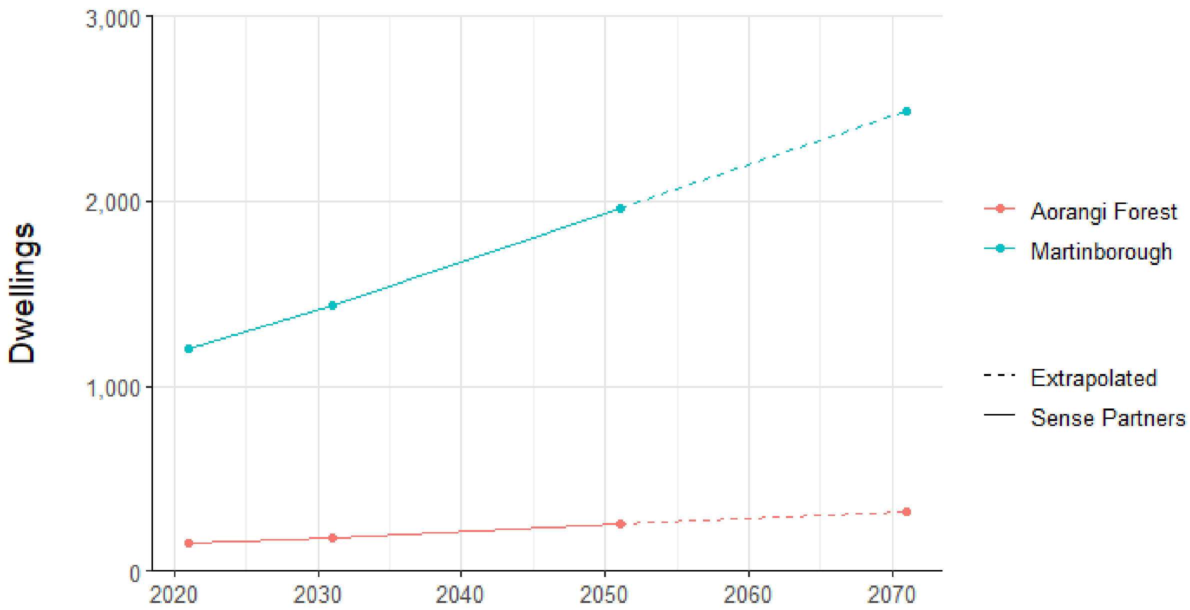


Figure 0-6: Martinborough/Aorangi Forest Population projection

The scenarios developed are summarised in Table 0-3.

Table 0-3: Martinborough Current and Future day peak demand summary

	Horizon	Residential (m3/day)	Non-Residential (m3/day)	Leakage (m3/day)	Total (m3/day)
Martinborough	**2021**	1,041	265	1076	2,382
	2031	1,251	265	1076	2,592
	2051	1,680	265	1076	3,021
	2071	2,121	265	1076	3,462

System Performance and ZMP Martinborough

Analysis of the system performance under current demand calculations identified several fire flow and storage deficiencies. Under future demand conditions some areas of concern were identified, but these are too minor to warrant upgrades.

Martinborough DMA has a dedicated source from Ruamahanga WTP which operates a push-pull system with the four Hinekura Reservoirs at the other end of the town supplying the area when the pumps at the WTP are switched off.

The storage at the Hinekura reservoirs will need to be increased in the future. By 2050 it is under capacity for PDD with a shortfall of 0.2ML and by 2071 it is under capacity for PDD as well as seismic requirements with a shortfall of 0.8ML.

The fire flow deficiencies are mainly located in two areas: at network extremes where pipe size is insufficient to supply FW3 buildings, and in the town centre where the possible absence of cross connections is limiting fire flow for FW3 buildings. At network extremes, pipe sizing upgrades have been recommended to meet the requirements of the Fire Code. In the town centre, several locations have been identified for possible cross connections. WWL are in the process of checking these locations to see if cross connections exist in these locations already. If cross connections are not found, then it is recommended to install new cross connections as this will improve the availability of fire flow in the town centre by up to 5l/s out of some hydrants. Figure 0-6 shows all fire flow upgrades in Martinborough.

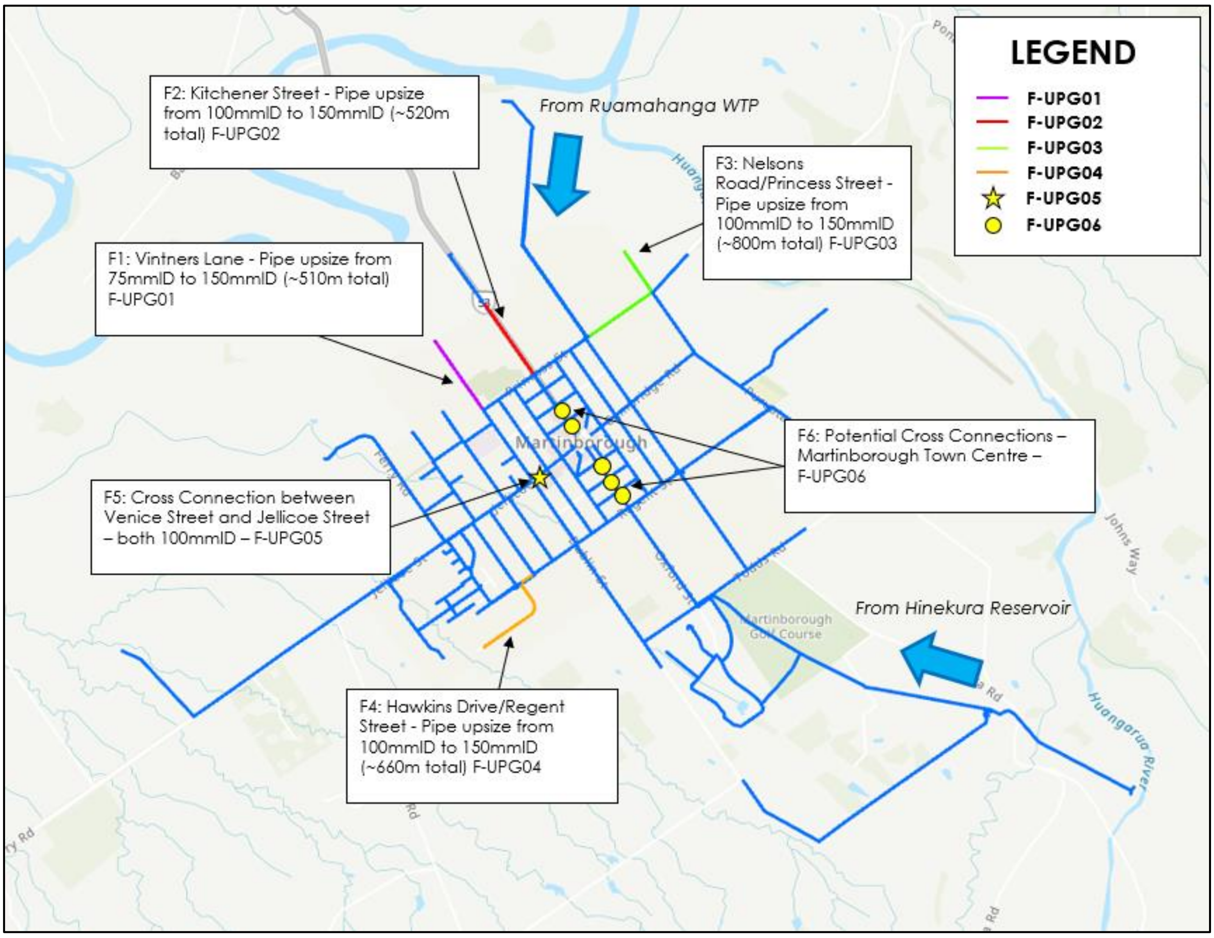


Figure 0-7: Martinborough fire flow upgrades

These upgrades are estimated to cost a total of $14.1M, and a breakdown can be seen below in Table 0-4 and Figure 0-6

Table 0-4: Martinborough Cost summary ($M)

Upgrade category	2021	2031	2051	2071	Total
Fire	$8.3				$8.3
Pressure					$0.0
Storage			$5.8		$5.8
Total	**$8.3**	**$0.0**	**$5.8**	**$0.0**	**$14.1**

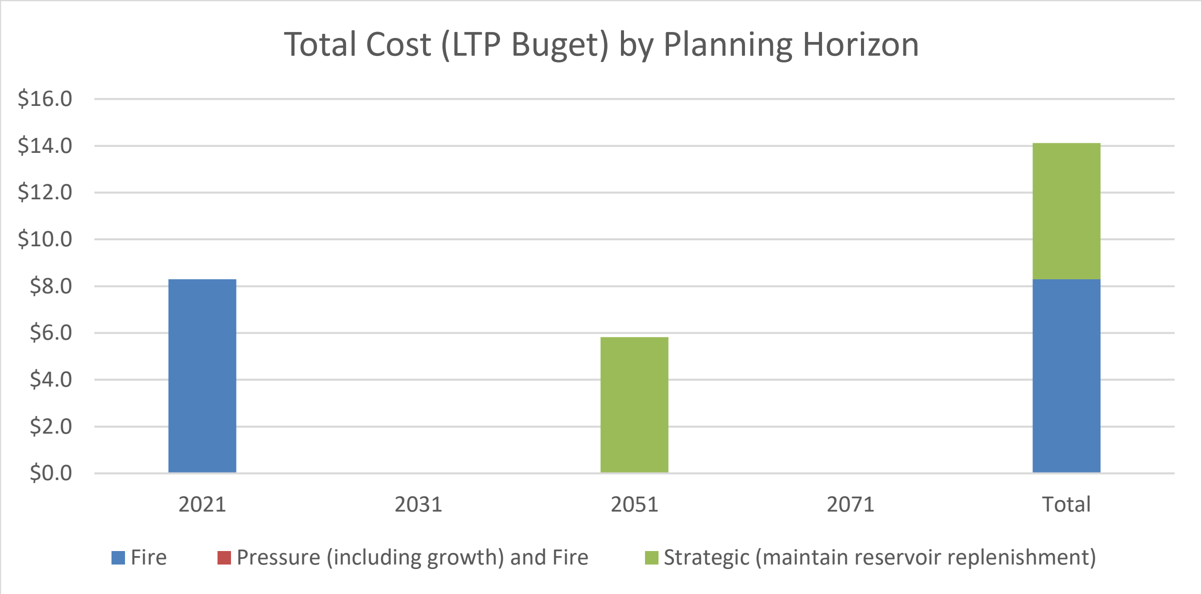


Figure 0-8: Martinborough total cost of upgrades by planning horizon

1.0 INTRODUCTION

1.1 OBJECTIVES

Wellington Water Limited (WWL) has commissioned Stantec to undertake a Model Build, Calibration and Zone Management Plan for the water supply network for South Wairarapa District Council (SWDC) which covers three water supply zones (WSZ) – Featherston, Greytown and Martinborough.

This work was undertaken in different stages over last four years as outlined below -

- **Model Build**

The objectives of the model build phase were as follows:

- Review data sources.
- Build the model network from recent GIS.
- Add the model demand based on recent data.

The output of the model build phase was an un-calibrated model - **SWDC WS BASE01 and a Model Development Report** delivered to WWL in March 2021.

- **Model Calibration**

The objectives of the calibration phase were as follows:

- Prepare and oversee a calibration field test.
- Undertake a calibration of the new model.

The output of the calibration phase was the calibrated model **SWDC WS MOP02 and a Model calibration Report** delivered to WWL in June 2021.

- **Working Model Development**

The objective of the Working Model phase was as follows:

- Peak Day Demand (PDD) and Average Day Demand (ADD) demand scenarios were developed.
- Adjustments to model controls applied to reflect real network operation.

The output of this phase was a working model **SWDC WS MOP03 and a Working Model Report** delivered to WWL in September 2021.

- **Zonal Management Plan**

The objectives of the Zonal Management Plan (ZMP) phase are to:

- Create future planning horizons
- Conduct a performance assessment to identify system deficiencies
- Propose network upgrades to facilitate growth over the next 50 years.

This was undertaken in two stages –

- First stage included Featherston and Greytown - The output of this phase was the Master Planning Model **SWDC WS MPL04 and Featherston and Greytown ZMP Report** delivered to WWL in June 2023
- Second stage included Martinborough and has been added in this version of the report

2.0 STUDY AREA

2.1 GENERAL

SWDC is part of the Greater Wellington region, located to the East of the Remutaka and Tararua ranges. It comprises three rural towns of Greytown, Featherston and Martinborough and a number of smaller communities. This area is shown below in Figure 2-1. The area is mostly rural, and the topography is relatively flat, with only a few small hills.

Only Martinborough, Greytown and Featherston have a reticulated water distribution network. All three were included in the model development phase of this study. The modelled area is shown in Figure 2-2.

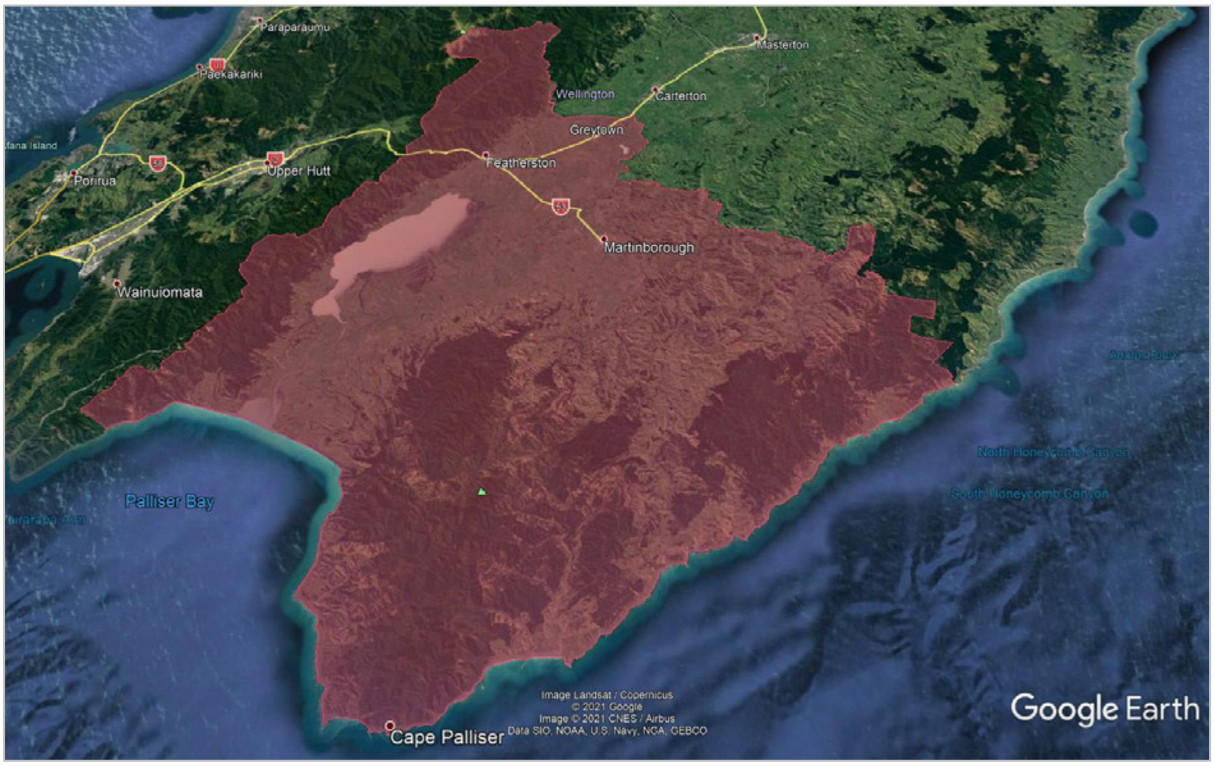


Figure 2-1: SWDC Study area

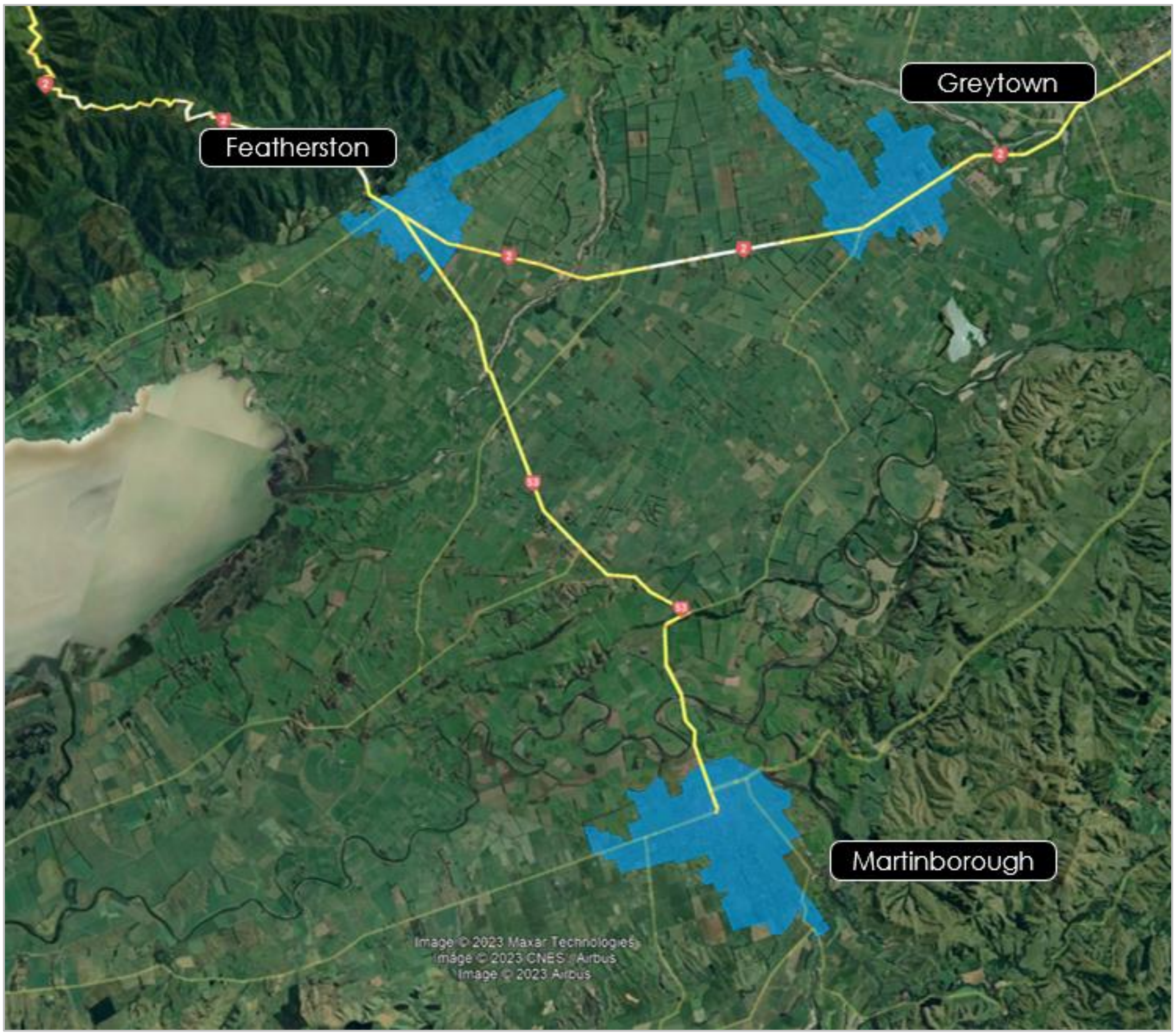


Figure 2-2: Modelled Area

There are three Water Treatment Plants (WTP) in the area: Waiohine WTP, which supplies Greytown and Featherston; Memorial Park WTP, which also supplies Greytown; and Ruamahanga WTP, which supplies Martinborough.

The Waiohine complex includes the Waiohine bores, the Waiohine water treatment plant (WTP), the Greytown Reservoir and a 8,000m^3 flexible bladder referred to as the Treated Water Reservoir (TWR). We were unable to confirm the maximum combined capacity of the consent, bores and treatment[1].

Treated water is stored in the TWR, from where it can flow through a 200mmID PE pipe and through the old pump shed towards the shared line to both the Greytown Reservoir and the Featherston Boar Bush Reservoirs.

[1] Consent states 60l/s ground water take (consent number WAR200062) (https://www.gw.govt.nz/assets/Resource-Consents/Water-restrictions/2022-23/Waiohine-River-GW-2022-2023.pdf), anecdotal evidence from Operations suggests a maximum achievable flow of 3.8MLD for the WTP. The indicated design flow is 5.2MLD (https://www.wellingtonwater.co.nz/resources/topic/drinking-water/water-treatment-plants/)

The Timber Tank has historically been used for both Greytown and Featherston but has since been taken out of service.

A network schematic is shown below in Figure 2-3.

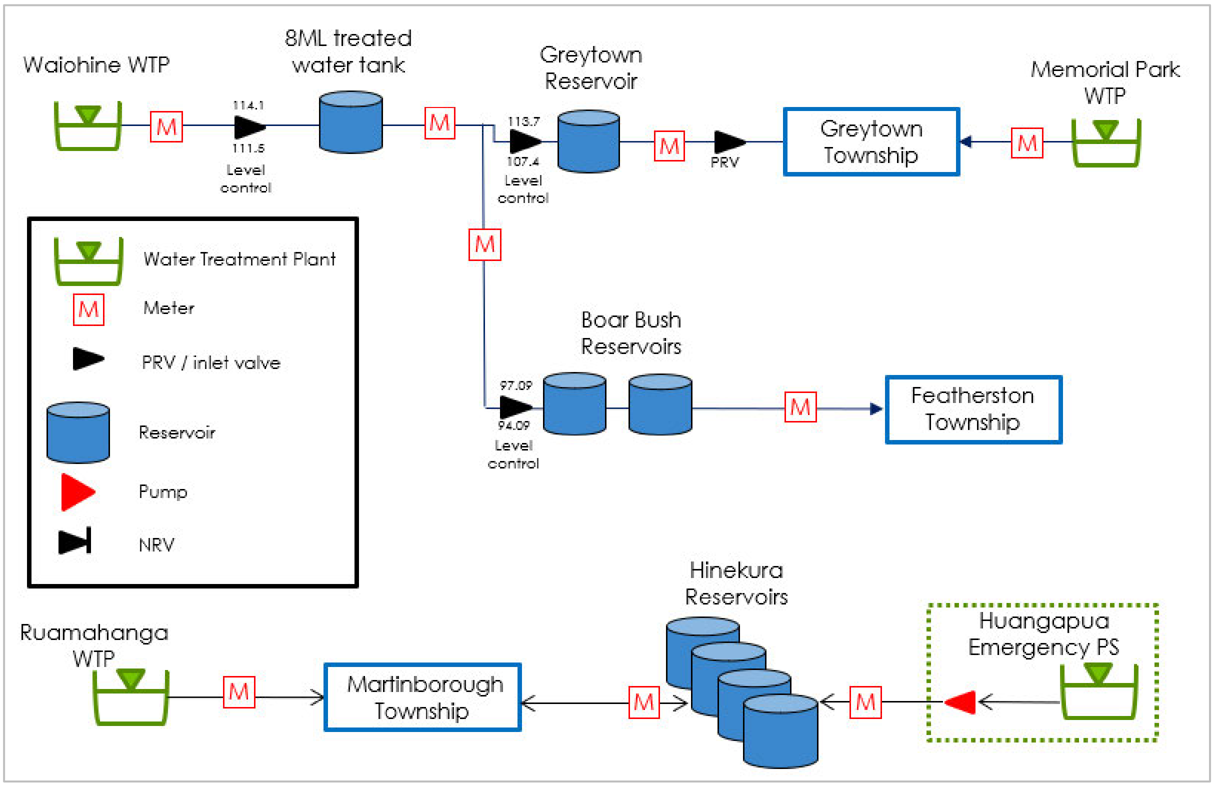


Figure 2-3 : Network Schematic

2.2 NETWORK DESCRIPTIONS

2.2.1 General

Key metrics describing the distribution network are presented in Appendix A and throughout Sections 3 and 4. Appendix B and C contains Asset Data Cards describing key network objects in detail.

2.2.2 Greytown DMA

Greytown DMA consists of approximately 1,500 properties and receives its water supply from two sources.

The Memorial Park WTP to the East of the town is supplied from an on-site bore which is then pumped directly into distribution at a fixed pressure, with a maximum supply rate of approximately 32 l/s.

Greytown is also supplied from Waiohine WTP via the Treated Water Reservoir (TWR) through to Greytown Reservoir to the West of the town. This supply gravity feeds into the DMA via Humphries Street PRV which opens when the downstream pressure drops below a set pressure, for example during high-demand periods. An overview of the Greytown DMA supply is shown in Figure 2-4.

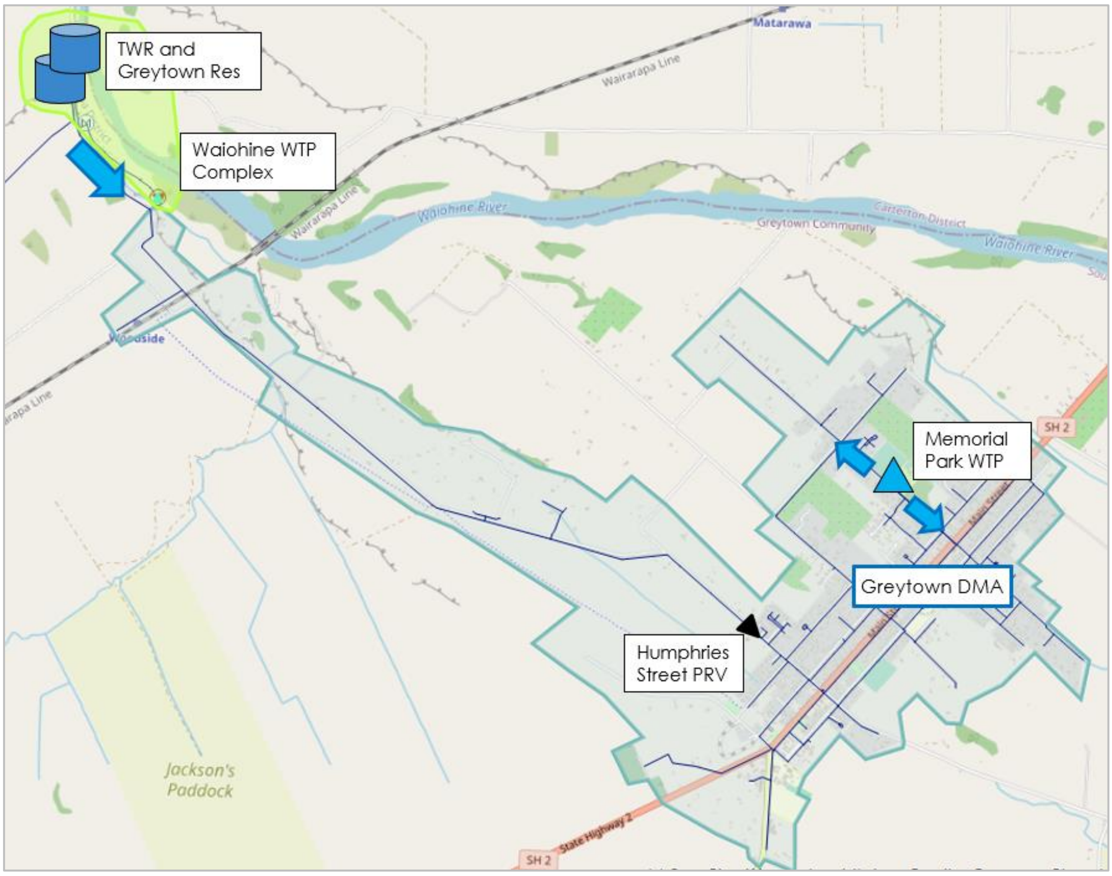


Figure 2-4: Greytown DMA Overview

2.2.3 Featherston DMA

Featherston DMA contains approximately 1,300 properties and is gravity fed from Boar Bush Reservoirs. This is in turn gravity fed from the Treated Water Reservoir which is supplied from Waiohine WTP. An overview of the Featherston DMA system is shown in Figure 2-5.

Figure 2-5: Featherston DMA Overview

2.2.4 Martinborough DMA

Martinborough DMA has a dedicated source from Ruamahanga WTP which provides supply direction into the DMA. Four Hinekura Reservoirs are located at the other end of the town and are supplied from the Ruamahanga WTP via a rising-falling main.

The reservoirs are used to provide supply during peak periods and when the pumps at the WTP are switched off. An emergency supply exists at Huangapua PS; however, this is rarely used and is considered redundant. An overview of Martinborough DMA is shown in Figure 2-6.

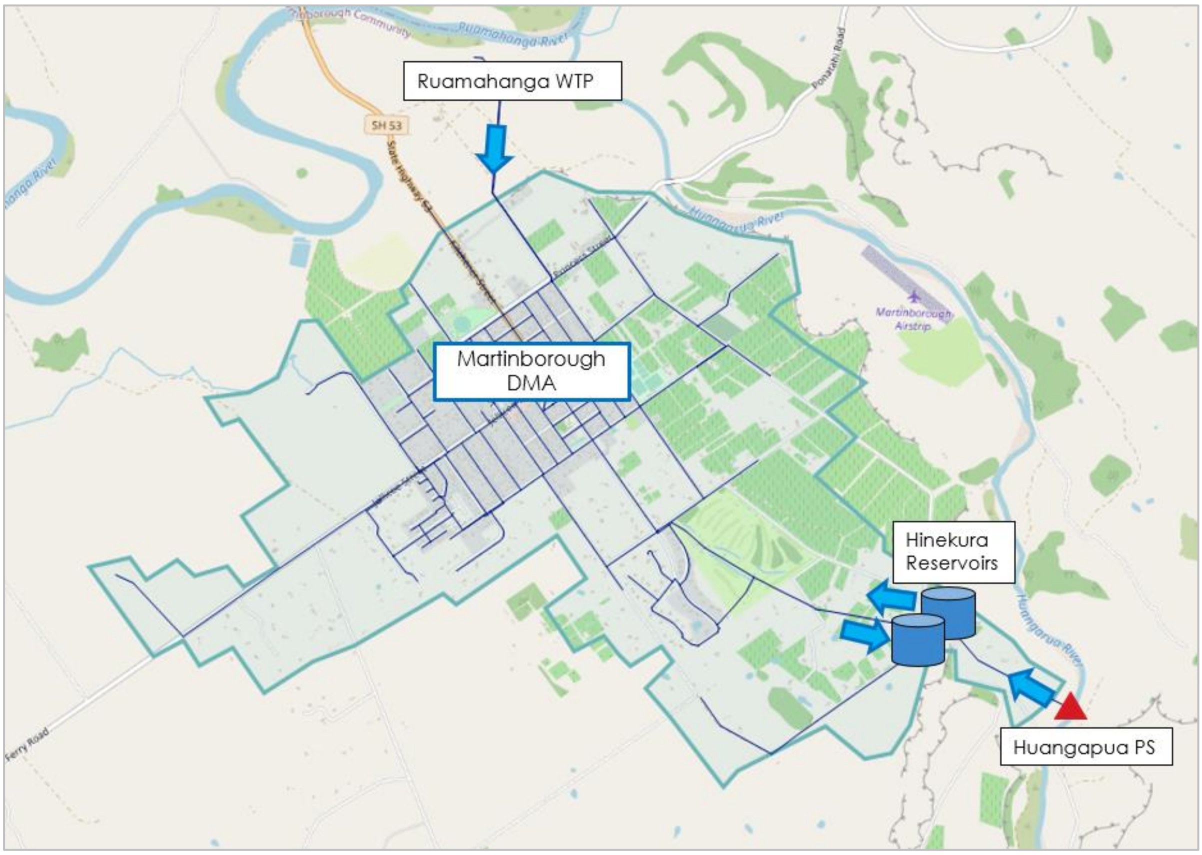


Figure 2-6: Martinborough DMA Overview

3.0 DATA SOURCES AND SUMMARY

3.1 DATA PROVIDED

3.1.1 Data Received

Wellington Water provided the following data:

- GIS layers including locations of:
  - Pipes (SWDC_Potable_Water_Pipe.shp)
  - Valves (SWDC_Potable_Water_Valve.shp)
  - Pump Stations (SWDC_Potable_Water_Pump.shp)
  - Hydrants (SWDC_Potable_Water_Hydrant.shp)
  - Reservoirs (SWDC_Potable_Water_Tank.shp)
- Customer points. (CoreLogic – 2020 dataset).
- Sample of SCADA data for flow through area meters, water levels in reservoirs and pressure at transducers where available. (16th November 2020 to 11th December 2020)
- Billing Data between 2017 and 2020 (mreadings_June_2020.xlsx)
- Network schematics dated October 2020.
- Sense Partners data dated March 2022 (Dwellings by SA2 – March 2022.xslx)

A digital ground elevation model was obtained from LINZ.

The work is carried out in accordance with the *Regional Water Model Specifications 2018 v9*.

3.1.2 Reservoirs

There are 9 active reservoirs in the modelled area (Table 3-1). The GIS file supplied by Wellington Water indicates the location of the reservoirs. The shape, capacity, top and bottom water level were sourced from the Wellington Water network schematic. As-built drawings were requested to obtain missing values, however no additional information was available at the time of the request.

All information on the TWR is based on as-built drawings and there are uncertainties around the operation of the TWR.

Waiohine N0.1 (Timber Tank Reservoir) has been taken out of service, as found during the ZMP phase.

Table 3-1 : Reservoirs

Reservoir Name	Shape	Date Installed	Capacity (m^3)	Bottom water level (m)*	Top water level (m)
Waiohine No.1 (Timber Tank Reservoir)	Cylindrical	Unknown	700	Unknown	Unknown
Waiohine No.2 (Greytown Reservoir)	Cylindrical	Unknown	750	Unknown	Unknown
Boar Bush No.1	Cylindrical	Unknown	40	Unknown	Unknown

Reservoir Name	Shape	Date Installed	Capacity (m³)	Bottom water level (m)*	Top water level (m)
Boar Bush No.2	Trapezoidal	Unknown	450	Unknown	Unknown
Hinekura No.1	Cylindrical	Unknown	860	73.8	Unknown
Hinekura No.2	Cylindrical	Unknown	860	Unknown	Unknown
Hinekura No.3	Cylindrical	Unknown	920	Unknown	Unknown
Hinekura No.4	Cylindrical	Unknown	920	Unknown	Unknown
Waiohine's treated water reservoir (TWR)	Bladder	2022	8000	111.51	114.15

*All unknown at the time of writing

3.1.3 Pump Stations

There are ten active pump stations in the SWDC network according to the GIS provided by Wellington Water. These are all associated with the raw water supply from boreholes upstream of the Water Treatment Plant. Only pump stations relevant to the network hydraulics are modelled:

- The Waiohine WTP booster pump
- The Memorial Park WTP booster pump
- The Ruamahanga WTP pump

3.1.4 Flow Meters and DMAs

The location of flow meters was determined based on network schematics. A total of 8 flow meters were identified.

The SWDC network is split into three District Metered Areas (DMAs), where all exports and imports are metered, and the net demand can be calculated. These DMAs are:

- Greytown DMA
- Featherston DMA
- Martinborough DMA

3.1.5 Closed and Control Valves

Closed valves have not been identified during model build as there is insufficient information in GIS and the Network Schematic (Wellington Water Network Plan). Closed and control valves were reviewed during the model calibration.

3.1.6 Distribution

The SWDC water supply network contains approximately 117km of mains, made up of a mixture of materials including Asbestos Cement, PVC, Cement Lined Steel and Polyethylene.

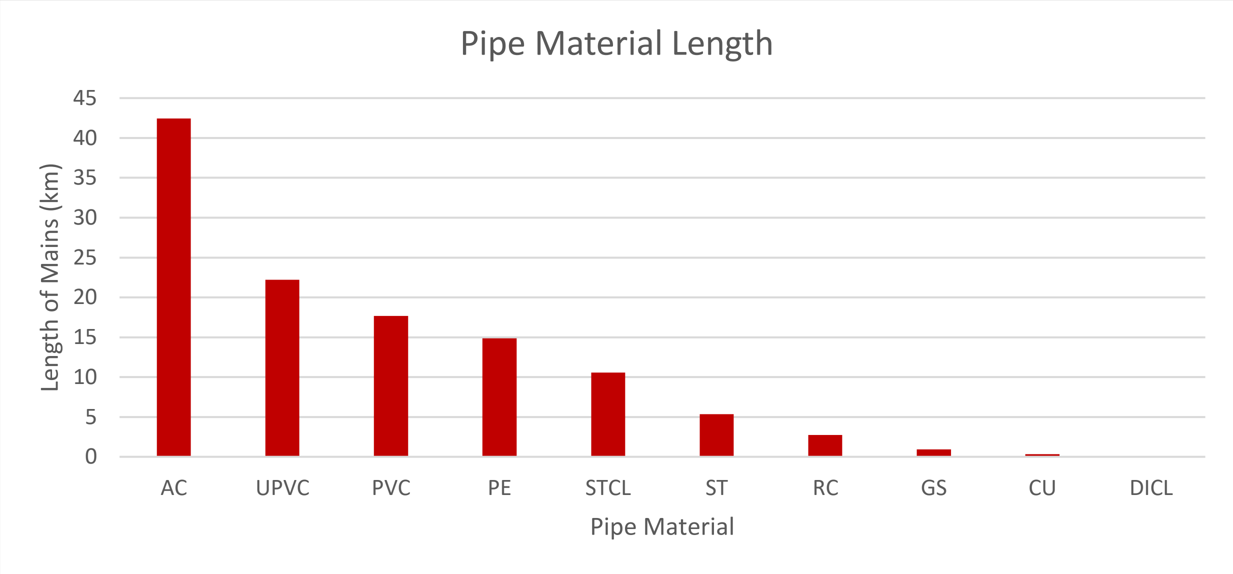


Figure 3-1: Length of Water Network Mains by Material

3.2 SCADA – PRELIMINARY DEMAND ANALYSIS

To ensure that the movement of water throughout the network was understood, flows in and out of each DMA were combined in 'function sets' to check the demand in each DMA.

- The profile of the net demand in each DMA was reviewed visually to confirm it represented a realistic portrayal of water use across the day (i.e. a smooth diurnal profile).
- The net demand in each DMA was also checked against property numbers to ensure that a realistic volume of water per property was being reported.

The DMAs and their function sets are captured in Table 3-2.

Table 3-2 : Function Sets

Direction	Tag	Description
	Greytown	
In	M043021	Memorial Park Bore Flow
in	M001014	Greytown Feed Flow
	Featherston	
in	M0046001	Boar Bush Reservoir Outflow
	Martinborough	
in	M045001	Martinborough Reservoir Outflow
out	M045002	Martinborough Reservoir Inflow
in	M040031	Martinborough Plant Outflow

Table 3-3 : Preliminary Demand Analysis Summary

DMA	No. of Residential Connections	No. of Non-Residential Connections	Avg. residential demand per res. Property (l/prop/day)	Preliminary Demand Analysis - Average Total Demand (l/s)	(m3/day)	Non-Revenue Water (m3/day)	Comment
Greytown DMA	1282	237	600	19.5	1681	910	Leakage appears to be very high. There are spikes in flow throughout the day – suspected large user in DMA which does not appear in billing data.
Featherston DMA	1190	134	N/A	N/A	N/A	N/A	Preliminary Demand Analysis could not be done for this DMA as the Featherston DMA inlet flow was not available on SCADA prior to the field test.
Martinborough DMA	1189	223	649	11.2	967	318	No issues.

*Preliminary demand analysis used data from 23-11-20.

3.3 CONTROL SETTINGS

3.3.1 Pump Controls

Some pumps have been modelled as part of the distribution network. The control settings for each modelled pump station are shown in Table 3-4.

Table 3-4: Modelled Pump Station Settings

Pump Station	Design Flow (l/s)	Design Head	Control Node	Pump Control
Waiohine WTP	22.5	40	TWR	Level Control
Ruamahanga WTP	20	20	Hinekura Reservoirs	Booster Control
Memorial Park WTP	32	40	Memorial Park Y	Booster Control

3.3.2 PRVs

There is a single PRV in the network, located near the inlet of Greytown DMA. This is set to open if the downstream pressure in Greytown drops too low.

The PRV setting was increased from 38m to 42m during the ZMP phase as an operational improvement. This was set subjectively to strike a good balance between high pressures and the number of upgrades needed.

Table 3-5: Modelled PRV Settings

PRV	Upstream Pressure (m)	Downstream Pressure (m)	Setting (m)	Comment
Humphries Street	55	38	42	Outlet setting obtained from operations and confirmed in calibration. Setting updated to 42m.

3.3.3 Reservoirs

The only control setting associated with reservoirs is the starting depth, shown in Table 3-6. The physical characteristics of the reservoirs are set out in section 3.1.2.

Table 3-6: Reservoir Initial Depth

Reservoir	Start Depth (m)
Timber Tank Reservoir	4.30
Greytown Reservoir	5.32
Boar Bush 1 Reservoir	2.82
Boar Bush 2 Reservoir	2.82
Hinekura 1 Reservoir	3.95
Hinekura 2 Reservoir	3.95
Hinekura 3 Reservoir	3.95
Hinekura 4 Reservoir	3.95
Waiohine's treated Water Reservoir (Waiohine TWR) *	2.40

*Information on the TWR is based on as-built drawings and there are uncertainties around operation of the TWR.

3.4 CUSTOMER DATA

3.4.1 Metered customers

The following information was provided regarding metered customers:

- Billing data for 4060 customers within the SWDC area across the three towns.
  - 14 customers had consumption greater than 2,500 m3/year – these were categorised as "Large Metered Customers" (LMCs)
  - Of these, 6 were prioritised for logging during the field test – with at least one LMC logged per DMA.
  - During the field test, only four could be logged.

3.4.2 Customer Points

3.4.2.1 Summary

Customer point locations and demand assignments were based on the 'Corelogic' data set for residential customers and the 'water users swdc_v01' meters shapefile, both supplied by Wellington Water.

In the 'Corelogic' data set, there are:

- 3,656 customer points have been identified as residential properties.
- 607 customer points have been identified as non-residential properties.
- 607 + 3,656 = 4,263 total customer points in the SWDC network
- 14 customer points were identified as LMCs. Only four of these could be logged during the field test and were assigned with demands and patterns as set out in section 4.3. The remainder were treated as small metered customers.

3.4.2.2 Assigning metered demand to Large Metered Customers (LMCs)

There are 14 metered users in the SWDC water network area with water demand greater than 2,500 m^3/year. Four of these customers were logged during the field test which have been set up with their own demand categories in the model. These are presented in Table 3-7, with the LMCs included in the model highlighted.

Table 3-7: Large Users

Name	Address	Customer	m3/year	Meter ID	DMA	Comment
LMC01	29-31 Main Street, Greytown	Arbor Motels	13,584	1510017	Greytown	Logged – included in model
LMC02	109 Main Street, Greytown		4,306	8SEN0130156740	Greytown	Not logged
LMC03	15 Main Street, Greytown		3,203	1525127	Greytown	Not logged
LMC04	1-3 Reading Street, Greytown		3,085	080107	Greytown	Not logged
LMC05	6 Wakelin Street, Greytown	Kuranui College	2,681	A2296	Greytown	Not logged
LMC07	12 Main Street, Greytown		2,676	1523790	Greytown	Not logged
LMC11	132 Main Street, Greytown		2,616	1525303	Greytown	Logged – included in model
LMC08	109 Brandon Street, Featherston		2,537	1530483	Featherston	Not logged
LMC09	284 Lake Ferry Road, Martinborough		3,726	1510015	Martinborough	Not logged
LMC10	23 Huangarua Road, Martinborough		3,427	1534007506	Martinborough	Not logged
LMC06	108 Ferry Road, Martinborough		3,300	157024	Martinborough	Logged – included in model
LMC12	277 Lake Ferry Road, Martinborough		3,189	1561589	Martinborough	Logged – included in model
LMC13	Kitchener Street, Martinborough		2,920	090512027	Martinborough	Not logged
LMC14	90 Purutanga Road, Martinborough	Dry River Wines	2,551	10130156736	Martinborough	Not logged

3.4.2.3 Assigning smaller metered demand to customer points

As most metered customers cannot be linked to a non-residential demand pattern, smaller metered customers were assigned a Domestic Equivalent pattern in the model.

3.4.2.4 Assigning unmetered residential demand to customer points

All customer points with no metered demand allocated were assumed to be unmetered residential properties. The residential demand calculated through the demand analysis was split evenly across all residential customer points within each DMA.

3.5 INITIAL DATA ASSESSMENT SUMMARY

The asset and demand information available at this stage was NOT sufficient for the purpose of developing a hydraulic model for the Zone Management Plan. Featherston DMA flow data needed to be captured during the field test and was not available on SCADA.

Wellington Water decided that the calibration field test should proceed and that a temporary flow meter should be attached to the Boar Bush Reservoir outlet main to measure the Featherston DMA inlet flow; however, during the field test, Wellington Water confirmed that the existing meter was still functional and was connected to SCADA by Wellington Water. Data from this meter was eventually available for calibration.

4.0 MODEL BUILD (ZMP PHASE 1)

This section covers aspects relating to the development of the model **SWDC WS BASE01** using InfoWorks WS Pro 4.5.1.

4.1 GIS DATA IMPORT

GIS data received from Wellington Water in December 2020 was edited based on the Wellington Water Network Plan updated in February 2018 with respect to pipe connectivity, valve status, additional meters, abandoned network, private network etc. The modelled network was initially based on the December 2020 GIS, with updates based on the Wellington Water network plan (2018) as they capture better information on network connectivity.

4.1.1 Pipes

The main source of information for the pipe network is the GIS layer "SWDC_Potable_Water_Pipe"

Table 4-1: Pipes Field Mapping

WLL Water Network Pipes	Field in IW
Asset ID	Asset ID
Date_Insta	Year
Material	Material
Diameter_m	UN01 – Nominal Diameter
DMA_Zone	UT01_DMA

The "Diameter" field in the model was updated as internal diameter of pipes based on the nominal diameter and pipe material using Appendix B: Pipe Internal Diameters table from WWL's Regional Water Model Specifications 2018 v9.

Pipes equivalent sand roughness Ks was assumed based on pipe material and year built using the Table 4-3 from the WWL's Regional Water Model Specifications 2018 v9. InfoWorks WS Pro 4.5 model was set to use the Colebrook White method for calculating head losses.

Note: as outlined in sections 4.2.1 and 4.2.2 pipes were split in the model by hydrants and valves. This means there are multiple modelled pipes with the same Asset ID. This has no effect on model performance.

4.1.2 Nodes

Nodes were created automatically within InfoWorks and named based on the asset ID of the associated link.

The node elevations were updated using the 1m DEM LIDAR data from the Land Information New Zealand (LINZ) service (lds-wellington-lidar-1m-2013-2014).

Checks were made to ensure all pipes and nodes were topologically correct.

Table 4-2: Nodes Field Mapping

WLL Water Network Nodes	Field in IW	Note
Asset_id	Asset ID	
node_id	Node_ID	
elevation	Elevation	Obtained from LINZ LiDAR data

4.2 ANCILLARY STRUCTURES

4.2.1 Hydrants

Hydrants were imported from the "SWDC_Potable_Water_Hydrant" shapefile. These nodes float in GIS, i.e. they are not connected to the network. These were connected into the model by splitting pipes in two at hydrant locations and attaching both pipes to the hydrants.

Table 4-3: Hydrants Field Mapping

WLL Water Network Nodes	Field in IW	Note
Asset_id	Asset ID	
node_id	Node_ID	
elevation	Elevation	Obtained from LINZ LiDAR
area_code	Area Code	

Additional parameters required for modelling were set as follows:

- Hydrant diameters were not stated in the GIS database, so all hydrants were modelled with a diameter and valve diameter of 80mm.
- Valve types were set to GATE.
- A local loss coefficient of 3.5 was applied to all modelled hydrants.

4.2.2 Valves

Valves were imported from the "SWDC_Potable_Water_Valves" shapefile. Only the valves within the distribution network were imported.

Valves are point features but are modelled as links in InfoWorks Pro which undertakes that conversion and creates two-point features with the same coordinates. The modelled valve in-between the points initially had no length and a random direction. Valves were expanded using the 'expand short links' tool in InfoWorks to a minimum of 0.5m or changed manually where necessary. The orientation of control valves was reviewed manually and corrected where necessary. Valve curves were set to GATE, except PRV's which were set to PLUG.

A total of 545 valves were imported in the model, including 1 PRV.

Table 4-4: Valves Field Mapping

WLL Water Network Valves	Field in IW
Asset_id	Asset ID
Diameter	Diameter (mm)

4.2.3 Pump Stations

Table 4-5 shows the pump stations which were imported into the model from the GIS layer "SWDC_Potable_Water_Pump".

Table 4-5: Pump Stations imported from GIS

Pump Name	Asset ID	Make	Comment
Waiohine WTP PS 1	NEWF00854	Unknown	Not used in calibration (modelled as fixed flow)
Waiohine WTP PS 2	NEWF00855	Unknown	
Waiohine WTP PS 3	NEWF00865	Unknown	
Waiohine WTP PS 4	NEWF00869	Unknown	
Waiohine WTP PS 5	NEWF00876	Unknown	
Ruamahanga PS 1	NEWF00890	Lowara	Not used in calibration (modelled as fixed flow)
Ruamahanga PS 2	NEWF00891	Goulds	
Ruamahanga PS 3	NEWF00768	Goulds	
Ruamahanga PS 4	NEWF00895	Unknown	
Huangarua PS	NEWF00909	Pulsometer	Not modelled – not operational
Memorial Park WTP PS	Unknown	Unknown	Not in GIS layer – manually added. Not used in calibration (modelled as fixed head)

4.2.4 Reservoirs

The SWDC water network contains 9 reservoirs. The settings used in the model are set out below in Table 4-6.

Table 4-6: Modelled Reservoir Settings

Reservoir Name	Shape	Capacity (m^3)	Bottom water level (m)	Top water level (m)	Level Control	Comment
Timber Tank Reservoir	Cylindrical	700	112.65	118.65	Waiohine WTP On/Off	As of 2023 Timber Tank has been taken out of service
Greytown Reservoir	Cylindrical	750	107.20	113.2	Float Valve On/Off	Control Depth - 6.27m Regulating Range - 1.09m
TWR	Bladder	8000	111.51	114.15	Unknown	Information on the TWR is based on as-built drawings and there are uncertainties around operation of the TWR.
Boar Bush No.1	Cylindrical	40	94.09	97.09	N/A	Bypassed in the model for the purpose of calibration. Will be corrected for working model.
Boar Bush No.2	Trapezoidal	450	94.09	97.09	Float Valve On/Off	Control Depth - 2.84m Regulating Range - 0.53m
Hinekura No.1	Cylindrical	3560	67.07	71.57	Ruamahanga WTP On/Off	Reservoir volumes combined and WWL operations confirmed that these are hydraulically linked and operate as a single unit. All pipework and reservoir objects were kept in model with closed inlet/outlet pipes.
Hinekura No.2	Cylindrical					
Hinekura No.3	Cylindrical					
Hinekura No.4	Cylindrical					

4.3 DEMAND

4.3.1 Non-Residential Demand

Non-residential customer points were identified from the CoreLogic data set. The demand for these customers was assigned by connecting customer points to the billing data by matching addresses. A Domestic Equivalent pattern was used for commercial customers not logged during the field test.

4.3.2 DMA Allocation

Once the customer points had been imported into the model, the nearest model pipe and nearest model junction were identified. The property counts are shown in Table 4-7.

Table 4-7: Customer Points by DMA

DMA	No. of Residential Connections	No. of Non-Residential Connections	Total
Greytown DMA	1,278	243	1,521
Featherston Trunk	15	4	19
Featherston DMA	1,175	130	1,305
Martinborough DMA	1,188	230	1,418
Total	3,656	607	4,263

4.3.2.1 Featherston Trunk Zone

A new zone was created between Timber Tank Reservoir and Boar Bush Reservoir. As demand along this main is unmetered and assumed to be negligible in comparison to the measured Featherston Feed Flow, specific consumption and leakage values were the same as Featherston DMA. These customers (19 in total) were not included in the demand analysis for Featherston DMA as these customers are upstream of the reservoir, and therefore the flow meter.

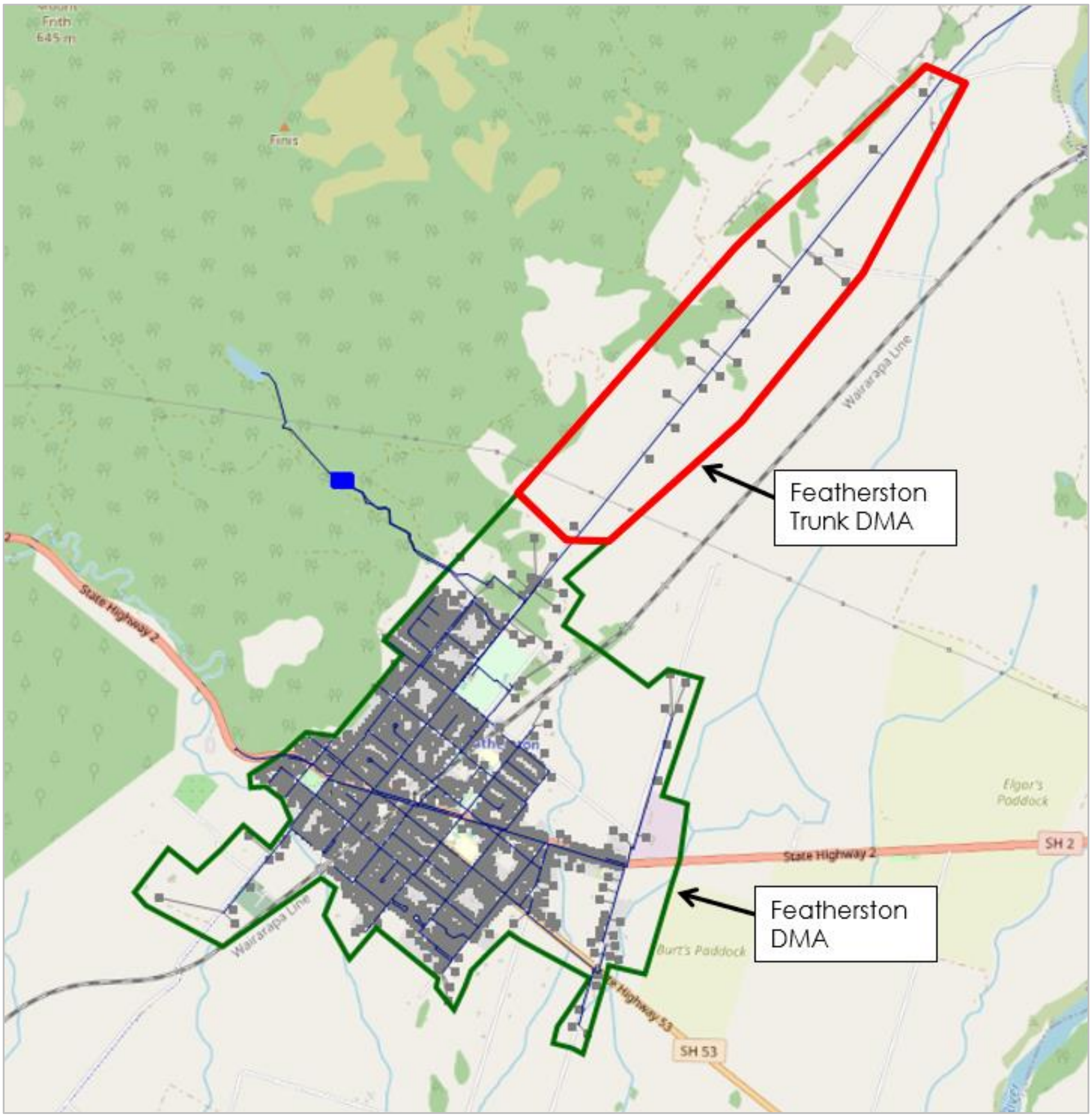


Figure 4-1: Featherston Trunk DMA

4.3.3 Residential and Water Loss Demand Derivation

As per the Specification, leakage was considered to be the minimum night flow minus legitimate night use (LNU), which was assumed to be 2 l/hour/connection[2]. Small metered customers are treated as residential customers. The residual demand is equal to the total flow balance after leakage and LMC usage is removed.

Once water loss at the time of minimum night flow is determined, the standard pattern set out in the Specifications is used to define how water loss is spread throughout the day, and to derive a value for daily total water loss in the DMA.

Water loss is then assigned directly to nodes and hydrants under the Leakage demand category.

[2] 2.7 l/hour/connection on average was found in the Greytown Smart Water Meter Trial Final Report

Water loss is spread across nodes and hydrants proportionally to the number of properties assigned to them.

Details of Demand Analyses used prior to Calibration are shown in Section 3.2.

4.4 NETWORK VERIFICATION AND MODEL RUN TEST

4.4.1 DMA Boundary Trace

Following the network import and data cleaning, the "boundary trace" function of InfoWorks was used to trace PMAs and DMAs, as a means to check/confirm connectivity. Anomalies were resolved by reviewing network schematics.

4.4.2 Model Run Configuration

The following run settings were adopted:

- Time step was set to 5 minutes.
- Run time was set to one day
- Computational accuracy was changed from the default of 1 l/s to 0.1 l/s.
- Maximum iterations per timestep was changed to 199.
- Calculations are undertaken at the start of the time step.

Demand patterns created during the preliminary demand analysis were used for Greytown DMA and Martinborough DMA, along with figures for demand and leakage. A standard demand pattern and usage was applied to customers in Featherston DMA.

A fixed head was set near each WTP outlet as a boundary condition, with float valves set on reservoir inlets to prevent them from overfilling.

4.4.3 Model Run Test Evaluation

Key model information, such as reservoir depths or float valve settings etc. was not available. A model run test was performed with assumed values which will be corrected when these are confirmed.

The results of the Model Run Test displayed a pressure range of between 15 m and 55 m for most customers in the network. The exceptions were customers at high elevations and nearby reservoir outlets. Reservoirs were found to replenish without overflowing or draining completely.

This confirmed the model was ready to be calibrated from field test data.

4.5 MODEL BUILD INTERIM CONCLUSIONS

At this stage in the model build there were several unknowns which could impact on the quality of the eventual model for the SWDC area.

Prior to the field test, the inlet flow to Featherston DMA (Boar Bush Reservoir Outlet Flow) was unavailable on SCADA. This was intended to be logged during the field test as this is highly critical to understanding demand in this area. However, the existing meter was found to be working and was connected to SCADA. Data from this flow meter was available for the calibration field test period.

In the model the characteristics of the reservoirs are largely unknown and are based on assumptions. This is due to information which was not in GIS provided by Wellington Water. These values were derived from aerial views and is expected to have a medium impact on the final model.

Spikes in the flow profile of Greytown DMA indicate an LMC which draws a high volume of flow over a short period of time. This was not identified during the calibration field test period and appears to have been resolved.

Inlet flows for the reservoirs at Waiohine WTP (Timber Tank Reservoir and Greytown Reservoir) do not have individual inlet flow meters available on SCADA. These would be useful to verify control settings in the model but are not critical for the model build and calibration. These flows were not included in the model at this stage, although it was eventually assessed in more detail.

5.0 MODEL CALIBRATION (ZMP PHASE 2)

This section relates to the calibration of the model based on the outputs of the calibration field test carried out in March 2021.

A Calibration Model was produced and is contained in a separate model group **SWDC WS MOP02**.

5.1 PERFORMANCE CRITERIA

The target criteria for calibration are outlined in the Regional Water Model Specification as follows:

A flow point is considered calibrated if, at 100% of time steps, the modelled flow is:

- Within +/- 5% of the measured flow if this is greater than 2l/s.
- Less than 2 l/s if the measured flow is less than 2l/s.

A pressure point is considered calibrated if:

- At 85% of time steps, the modelled pressure is within +/- 1m of the measured pressure.
- At 95% of time steps, the modelled pressure is within +/- 2m of the measured pressure.

A level point (reservoir) is considered calibrated if, at 95% of time steps, the modelled pressure is within +/- 0.2m of the measured pressure.

For flow testing at hydrants, the modelled difference between static and residual pressure should be:

- Within +-/ 2m of the pressure drop observed in the field if the latter is 0-15m.
- Within +/- 5m of the pressure drop observed in the field if the latter is 15-100m.

5.2 CALIBRATION APPROACH

5.2.1 Calibration Day Selection

Calibration day was selected based on the quality of data available in each supply zone. The calibration day selected for each zone was:

- **Greytown DMA – Thursday 18th March 2021**
- **Featherston DMA – Thursday 18th March 2021**
- **Martinborough DMA – Monday 22nd March 2021**

Weekends were not included in the selection process: the calibration diurnal profile will be in the working model and it is preferrable to have a typical day profile.

In addition, Hydrant Flow Tests (HFTs – Section 5.2.4) were carried out in all three DMAs on the 30th March 2021.

5.2.2 Calibration Day Demand Analysis

Demand analysis was carried out for all DMAs using SCADA from the field test period. The process followed was the same as for the Preliminary Demand Analysis, outlined in Section 3.2.

Refer to Appendix D for the final Calibration Day demand analyses for all DMAs.

5.2.2.1 Flow Data Interpolation

The SCADA provided for all flow series was found to have time steps without any recorded data. It was evident from the DMA demand balance that this did not represent a zero-value in reality. In order to make sense of these gaps, a linear interpolation between data points was done to ensure each time step had a value.

These modified flow series provided a noticeably more realistic demand derivation

5.2.2.2 Boar Bush Reservoir Outlet Meter (Featherston DMA Inlet)

Prior to the field test, it was identified that Boar Bush Reservoir Outlet Flow meter was not being recorded on SCADA due to a lightning strike. During the deployment stage of the field test, it was confirmed that the meter was operational and was connected to SCADA.

5.2.3 Pressure Calibration Approach

A new 'calibration day' scenario was set up in the model group. The derived demand patterns and daily consumptions were applied in the model and the initial reservoir level was set based on the SCADA level at midnight on calibration day.

Initially, flows at the inlets and outlets to each DMA were fixed to match the calibration day field test data. This is to ensure that water flows across the network as close to flows on the actual day as possible. The model simulated predictions for pressure were then compared to field measurements from the pressure loggers deployed on hydrants.

The theory is that if flow in the network is identical to calibration day, and the reservoirs start at the same levels, then the calculated head losses in the model should be a close match for reality and pressures at hydrants should be the same. Where significant differences are identified between pressures in the model and the field, these can only be explained by the differences between the modelled network and the actual network.

These anomalies can generally be addressed by the following actions (in order of preference):

1. Changes to pump controls or control valve settings.
2. Opening or closing line valves, including throttling of valves where required.
3. Adjustment of pipe roughness values. Where changes are made, they are carried out on a network wide basis, i.e. the roughness of a single AC main should not be changed unless the roughness of all AC mains is changed.
4. Changes to pipe diameters.

Once all anomalies within DMAs were addressed, the DMAs were re-connected and the flows in and out of the DMAs were "unfixed", i.e. set to respond to hydraulic conditions rather than fixed to reflect measured data.

5.2.4 Hydrant Flow Test Calibration Approach

Hydrant flow tests (HFTs) were undertaken during the field test to put additional load on the network.

This step often results in identification of anomalies which are not apparent in normal operation due to low flows in some parts of the network.

The HFTs were undertaken over a period of 5 minutes by the field test crew, who recorded the time of testing and the flow taken from the network each minute of the 5-minute test. HFTs were undertaken close to points where loggers were installed on the network for the field test.

To calibrate against the HFTs, the recorded flows were then simulated in the model by adding an "exceptional flow profile" control at the HFT location and at the correct time. The drops in pressure observed from field data at nearby pressure loggers were then compared to the modelled drops in pressure at the same points.

Where there were significant differences, changes were made to the network configuration to achieve a better match.

5.3 CALIBRATION FINDINGS – OVERVIEW

This section provides an overview of the calibration and a summary of the status of the resulting model.

5.3.1 DMA Summary

The calibration was successful in all DMAs, with some limitations in Featherston Table 5-1 below contains details of the calibration status of each DMA.

Table 5-1: Calibration Summary – DMAs

DMA	Model Reliability and General Comments
Greytown DMA	**Calibration anomaly. Possible explanation disproved through field checks. Not currently explained. No significant impact on performance.**
Featherston DMA	**Calibration anomaly. Possible proposed explanation confirmed through field checks.**
Martinborough DMA	**Reliable network hydraulics.**

Some reservoir dimensions were assumed due to lack of information included in the GIS layer, and from other sources such as network schematics. Reservoir volumes were available, but all reservoir diameters were inferred from aerial views on Google Earth. This was then used to calculate reservoir depths.

5.3.2 Site-by-site Summary

Table 5-2 presents an overview of the calibration pressure logging sites, and their status against the performance criteria outlined in section 5.1 following calibration actions. Table 5-3 presents the same for flow, and Table 5-4 for reservoir level.

Table 5-5 contains the details of the HFT calibration.

Appendix E contains the individual calibration plots of field vs calibrated model data for each of the flow, pressure, and reservoir level sites.

Table 5-2: Summary of Calibration Findings - Pressures

Ref	AssetID	Model ID	Offset (INPUT)	DMA	% timesteps within criteria #1	Pass/fail	% timesteps within criteria #2	Pass/fail	Comments
P01	SWDC_PW009616 (P01)	P01		Greytown DMA	100%	PASS	100%	PASS	Within criteria
P02	SWDC_PW009600 (P02)	P02		Greytown DMA	100%	PASS	100%	PASS	Within criteria
P03	SWDC_PW009646 (P03)	P03		Greytown DMA	93%	PASS	100%	PASS	Within criteria
P04	SWDC_PW009623 (P04)	P04		Greytown DMA	92%	PASS	100%	PASS	Within criteria
P05	SWDC_PW009123 (P05)	P05	0.6	Greytown DMA	90%	PASS	100%	PASS	Possible error from LINZ elevations
P06	SWDC_PW009486 (P06)	P06		Greytown DMA	100%	PASS	100%	PASS	Within criteria
P07	SWDC_PW009773 (P07)	P07		Featherston DMA	100%	PASS	100%	PASS	Within criteria
P08	SWDC_PW009421 (P08)	P08		Featherston DMA	90%	PASS	98%	PASS	Within criteria
P09	SWDC_PW009320 (P09)	P09		Featherston DMA	99%	PASS	100%	PASS	Within criteria
P10	SWDC_PW009337 (P10)	P10		Featherston DMA	98%	PASS	100%	PASS	Within criteria
P11	SWDC_PW009662 (P11)	P11		Featherston DMA	100%	PASS	100%	PASS	Within criteria
P12	SWDC_PW009325 (P12)	P12		Featherston DMA	98%	PASS	100%	PASS	Within criteria
P13	SWDC_PW009282 (P13)	P13		Martinborough DMA	100%	PASS	100%	PASS	Within criteria
P14	SWDC_PW009140 (P14)	P14		Martinborough DMA	100%	PASS	100%	PASS	Within criteria
P15	SWDC_PW009265 (P15)	P15		Martinborough DMA	100%	PASS	100%	PASS	Within criteria
P16	SWDC_PW009191 (P16)	P16		Martinborough DMA	100%	PASS	100%	PASS	Within criteria
P17	SWDC_PW009276 (P17)	P17		Martinborough DMA	100%	PASS	100%	PASS	Within criteria
P18	SWDC_PW009299 (P18)	P18		Martinborough DMA	100%	PASS	100%	PASS	Within criteria
P19	SWDC_PW009297 (P19)	P19		Martinborough DMA	100%	PASS	100%	PASS	Within criteria
P20	SWDC_PWP001852 (P20	P20	1	Waiohine WSZ	90%	PASS	92%	FAIL	Spikes due to pump not replicated in model. Uncertainty in elevation from LINZ

Table 5-3: Summary of Calibration Findings - Flows

Ref	Description	% timesteps within criteria	Pass/fail	Comments
F01	Waiohine WTP Outlet Flow	N/A	N/A	Flow set for calibration
F02	Greytown Reservoir Outlet Flow	100%	PASS	Good match – low flow out of reservoir
F03	Memorial Park WTP Outlet Flow	100%	PASS	Good match
F04	Featherston Feed Flow	82%	FAIL	Meter possibly under reading – factored up by 8%. Downstream reservoir achieves good match with this flow.
F05	Boar Bush Reservoir Outlet Flow (Featherston DMA Inlet Flow)	100%	PASS	Perfect match
F06	Ruamahanga WTP Outlet Flow	N/A	N/A	Flow set for calibration
F07	Hinekura Reservoirs Inlet Flow	75%	FAIL	Directional meter – good match. Actual Pass
F08	Hinekura Reservoirs Outlet Flow	52%	FAIL	Directional meter – good match. Actual Pass

Table 5-4: Summary of Calibration Findings - Water Level

Reference	% Criteria1	Pass/Fail	Comments
Timber Tank Reservoir	85%	FAIL	Poor match could be due to low confidence in reservoir dimensions or meter accuracy
Greytown Reservoir	97%	PASS	Good match
Boar Bush Reservoir (1&2 combined)	100%	PASS	Good match
Hinekura Reservoir (1-4 combined)	100%	PASS	Good match

Table 5-5: Hydrant Flow Test Result Comparison

Site ID	Actual Hydrant Flow Test Location	Affected	Comments	Result	Field Checks
HFT-01	142 Kuratawhiti Street, Greytown	Greytown DMA – P01, P04, P06	Hydrant Flow Test period extended to allow PRV to open P01 good match P04 good match P06 good match	PASS	FC01 – check valves on Memorial Park WTP outlet main for restriction
HFT-02	51 McMaster Street, Greytown				
HFT-03	4 North Street, Greytown				
HFT-04	11 Boundary Road, Featherston	Featherston DMA – P09, P10, P12	Anomalies remain unresolved – a good match was obtained by closing a different set of valves compared to calibration day. This confirms multiple closed valves/restrictions existing in Featherston DMA.	FAIL	FC02 – check valves within Featherston DMA
HFT-05	73 Bell Street, Featherston				
HFT-06	29 Moore Street, Featherston				
HFT-07	16 Fairway Drive, Martinborough	Martinborough DMA – P19, P13, P16	Good match for all logged points	PASS	No anomalies identified
HFT-08	13 Hawkins Drive, Martinborough				
HFT-09	2 Grey Street, Martinborough				

5.4 CALIBRATION FINDINGS – ANOMALIES AND RESOLUTION

5.4.1 Pipe Roughness

The roughness value of pipes in the model with GIS material 'RC' was initially causing too much headloss in the Hydrant Flow Test run. 'RC' or reinforced concrete is not usually a material associated with potable water mains and was initially assumed to be a GIS error. It was later confirmed that this material is genuine. However, when a value of k=0.5 was used for these mains, better calibration results were achieved.

5.4.2 Featherston Trunk Main Valves

Several valves along the 300mm trunk main connecting Timber Tank Reservoir and Boar Bush Reservoir have a diameter of '50' in the GIS layer which was then imported into the model. In the calibration, these diameters caused too much head loss to fill Boar Bush Reservoir and therefore assumed to be a GIS error. The diameters of these valves were changed to 300mm, which is the same diameter of other valves on this trunk main, as well as the surrounding pipework. The valves with changed diameters are shown below in Figure 5-1.

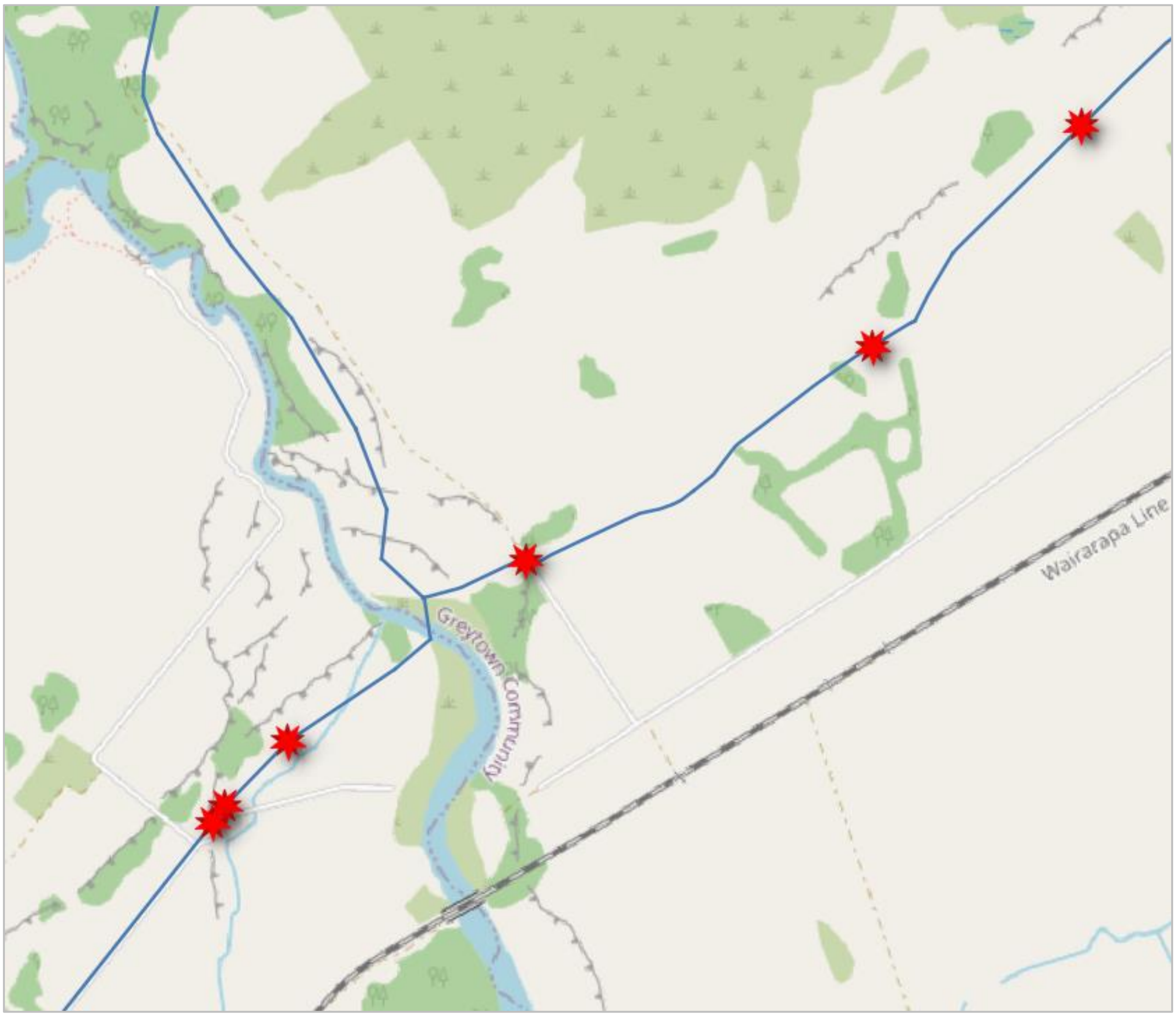


Figure 5-1: Featherston Trunk Main valves with corrected diameters

5.4.3 Waiohine WTP

5.4.3.1 Pressure Tapping

The flow from Waiohine WTP was modelled as a fixed flow upstream of Timber Tank Reservoir. The logged pressure points on this main achieved a fair match, however the spikes observed in the field were not replicated in model. It is suspected these pressure spikes are a result of the pumps switching on/off and or float valves actuating. This is shown in Figure 5-2.

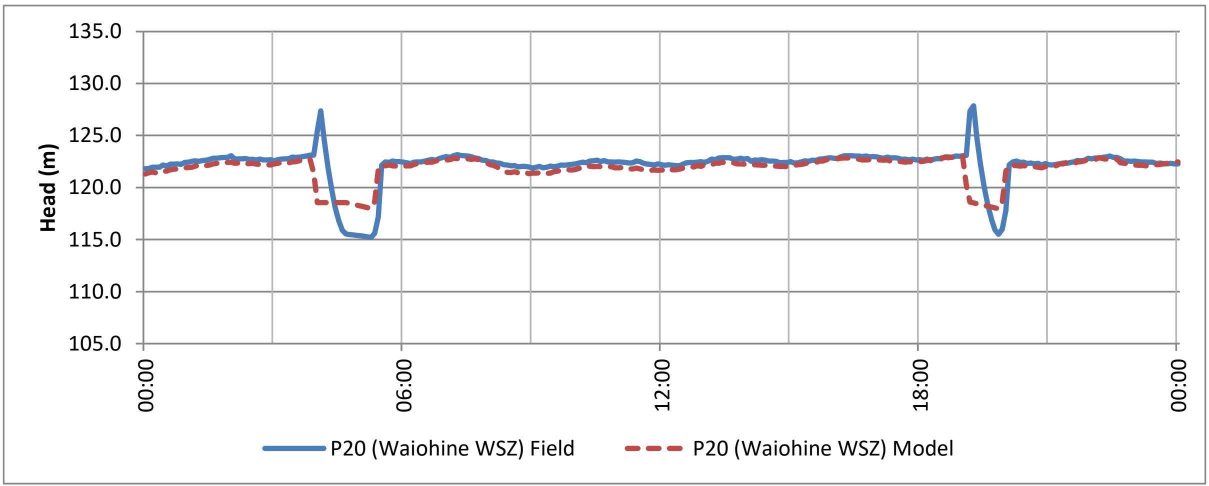


Figure 5-2: P20 - Modelled/Field pressure comparison

This spike in pressure could indicate that pressure surges are present downstream of the bores. It should be noted that the actual pressure spike is likely to be greater than that captured in 5-minute timesteps in the pressure logger. It is recommended that this is investigated further.

5.4.3.2 Anomaly Flow Balance

To achieve a tank level calibration at Timber Tank Reservoir, the Waiohine WTP Outlet flow was reduced by 12%. Possible explanations include a leak from the reservoir, or an under-recording meter on the reservoir outflow. In the calibration model, Featherston Feed Flow was increased by 8% which resulted in a good level calibration for Timber Tank Reservoir and the downstream Boar Bush Reservoir.

It is recommended that these meters are checked to ensure they are recording flow accurately.

5.4.4 Greytown DMA

5.4.4.1 Anomaly - Throttled Valve (Unresolved)

The model initially under-predicted headloss across logged points downstream of Humphries Street PRV (Figure 5-3), by approximately 2m as shown in Figure 5-4.

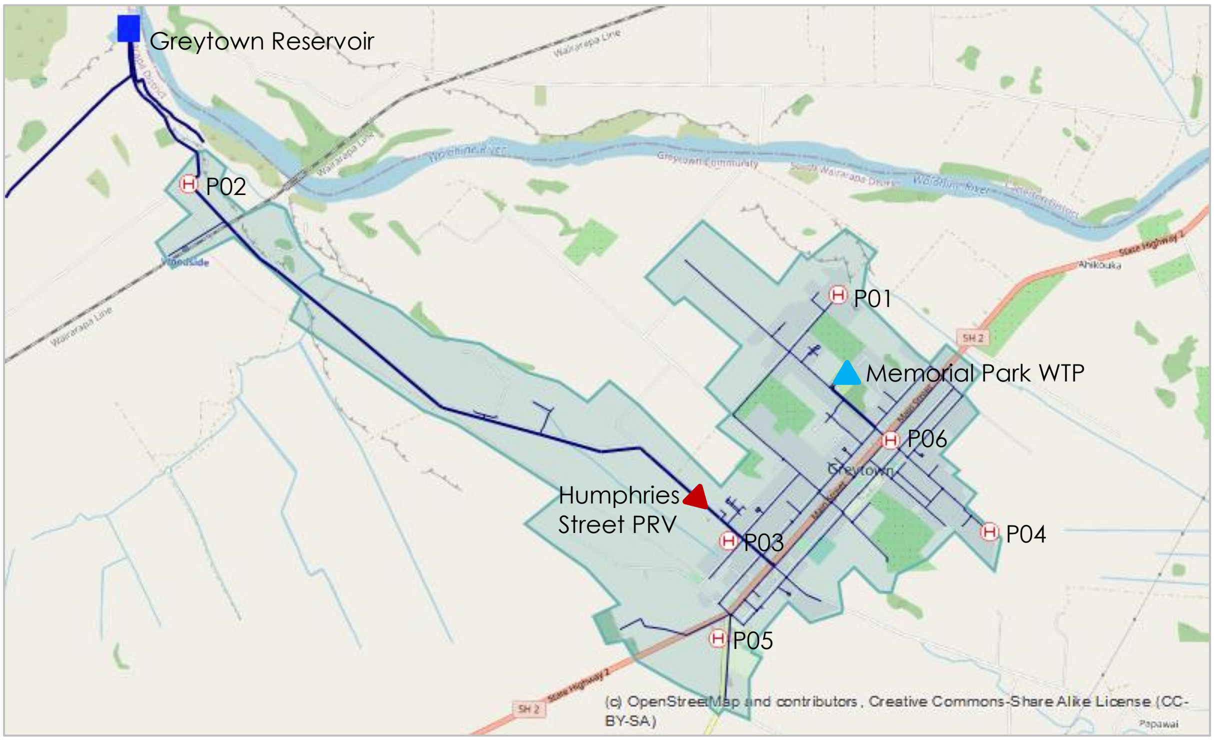


Figure 5-3: Greytown DMA Logger Locations

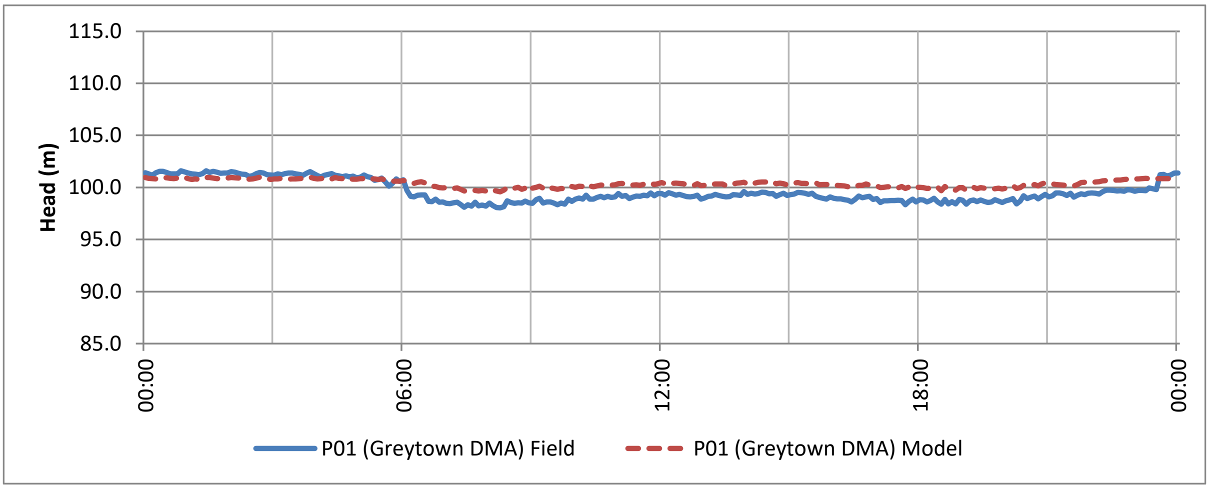


Figure 5-4: P01 - Modelled/Field Pressure before calibration

As the headloss appeared to remain consistent across all logged points in the pressure zone, this suggests a single point restriction as the source of this headloss.

We throttled the modelled valve, nearby the outlet of Memorial Park WTP (Figure 5-5) to 30% open. This provided a better calibration (Figure 5-6).

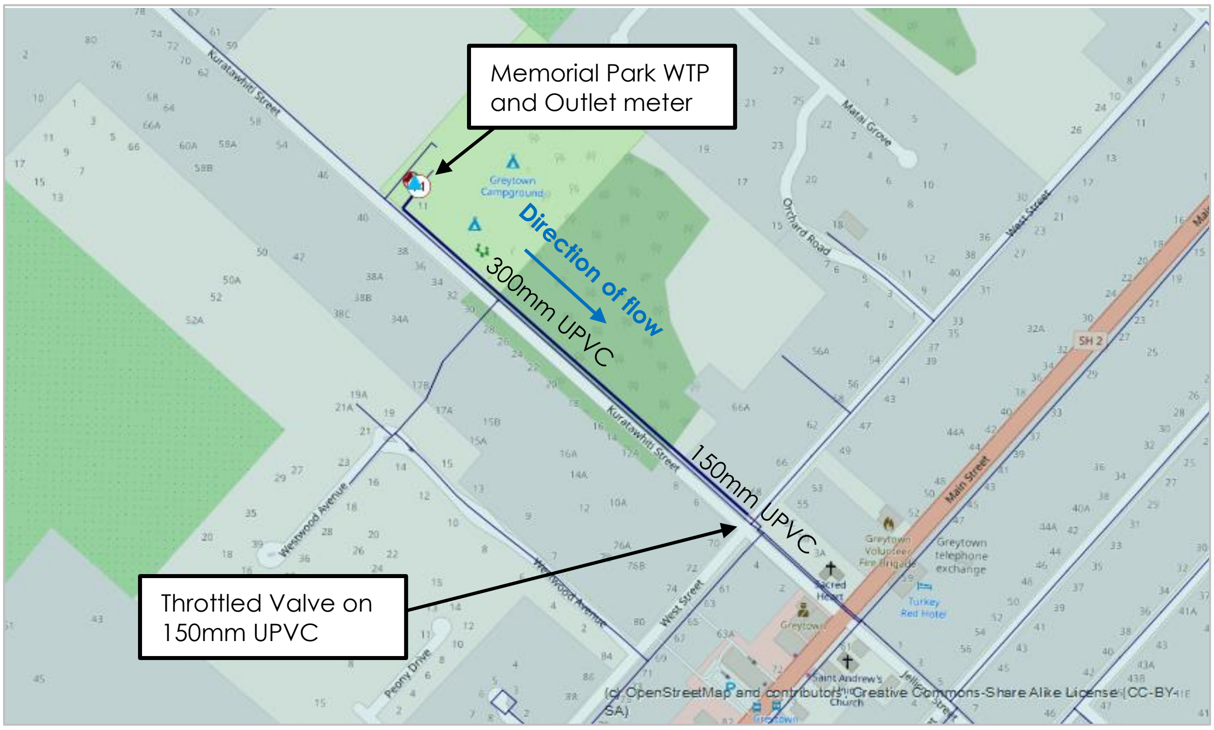


Figure 5-5: Location of modelled restriction in Greytown DMA.

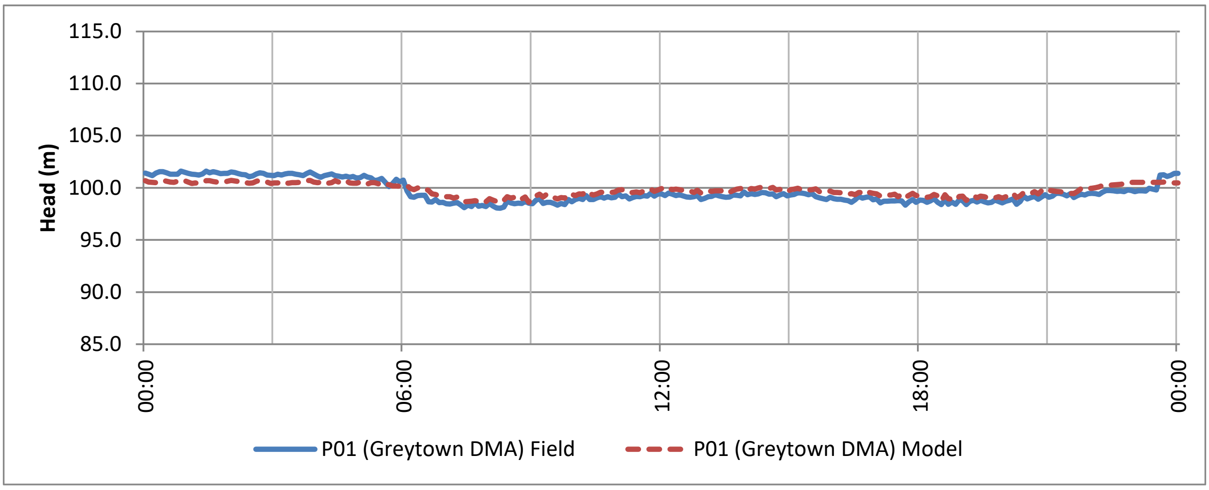


Figure 5-6: P01 - Modelled/Field Pressure after calibration

This action was supported in the Hydrant Flow Test run, with the model meeting the criteria at all HFT locations in the DMA.

The main highlighted in Figure 5-7 was checked to ensure that both valves are fully open, and no restriction exists on the Memorial Park WTP outlet pipework and flow meter. No restriction was found; however this action was retained pending the resolution of this anomaly.

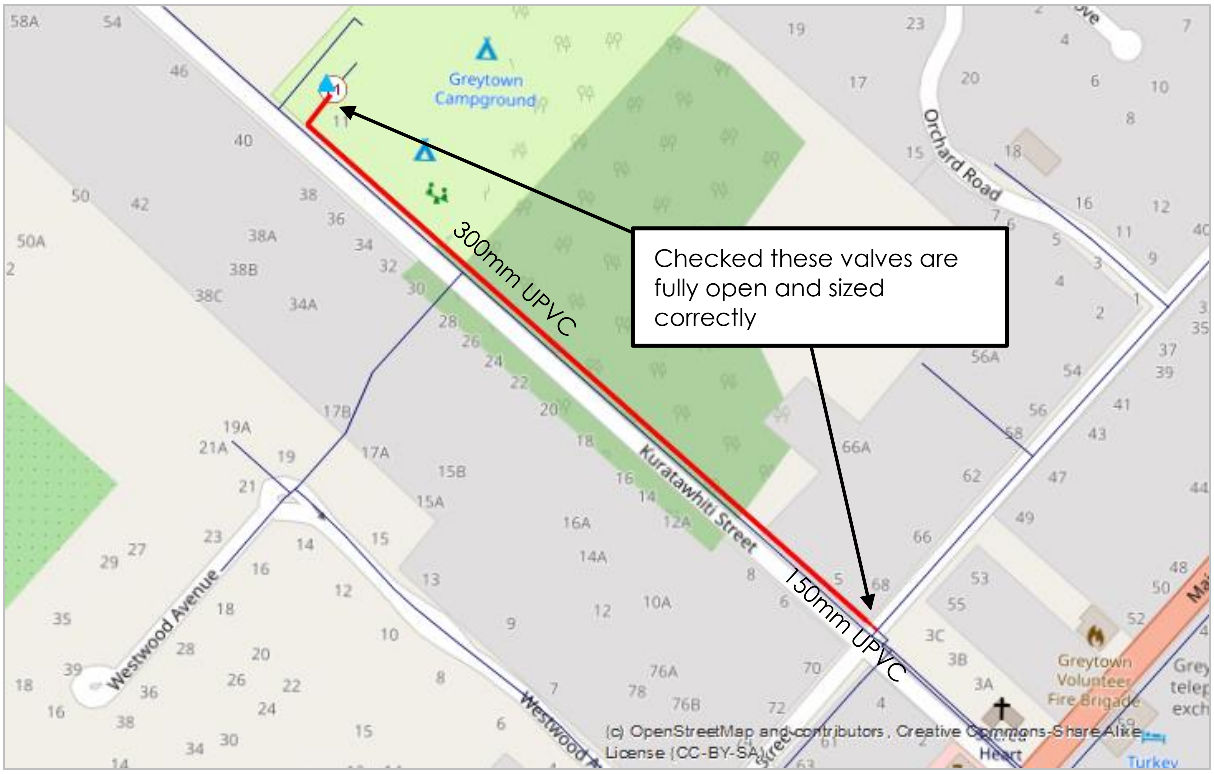


Figure 5-7: Location of proposed valve checks

It is possible that the Memorial Park outlet pressure is slightly incorrect. However, subsequent analysis has shown that this would have no significant effect on system performance and recommended upgrades.

5.4.5 Featherston DMA

5.4.5.1 Anomaly - Closed Valves (Resolved)

The model initially underpredicted headloss across logged points to the South and East of the intersection of Watt Street and Bell Street, by approximately 3m as shown in Figure 5-8.

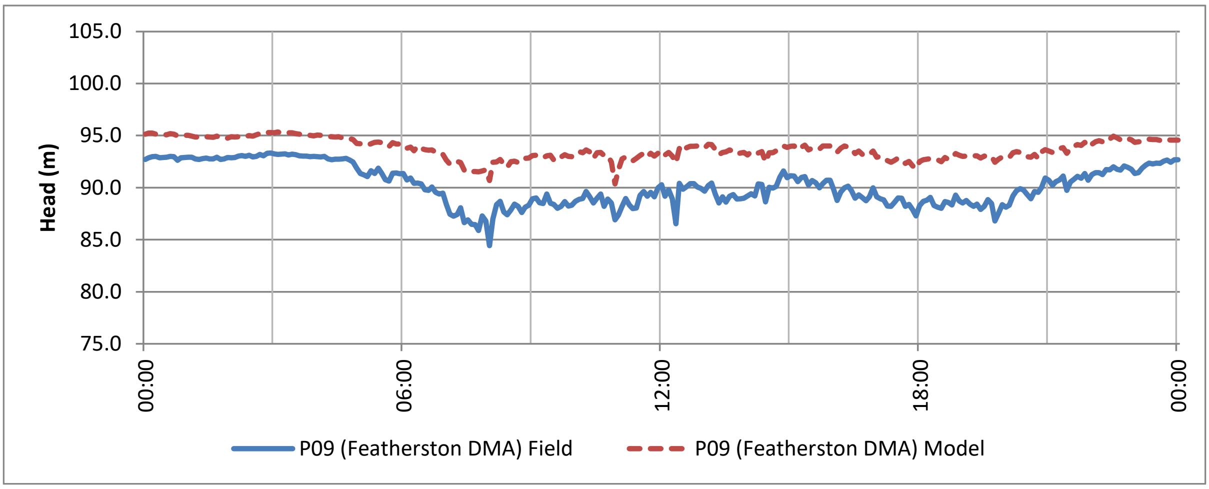


Figure 5-8: P09 - Modelled/Field Pressure before calibration

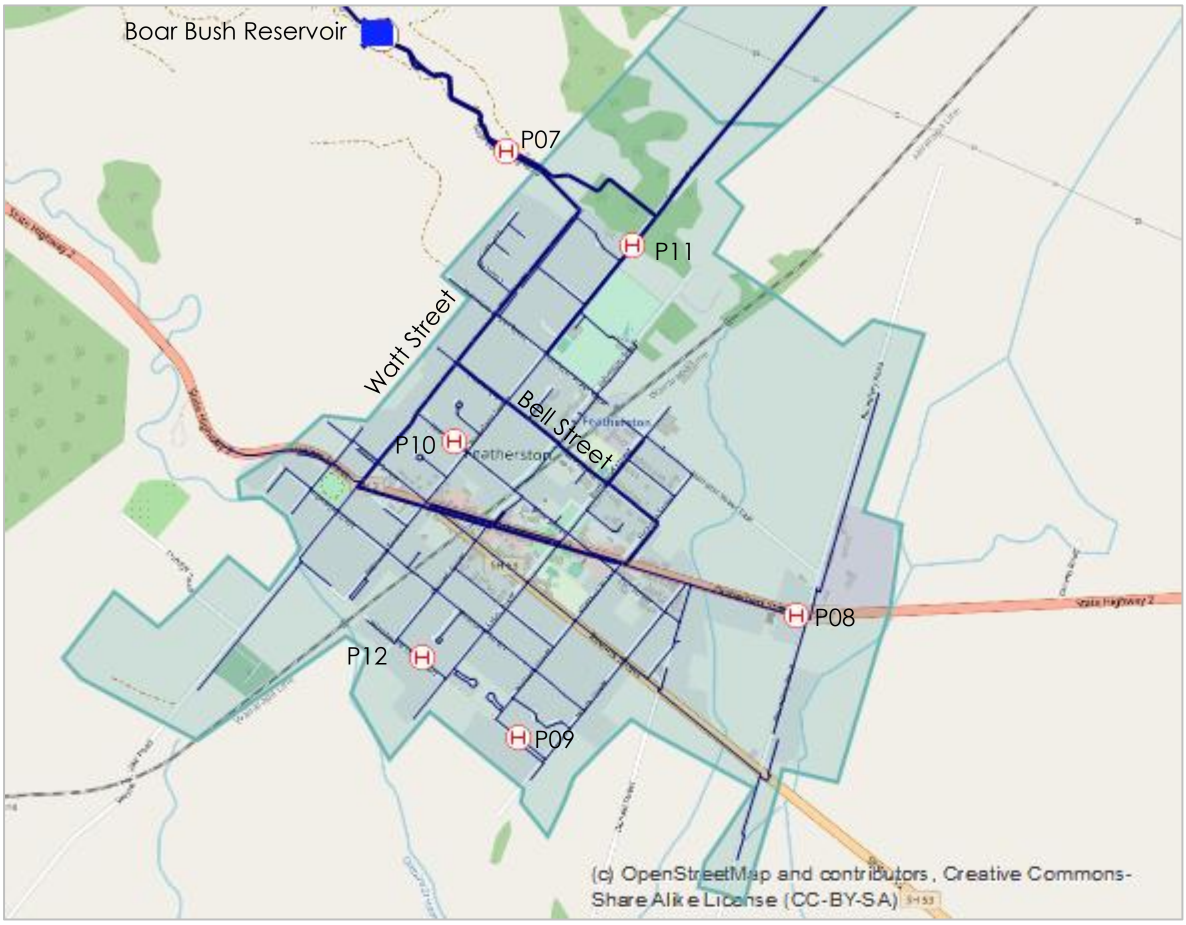


Figure 5-9: Featherston DMA Logger Locations

The exception was the two logged points closest to Boar Bush Reservoir (P07 and P11) which had a perfect match.

This suggests that a network restriction exists between P11 and P10 that is not replicated in the model. We closed valves downstream of P07 and P11 to achieve a match at the remaining points in Featherston DMA.

We identified approximately 70 valves for Council to check, which was undertaken in July and August 2021. Valve SWDC_PW005199 was found to be throttled. The model supports the fact that this was the cause of the anomaly. This valve is now open in the field and was set to open in the working model. There is a residual, minor anomaly near Underhill Road, which remains unexplained. Following discussions with WWL, this was found not to warrant further investigations.

5.4.5.2 Anomaly - Unknown Large User

The pressure recorded at P08 shows large spikes in pressure, which has not been replicated in the model (Figure 5-10). These spikes are observed at other logged points throughout the DMA, which confirms the flow is genuine. However, the impact at these points is not as significant which suggests there is a large user close to P08 which causes a local drop in pressure.

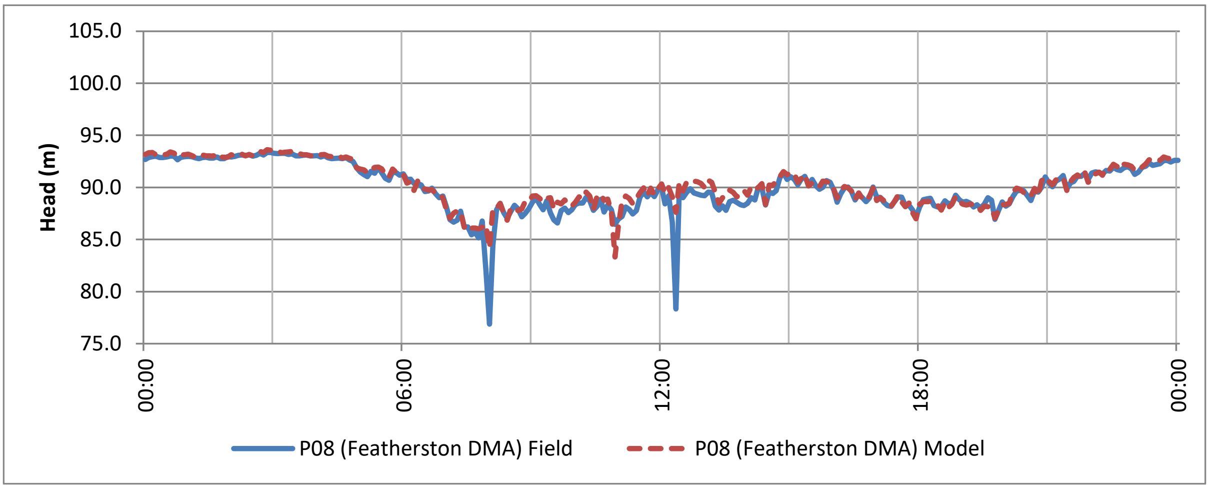


Figure 5-10: P08 - Modelled/Field Pressure

The billing data did not suggest a large user in this location. This does not pose a problem for the overall model reliability and was left unresolved.

5.4.6 Martinborough DMA

5.4.6.1 Anomaly - Hinekura Reservoir Head

The model initially overpredicted pressure by approximately 2.5m at all points in Martinborough DMA (Figure 5-11).

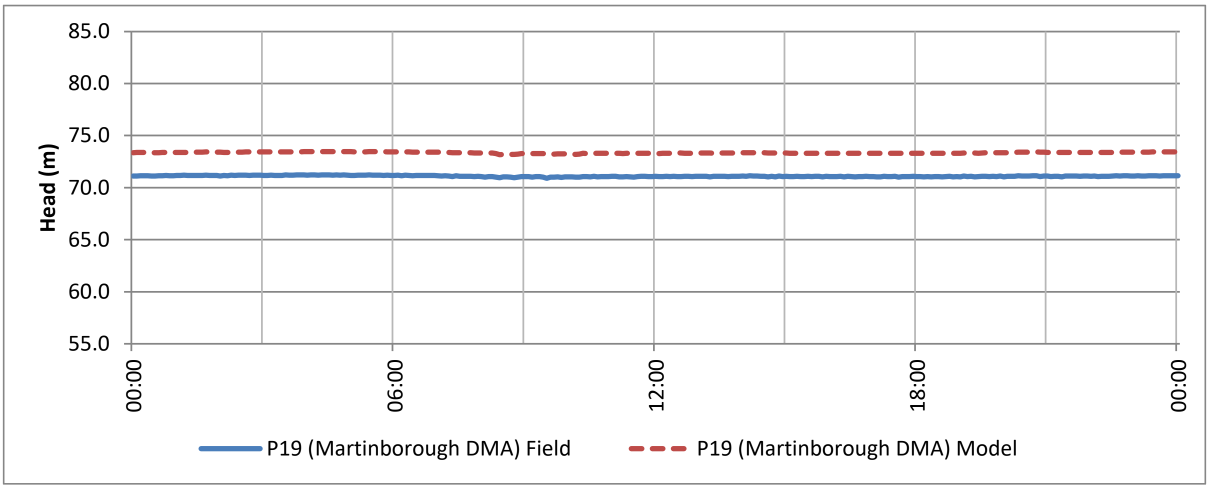


Figure 5-11: P19 - Modelled/Field Pressure before calibration

The logged locations are shown in Figure 5-12.

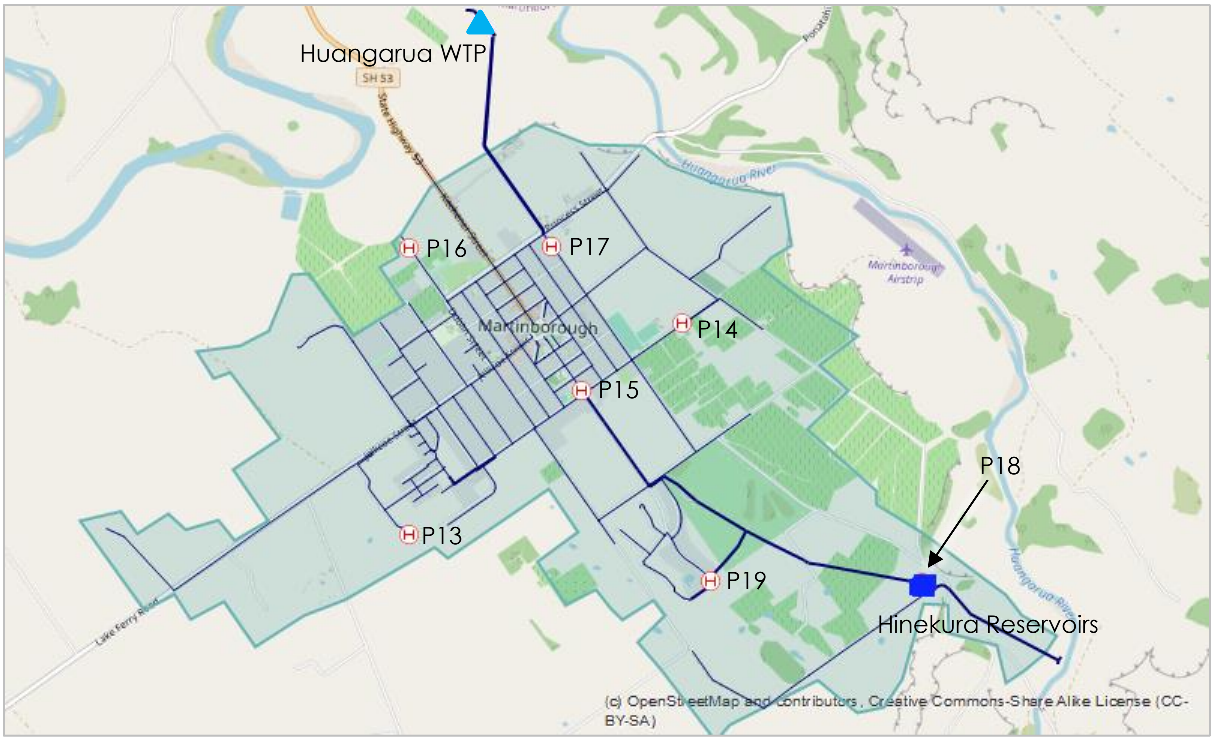


Figure 5-12: Martinborough DMA Logger Locations

The operating level of the Hinekura Reservoirs was reduced by 2.5m and this provided a better calibration at all points within Martinborough DMA (Figure 5-13).

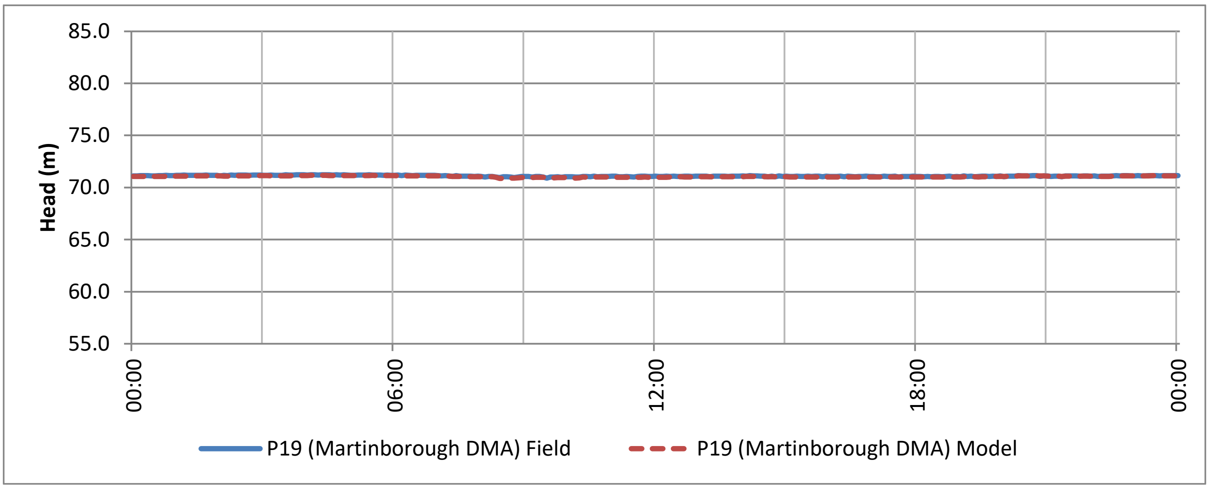


Figure 5-13: P19 - Modelled/Field Pressure after calibration

This was supported by the Hydrant Flow Test run which did not require any further calibration actions.

As the SWDC Schematic notes the Top Water Level (TWL) of the Hinekura reservoirs as 73.8m, it is recommended that any available As-Built drawings are checked to ensure this matches the assumptions made in the model. If this does not resolve this anomaly, the Hinekura Reservoirs should be surveyed to determine the TWL, depth and diameter.

It is also possible that the SCADA level measurements were interpreted incorrectly which should be confirmed.

5.5 FIELD CHECKS – SEPTEMBER 2021

Table 5-6 summarises the recommended field checks based on the anomalies described in the previous section. The status of these field checks is shown as of 02 September 2021.

Table 5-6: Field Checks

Anomaly	Section	Field check	Priority	Status
1	5.4.1	Check that both valves between Memorial Park WTP outlet and West Street are fully open and that no restrictions exist on the flow meter.	**Medium**	Check undertaken - unresolved
2	5.4.5	Check approximately 70 valves around Bell Street between Watt Street and Hickson Street, which should normally be open.	**High**	Resolved
3	5.4.6	Check Hinekura Reservoirs volume and level from As-Built drawings and site survey if no drawings available.	**Low**	Check not undertaken
4	5.4.3.2	Check Waiohine WTP Outflow meter is reading accurately. Firstly, through a controlled hydrant flow downstream	**Low**	Check not undertaken
5	5.4.3.2	Check Timber Tank Reservoir volume and level from As-Built drawings and site survey if no drawings available.	**Low**	Check not undertaken
6	5.4.3.2	Check Featherston Feed Flow meter is reading accurately. Firstly, through a controlled hydrant flow downstream.	**Low**	Check not undertaken

5.6 CALIBRATION CONCLUSION

A working model has been developed which reflects the operation of the water network in South Wairarapa under Peak Day and Average Day conditions.

There remains a minor, unresolved network anomaly in Greytown, however generally there is a good level of confidence in the model to predict the network performance for planning and operational queries.

6.0 CURRENT WORKING MODEL (ZMP PHASE 3)

6.1 MODEL SCENARIO SETUP

The Working Model has been developed from the Calibration Model "SWDC WS MOP02_CDay" with adjustments to replicate the understood and likely network operation under various demand conditions. It is intended to be used to assist with operational studies such as shutdown planning, checks on fire flow availability and network reconfiguration.

The Working Model is contained in the model group **SWDC WS MOP03.**

The Working Model contains the following demand scenarios reflecting current average and peak day demands.

Table 6-1: Working Model Scenario Summary

Model Database Reference	Scenario Description	Total System Demand (m3/day)
SWDC WS MOP03 ADD_2021	Current Average Day (2021)	4,386
SWDC WS MOP03 PDD_2021	Current Peak Day (2021)	6,584

Table 6-2: Working Model Demand Summary

Scenario	No. Properties	Residential (m^3/day)	Commercial (m^3/day)	Leakage (m^3/day)	Total (m^3/day)
Current PDD (2021)	4263	4,367	438	1,779	**6,584**
Current ADD (2021)	4263	2,169	438	1,779	**4,386**

6.2 NETWORK ADJUSTMENTS

6.2.1 Boundary Conditions – Fixed Heads

Each treatment plant was modelled as a pump drawing water from a fixed head object.

The fixed head objects were set at the approximate ground level at each Water Treatment Plant. The details of these fixed heads are contained in Table 6-3.

Table 6-3: Working Model Boundary Conditions

Location	Fixed Head (m)
Waiohine WTP	80
Memorial Park WTP	60
Ruamahanga WTP	20

6.2.2 Pump Stations

One pump for each WTP was retained in the model. Pump curves were requested from Wellington Water. Where these were not available, a synthetic pump curve was generated using operational information, such as known pressures and flow limitations.

Table 6-4: Pumping Station Modelled Characteristics

Pump Name	Asset ID	Calibration Model Settings	Working Model Settings	Working Model Control Node	Control
Waiohine WTP PS 1	NEWF00854	Not used in calibration (modelled as fixed flow)	Combined into single pump from fixed flow – synthetic pump curve generated	Timber Tank Res	On/Off – 5.3/5.9
Waiohine WTP PS 2	NEWF00855				
Waiohine WTP PS 3	NEWF00865				
Waiohine WTP PS 4	NEWF00869				
Waiohine WTP PS 5	NEWF00876				
Ruamahanga PS 1	NEWF00890	Not used in calibration (modelled as fixed flow)	Combined into single pump from fixed flow – pump curve provided by Wellington Water	Hinekura 2 Res	Level – 4.00m
Ruamahanga PS 2	NEWF00891				
Ruamahanga PS 3	NEWF00768				
Ruamahanga PS 4	NEWF00895				
Huangarua PS	NEWF00909	Not modelled – not operational			
Memorial Park WTP PS	Unknown	Not used in calibration (modelled as fixed head)	Synthetic pump curve generated	Memorial_Park_Y	Outlet Pressure – 42.5m

6.2.3 Reservoirs

Control settings for reservoirs were unchanged from the calibration model. Where the flow into the reservoir was dictated by a fixed head or a fixed flow, these fixed conditions were removed, and flow was determined by the settings of the pump upstream. Reservoir settings used in the working model are detailed in Table 6-5.

Table 6-5: Working Model Reservoir Settings

<table>
<tr><th rowspan="2">Reservoir</th><th rowspan="2">Depth Control</th><th rowspan="2">Initial Depth (m)</th><th colspan="2">Float Valve</th><th rowspan="2">Comments</th></tr>
<tr><th>Control Depth (m)</th><th>Reg. Range (m)</th></tr>
<tr><td>Timber Tank Reservoir</td><td>Waiohine WTP Pump</td><td>4.30</td><td colspan="2">N/A</td><td></td></tr>
<tr><td>Treated Water Reservoir (TWR)</td><td>Unknown</td><td>4</td><td colspan="2">N/A</td><td>Information on the TWR is based on as-built drawings and there are uncertainties around operation.</td></tr>
<tr><td>Greytown Reservoir</td><td>Float Valve</td><td>5.32</td><td>6.27</td><td>1.09</td><td></td></tr>
<tr><td>Boar Bush 1 Reservoir</td><td rowspan="2">Float Valve</td><td rowspan="2">2.82</td><td rowspan="2">2.84</td><td rowspan="2">0.53</td><td rowspan="2">Modelled as a single reservoir</td></tr>
<tr><td>Boar Bush 2 Reservoir</td></tr>
<tr><td>Hinekura 1 Reservoir</td><td rowspan="4">Ruamahanga WTP Pump</td><td rowspan="4">3.95</td><td rowspan="4" colspan="2">N/A</td><td rowspan="4">Modelled as a single reservoir</td></tr>
<tr><td>Hinekura 1 Reservoir</td></tr>
<tr><td>Hinekura 1 Reservoir</td></tr>
<tr><td>Hinekura 1 Reservoir</td></tr>
</table>

6.2.4 Control Valves

Control valve settings were retained as per calibration (Table 3-5).

6.2.5 Assumed Restrictions and Calibration Actions

Field checks were undertaken to investigate anomalies found during the model calibration. The results of these field checks and the status of the calibration actions are shown in Table 6-6.

Table 6-6: List of Calibration Actions and their status in the Working Model

No.	DMA	Calibration Action	Working Model
1	Featherston DMA	K values of RC pipes changed from 3 to 0.5 No check necessary.	Retained
2	N/A	Valves along transmission main between Timber Tank Reservoir and Boar Bush Reservoir – diameter increased to 300mm. No check necessary.	Retained
3	Greytown DMA	Throttled valve on Memorial Park WTP outlet (150mm UPVC) main Unresolved. Minimal impact on network operation (2m pressure reduction, does not impact fire flow)	Retained
4	Featherston DMA	Closed valves throughout Featherston DMA. Resolved – field checks were conducted, and a valve was found to be partially opened, which was then fully opened.	All valves fully opened
5	Martinborough DMA	Hinekura Reservoirs operating level. Unresolved – not checked.	Retained

6.3 CURRENT AVERAGE DAY AND PEAK DAY SCENARIOS

This section details how the demand was constructed for current average and peak day in the Working Model. The following demand scenarios were developed:

- Average day, reflecting average network performance
- Peak day, reflecting network performance over a single day of very high demand

Although three years of flow data was requested, only data recorded in the last year was used due to unusual patterns in the demand or no available data.

Therefore, the period between **1st June 2020 - 1st June 2021** was used to determine the average day and peak day demand.

Table 6-7: Working Models Demand Scenarios

DMA	Peak Day	Total PDD (m^3)	Average Day (representative)	Total ADD (m^3)
Greytown DMA	25 January 2021	2,365*	30 January 2021	1,647*
Featherston DMA	10 January 2021	1,989*	27 December 2020	1,500*
Martinborough DMA	24 January 2021	2,461*	16 December 2020	1,237*

**Total volumes differ from modelled volumes. Peak Day and Average Day selections are based on accumulated instant flows over 24 hours between 8.00am and 8.00am.*

Diurnal residential demand profiles were created for each adopted peak and average day.

Where possible, instant SCADA flow records were used to produce these profiles.

Where instant SCADA data was not available, Calibration day profiles were used.

6.3.1 Greytown DMA

Figure 6-1 shows the accumulated flow from Memorial Park WTP and Greytown Feed from the available SCADA. Peak Day Demand was selected as 30th January 2021 from this period, with the Average Day Demand calculated over the period of one year.

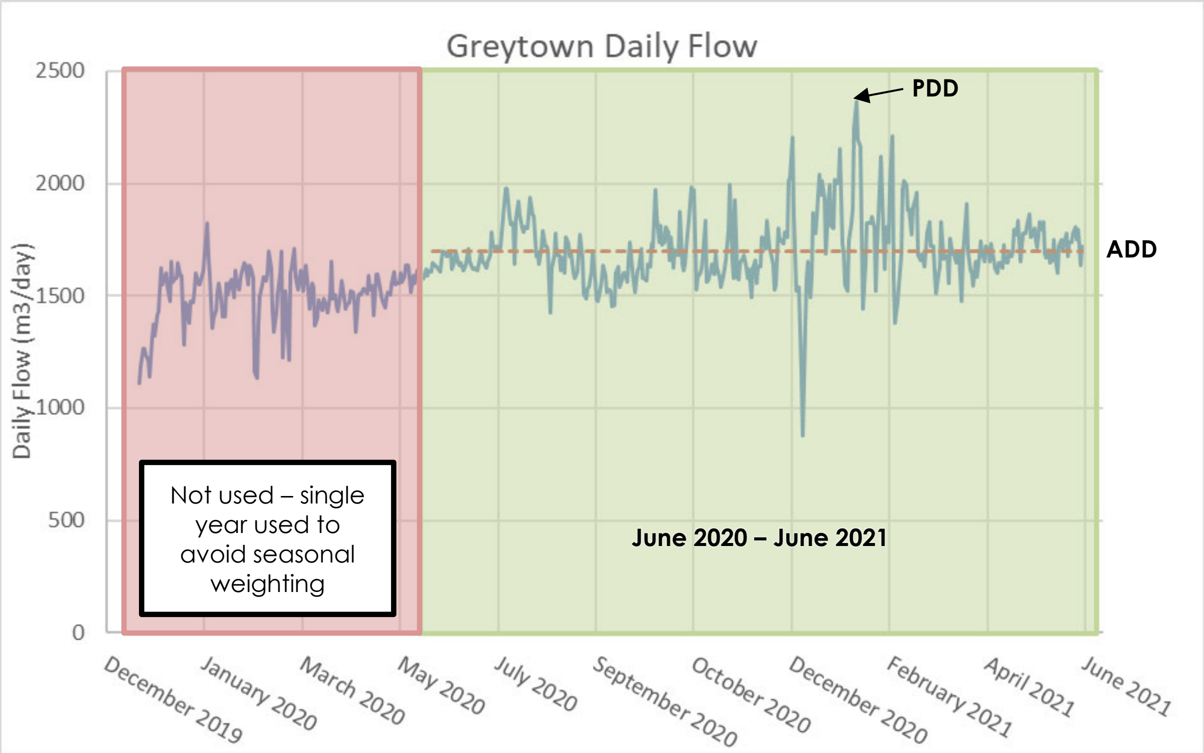


Figure 6-1: Greytown DMA Peak and Average Day Selection

The spikes from the diurnal profile taken from instant SCADA were removed by taking a rolling average over 15 minutes to smoothen the demand pattern. The PDD scenario profile for each DMA is shown in Figure 6-2, and the ADD scenario profile is shown in Figure 6-3.

The profiles contain a distinct demand spike in the middle of the day. As it is recorded for most days, it is believed to be a genuine demand from a specific user.

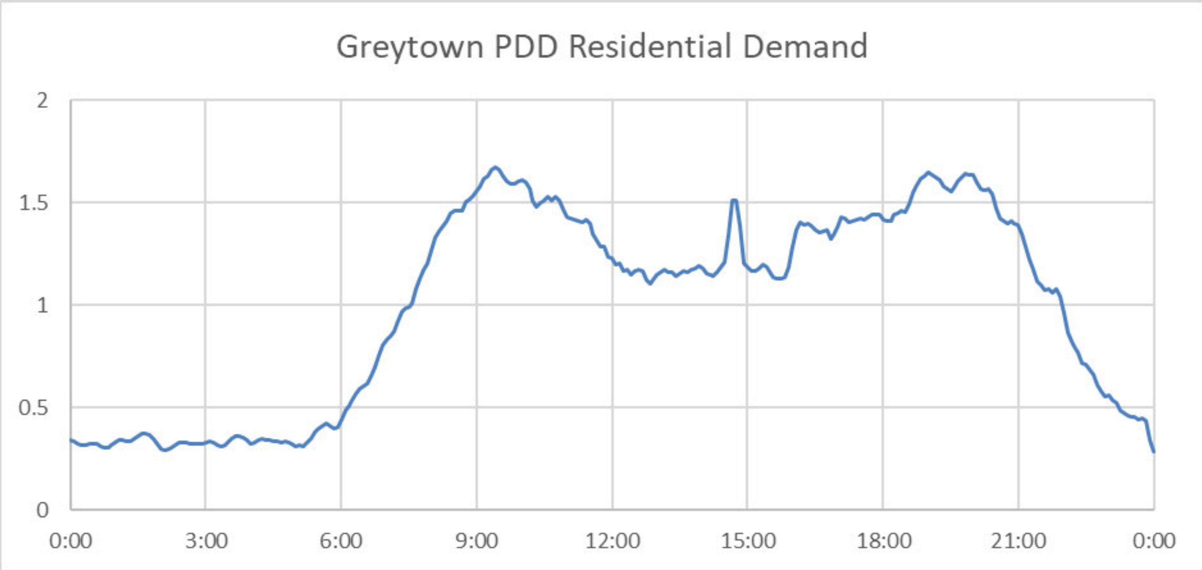


Figure 6-2: Greytown DMA Residential Demand Profile (PDD)

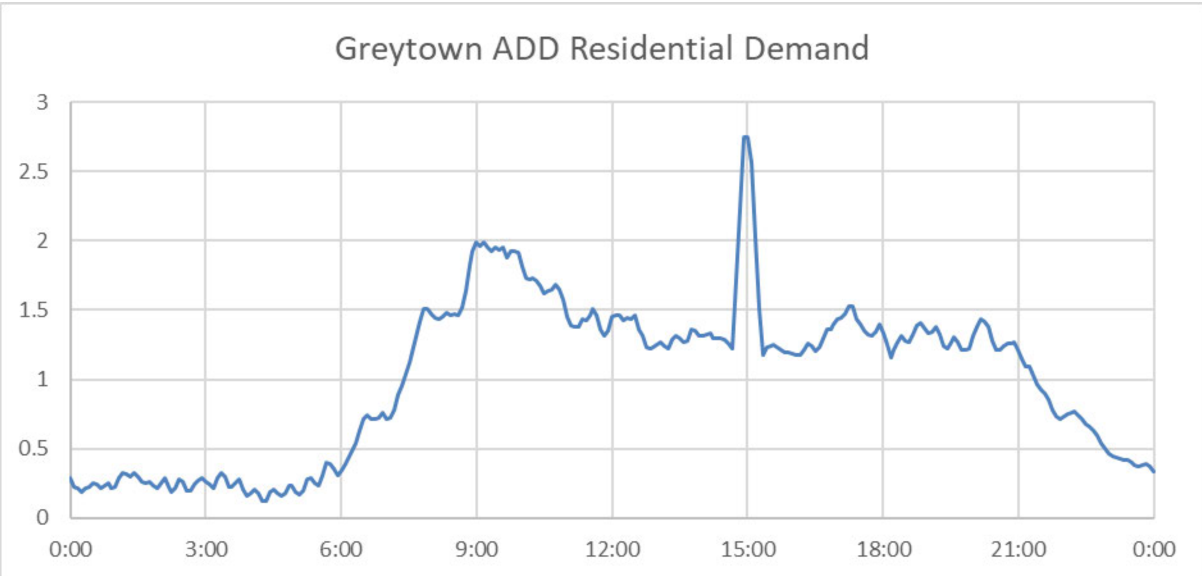


Figure 6-3: Greytown DMA Residential Demand Profile (ADD)

6.3.2 Featherston DMA

Figure 6-4 shows the accumulated flow from Featherston Feed from the available SCADA. Peak Day Demand was selected as 10th January 2021 from this period, with the Average Day Demand calculated over the period of one year to avoid any seasonal weighting.

The period up to June 2020 was discounted as this does not appear to represent the current operation of the system.

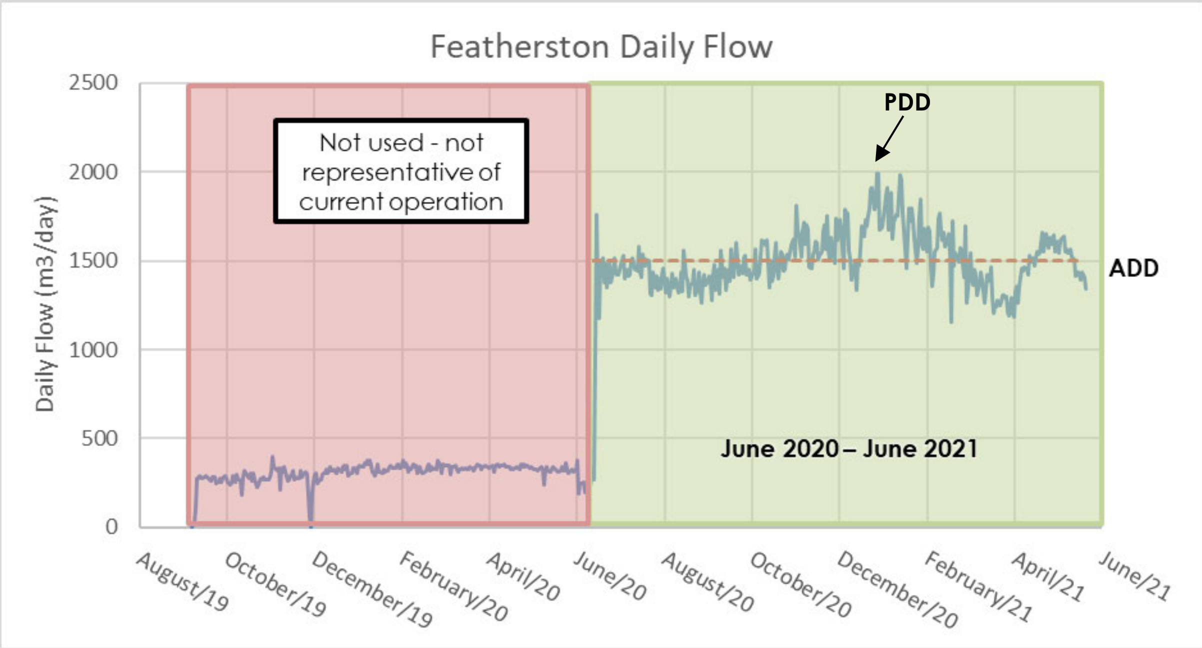


Figure 6-4: Featherston DMA Peak and Average Day Selection

As the instantaneous flow into Featherston DMA was not available, the demand pattern from calibration was retained, and the residential demand in the model was scaled to match the value observed on the identified Peak Day and Average Day.

The profile was originally very spikey, large jumps in demand. These were not considered genuine and removed. The overall profile was smoothed by taking a rolling average over three timesteps. This normalised profile was used for the ADD and PDD scenarios and is shown in Figure 6-5.

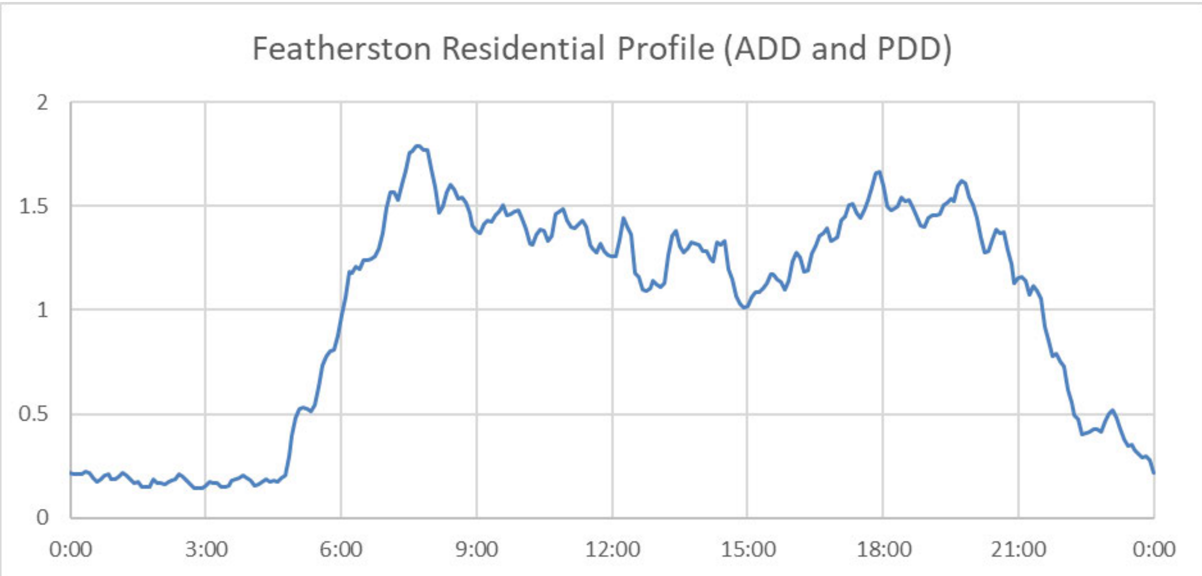


Figure 6-5: Featherston DMA Residential Demand Profile (ADD and PDD)

6.3.3 Martinborough DMA

Figure 6-6 shows the accumulated flow from Ruamahanga WTP from the available SCADA.

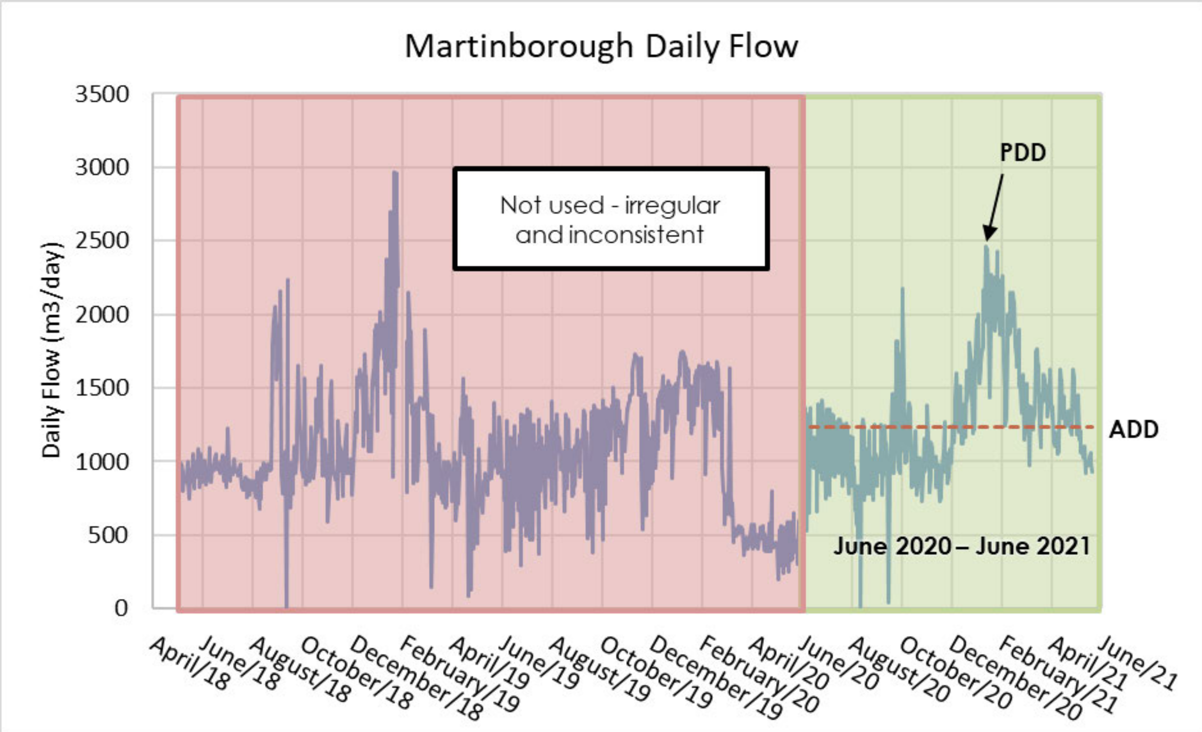


Figure 6-6: Martinborough DMA Peak Day and Average Day Selection

The PDD scenario profile is shown in Figure 6-7 and the ADD scenario profile is shown in Figure 6-8.

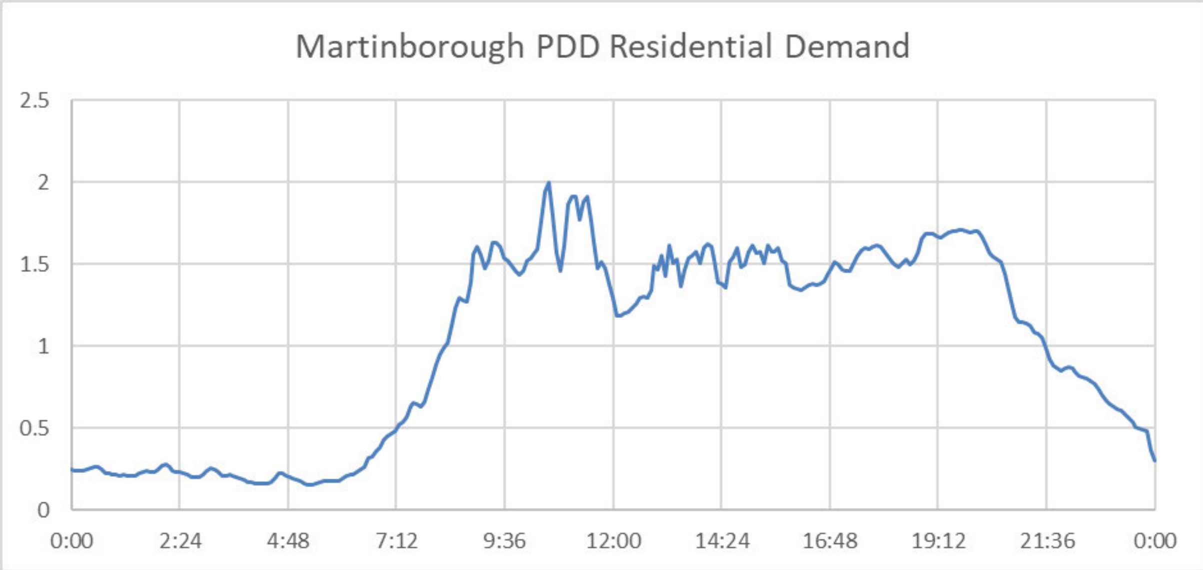


Figure 6-7: Martinborough DMA Residential Demand Profile (PDD)

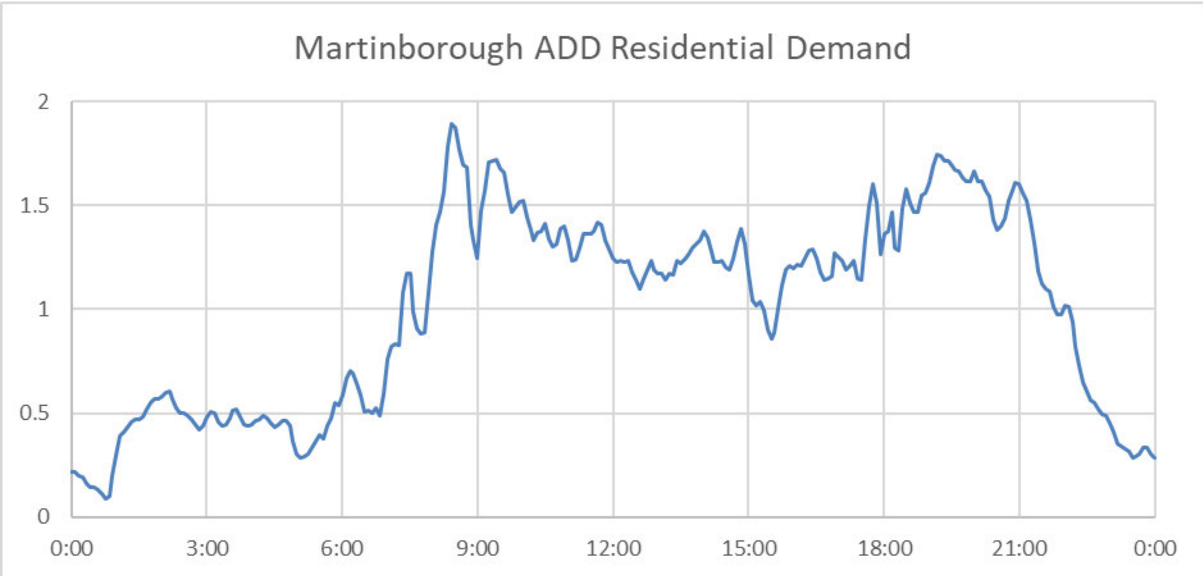


Figure 6-8: Martinborough DMA Residential Demand Profile (ADD)

Note - This peak day scenario has been superseded based on the updated peak day demand identified from the most recent three years SCADA data (2021 to 2024) while undertaking Martinborough system performance and ZMP as discussed in section 8.1 further down the report.

7.0 SYSTEM PERFORMANCE ASSESSMENT AND ZMP (FEATHERSTON AND GREYTOWN)

The Featherston and Greytown ZMP model has been developed from the current working model **SWDC WS MOP03,** which has been discussed in section 6.0 Working Model (ZMP Phase 3). Updated growth data (provided by Wellington Water, 2022) was used to develop future demand in the model. The software used was InfoWorks WS Pro v2021.5

A ZMP Model was produced and is contained in a separate model group **SWDC MPL04 – Featherston and Greytown.**

The Martinborough master plan was undertaken separately and is presented in section 8.0..

7.1 GROWTH PROJECTIONS

Future water demand is driven largely by population growth. The existing number of dwellings developed by CoreLogic (2020) were used as a base. This is the same number as the customer points in the SWDC WS MOP03 2021 model.

The modelling specifications distinguish diffuse growth where location is not known precisely as "infill" growth and where growth location is known as "greenfield". Known greenfield growth can be seen in Table 7-1.

Infill growth has been developed from Sense Partners dwellings 2022 data provided by Wellington Water. Greenfield growth for Featherston and Greytown was calculated based on known development lots provided by Wellington Water. This was subtracted from the Sense Partners total dwellings to create infill growth, which was then used to calculate a scaling factor for equivalent dwellings in the model.

Table 7-1 shows growth data for the 2024 – 2071 planning horizons taken from the Sense Partners dwellings 2022 data up to 2051.

Table 7-1: Featherston and Greytown Sense Partners Dwellings Growth Data

	2021 dwell	2024 add. dwell from 2021	2024 total dwellings	2031 add. dwell from 2021	2031 total dwellings	2051 add. dwell from 2021	2051 total dwellings
Featherston 2022 dwellings data	1331	57	1388	183	1514	940	2271
Greytown 2022 dwellings data	1431	52	1483	63	1494	63	1494

7.2 APPLICATION TO THE MODEL

We have retained the current number of residential customer points in the model as it is very close to that indicated by Sense Partners (1194 vs 1331 for Featherston and 1278 vs 1431 for Greytown).

We have assumed that the rate of growth from 2031 – 2051 remains valid for the period of 2051 – 2071.

Table 7-2: Featherston and Greytown Infill and Greenfield growth data from the model

		Current dwell	2024 dwell	2024 scaling	2031 dwell	2031 scaling	2051 dwell	2051 scaling	2071 dwell (extrapol-ated)	2071 scaling
Featherston	**Total 2022 dwellings data**	1194	1388	1.12	1514	1.14	2271	1.62	3028	2.25
	Existing + Infill growth	1194	1336		1354		1925		2682	
	Known Greenfield growth	0	52		160		346		346	
Greytown	**Total 2022 dwellings data**	1278	1483	1.16	1494	1.17	1494	1.17	1494	1.17

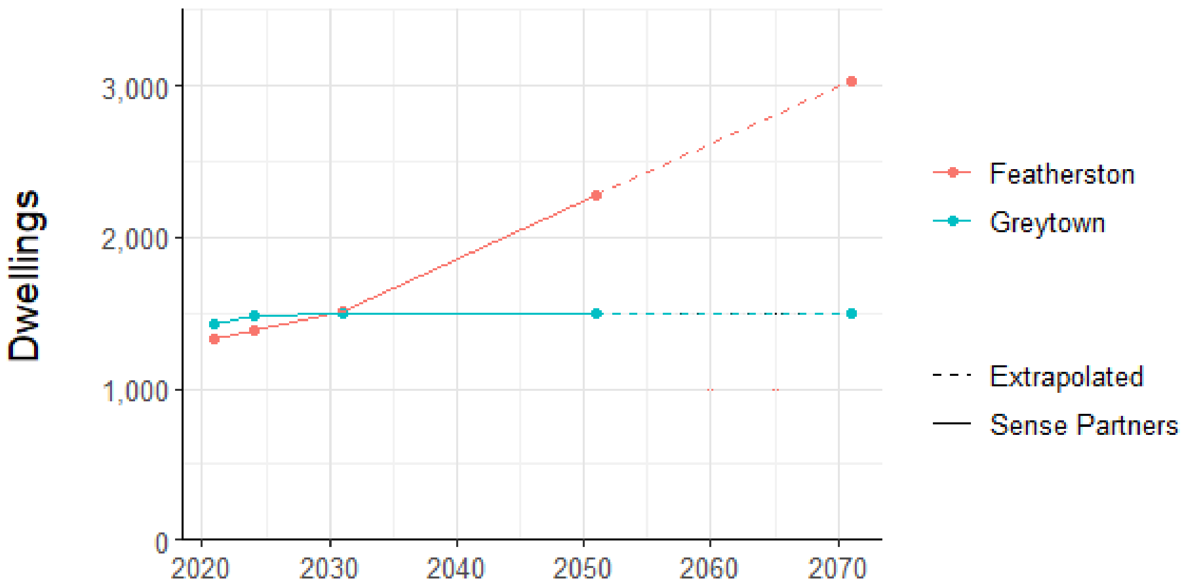


Figure 7-1: Featherston and Greytown adopted growth forecast

7.3 FUTURE WATER DEMAND

7.3.1 Assumptions

The Modelling Specifications were followed to convert the increase in number of dwellings into an increase in water usage.

The following assumptions were made:

- The specific consumption of existing households remains unchanged into the future.
- Existing leakage and commercial demands are unchanged.
- Peak demands for infill growth households are the same as peak demands for existing households.
- Infill demand was assigned the same pattern as the residential demand in the Featherston DMA
- Greenfield demand was assigned the DomEq_RSWS demand pattern as per the updated Specifications.

7.3.2 Demand assignment in the model

A separate network was set up for each planning horizon (2024 ,2031, 2051 and 2071). Changes had to be made to specific consumptions of customer points to reflect future demand.

The specific consumption of each residential customer point was changed by multiplying the current PDD specific consumption by the scaling factors determined in Section 7.2, as agreed by Wellington Water. Note that the specific demand in the model now represents more than one dwelling. Greenfield growth which was given a specific consumption relative to the occupancy rate and l/person requirements in the Specifications.

To assign a specific consumption to greenfield growth, section 6.3.1.1 from the Specifications was used (see Table 7-4 below).

Table 7-3: Featherston and Greytown Occupancy rate calculations

		Pop_by_SA2_annual.csv	Dwellings by SA2 - March 2022.csv	Occupancy Rate*
Featherston	**2021**	2710	1331	2
	2024	2632	1388	1.9
	2031	3047	1514	2
	2051	4418	2271	1.9
Greytown	**2021**	2720	1431	1.9
	2024	2669	1483	1.8
	2031	2644	1494	1.8
	2051	2507	1494	1.7

*All simplified to have an occupancy of 2

Table 7-4: Greenfield growth specific consumption calculations

Reference		
RSWS 6.3.1.1, table 6.2	700	l/person spec cons per person
RSWS 6.3.1.1	0.0162	l/s/person instant peak
Calculated	1.999543	peaking factor (DomEq_RSWS)

Reference		
Calculated from Sense Partners	2	occupancy calculated from Sense Partners
Calculated	1400	l/prop/day specific consumption for greenfield PDD

The changes were made directly in the customer points in the model network. The “scaling factor” object of Infoworks Pro was not used for this study.

User number fields in each customer point have been used to record the equivalent dwellings (equal to the scaling factor set out in Table 7-2), the initial specific consumption and the scaled specific consumption.

- Initial Specific Consumption – UN01
- Equivalent Dwellings – UN02
- New Specific Consumption – UN03

The water demand allocated in the model for Featherston’s and Greytown’s future planning horizons is summarized below (Table 7-5) and can be seen in Figure 7-2

Table 7-5: Featherston and Greytown water demand allocated in model

	Horizon	Infill	Greenfield	Number Dwell	Infill spec consumption (l/prop/day)	GF spec cons	Residential (m3/day)	Non-Residential (m3/day)	Leakage (m3/day)	Total (m3/day)	Modelled number infill dwell	Modelled infill spec cons (l/prop/day)
Featherston	**2021**	1190	0	1190	963	1400	1,146	40	804	1,990	1,190	963
	2024	1336	52	1388	963	1400	1,359	40	804	2,203	1,190	1081
	2031	1354	160	1514	963	1400	1,528	40	804	2,371	1,190	1096
	2051	1925	346	2271	963	1400	2,338	40	804	3,181	1,190	1558
	2071	2682	346	3028	963	1400	3,067	40	804	3,910	1,190	2170
Greytown	**2021**	1278	0	1278	1190	1400	1,520	126	659	2,305	1,278	1190
	2024	1483	0	1483	1190	1400	1,764	126	659	2,550	1,278	1380
	2031	1494	0	1494	1190	1400	1,777	126	659	2,563	1,278	1391
	2051	1494	0	1494	1190	1400	1,777	126	659	2,563	1,278	1391
	2071	1494	0	1494	1190	1400	1,777	126	659	2,563	1,278	1391

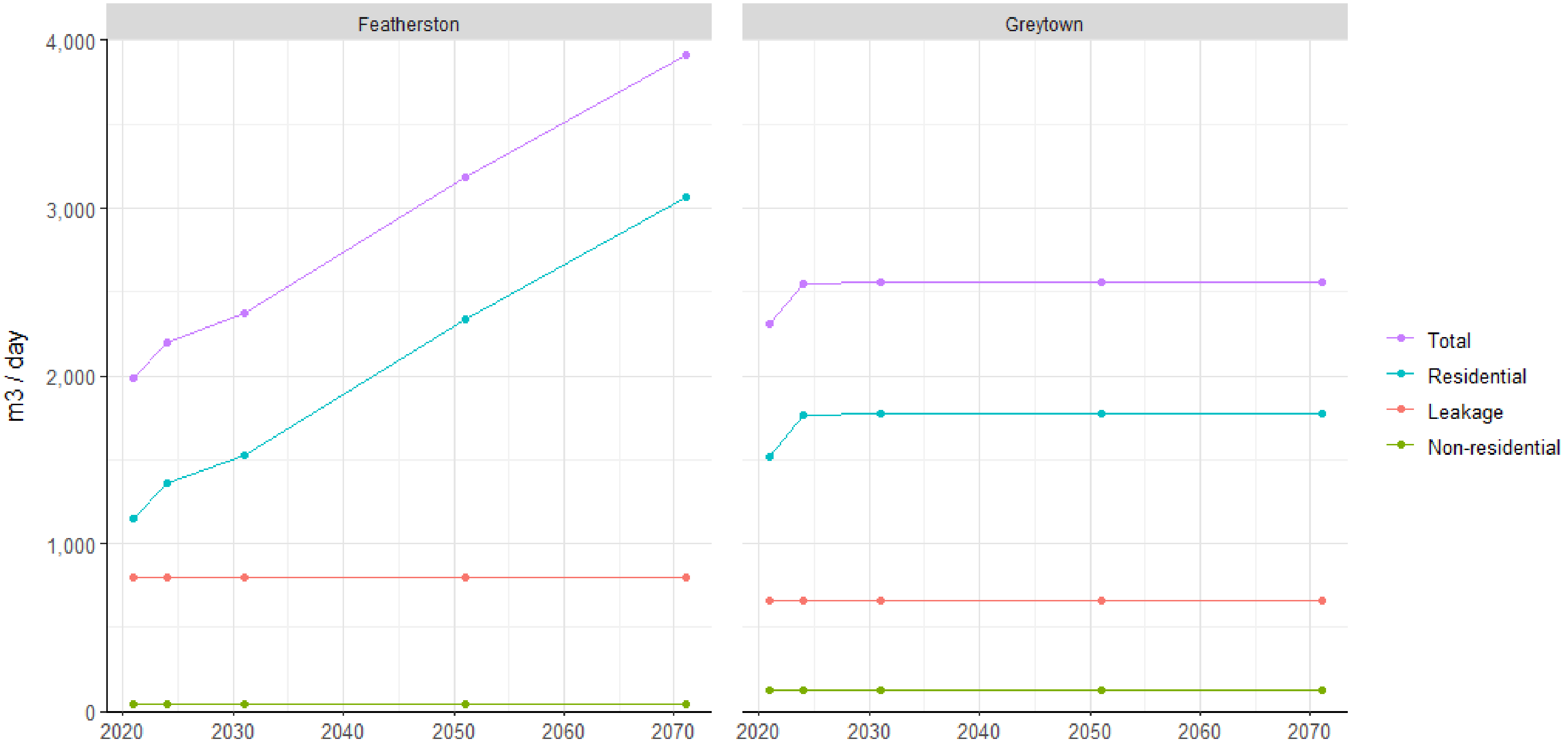


Figure 7-2: Featherston and Greytown water usage breakdown per DMA (Featherston and Greytown only)

7.4 STRATEGIC UPGRADES

7.4.1 Key network features

Section 2.2 provides a full description of the system. For convenience, key aspects relevant to the identification of strategic upgrades are shown in Figure 7-3

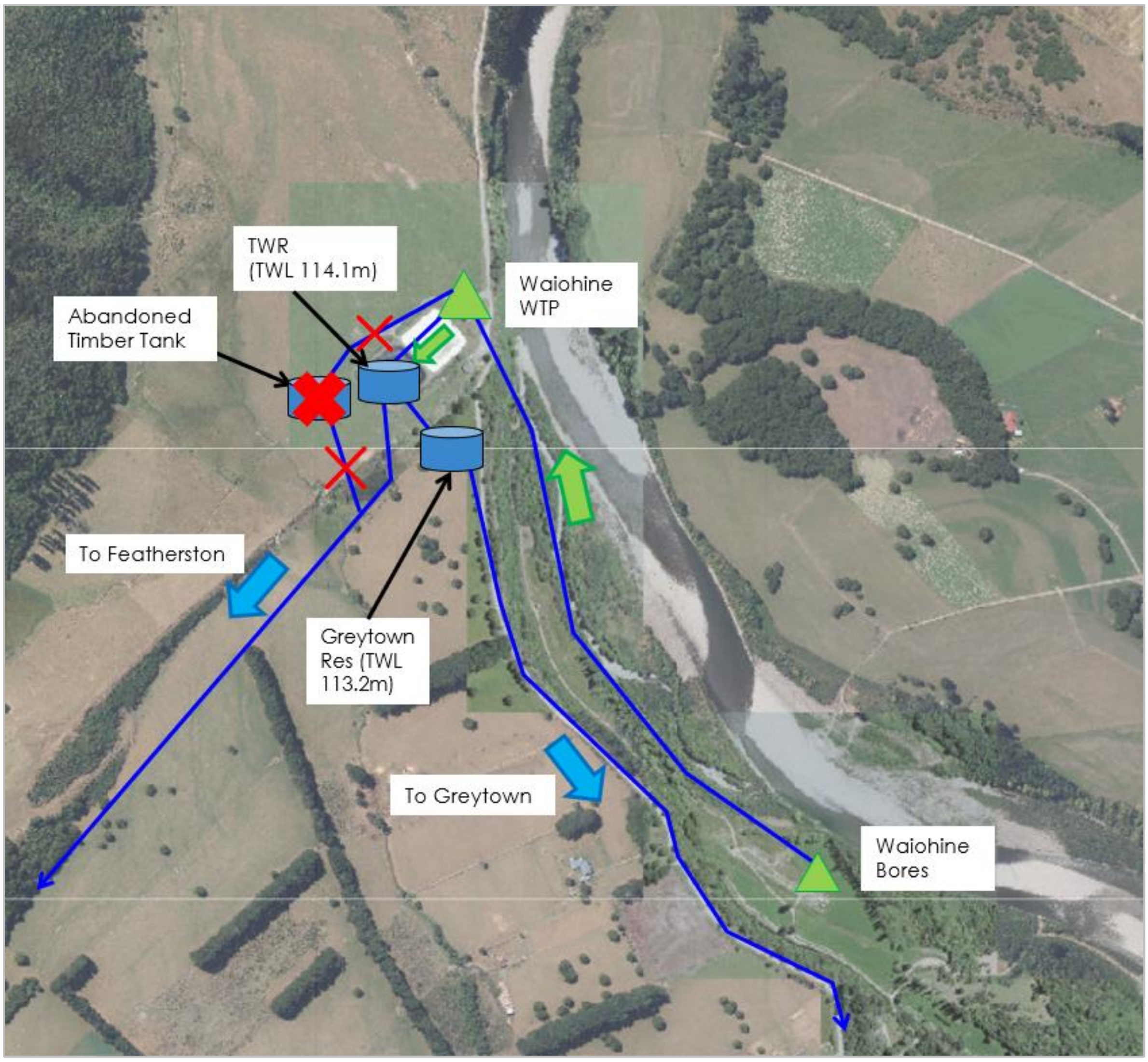


Figure 7-3: Waiohine Complex (map)

7.4.2 Replenishment issue

Under current high-demand conditions in Greytown, the water level is in the Greytown Reservoir can drop to 40% full. This can be compounded by three elements:

- If Memorial Park WTP is OFF, this puts extra demand on the Greytown Reservoir. Wellington Water would like to be less dependent on the Memorial Park WTP and turn it off for a several month maintenance period if possible.

- If both the inlet valves of the Boar Bush Reservoirs and Greytown Reservoirs are open at the same time, the difference in elevation (Greytown Res TWL is 113.7m while the Boar Bush TWL is 97.09m) results in the Greytown Reservoir back-feeding into the Boar Bush Reservoir.
- Population growth (discussed in Section 7.1), albeit moderate, is predicted in Greytown.

In the 2071 PDD model, the Boar Bush Reservoir is predicted to drain. Therefore, there are both short-term and long-term reservoir replenishment concerns.

This section discusses possible solutions. A solution has been chosen as a placeholder by Wellington Water until this is confirmed through subsequent investigations.

All of the upgrades considered will have a similar effect on the system performance, mainly keeping both reservoirs replenished. Selected strategic upgrades were included in the model prior to assessing the non-upgraded system performance.

7.4.3 Strategic upgrade options

This section discusses possible solutions to the replenishment issues. Several solutions would achieve the same result but present difference costs and risks. The selection of a preferred solution will require investigations outside the scope of this study. A solution was selected as a placeholder to enable modelling of system performance and for cost estimating purposes.

7.4.3.1 Overview

Recommended network upgrades fall into three categories:

- Upgrades between Waiohine Bores and TWR: required regardless of the other upgrade categories.
- Upgrades between TWR and Boar Bush
- Upgrades between TWR and Greytown Reservoir

There may be some overlap between the upgrades to Boar Bush and Greytown, and these are best considered jointly.

7.4.3.2 Waiohine Bores to TWR – Strategic Upgrade (S-UPG-07)

In order to supply the TWR with enough water under future demand, it will be necessary to upgrade the capacity between the Waiohine bores and the TWR. The additional capacity depends on whether the Memorial Park source is operational.

Upgrades include:

- Increasing the Waiohine bore pumping capacity to 6.47MLD for the 2071 planning horizon (upgrade needed in 2051 with the upgrade sized for 2071 demand requirements). Note that the current consent and bore capacity could not be confirmed as part this study.
- A new 200mmID main in parallel to the existing 160mmID main, from the bore, 170m in length.
- Increasing the treatment capacity of the Waiohine WTP to 6.47MLD for the 2071 planning horizon (upgrade needed in 2051 with the upgrade sized for 2071 demand requirements). Note that the current treatment capacity could not be confirmed as part this study.

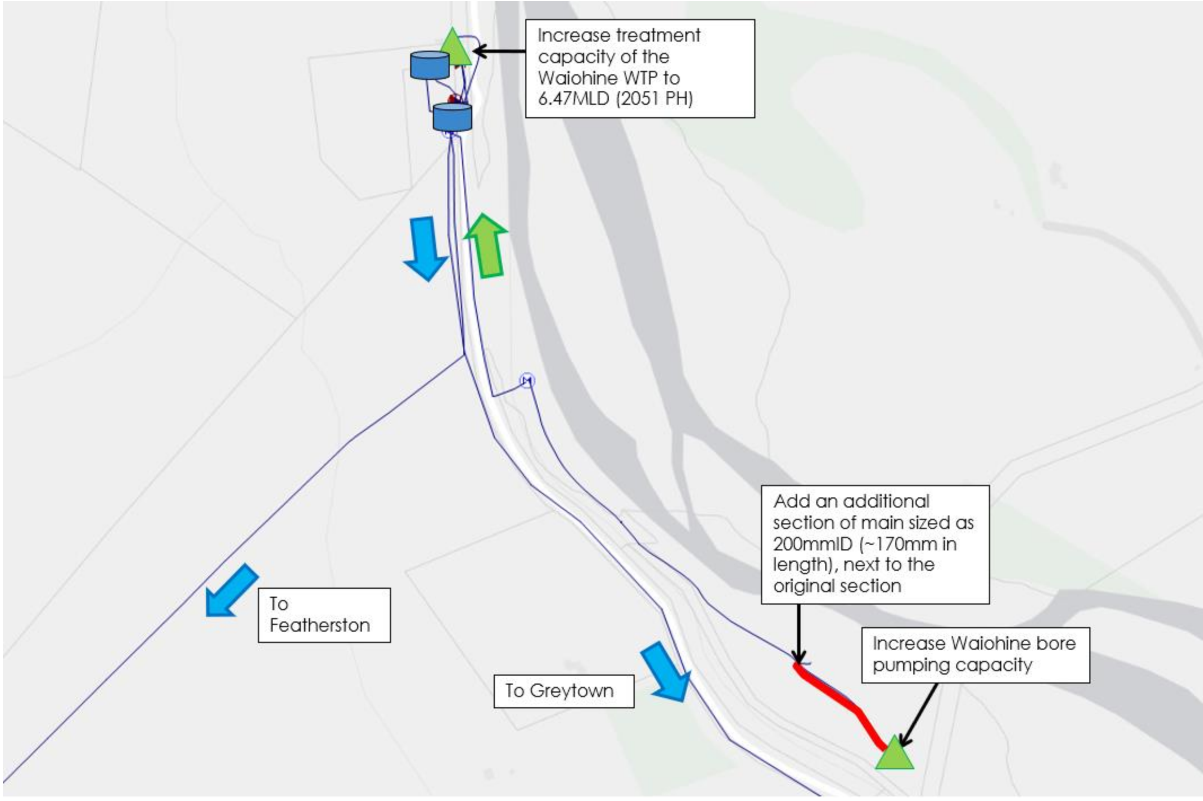


Figure 7-4: Waiohine Bores to TWR - Strategic Upgrade Options

The flow required from Waiohine bores and Waiohine WTP increases if Memorial Park WTP is off. Note that the current consent / bore / treatment capacity could not be confirmed as part this study. The scope of the Waiohine upgrades therefore depends on the status of Memorial Park. The pipe duplication, however, is required regardless. This is shown in Table 7-6.

Table 7-6: Waiohine WTP treatment capacity upgrade

	Memorial Park ON	Memorial Park OFF
2024 required Waiohine bore pumping capacity / WTP treatment capacity	2.46MLD (from Model Demand Analysis)	4.75MLD (from Model Demand Analysis)
2024 pipe duplication	YES	YES
2071 required Waiohine bore pumping capacity / WTP treatment capacity (upgraded needed from 2051)	3.87MLD	6.47MLD (from Model Demand Analysis)

This is required unless a new source is mobilized for Greytown and Featherston.

If these upgrades are not in place, the TWR is predicted to drain, leading to a loss of supply to both Greytown and Featherston.

7.4.3.3 TWR to Boar Bush - Strategic Upgrade Option

The model suggests that the network upstream of the Boar Bush Reservoir is unable to convey the equivalent of future peak day demand, leading to the reservoir draining in the 2051 and 2071 planning scenarios.

Modelling suggests it will be necessary to install a new booster pump between the TWR and Boar Bush Reservoir with a capacity of ~9kW. This option may work alongside Option 3 (as described below) to supply both Greytown Res and the Boar Bush Reservoir with a combined upgrade.

This strategic upgrade will be needed regardless of other strategic upgrades and will work with any of the options described below. This pump is one of the two pumps recommended in Option 2b.

7.4.3.4 TWR to Greytown Reservoir - Strategic Upgrade options

Option 0: Do Nothing

It is possible that, while the Greytown Reservoir drops to 40% full, it stays more or less at that level even under high demand.

There is only a small elevation difference between the TWR and Greytown Reservoir (TWR at ~114.7m and Greytown Reservoir at 113.7m, as shown in Figure 7-5), meaning that operational changes in the water level in the Greytown Reservoir have a noticeable impact on the head difference from the TWR to the Greytown Reservoir. Therefore, the lower the water level in the Greytown Reservoir, the higher the flow to the Greytown Reservoir.

If the capacity between the TWR and the Greytown Reservoir is indeed sufficient to maintain the 40% level, the volume of the Greytown Reservoir should be considered in conjunction with that of the TWR, which is very large. The concern of the low level in the Greytown Reservoir would be in "in principle" rather than a genuine risk to the operation of the reservoir.

The risks of this option are:

- It does not address the back-feeding to the Boar Bush Reservoir, leaving the risk of the Greytown Reservoir becoming empty under very high demand.
- The capacity may not be sufficient. This is hard to evaluate because of the complicated pipework between the TWR and Greytown Reservoir, the unknows and uncertainties surrounding the relative levels of the inlet / outlets, the internal diameters of pipes and the local losses.

Option 1: Non-Return valve

This option consists of installing a non-return valve on the inlet branch to the Greytown Reservoir. This would prevent back-feeding from Greytown Reservoir to Boar Bush Reservoirs.

The risk of this option is the capacity may not be sufficient.

The network schematic for this option is shown in Figure 7-5.

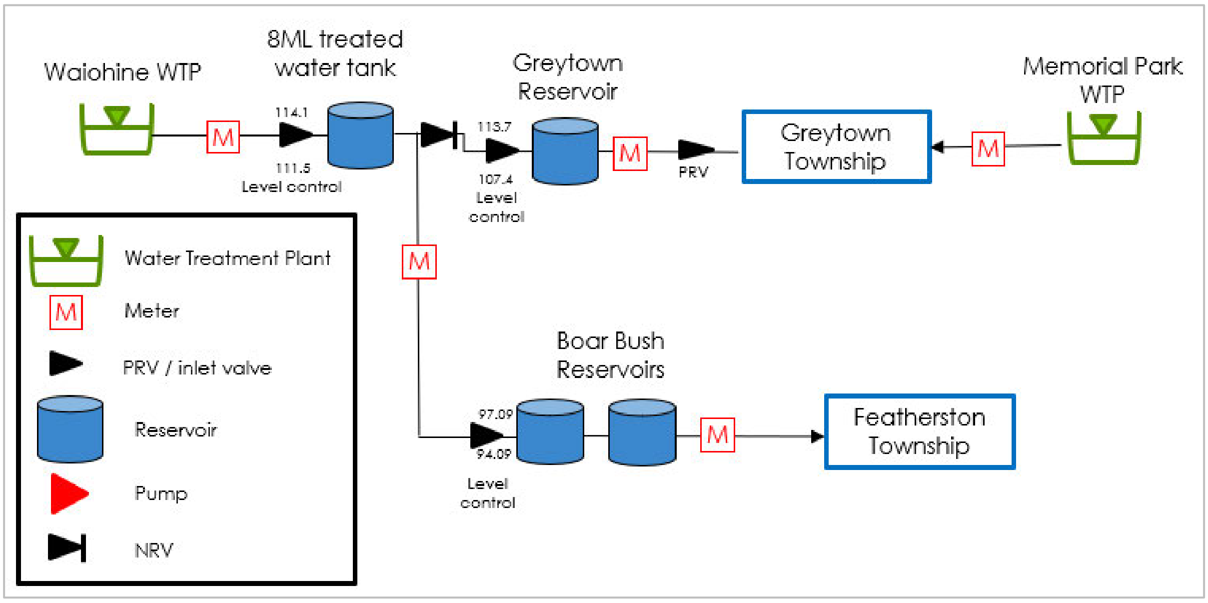


Figure 7-5: Featherston and Greytown Option 1 Schematic

Option 2: Combined Pump for Boar Bush and Greytown

This option consists in installing a pump in the currently empty pump shed. This would increase the capacity of both the Greytown Reservoir and Boar Bush Reservoirs. Depending on the duty point of the pump, it may be combined with Option 1: a non-return valve on the Greytown Res branch.

The network schematic for this option can be found in Figure 7-6.

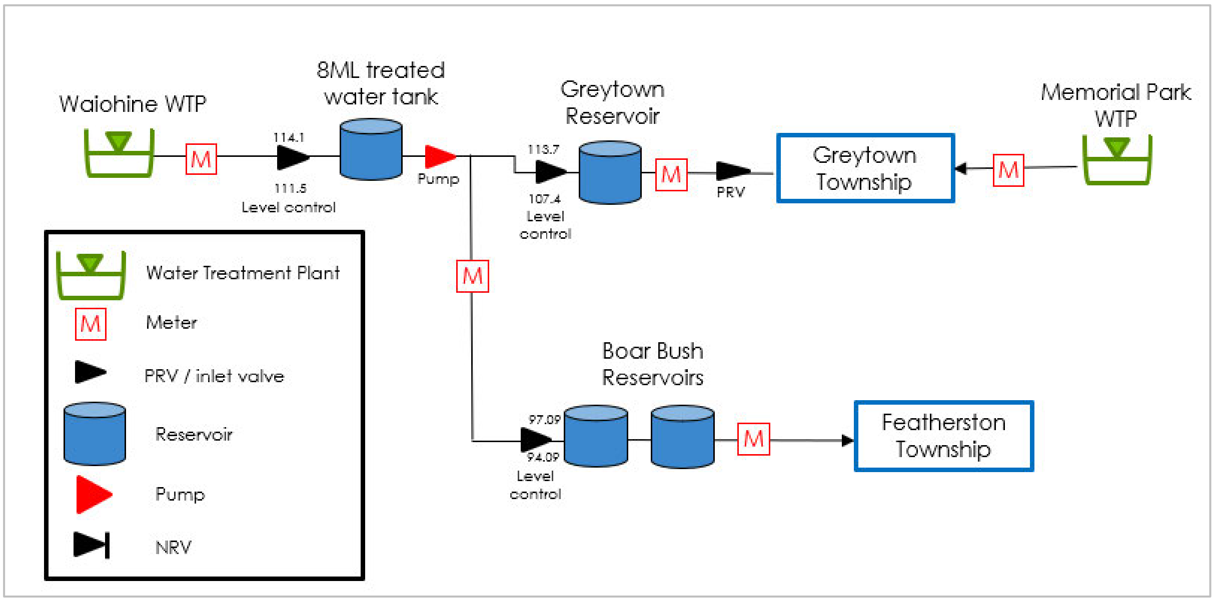


Figure 7-6: Featherston and Greytown Option 2 Schematic

Following discussion with Wellington Water, it was found that a single pump would be too problematic to design and operate and Option 2b may be more suitable.

Option 2b: Two pumps (S-UPG-08)

A more workable option would be to have two separate pumps on each branch – one solely controlled by levels in the Greytown Reservoir, and the other solely controlled by the levels in the Boar Bush Reservoir.

The risks of this option are:

- Because of the unknowns and uncertainties surrounding the relative levels of the inlets / outlets, the internal diameters of pipes and the local losses, hydraulic calculations could be complicated.
- It may not be practical because of the location of the space available in the pump shed, or other site constraints.
- Operation costs are likely to be the highest of the options identified due to the initial purchase cost, initial construction costs and then operations costs.

While operational costs are likely to be the highest with this option, having two pump stations will be easier to operate and maintain in the future.

This option may work to supply both the Greytown Reservoir and Boar Bush Reservoir or could be combined with Option 3 to supply both reservoirs.

The network schematic for this option can be found in Figure 7-7

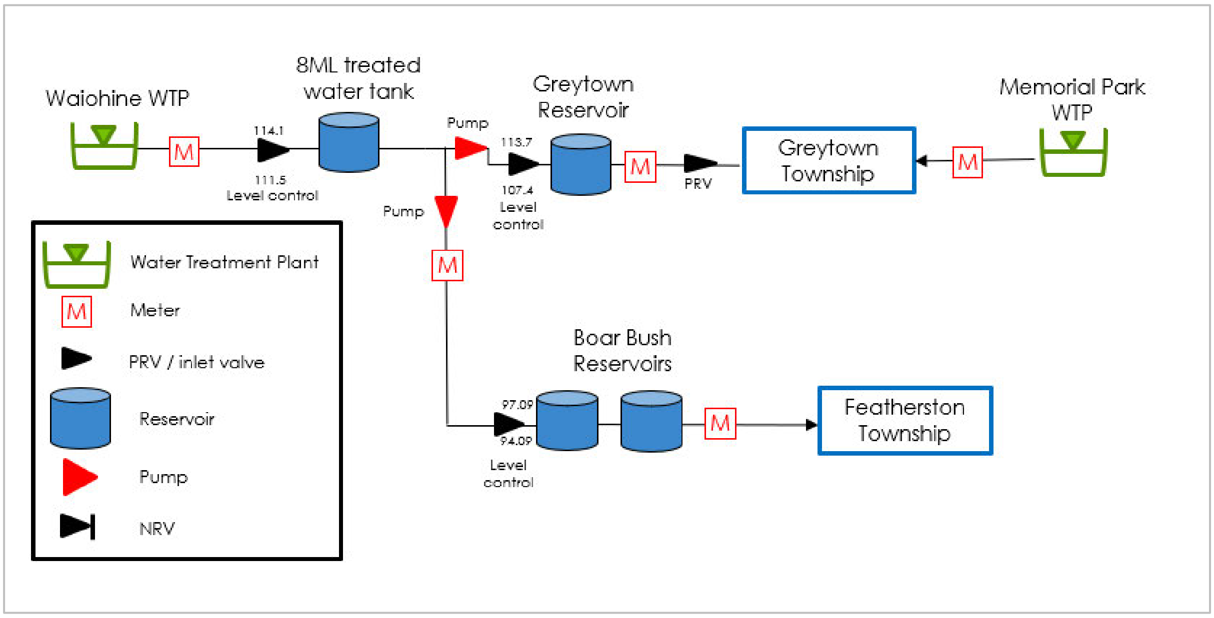


Figure 7-7: Featherston and Greytown Option 2b schematic

Option 3: Pump station for Boar Bush and Dedicated Inlet to Greytown

This option consists in creating a new inlet from the TWR to the Greytown Res and retaining the existing pipe section entirely for the Boar Bush Reservoir. This would increase the flow from the TWR to the Greytown Res and also prevent back-feed to the Boar Bush Reservoirs.

The risks of this option are:

- It may not be practical because of the need to cut into the TWR. This would require the TWR to be empty.
- It may not be practical because of the location of the pipes and valve chambers.

Penetrating the TWR to create a new inlet to the Greytown Reservoir will be very challenging and will require the TWR to be empty. This option will require the Timber Tank to be temporarily in place during works.

Estimating the hydraulic capacity of this option is comparatively more reliable because it eliminates the unknowns and uncertainties of the existing pipework between the TWR and the Greytown Res. This is shown in Figure 7-8.

As well as having dedicated inlets, another option would be to add a bypass around the Greytown Reservoir. This would provide Operations with added flexibility and simplify the maintenance of the Greytown Reservoir.

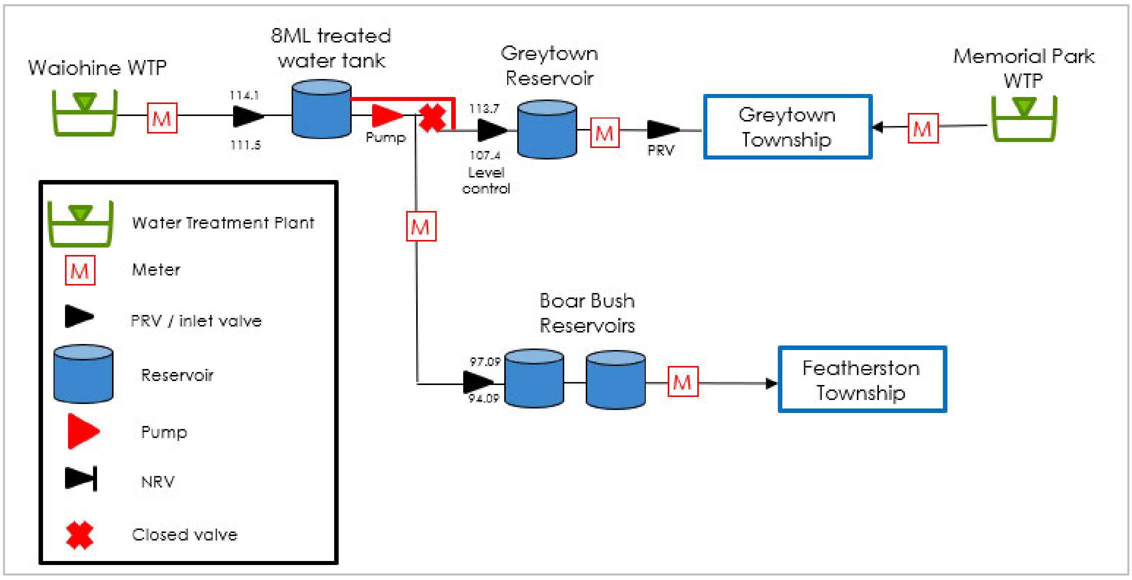


Figure 7-8: Featherston and Greytown Option 3 Schematic

Option 3b: Tee out of the TWR

A more workable option may be to create a dedicated inlet straight out of the tee of the TWR, downstream of the outlet valve, if feasible. This would ensure the TWR would be able to continue to operate.

The risks are similar as with Option 3 except the TWR would be able to continue to operate.

The network schematic for this option can be seen in Figure 7-9.

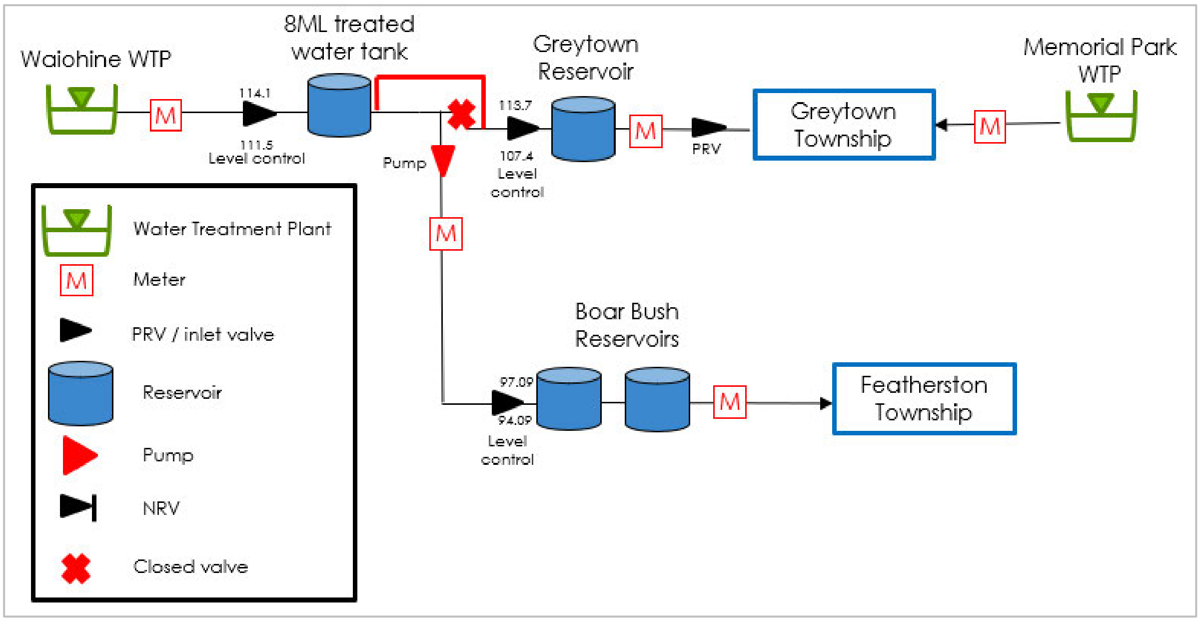


Figure 7-9: Featherston and Greytown Option 3b Schematic

7.4.3.5 Conclusion on strategic upgrades

Based on the information available, the recommended configuration for strategic upgrades between the TWR, Greytown Reservoir and the Boar Bush Reservoirs is Option 2b: Two Pumps. This configuration seems the most workable and will require the least amount of disruption to the network.

However, at the time of writing, the strategic upgrades decision will require further investigation, outside of this project.

For the purpose of the system performance assessment, it is only required that both Boar Bush and Greytown Reservoirs remain replenished. To enable the system performance assessment, the following strategic upgrades were assumed in the 2051 and beyond planning horizon (shown in Figure 7-10):

- Upgrade to bore capacity, bore rising main duplication.
- Upgrade capacity from TWR to Boar Bush and Greytown reservoirs by Option 2b - two pumps:
  - A pump station for Boar Bush Reservoir, controlled by water level in the Boar Bush Reservoir.
  - A pump station for Greytown Reservoir, controlled by water level in the Greytown Reservoir

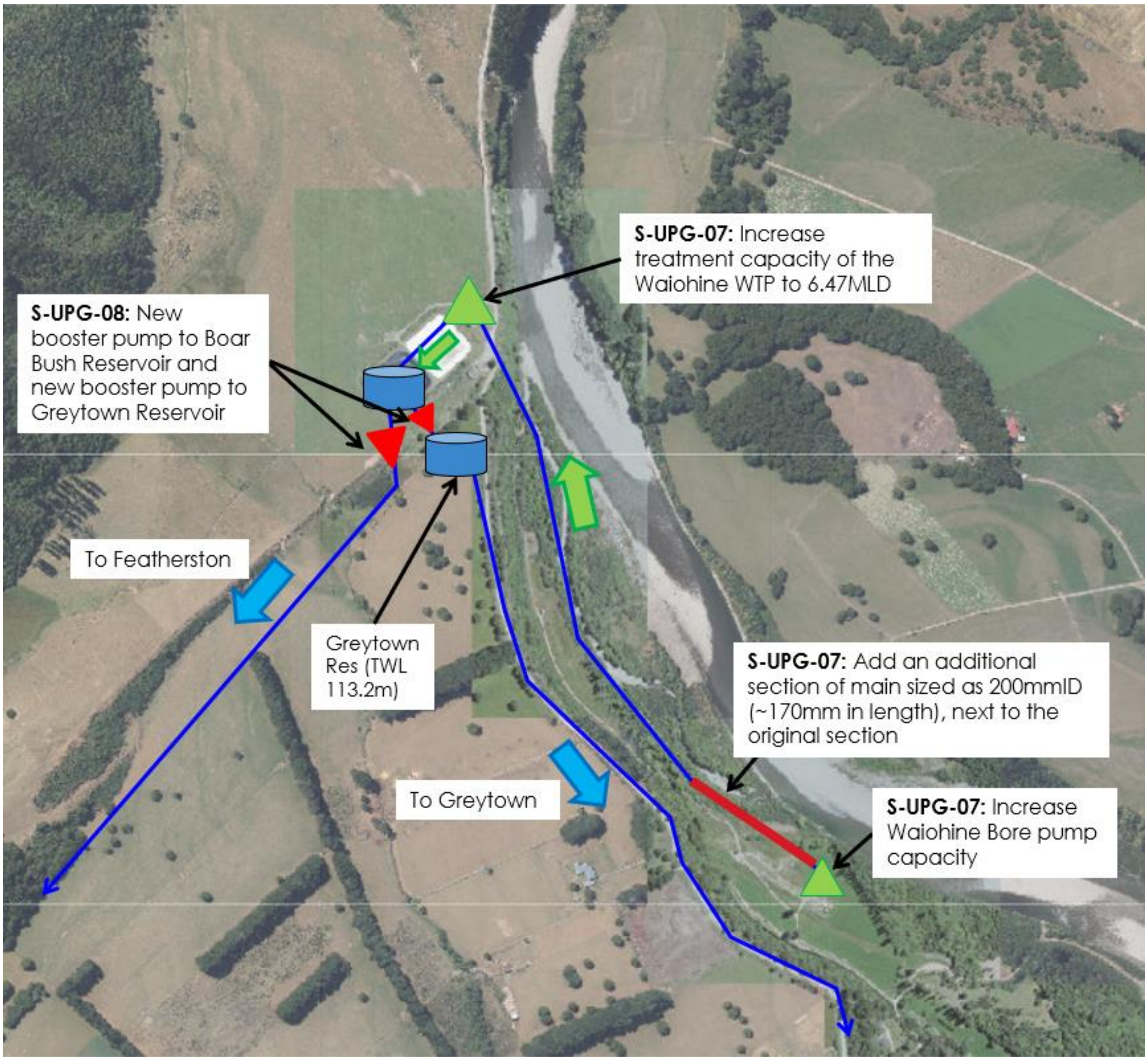


Figure 7-10: All Strategic Upgrades required

7.5 PERFORMANCE CRITERIA

The model **SWDC MPL04 – Featherston and Greytown** was used for the performance assessment.

This section defines the performance criteria that were used to assess the capacity of the network to accommodate growth in next 50 years.

7.5.1 Pressures

Pressures have been assessed at the customer point level rather than at the model node level, as this avoids confusion over nodes on parts of the network where there are no customers (e.g., near reservoirs). However, customer points are modelled at the centroids of properties, whereas the levels of service technically apply to water pressure at property boundaries. The maps therefore sometimes show issues with pressures on individual large properties where levels of service are in fact met.

For the purposes of this study, areas have been identified where there are groups of 5 or more customers where pressure drops below 25m under peak day demand. However, due to the extremely hilly nature of the area existing deficiencies are common, and some prioritisation is required to develop a realistic plan for network development.

Based on discussions and agreement with Wellington Water, following Table 7-7 has been used to categorise severity of the pressure deficiencies based on number of properties and minimum pressure range and trigger for upgrades has been suggested.

Table 7-7: Pressure deficiency category and trigger for upgrades

Criteria	<10m min. pressure	10-15m min. pressure	15-20m min. pressure	20-25m min. pressure
>15 properties	Severe	Severe	Severe	Medium
10-15 properties	Severe	Severe	Medium	Medium
5-10 properties	Medium	Medium	Minor: do not seek **Capital** upgrade	Minor: do not seek **Capital** upgrade
0-5 properties	Medium	Minor: do not seek **Capital** upgrade	Minor: do not seek **Capital** upgrade	Minor: Not reported

Pressure deficiencies were identified in the current and 2071 planning horizons.

7.5.2 Fire Flows

The Specs state that the network must have the capacity to meet the requirements of the New Zealand Fire Service Firefighting Supplies Code of Practice SNZ: PAS 4509:2008 (known as the Fire Code).

7.5.2.1 Initial Fire Class

The Fire Code states that the required fire flow depends on the fire class of a building, which in turn depends on several characteristics which will vary from building to building, including the size of rooms (fire cells) and what that building will be used for.

A data set of all buildings in the region has been supplied by WWL. This has been used as a basis for an automated fire flow assessment, as set out below:

- Fire Hazard Classifications for each building, supplied by WWL.
- Building footprints from the CoreLogic data set - The largest fire cell size of each building was calculated from the footprint area, assuming as a worst-case that the building contains only one room equal in area to the building footprint.

7.5.2.2 Assessment methodology

The Fire Code also states how far a hydrant can be located from a building in order to serve as a source of fire flow for that building.

To assess compliance, the available fire flow at each hydrant in the model was determined from modelling. Properties (with fire class assigned) and the hydrant flows were then exported from the model and imported to Stantec's fire flow assessment webtool.

In broad terms, the webtool uses GIS processes to check the distance of each property from the road, and then check the distance along the road to nearby hydrants. From this information, the webtool determines for each building whether the fire flow available within the allowable distance meets Fire Code requirements.

- If more than 110% of the required flow is available from nearby hydrants, the building is considered compliant.
- If between 90% and 110% of the required flow is available from nearby hydrants, the building is considered marginal.
- If less than 90% of the required flow is available from nearby hydrants, the building is considered non-compliant.

Each fire class requires a certain flow rate to be available from hydrants within 135m, and an additional flow rate to be available within 270m. The modelling analysis undertaken for the ZMP looks at both modelled hydrant flows and distances from properties to hydrants.

This assessment provided a list of deficiencies across the network, some of which can be addressed by network upgrades and some of which may be caused by other issues. Severity of the deficiency has been assigned based on the fire flow requirement at the property and whether it is because of insufficient network capacity or just the long driveway or insufficient number of hydrants issue.

7.5.2.3 Long Driveways

In several cases, the network capacity is sufficient to supply required fire flow to properties in the vicinity, but the location of some properties relative to the hydrants is such that they do not meet fire code requirements. Examples of this are properties with long driveways where the properties themselves are more than 135m away from the water network and are therefore non-compliant. Similarly, there may be network capacity but insufficient number of hydrants to supply required fire flow. These properties have been identified, but no network upgrades are proposed.

7.5.3 Storage

Wellington Water's 'Regional Standards for Water Supply' states that storage requirements for water supply reservoirs need to be considered in terms of operational and seismic resilience.

A. Operational Resilience –

Operational emergency storage is required in the event of a source contamination, a bulk network failure, or the outage of pumps / rising mains system to the study area.

Total reservoir capacity should meet the following criteria for operational resilience:

- Twice the total Average Day Demand (ADD) where existing demand is known.
- Peak Day Demand (PDD) + 20% + Fire Fighting Storage requirements where existing demand is known.
- 700 l/person storage where existing demand is unknown (i.e. greenfield areas).

B. Seismic Resilience –

The storage required for seismic resilience is intended for a minimal consumption from Day 7 to Day 30. 70% of the nominal storage must be sufficient to supply 20 l/person/day, as well as critical users and businesses with various levels of priority.

This is summarised as follows:

- From Day 8 to Day 30:
  - Public distribution points
  - Critical Users Category 1 (Civil Defense centers, major hospitals, lifelines)

- From Day 14 to Day 30:
  - Critical Users Category 2 (aged care facilities, medical centers)

- From Day 21 to Day 30:
  - Critical Users Category (education)

Storage assessment is done for all planning horizons – current and future peak day.

7.5.4 Reservoir Replenishment

All reservoirs should replenish to their start levels after 24 hours on a peak summer day.

7.6 PLANNED RENEWALS – FEATHERSTON

Wellington Water Operations has provided a list of renewals already planned for Featherston. These are shown in Figure 7-11.

Renewal 4, 5, 10 and 11 have been identified as part of upgrade F-UPG-03 and will be further discussed in Section 7.11.1.

At the time of writing there are no renewals planned for Greytown.

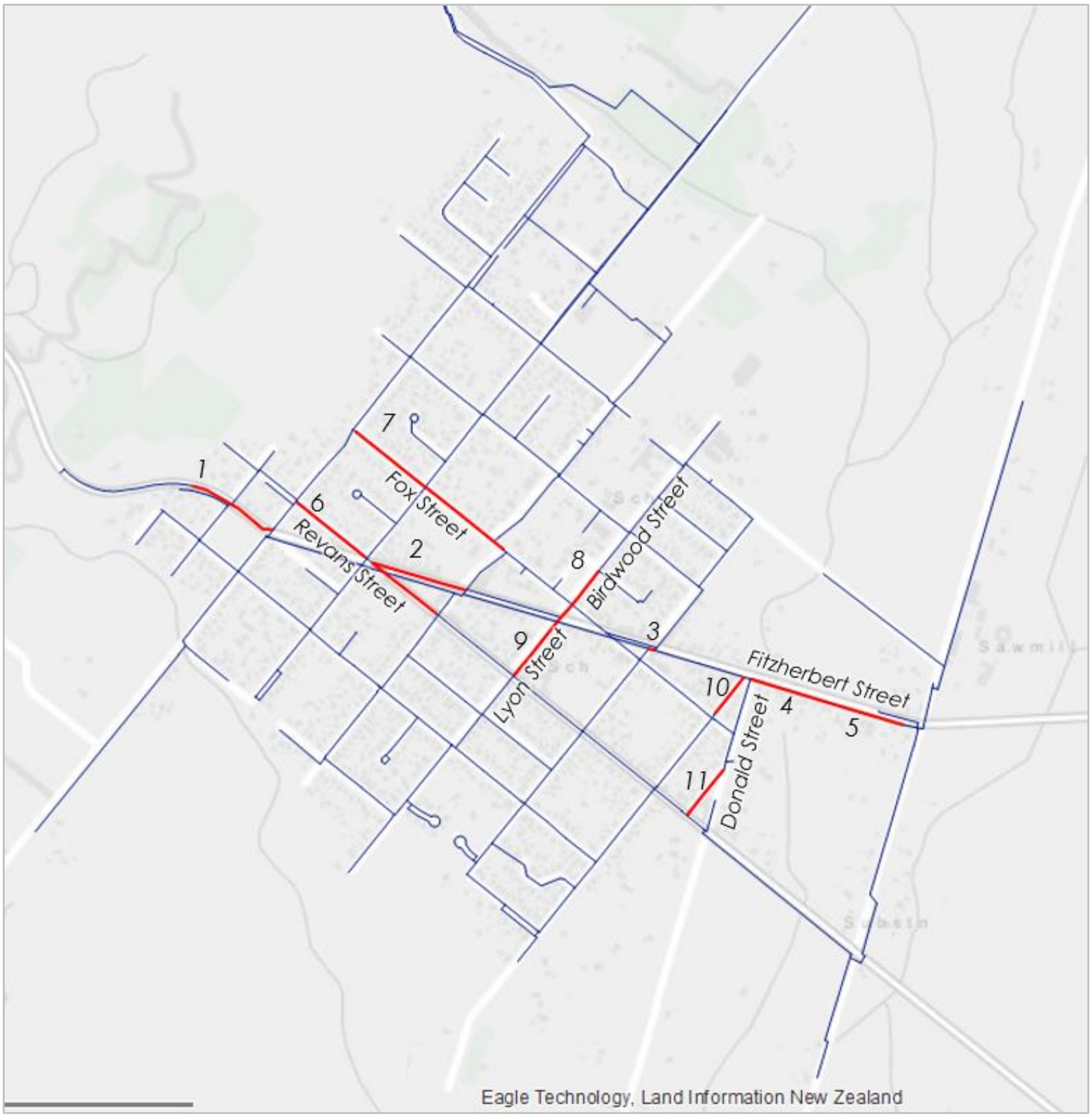


Figure 7-11: Planned Pipe Renewals in Featherston

Table 7-8: Planned Renewals for Featherston

No.	Road	Start	End	Diam.	Material	Year	Length (m)	Proposed as part of ZMP
1	Ludlam St	Hart Street Valve	Watt St	100mm	RCON	1981	225	
2	Fitzherbert St	Wakefield St	Daniell St	100mm	RCON	1981	235	
3	Fitzherbert St	Across the Wallace St Intersection		100mm	RCON	1981	20	
4	Fitzherbert St	Donald St Valve	Branch at 130 Fitzherbert St	100mm	RCON	1981	130	Upsize to 150mmID
5	Fitzherbert St	Branch at 130 Fitzherbert St	Boundary Rd	100mm	RCON	1981	278	Upsize to 150mmID
6	Revans St	Watt St valve	Fitzherbert St Intersection	100mm	RCON	1981	365	
7	Fox St	Watt St Intersection	Daniell St Intersection	100mm	PE100	2021	430	
8	Birdwood St	Bell St Intersection	Fitzherbert St Intersection	100mm	RCON	1981	270	
9	Lyon St	Revans St Intersection	Fitzherbert St Intersection	100mm	RCON	1981	170	
10	Waite St	Fitzherbert St	Fox St Intersection	100mm	RCON	1981	100	Upsize to 150mmID
11	Crawford St	Donald St	Revans St	100mm	RCON	1981	140	Upsize to 150mmID

7.7 SYSTEM PERFORMANCE – FEATHERSTON

7.7.1 Minimum pressure

In Featherston, under current peak day demand, modelling shows an area of low pressures in the north-west edge of the town (Figure 7-12) which are due to the properties being at high elevations relative to the Boar Bush Reservoir.

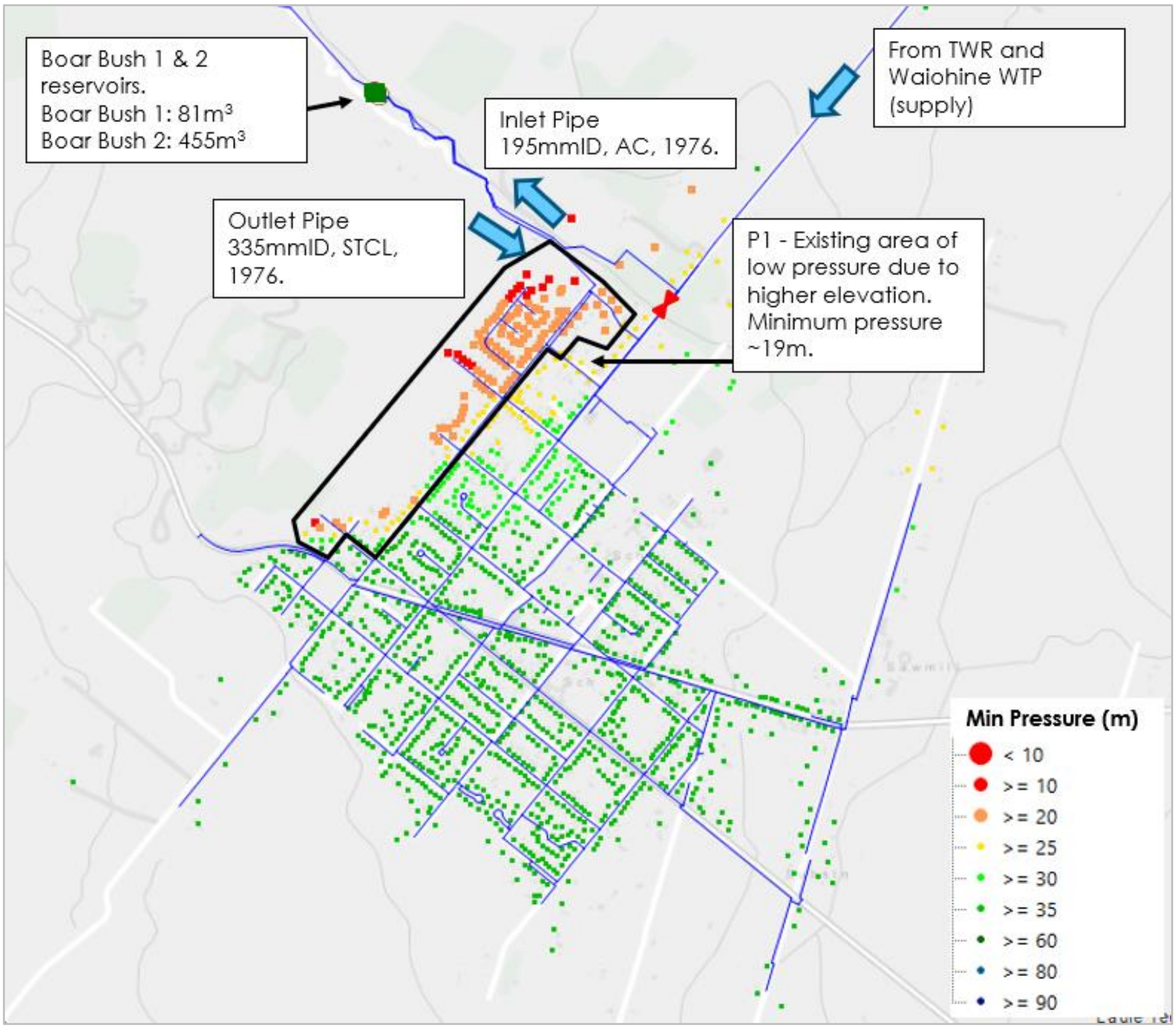


Figure 7-12: Featherston minimum pressure in the current planning horizon

This is predicted to worsen as population and water use increase in future planning horizons. The P1 area affects approximately 152 properties under current peak day demand, increasing to 302 in the 2031 planning horizon (Figure 7-13). Issue P1 may be resolved by upgrade UPG-01 (Section 7.10.1).

Additionally, the model indicates an area of low pressure in the south-east – however, this is due to a very small increase in demand at the end of a 700m long 25mm diameter steel pipe. This is not considered to be a genuine issue: if development occurs at this location, it must be accompanied by an extension of the reticulated supply.

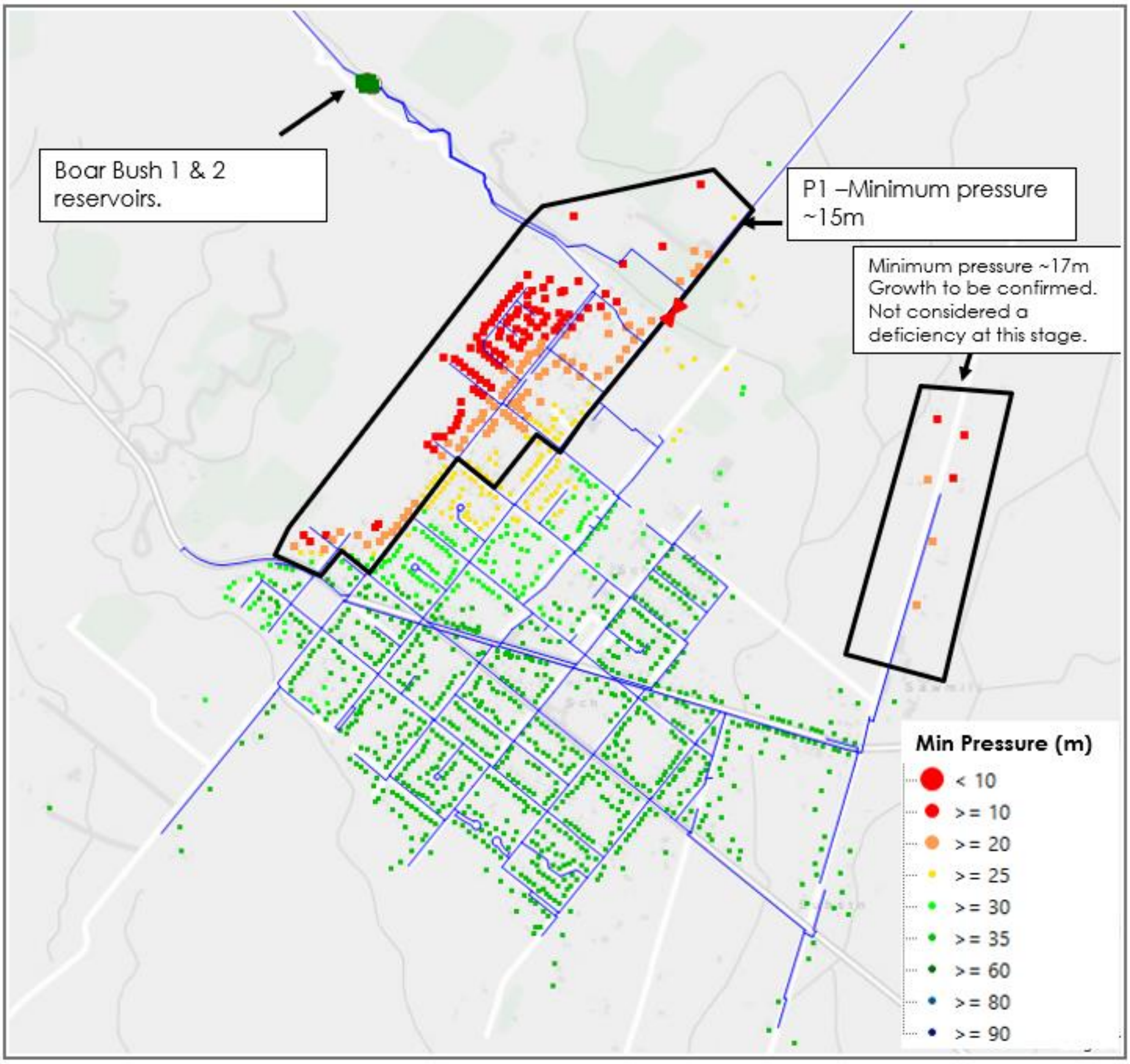


Figure 7-13: Featherston minimum pressure in the 2031 planning horizon

In the 2051 planning horizon, the predicted growth in demand leads to an instant peak flow of approximately 60 l/s through the Boar Bush Reservoir outlet pipe, causing a head loss of 25m/km. This in turn results in extremely low pressures across the entire distribution network.

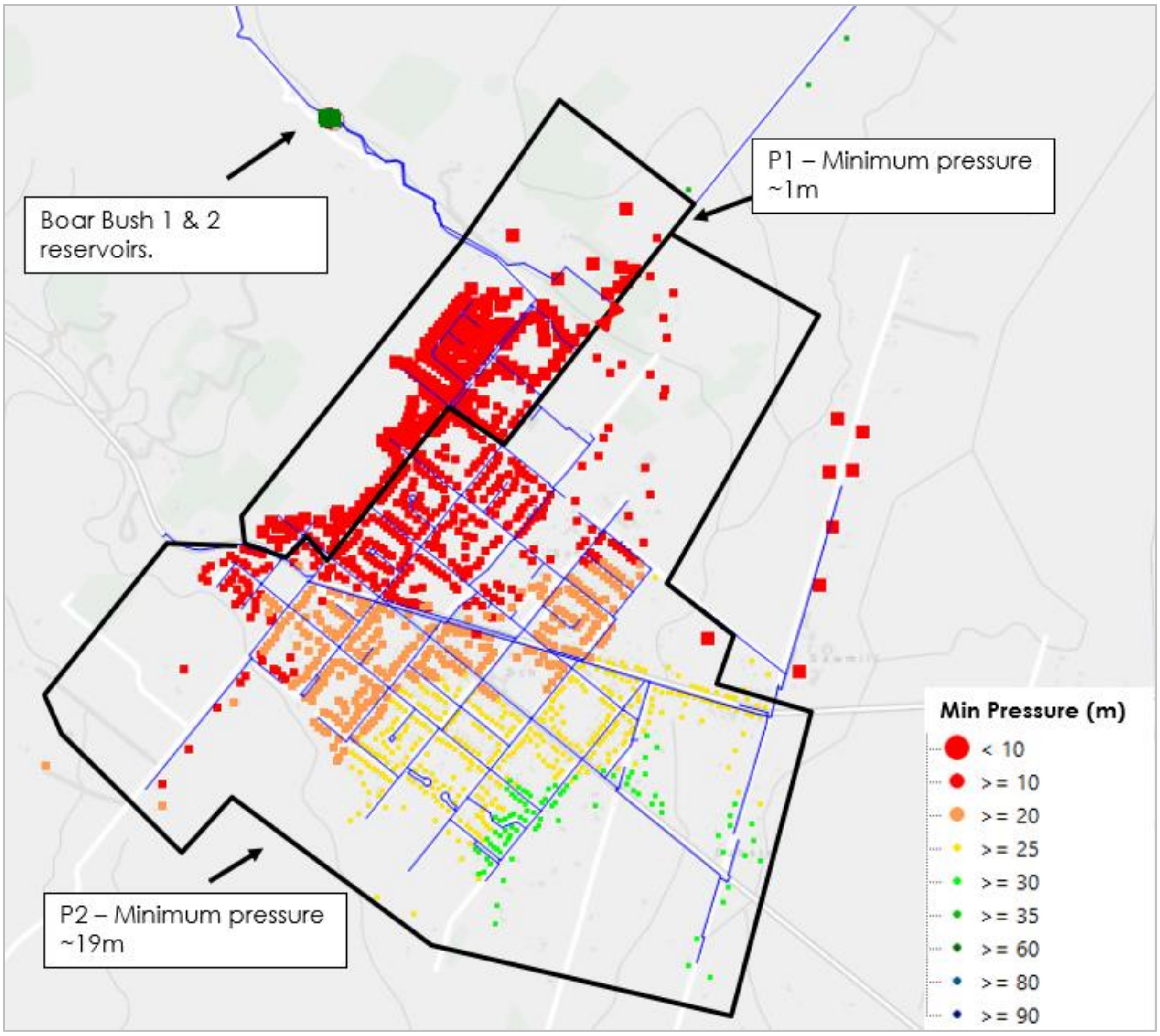


Figure 7-14: Featherston minimum pressure in the 2051 planning horizon

In the 2071 planning horizon, this worsens to widespread loss of supply across the entire network.

This issue is resolved by upgrade UPG-02 (Section 7.10.2).

7.7.2 Fire compliance

Figure 7-15 shows the fire compliance under current peak day conditions.

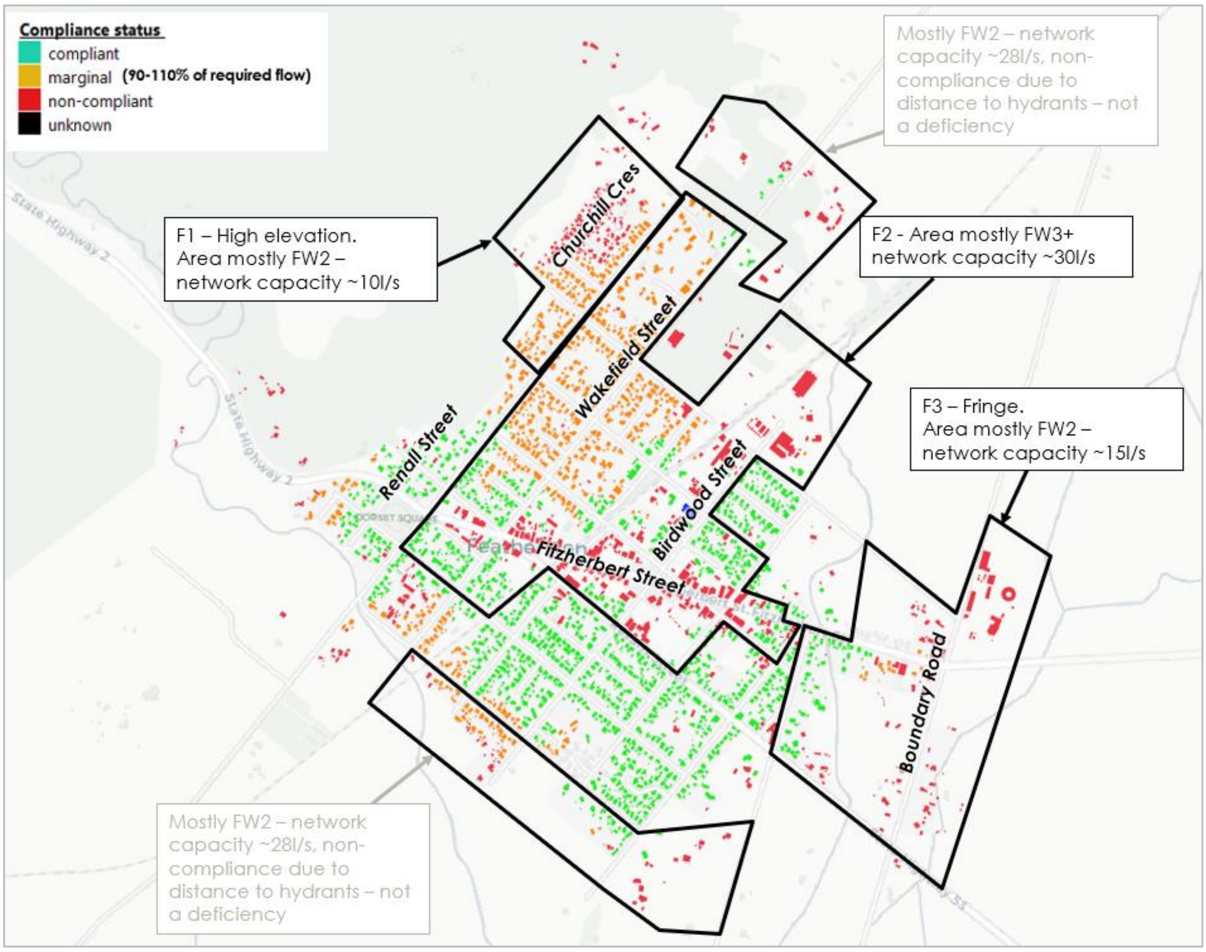


Figure 7-15: Featherston 2021 Fire flow compliance

7.7.2.1 F1 – Churchill Crescent

As shown in Figure 7-15, there are approximately 152 properties at Churchill Crescent and Renall Street that fail to meet the fire flow compliance standards. This is mainly driven by the small difference in elevation with the Boar Bush Reservoir.

This may be addressed by upgrade UPG-01 (Section 7.10.1).

7.7.2.2 F2 – Fitzherbert Street and end of Birdwood Street

The non-compliant area around Fitzherbert Street and the end of Birdwood Street is mostly FW3. This area fails to meet the fire flow compliance standards as the network capacity does not support enough flow to meet the 50l/s standard for FW3. The network capacity in this area is approximately 30l/s.

This is addressed by upgrade UPG-02.

7.7.2.3 F3 – Eastern end of Fitzherbert Street and Boundary Road

There are approximately 80 properties at the eastern end of Fitzherbert Street and Boundary Road that are non-compliant due to insufficient flow. The network capacity in this area is as low as 15l/s.

This is addressed by upgrade F-UPG-03.

7.8 SYSTEM PERFORMANCE – GREYTOWN

7.8.1 Minimum Pressure

In Greytown under current peak day demand with the Memorial Park WTP ON all properties achieve the minimum 25m pressure requirements (Figure 7-16). There are approximately 7 customer points to the north where pressure drops below 30m, but these still achieve minimum requirements.

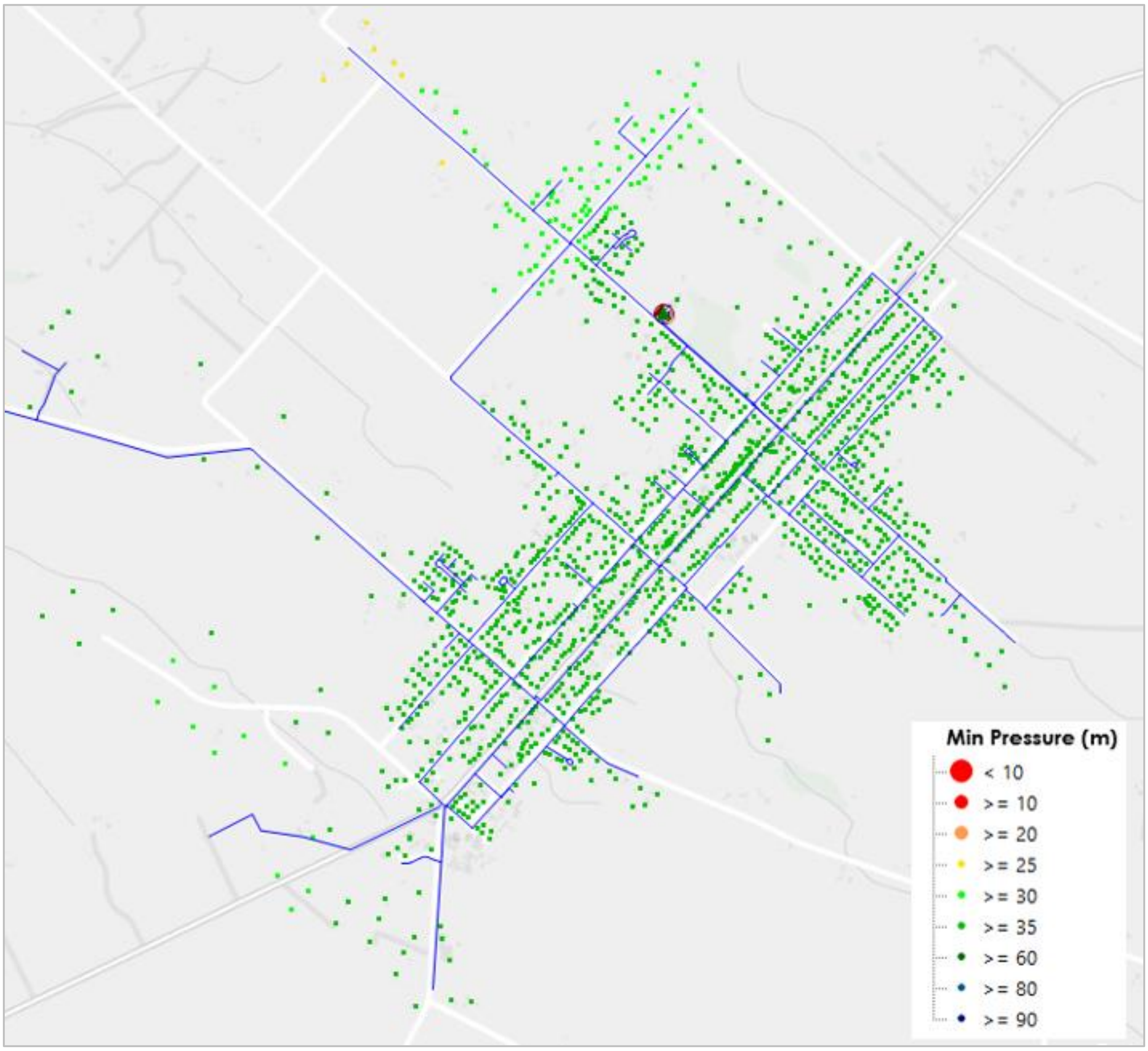


Figure 7-16: Current peak day pressure (m) in Greytown with Memorial Park WTP ON

Pressures under the current peak day demand with the Memorial Park WTP OFF are still above 25m, however, the marginal area to the north where pressures drop below 30m gets slightly bigger.

In the 2071 planning horizon with the Memorial Park WTP ON there is little change in minimum pressures. With the Memorial Park WTP OFF there is a small area of low pressure to the north, as shown in Figure 7-17.

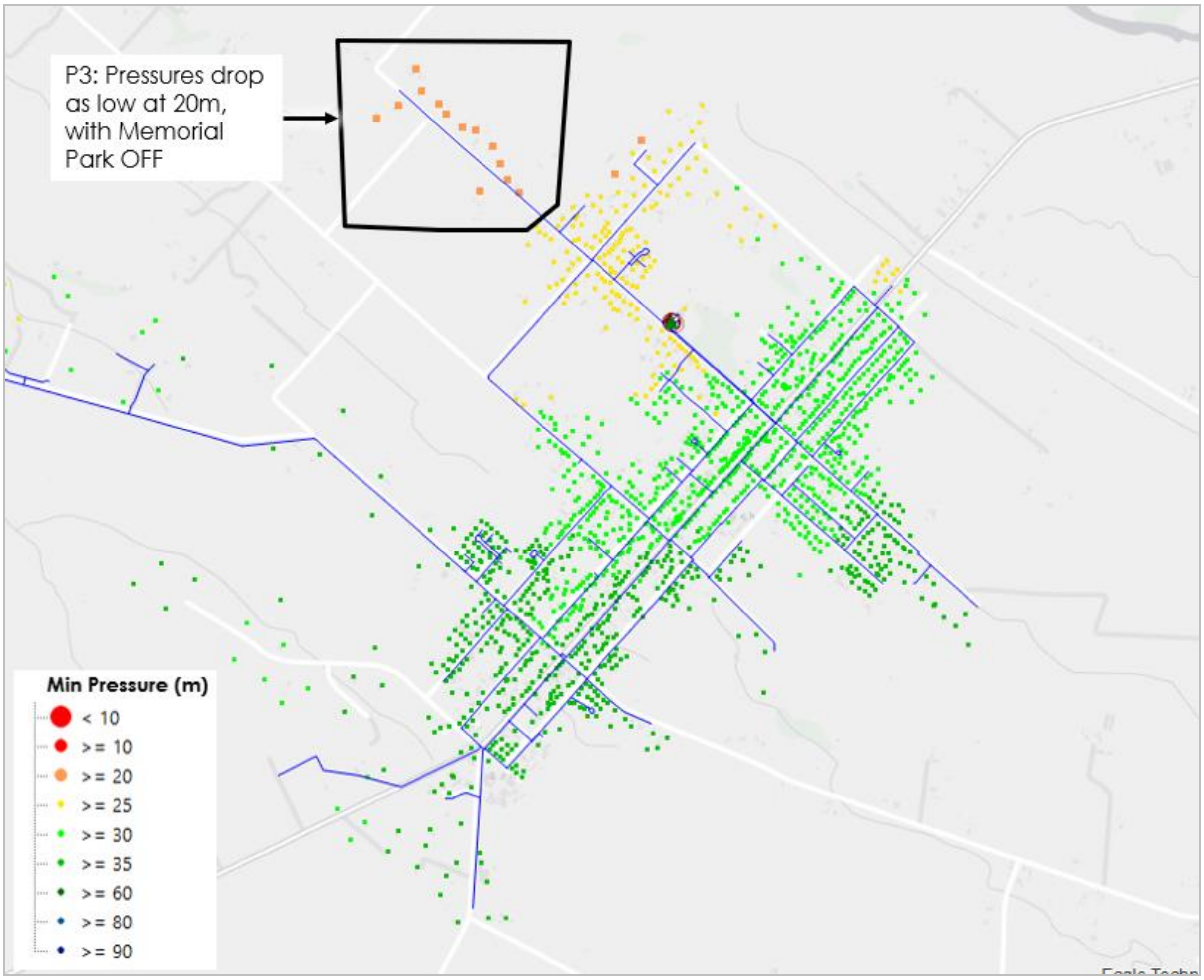


Figure 7-17: Future peak day (2071) pressure (m) in Greytown with Memorial Park OFF

7.8.2 Fire compliance (Memorial Park WTP ON)

Figure 7-18 shows the fire compliance under current peak day conditions with the Memorial Park WTP ON.

7.8.2.1 F4 – Kuratawhiti Street

As shown in Figure 7-18 there are approximately 250 properties on Kuratawhiti Street that fail to meet the fire flow compliance standards. This is mainly driven by low network flow, however some properties do not have sufficient hydrants within 270m.

This may be addressed by upgrade F-UPG-04 (Section 7.11.2)

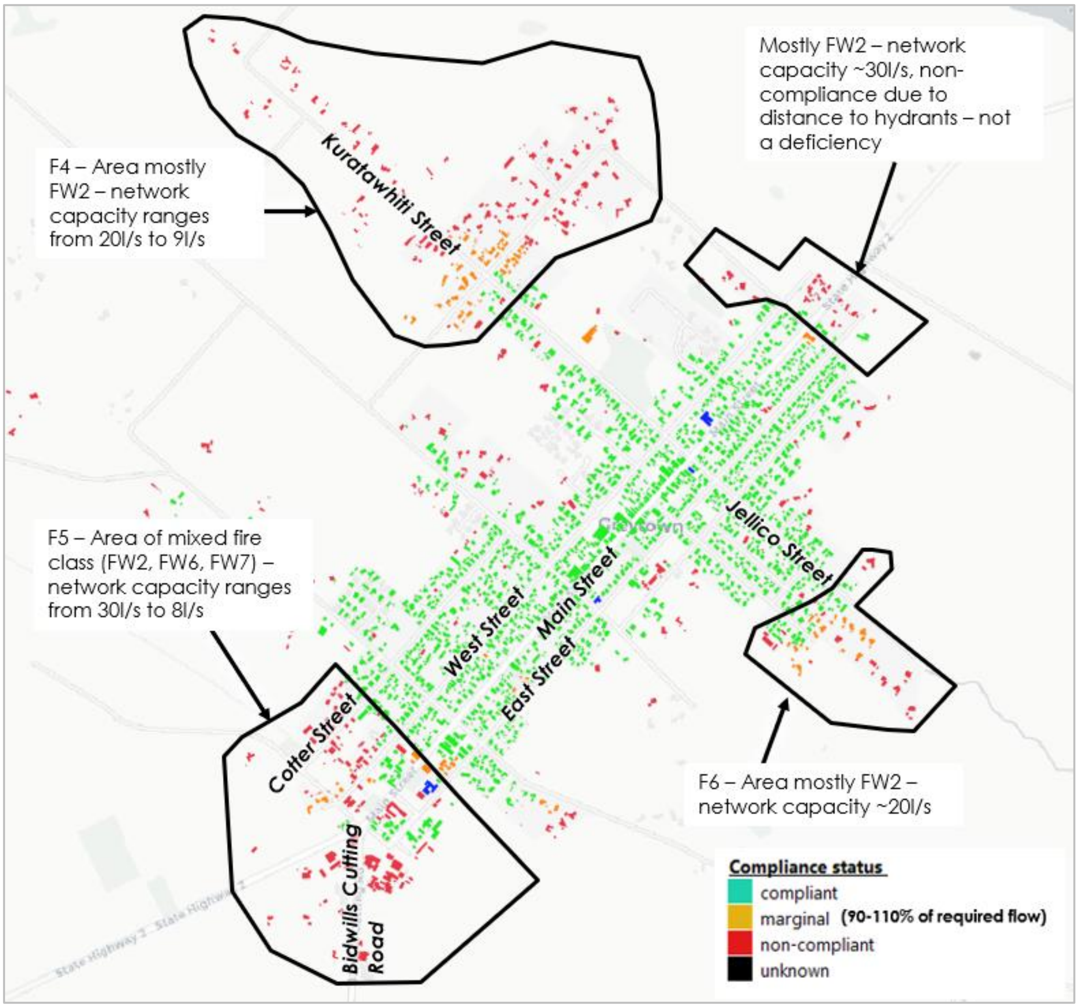


Figure 7-18: Greytown 2021 Fire Flow compliance with Memorial Park WTP ON

7.8.2.2 F5 – Western end of Greytown

The non-compliant area around the western end of Greytown (Cotter St, West Street, Main St, Bidwills Cutting Rd) has a range of fire class, mostly FW2 with some FW6 and FW7 buildings (including a few hotels, Kuranui School and Ultimate Care Palliser House). This area fails to meet fire flow compliance standards as the network capacity does not support enough flow to meet the 25l/s requirement for FW2 or the flow requirements for the FW6 / FW7 buildings.

This is addressed by upgrade F-UPG-05 (Section 7.11.3)

7.8.2.3 F6 - Eastern end of Jellicoe Street

There are approximately 84 properties at the eastern end of Jellicoe Street that are non-compliant due to insufficient flow. The network capacity in this area is as low as 18l/s.

This is addressed by upgrade F-UPG-06 (Section 7.11.4)

7.8.3 Fire Compliance (Memorial Park WTP OFF)

When Memorial Park WTP is off, the extremities of the network do not meet requirements. The network cannot provide the 50l/s required to support FW3 in the center of town.

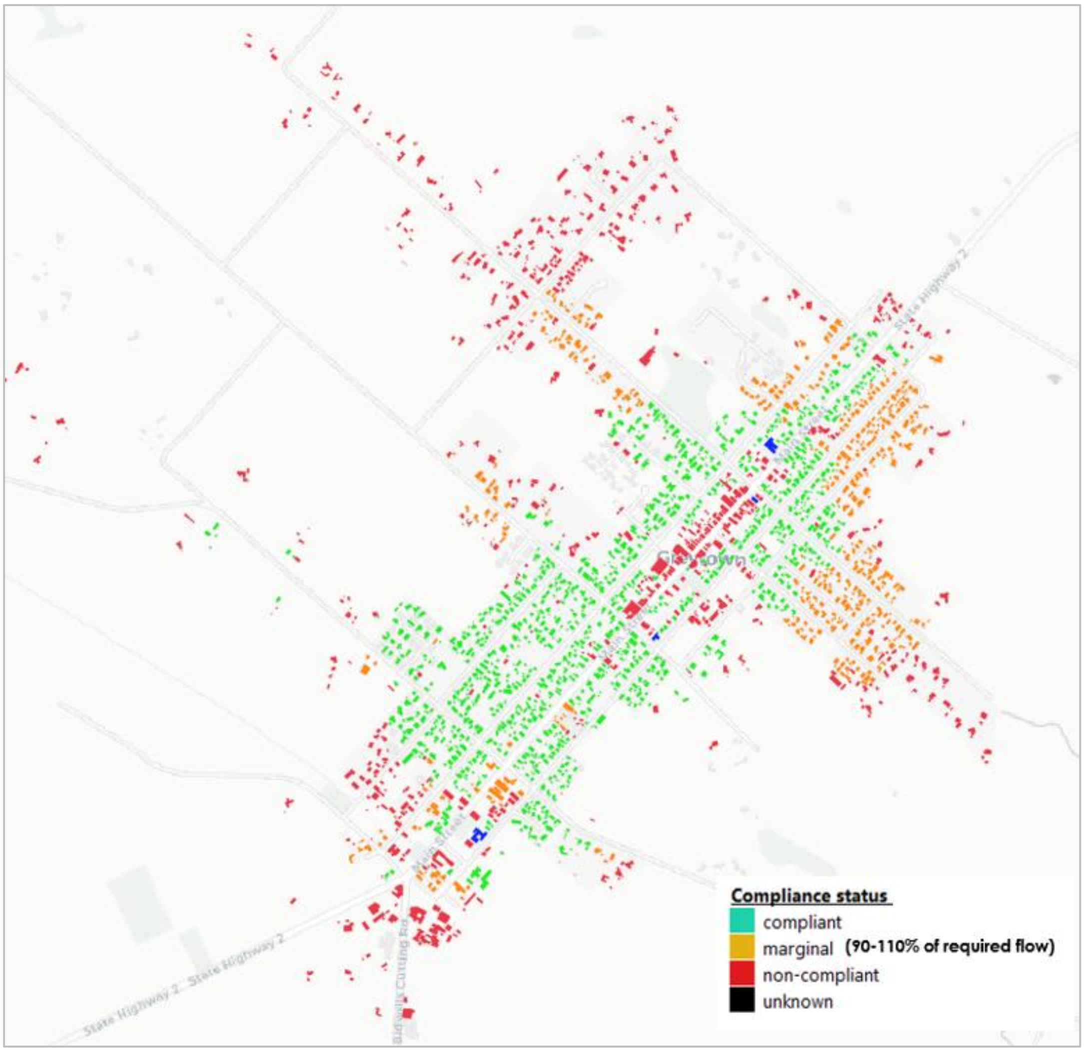


Figure 7-19: Greytown Fire flow compliance with Memorial Park WTP OFF

7.9 SUMMARY OF DEFICIENCIES

Table 7-9 shows the summary of deficiencies as described above. Section 7.10 and 7.11 describes each proposed upgrade.

Table 7-9: Greytown/Featherston summary of deficiencies

No.	Location	Town	Approx. properties affected	Planning Horizon	Comments	LoS failure	Associated Upgrade
P1	Churchill Crescent and Renall Street	Featherston	~152 in 2021 increasing to ~302 in 2031	2021	Existing low pressures due to properties at high elevations	Pressures range from <25m to ~25m	UPG-01
P2	Rest of Featherston	Featherston	~640 in 2051 increasing to ~870 in 2071	2051	Low pressures due to draining reservoir and high headlosses	Minimum pressure drops below 0m in 2071	UPG-02
P3	North end of Kuratawhiti Street	Greytown	~20 in 2071	2071	Low pressures due to network capacity	Minimum pressure drops below 20m	F-UPG-04
F1	Churchill Crescent	Featherston	~152	2021	Non-compliant fire flows due to high elevation.	Network capacity ~10l/s	UPG-01
F2	Fitzherbert Street and end of Birdwood Street	Featherston	~304	2021	Area mostly FW3, non-compliant due to insufficient network capacity	Network capacity ~30l/s	UPG-02
F3	Boundary Road	Featherston	~80	2021	Area mostly FW2, with some FW3 properties. Non-compliant due to insufficient	Network capacity ~15l/s	F-UPG-03

No.	Location	Town	Approx. properties affected	Planning Horizon	Comments	LoS failure	Associated Upgrade
					network capacity		
F4	Kuratawhiti Street	Greytown	~250	2021	Area mostly FW2. Non-compliant due to insufficient network capacity.	Network capacity as low as 8l/s	F-UPG-04
F5	Western end of Greytown	Greytown	~350	2021	Area of mixed fire class (FW2, FW6, FW7). Non-compliant due to network capacity	Network capacity as low at 9l/s, ranging to ~30l/s.	F-UPG-05
F6	Eastern end of Jellicoe St	Greytown	~84	2021	Area mostly FW2. Non-compliant due to network capacity	Network capacity ~18l/s.	F-UPG-06

7.10 PRESSURE UPGRADES

Pressure upgrades were identified in the 2071 planning horizon based on pressure deficiencies described in Sections 7.7.1 (Featherston) and 7.8.1 (Greytown), as well as fire flow deficiencies as described in Sections 7.7.2 (Featherston), 7.8.2 (Greytown – Memorial Park WTP ON) and 7.8.3 (Greytown – Memorial Park WTP OFF).

Please note that all upgrades indicated for Greytown are needed even with the Memorial WTP ON.

7.10.1 UPG-01 - Churchill Crescent and Renall Street

Churchill Crescent and Renall Street are at a higher elevation relative to the Boar Bush reservoirs. The Boar Bush reservoirs are at an elevation of 97m, and the Churchill Crescent and Renall Street properties range in elevation from ~62m to ~70m. This means the network can only deliver between 35m and 27m of head, which is not enough to support these properties. This also leads to non-compliance with the Fire Code and pressure requirements.

A pipe upsize from 100mmID to 200mmID along Churchill Cres can resolve the fire deficiency in the current peak day. However, to meet normal operation pressure requirements, a local booster pump will be needed in addition to the pipe upsize. This would affect the 55 customers along Churchill Crescent.

While it is not Wellington Water's preferred practice to supply a large number of properties through a booster pump (in this case 55 properties), there does not seem to be any practical alternatives in this case. It should be noted that the failure of this booster pump would not cause a loss of supply, but a relatively low pressure, around 10m. Modelling indicates that the pump would need to supply 5l/s at 13m head gain (~ 1 kW electrical power) to resolve pressure deficiencies.

Figure 7-20: Fire flow (left) and Pressure (right) with UPG-01

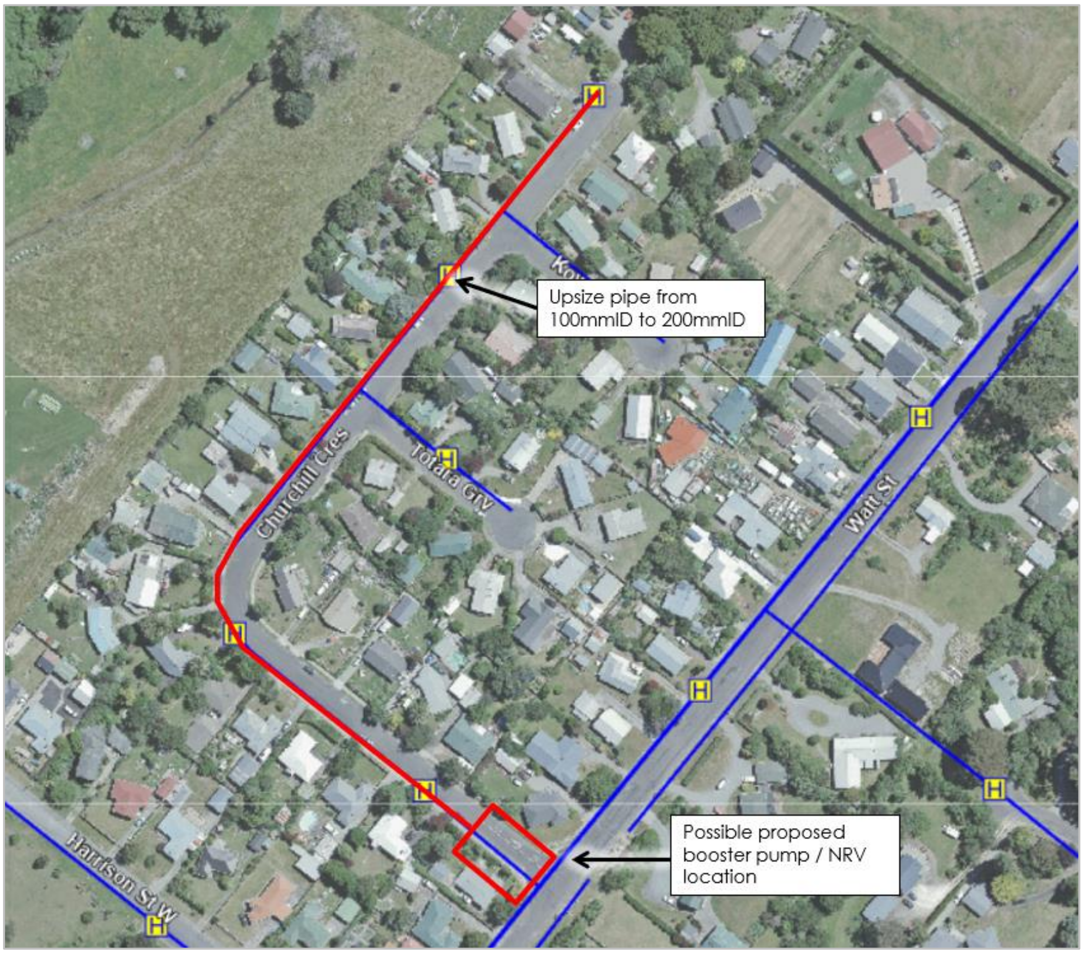


Figure 7-21: Possible location of proposed booster pump from Wellington Water GIS

7.10.2 UPG-02 – Rest of Featherston

Replacing the 200mmID outlet pipe from the Boar Bush Reservoir with a 350mmID pipe (1692 m in length) will significantly improve pressures across Featherston, as shown in Figure 7-22 . This upgrade is needed from the 2021 planning horizon onwards.

It should be noted that there are severe concerns with the ground erosion around the Boar Bush outlet pipe and this upgrade would provide an opportunity to strengthen this pipe.

UPG-02 improves the pressure and fire compliance within area P1 as well.

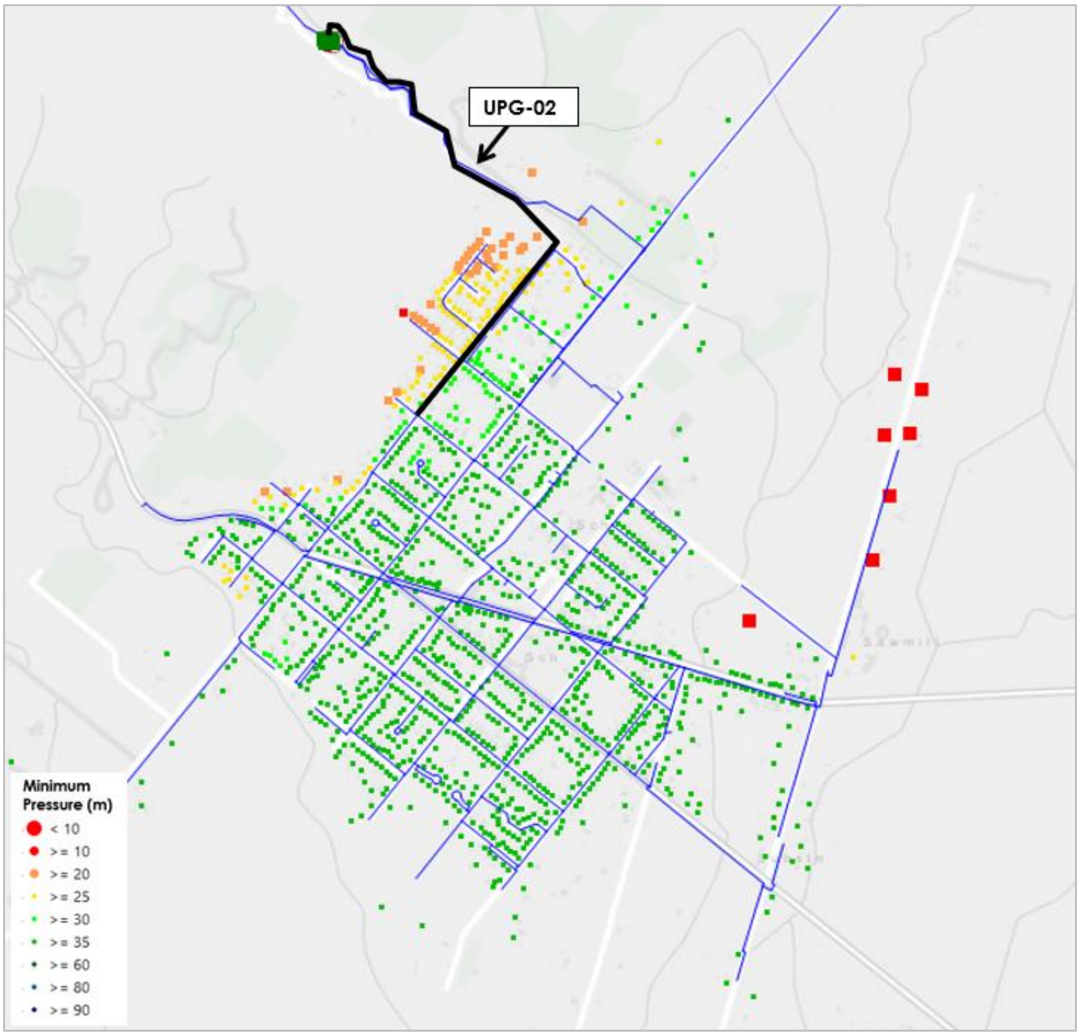


Figure 7-22: 2071 pressure (m) just with UPG-02

7.11 FIRE FLOW UPGRADES

There is a large range of fire classes in Featherston and Greytown, up to FW7. Following discussions with Wellington Water it was decided to size upgrades to ensure FW3 (50l/s).

7.11.1 F-UPG-03 – Boundary Road

There are several sections of planned pipe renewals happening throughout Featherston (Section 7.6). In order to support more flow through the eastern end of Fitzherbert Street and Boundary Road it is recommended to upsize a section of the planned renewal and add a new section of main to increase fire flow in the area, while minimizing costs with upgrades.

Instead of the recommended like-for-like upgrade, we recommend:

- An upsize to 150mmID, and
- A new connection between the 100mmID main along Boundary Road and an existing 50mmID pipe (Figure 7-23).

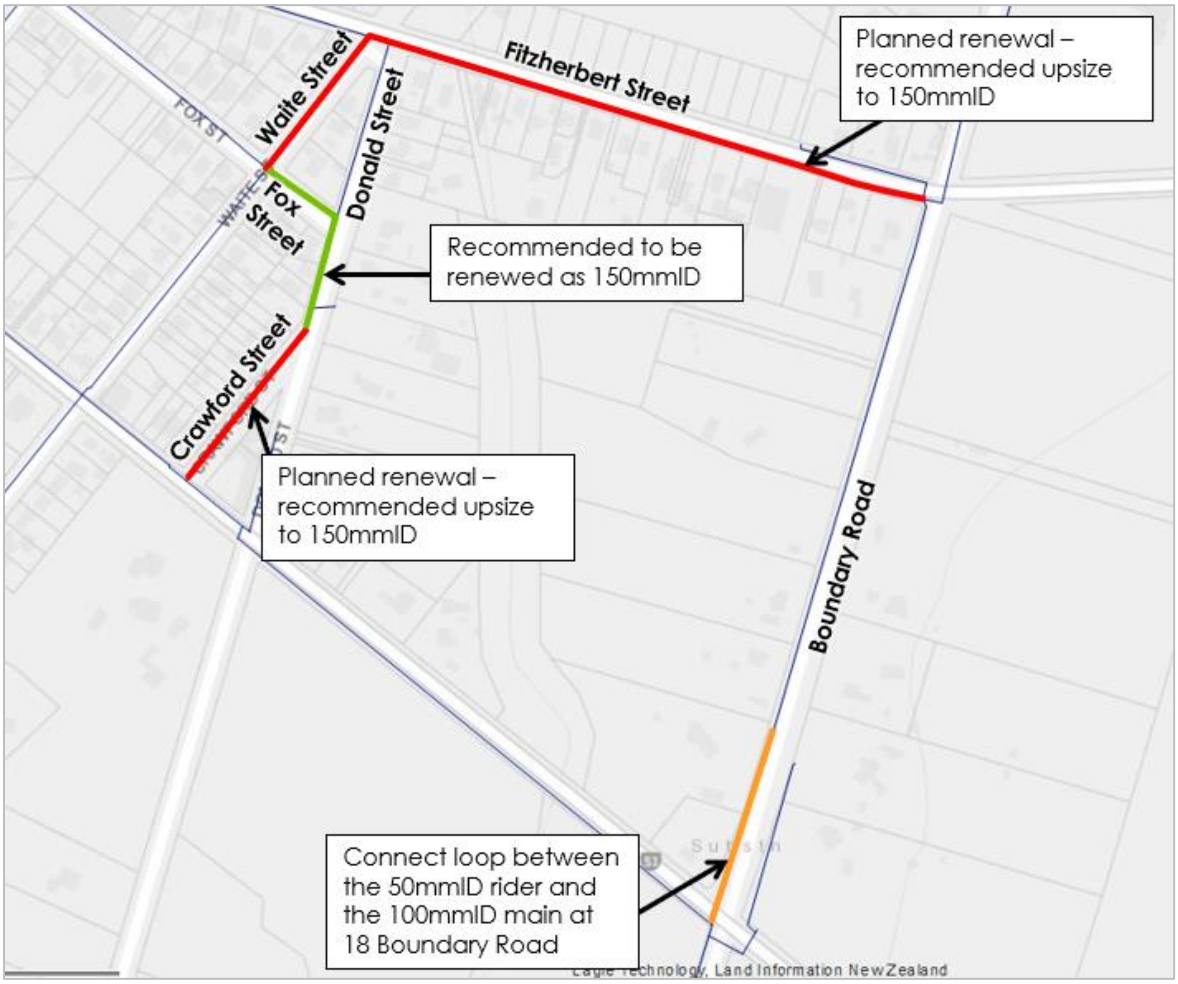


Figure 7-23: Recommended configuration of upgrade F-UPG-03

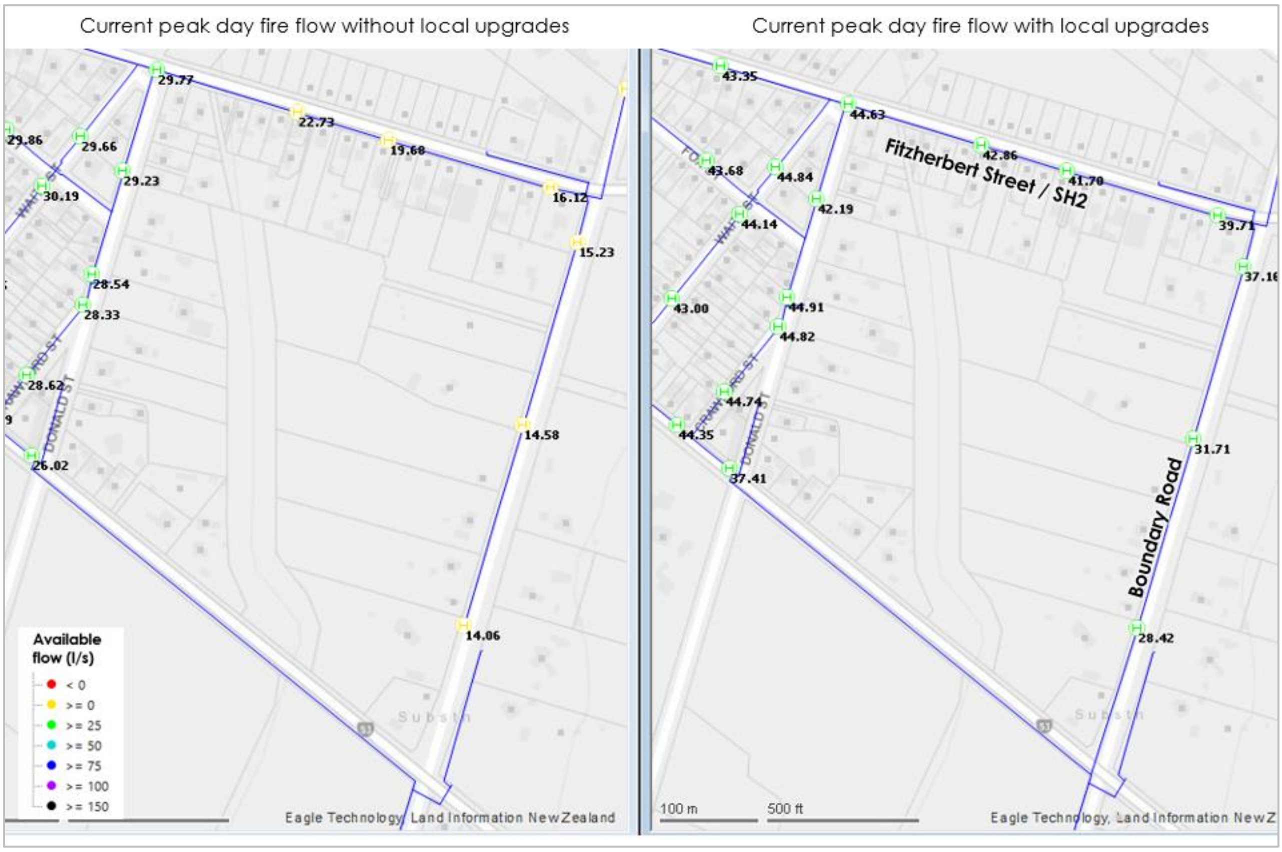


Figure 7-24: Fire flow (l/s) around Boundary Road with and without F-UPG-03

7.11.2 F-UPG-04 - Kuratawhiti Street

This upgrade is proposed to solve pressure and fire flow in the area P4 and F4 as described in Table 7-10. It is needed even if the Memorial Park WTP is ON. Network capacity in this area drops below 10l/s at some hydrants. To improve fire flow at the end of Kuratawhiti Street we recommend the following pipe upgrades which can be seen in Figure 7-25:

- Upsize the main on Kuratawhiti Street from 100mmID to 200mmID (~1400m long)
- Upsize the main on Udy Street from 100mmID to 150mmID (~600m long)
- Add a connection from the 300mmID Memorial Park WTP outlet to the upgraded 200mmID on Kuratawhiti Street.

These upgrades cause increases in flow of up to 20l/s at some hydrants, and leads to all hydrants within the F4 area to achieve the minimum 25l/s as per the Fire Code standards (Figure 7-26)

It should be noted that adding a connection from the Memorial Park WTP outlet and the 200mmID on Kuratawhiti Street may decrease the contact time between FAC and water in the pipe before water enters the distribution network and poses a risk to water safety. There may also be concerns on water quality, as the larger pipe size may require regular flushing.

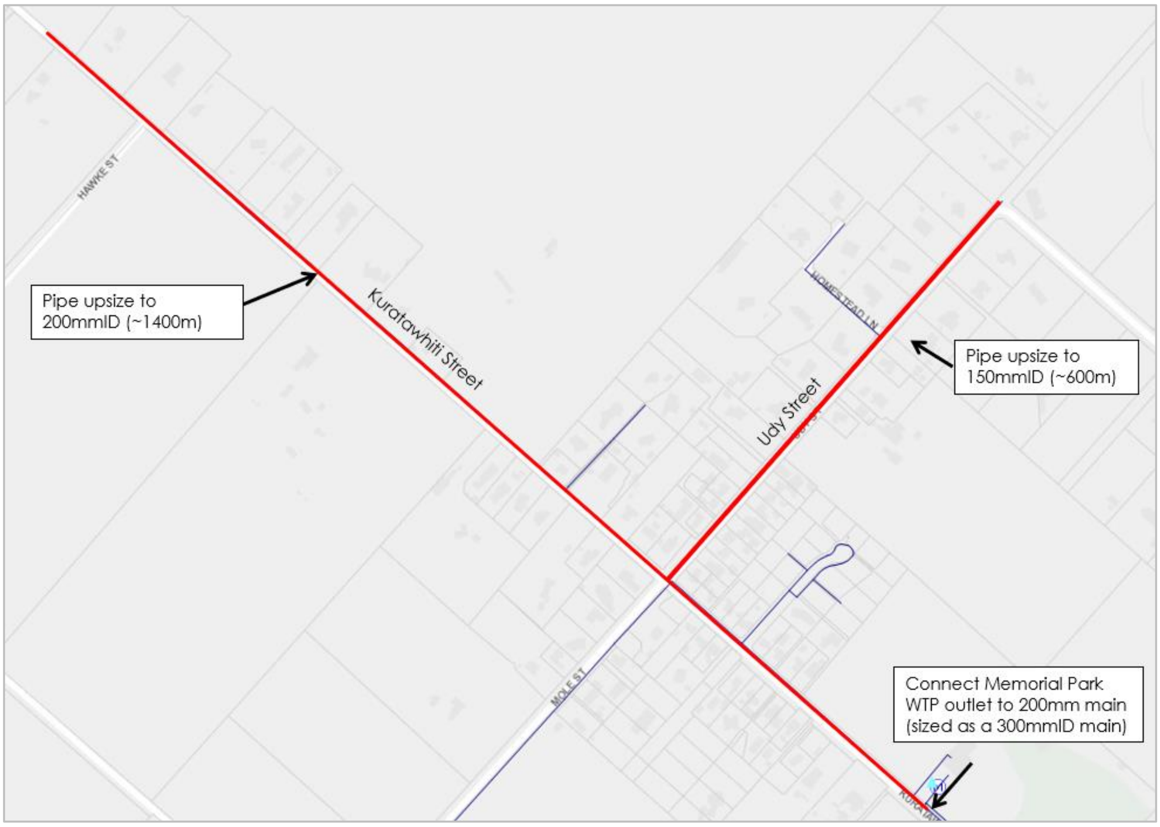


Figure 7-25: F-UPG-04 location of pipe upgrades

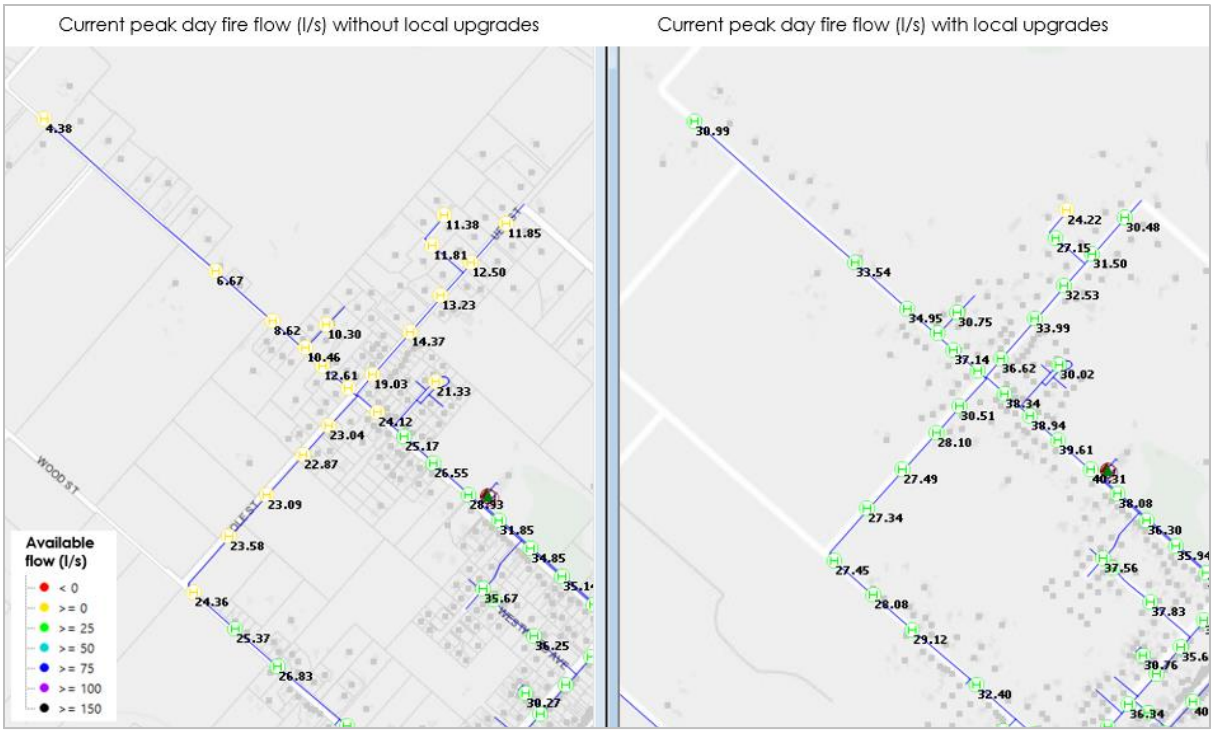


Figure 7-26: Current peak day fire flow (l/s) before and after F-UPG-04

7.11.3 F-UPG-05 – Western end of Greytown

The western end of Greytown has a mix of high FW buildings with some being classed as FW6 or FW7. The network capacity in this area is too low to accommodate these higher requirements. We recommend several pipe upgrades in this area. These are needed even if the Memorial Park WTP is ON. This upgrade consists of:

- Upsize East Street, Wakelin Street and West Street – all from 100mmID to 150mmID (a combined length of ~1156m)
- Add a new section of 150mmID pipe connecting the existing main on West Street, to the end of the existing main on Cotter Street (~244m long)

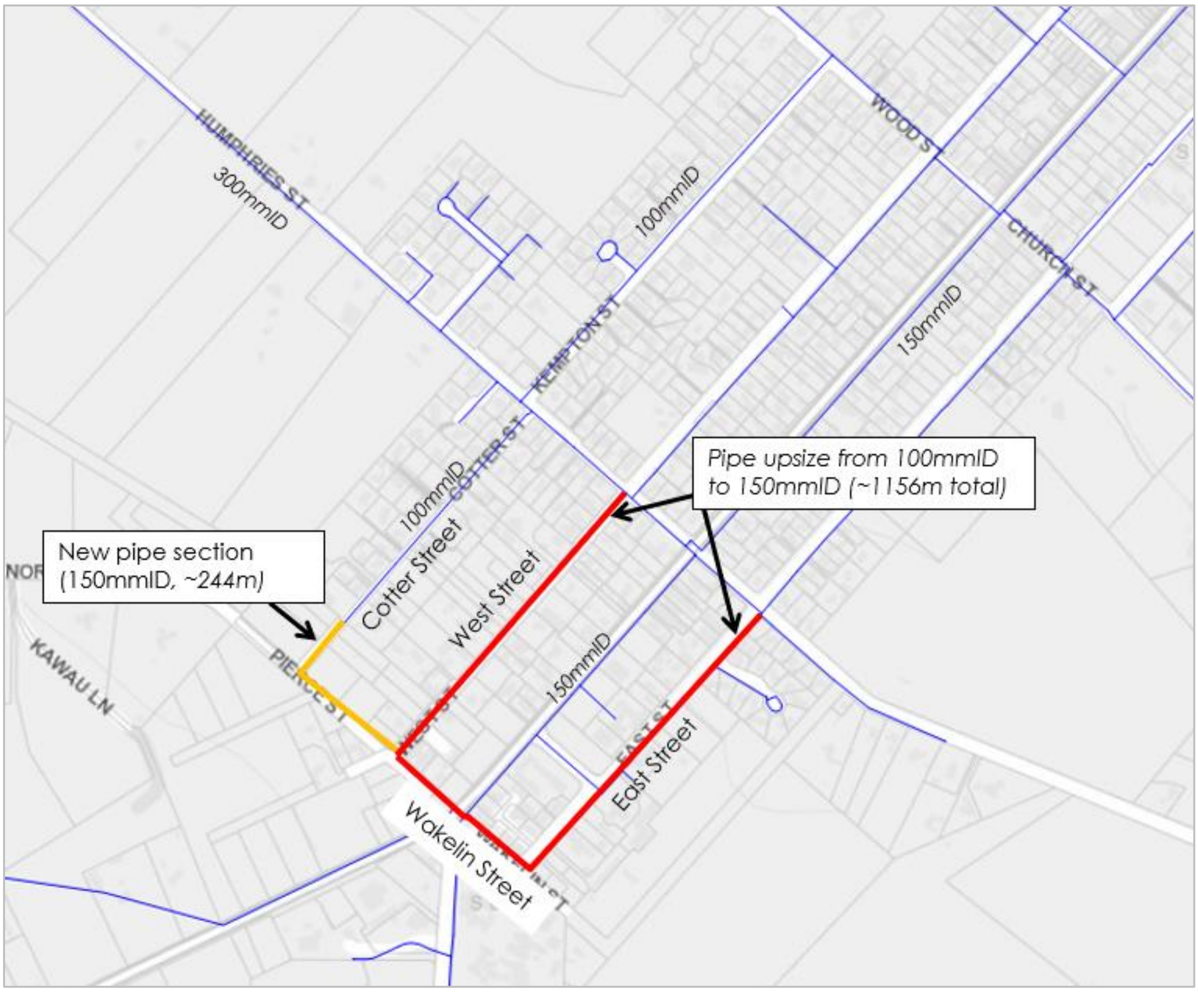


Figure 7-27: F-UPG-05 location of pipe upgrades

These upgrades improve fire flow in this area so that all hydrants reach the minimum 25l/s requirements, and hydrants along West Street reach the minimum 50l/s FW3 requirements.

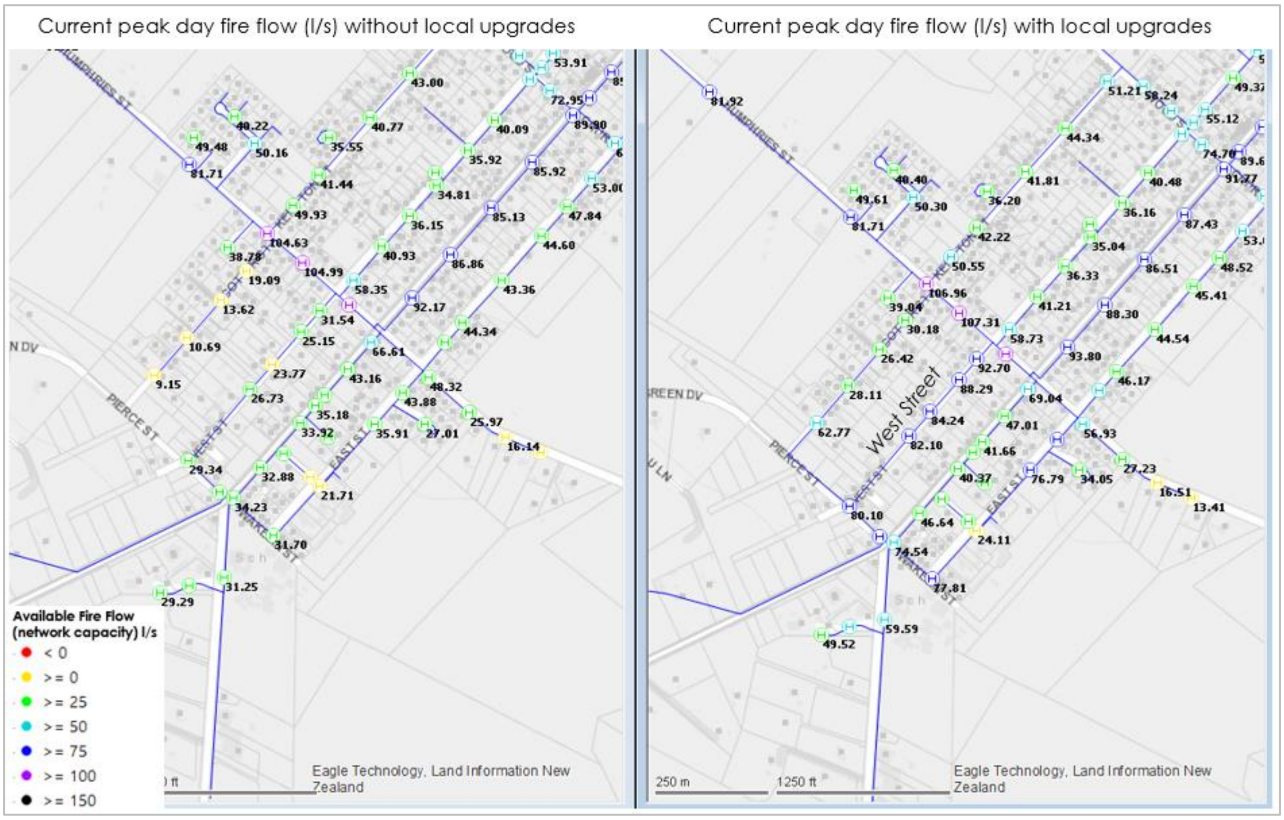


Figure 7-28: Current peak day fire flow (showing Network Capacity) (l/s) before and after F-UPG-05

7.11.4 F-UPG-06 – Jellicoe Street

The network capacity in Jellicoe Street is very low due to the size of the pipes conveying water to the hydrants in this area. Upgrading the main on Jellicoe Street (from the Massey Street intersection, shown in Figure 7-29) from 100mmID to 150mmID ensures enough flow can reach the end of the pipe and leads to hydrants reaching the minimum 25l/s requirement (shown in Figure 7-30). This is needed even if the Memorial Park WTP is ON.

Figure 7-29: F-UPG-06 location of pipe upgrade

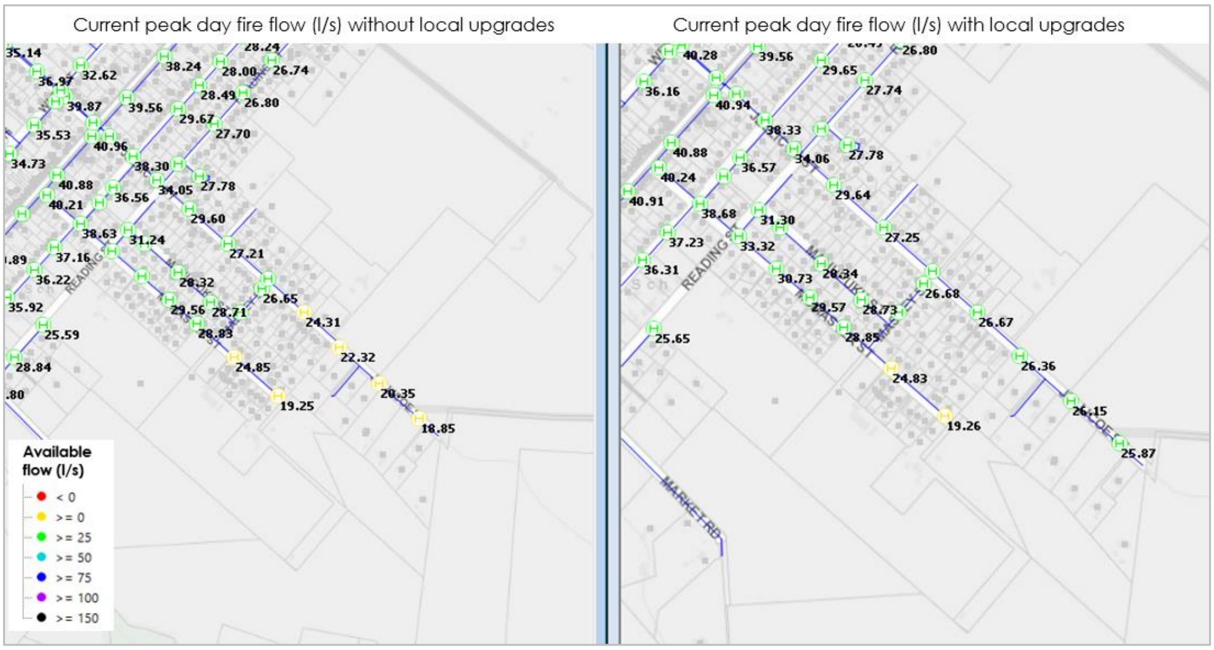


Figure 7-30: Current peak day fire flow (l/s) before and after F-UPG-06

7.12 SUMMARY OF NETWORK UPGRADES

Shown in Table 7-10 below is the summary of upgrades for both Greytown and Featherston.

Table 7-10: Featherston/Greytown summary of network upgrades

Planning Horizons	Ref	Upgrade	Upgrade Type	Capital Works	Associated Deficiency	Section Reference
2021 onwards	UPG-01	Churchill Crescent and Renall Street Booster pump and pipe renewal	Pressure, Fire	1 x new booster pump station 380m of 200mmID diameter pipe renewal	P1, F1	7.10.1
2021 onwards	UPG-02	Featherston Reservoir Outlet pipe renewal	Pressure, Fire	1700m of 350mmID diameter pipe renewal	P2, F2	7.10.2
2021 onwards	F-UPG-03	Boundary Road pipe renewal	Fire	25m of new 100mmID diameter pipe 650m of 150mmID diameter pipe renewal	F3	7.11.1
2021 onwards	F-UPG-04	Kuratawhiti Street pipe renewal and Memorial Park WTP cross connection	Pressure, Fire	1400m of 200mmID diameter pipe renewal 605m of 150mmID diameter pipe renewal 3m of new 300mmID diameter pipe cross connection	P3, F4	7.11.2
2021 onwards	F-UPG-05	Western end of Greytown pipe renewals	Fire	1000m of 150mmID diameter pipe renewal 250m of new 150mmID diameter pipe	F5	7.11.3
2021 onwards	F-UPG-06	Jellicoe Street pipe renewal	Fire	530m of 150mmID diameter pipe renewal	F6	7.11.4
2051	S-UPG-07	Waiohine pump station upgrade	Strategic, Pressure	Pump station upgrade 170m of new 200mmID diameter pipe (parallel to existing 160mmID)	N/A	7.4
2071	S-UPG-08	Waiohine Complex booster pump station upgrades	Strategic, Pressure	2 x New booster pump station	N/A	7.4.3.4 Option 2b

7.13 STORAGE

In the current peak day scenario, there are issues with reservoir replenishment. This is previously discussed in Section 7.4.2.

7.13.1 Water Storage Areas (WSA)

Shortfalls were identified on a WSA level, where the area supplied by a reservoir is considered in calculations for the required volume of storage in the reservoir.

We are assuming the following when calculating storage needs for Featherston and Greytown:

- The TWR is a part of available storage
- Featherston and Greytown are one WSA:

Therefore, Featherston and Greytown consist of a single WSZ, with 3 reservoirs supplying 3 DMAs in the area, which is summarized by Table 7-11.

Table 7-11: WSA Summary

No.	WSA	Associated Reservoirs	Available Storage (m3)	DMAs supplied
1	Waiohine	Boar Bush Reservoir 2	455	Featherston
		Greytown Reservoir	750	Greytown
		TWR	8000	All (including Featherston Trunk)

There is a risk that while there is storage at Waiohine, it may not be available in Featherston and Greytown, for example, if the transmission pipe is shut.

7.13.2 Storage Assessment

The performance criteria are as indicated in Section 7.5.3 and the assessment methodology and assumptions are outlined below –

- Residential connections in each WSA were taken from the modelled customer points.
- Population was taken from the Sense Partners 2022 population data.
    - The population for the 2071 planning horizon was calculated by using the extrapolated 2071 dwellings (as described in Section 7.1) and the assumption that the occupancy rate (see Table 7-3) does not change between 2051 and 2071
- Peak Day Demand in each planning horizon reflected the modelled demands set out in Section 7.3.
- Maximum Fire Class was assumed as FW3 as per discussions with Wellington Water.
- Critical users were assumed based on the region-wide NPS-UDC work (Stantec, 2019). This study did not cover SWDC, so assumptions were made and are shown below (Table 7-12).

Table 7-12: Featherston/Greytown Critical Users

Critical Level	Category	Usage (l/day)	DMA
Critical 1	Civil Defense Centers	5000	Featherston DMA
Critical 1	Civil Defense Centers	5000	Greytown DMA
Critical 1	Primary/Full Primary	1000	Featherston DMA
Critical 1	Primary/Full Primary	1000	Featherston DMA
Critical 1	Primary/Full Primary	1000	Greytown DMA
Critical 3	Secondary	5000	Greytown DMA
Critical 3	General Practitioners	1000	Featherston DMA
Critical 3	General Practitioners	1000	Greytown DMA
Critical 2	Aged Care Hospital	1000	Greytown DMA
Critical 2	Aged Care Hospital	1000	Greytown DMA

Table 7-13 shows details of the storage assessment for each planning horizon by WSA and for each of the criteria as described in Section 7.5.3.

Table 7-13: Grey Town/Featherston Storage shortfall

WSA	Combined WSA 2021	Combined WSA 2031	Combined WSA 2051	Combined WSA 2071
Sum of Peak Day MLD	4.3	4.9	5.5	6.2
Sum of total population	5,430	5,691	6,925	8,563
ADD (m^3/day)	3,203	3,528	3,877	4,305
Required volume 2 x ADD (m3)	6,407	7,056	7,753	8,610
PDD (m^3/day)	4,302.7	4,857	5,450	6,178
Max fire class	FW3	FW3	FW3	FW3
Required volume for fire (m^3)	180	180	180	180
Required volume 1.2 x PDD + fire (m3)	5,343	6,009	6,720	7,594
Public volume required (m^3/day)	109	114	139	171
Critical user cat 1 (m^3/day)	13.0	13.0	13.0	13.0
Critical user cat 2 (m^3/day)	2.0	2.0	2.0	2.0
Critical user cat 3 (m^3/day)	7.0	7.0	7.0	7.0
Required volume seismic (m3)	**4,144**	4,316	5,126	6,203
Max required volume (ML)	6.4	7.1	7.8	8.6
Driver	Average Day	Average Day	Average Day	Average Day
Existing Storage m^3/day	**9,205**	9,205	9,205	9,205
Storage Shortfall m^3/day	-2,798	-2,149	-1,452	-595
Storage Shortfall ML	**-2.8**	**-2.1**	**-1.5**	**-0.6**

Table 7-14 summarises the shortfall by WSA in each planning horizon and populates the main criteria driving each shortfall.

Table 7-14: Grey Town/Featherston Storage shortfall summary

WSA	2021		2031		2051		2071	
	Shortfall (ML)	Driver	Shortfall (ML)	Driver	Shortfall (ML)	Driver	Shortfall (ML)	Driver
Combined WSA	-2.8	Average Day	-2.1	Average Day	-1.5	Average Day	-0.6	Average Day

With the TWR a part of the existing storage, there is no shortfall in the current peak day. However, under future demand there is almost no spare storage from 2071.

7.14 RESERVOIR RESILIENCE

The non-upgraded Peak Day 2021 model was used to assess the continuity of supply to Featherston and Greytown DMAs in case any one of the reservoirs was shut, either for planned maintenance or in an operational emergency.

It is assumed that even if the reservoir is out of service, the connected pipe network will be intact. Simulations were run for 72 hours for each scenario to make sure the area affected is able to be provided with water supply for at least 3-days.

A summary of effects of outage of each reservoir and all possible options for alternative supply are shown in Table 7-15.

Table 7-15: Featherston/Greytown reservoir resilience options

Reservoir	Effects	Option	Solution	Useful
TWR	Complete loss of supply to Featherston and loss of supply to customers on the main coming from the Greytown Res.	Option 1	Supply through Timber Tank.	Yes
Greytown Reservoir	Loss of supply to some customers on the main coming from the Greytown Res. No adverse effect on pressure in Featherston	Option 1	Supply from Memorial Park WTP only	Yes
		Option 2	Possibility to install a usually closed by-pass valve connecting the inlet and outlet for emergencies	Yes
Boar Bush	Complete loss of supply to Featherston. No adverse effect on pressure in Greytown	Option 1	Open normally closed valve on Underhill Road to by-pass the reservoir completely. Results in pressure of up to 75m.	Yes

8.0 MARTINBOROUGH SYSTEM PERFORMANCE ASSESSMENT AND ZMP

The model group **SWDC WS IPL04** was created for this phase. Martinborough was assessed at a later stage, after Greytown and Featherston. Elements of the methodology, such as the performance criteria, are not repeated in full detail, and references are made to the Greytown/Featherston sections.

8.1 CURRENT WORKING MODEL DEMAND UPDATE FOR MARTINBOROUGH

The peak day demand of 2,461 m3/day was initially retained for Martinborough based on the previously developed working model identified from a peak period in January 2021. However, as discussed with WWL, the daily specific consumption based on the demand analysis carried out for the peak day seemed to be too high for the area at 1,431 l/prop/day for residential use without leakage.

The last 3 years of SCADA data was analyzed to check other peak periods after Jan 2021 (Figure 8-1).

The following periods were investigated:

- November 2021 (peak demand of 2,588 m3/day) - the instantaneous flow data for this period was not available as the Hinekura reservoir meters were being replaced at that time
- December 2022 (peak demand of ,1886 m3/day) – 742 l/prop/day (excluding leakage)
- January 2024 (2,409 m3/day) – range of 800-1100 l/prop/day (excluding leakage)
- February 2024 (2,412 m3/day)- 924 l/prop/day (excluding leakage)

The above numbers show that the calculated daily specific consumption has never been so high as the one estimated for January 2021.

The demand breakdown of summer peak period (January 2024) was compared to check why specific consumption was so different from 2021. Results showed that despite similar total demands, specific consumption was a lot less in 2024 than in 2021, but water loss was higher in 2024. The demand analysis for other peak and average periods also showed an increase in leakage while specific consumption was a lot lower than the originally used 1400l/prop/day. (Figure 8-2)

It was agreed with WWL to use the February 2024 peak day demand (2,412 m3/day) which is relatively close to the originally used (2,461m3/day). However, the demand profile for February 2024 was atypical (but plausible). Consequently, the January 2024 demand profile was used, and the demand was scaled up to match Feb 2024 demand.

The resulting residential per property consumption is 850 l/prop/day and the total calculated demand in the system is 2,382 m3/day. This is about 99% of the observed peak demand of 2,412 m3/day. The small difference is due in part to changes in reservoir levels over the day (accounted for in the DMA flows but not in the volume delivered to the system), and in part to rounding errors in conversion to WS Pro specific consumption.

Average Day Demand was calculated from SCADA as total daily demand of 1,233 m3/day – the breakdown for this was complex and is outlined in the memo to WWL dated 25/11/2024, shown in Appendix F
Again, due to rounding errors in WS Pro the ADD as per the model is 1,261 m3/day.

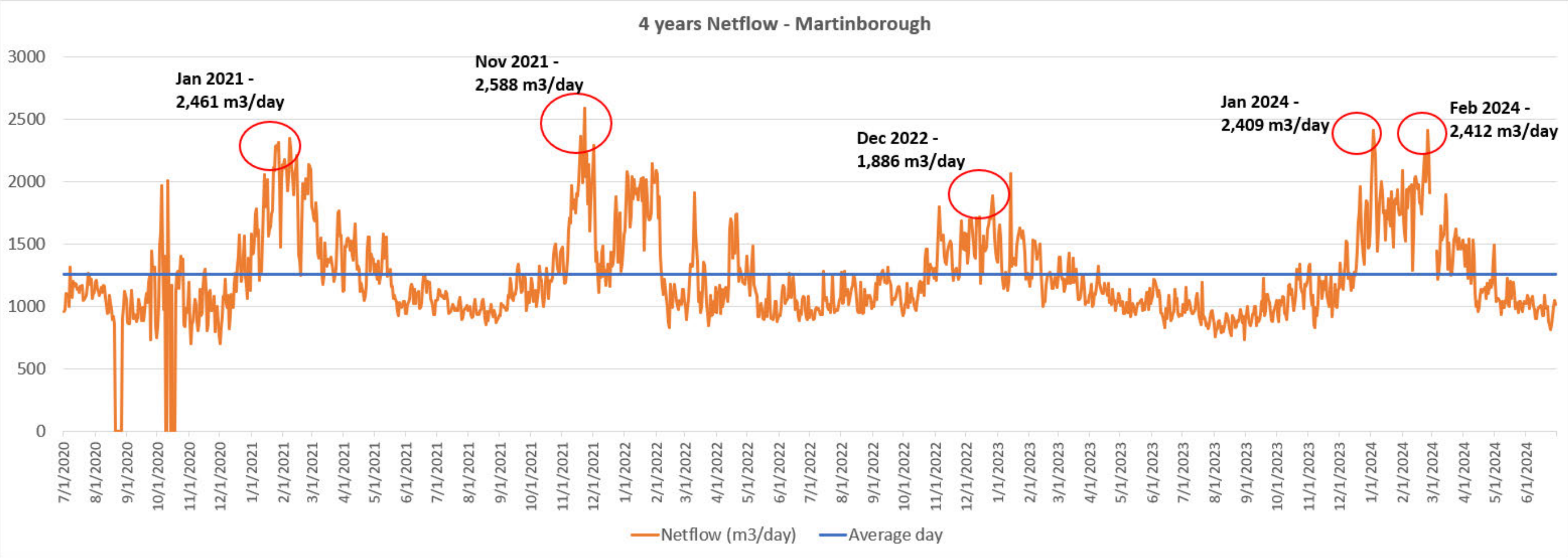


Figure 8-1: 2020-2024 Martinborough Net flow data

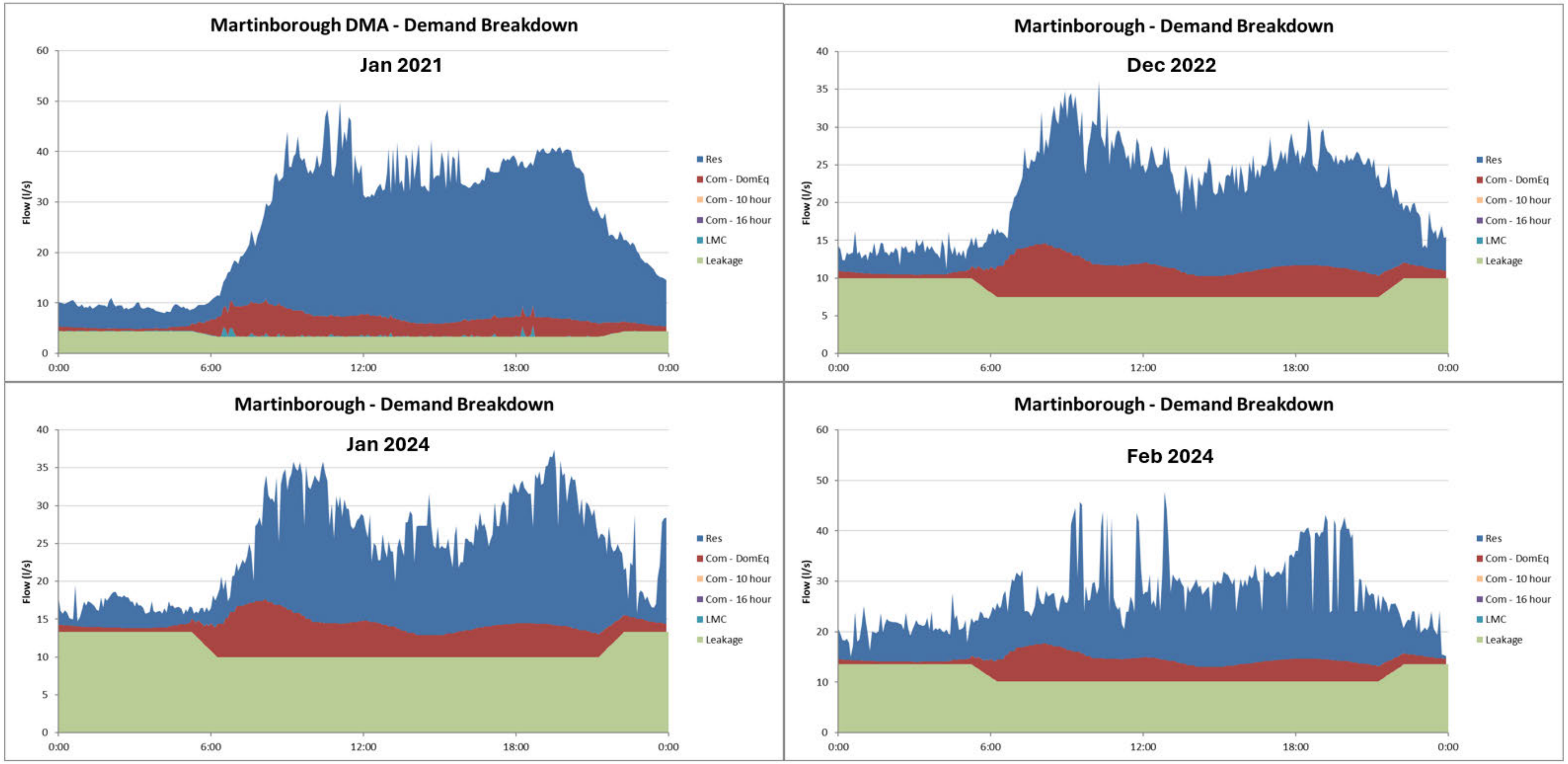


Figure 8-2: Demand breakdown of Martinborough DMA for different summer peak periods

8.2 NETWORK AND CONTROL UPDATE IN CURRENT WORKING MODEL

Following discussion with Wellington Water, the following network and control updates were made to the current working model.

8.2.1 Syrah Lane and Wilson Lane Network

Roughly 29 newly constructed residential properties on Syrah Lane and Wilson Lane were added to the model and outlined in Figure 8-3 below.

Figure 8-3: Network added on Syrah Lane and Wilson Lane.

8.2.2 Booster added to 50mm rider main South-West of Hinekura Reservoir

Following correspondence with Wellington Water on 08/05/24, a booster which is shown on Wellington Water GIS but not in the model was confirmed as operating (Figure 8-4). It boosts a 50mm rider main southwest of the Hinekura Reservoirs and delivers around 40m downstream pressure (fluctuating between 37m-47m) and there is a hydrant at the end of the main (at Shooting Butts Road).

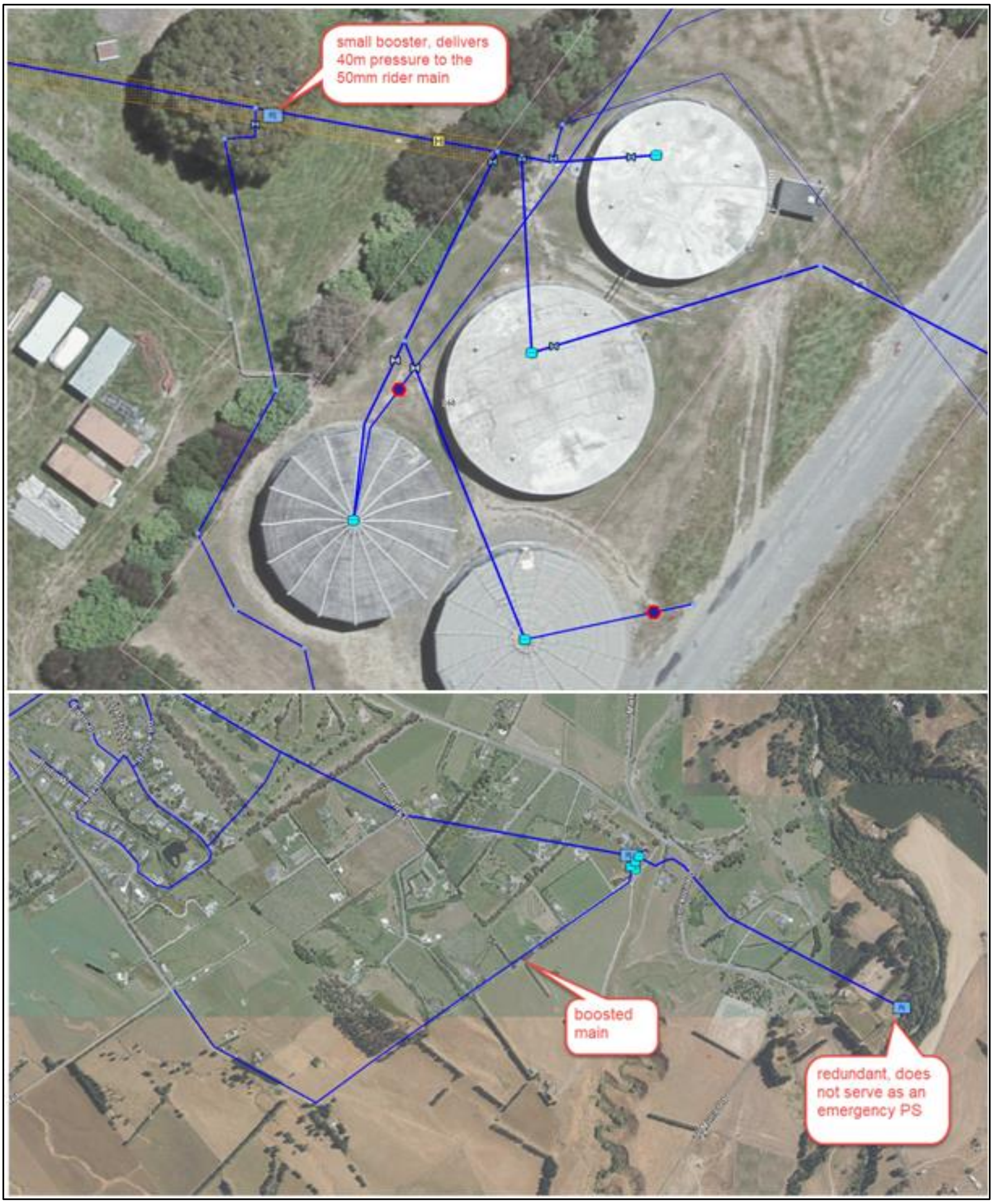


Figure 8-4: Booster confirmed on 50mm rider main.

8.2.3 Huangarua PS

On the same correspondence, the Huangarua PS was confirmed as redundant. It used to serve as an emergency PS, but a section of broken pipe has rendered it inoperable.

8.3 GROWTH – FUTURE MODEL DEVELOPMENT

In addition to the existing 2021 demand scenarios representing the current operation of the network, future peak demand scenarios have also been developed for 10-year (2031), 30-year (2051) and 50-year (2071) planning horizons in a new model group as listed in Table 8-1 below:

Table 8-1: Future Demand Scenarios

No.	Model Database Name	Description
1	IPL04 01 PDD 2021* (2,382 m3/day)	Current Peak Day Demand 2021
2	IPL04 02 PDD 2031 (2,592 m3/day)	Future Peak day Demand 2031
3	IPL04 03 PDD 2051 (3,021 m3/day)	Future Peak day Demand 2051
4	IPL04 04 PDD 2071 (3,462 m3/day)	Future Peak day Demand 2071

*Although the updated peak day identified is from 2024, 2021 was used as the current planning horizon to be consistent with the planning horizons used previously in Featherston and Greytown ZMP. This is because the billing data used was from financial year 2021-22.

The future growth scenarios help to understand if the current water supply network has capacity to support the future growth, or if upgrades need to be proposed to maintain the desired level of service in the network.

8.4 INFILL GROWTH DATA

Sense Partners population forecast data was used to calculate the future infill growth demand in each planning horizon. This data includes population and dwelling forecast numbers for each year (starting from 2018 to 2051) and for each Statistical Area (SA2) in Wellington Region, which are based on 50th percentile growth projection.

There are 2 SA2 areas that intersect Martinborough DMA. However, the extent of SA2 areas is different to the extent of DMAs and one DMA may intersect several SA2s (Figure 8-5).

The number of dwellings projected in each SA2 area intersecting Martinborough supply zone boundary for 2021, 2031, 2051 and 2071 planning horizons is shown in Table 8-2 and Table 8-3 below. The numbers in 2031, 2051 and 2071 planning horizon have been extrapolated.

The latest available Sense Partners projection is dated 2023; it did not show any future growth projections in Martinborough. It was therefore agreed with WWL to use growth projections dated 2022 instead.

The scale of growth in future planning horizons over the existing number of dwellings (also known as Equivalent Dwellings) was calculated as scaling factors and included in Table 8-2.

The scaling factors were only applied to the residential demand (specific consumption in the model) as commercial demand and water loss is assumed to remain unchanged in the future.

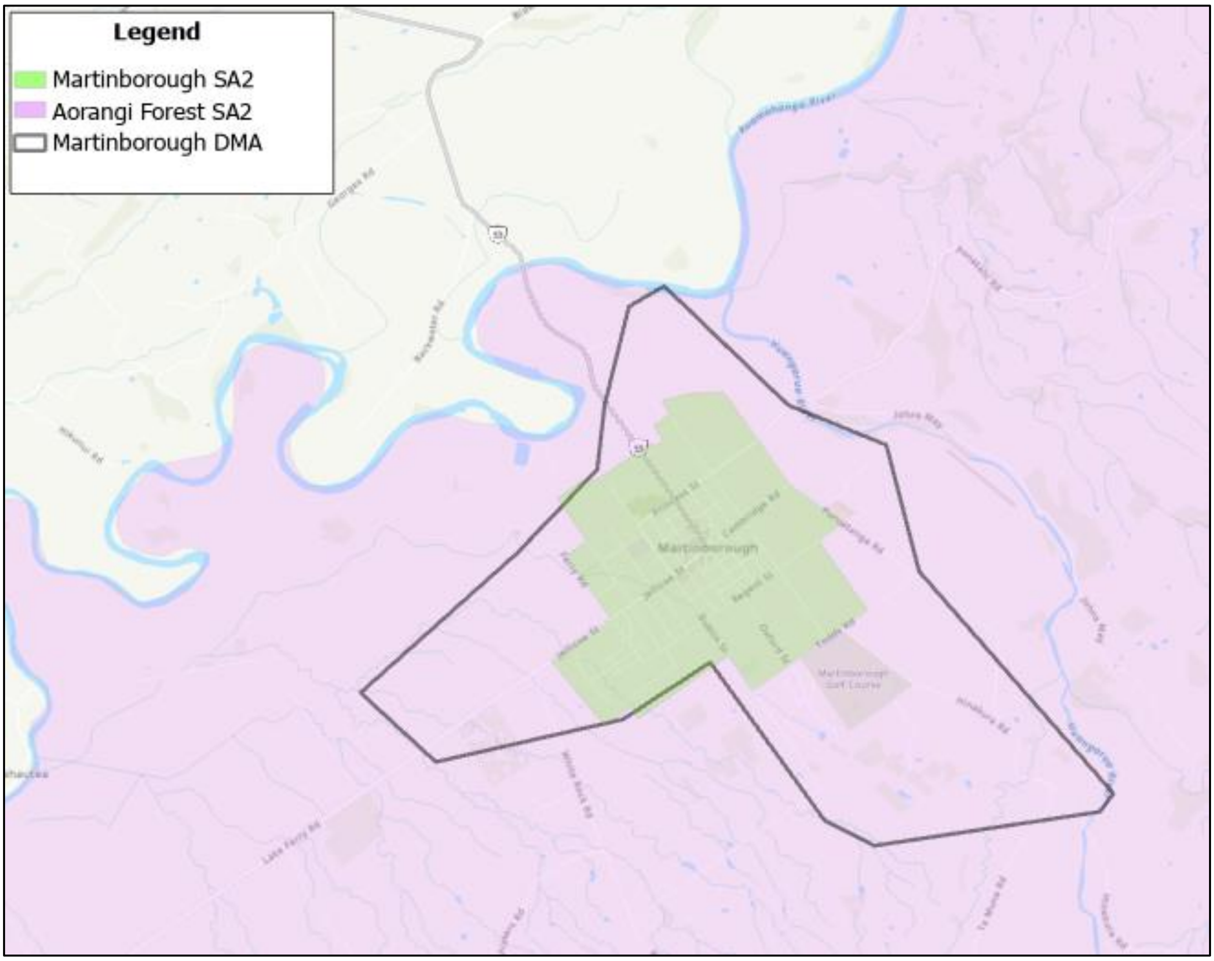


Figure 8-5: Growth Areas (SA2) intersecting Martinborough DMA.

Table 8-2: Dwellings (median projection) and scaling factors for each planning horizon

Statistical Area	Dwellings				Scaling Factor		
	PH 2021	PH 2031	PH 2051	PH 2071	PH 2031	PH 2051	PH 2071
Aorangi Forest	1274	1564	1779	2131	1.2276	1.3963	1.673
Martinborough	1202	1441	1965	2491	1.1988	1.6347	2.0726

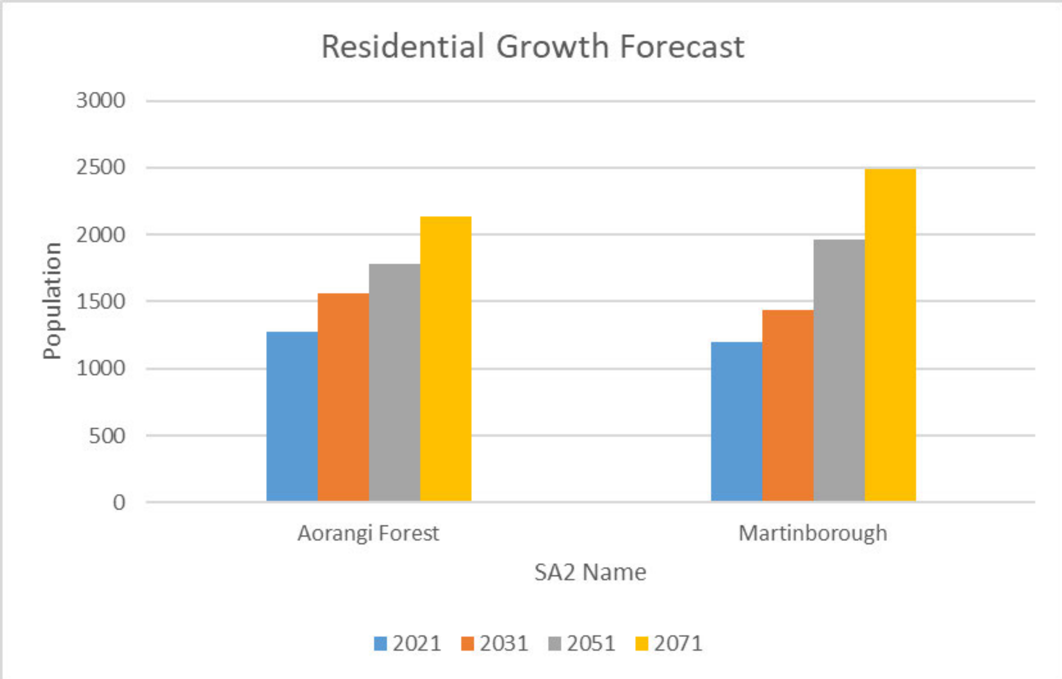


Figure 8-6: Residential properties forecast for each SA2 in each planning horizon.

8.5 GREENFIELD GROWTH

There is no confirmed greenfield growth in Martinborough and therefore as agreed with WWL, no greenfield growth demand has been added in the model.

8.6 GROWTH SUMMARY

Table 8-3 below shows the comparison of model demand in each planning horizon for each demand category.

Table 8-3: Current and Future Peak Day demand summary

Demand Category	Current PDD 2021 (m3/day)	10 yr PH 2031 (m3/day)	30 yr PH 2051 (m3/day)	50 yr PH 2071 (m3/day)
Residential	1,041	1,251	1,680	2,121
Commercial	265	265	265	265
Leakage	1076	1076	1076	1076
Total	**2,382**	**2,592**	**3,021**	**3,462**

8.7 PLANNED RENEWALS

There are no planned renewals in Martinborough as confirmed by WWL.

8.8 SYSTEM PERFORMANCE – MARTINBOROUGH

The model **SWDC IPL04_Martinborough ZMP** was used for the performance assessment. Please refer to section 7.5 Performance Criteria.

8.8.1 Minimum Pressure

Under current peak day demand, modelling shows an area of low pressure in the South-East of the town, near the Hinekura Reservoirs, labelled P1in **Table 8-8.**

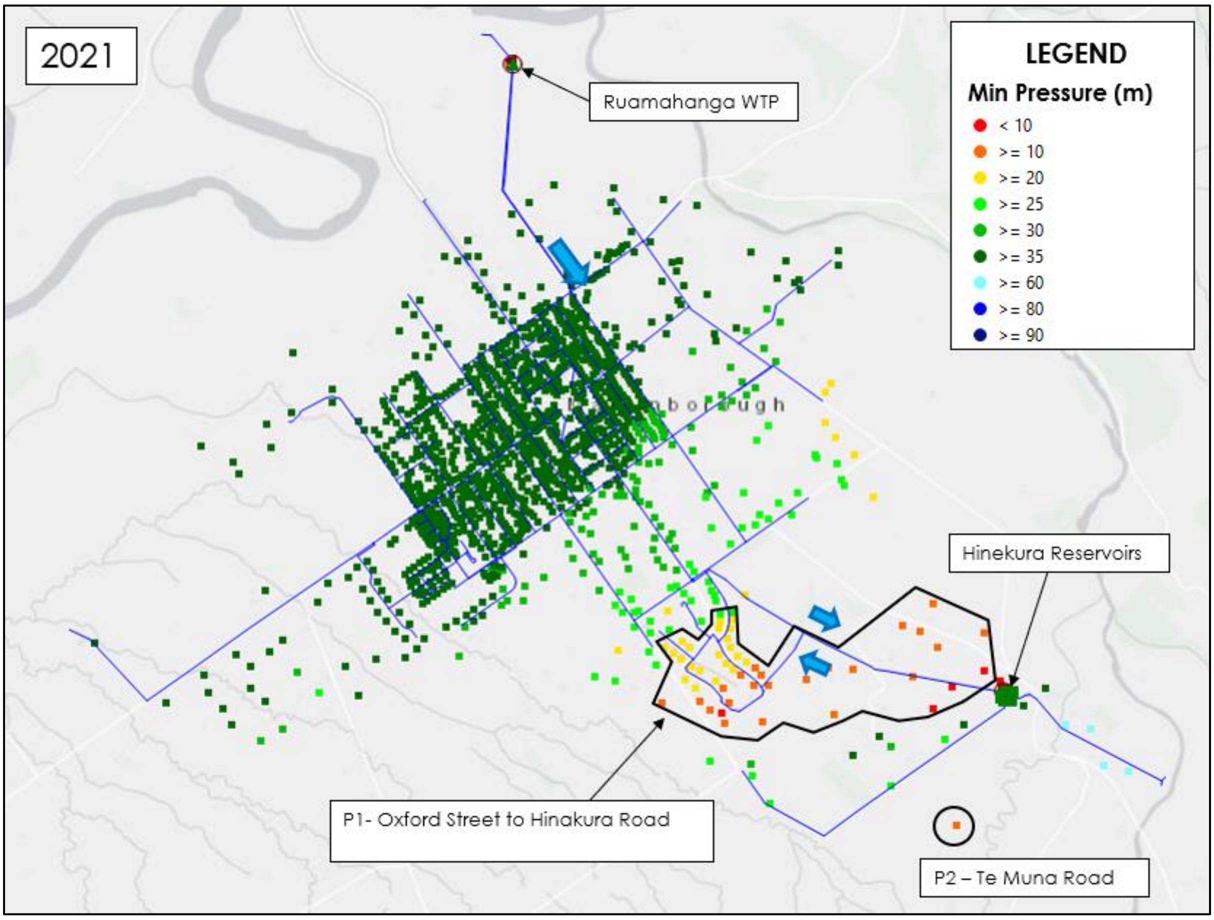


Figure 8-7: Martinborough minimum pressures in 2021 planning horizon

The P1 area affects approximately 49 properties under current peak day demand. As discussed with WWL, it is understood that the properties in this area probably have an additional or alternative source of water supply as there have been no customer complaints.

The situation does not get any worse in future planning horizons but when future storage upgrades are required in 2051 (0). It should also be noted that despite pipe capacity not being the cause of pressure issues, the 250mm AC main that supplies the reservoir is due for renewal in 2060 and this should also be considered in any future solution.

There is also 1 property, P2, that falls just below 20m. This is a minor deficiency, so no upgrade has been suggested.

There is little change in minimum pressures between the 2021 and 2031 planning horizon (Figure 8-8).

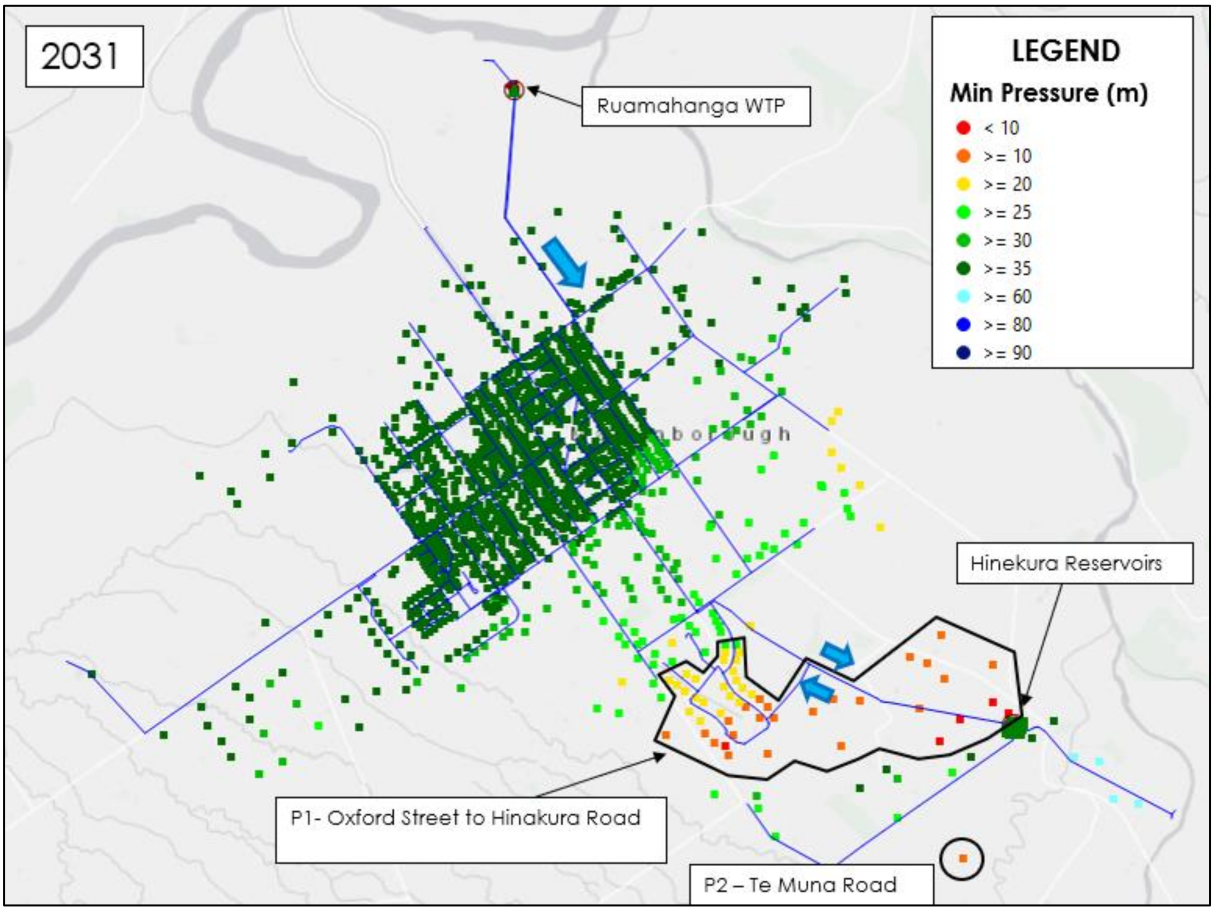


Figure 8-8: Martinborough minimum pressures in the 2031 planning horizon

In the 2051 planning horizon, modelling shows the small area, P3, on Todds Road worsen with 1 property falling under 20m minimum pressure, this is also a minor deficiency, so no upgrade has been considered (Figure 8-9).

A new area, P4, on Puruatanga Road is now at risk of low-pressure deficiencies with 4 properties affected. This area is considered a minor deficiency, and no upgrade has been sought.

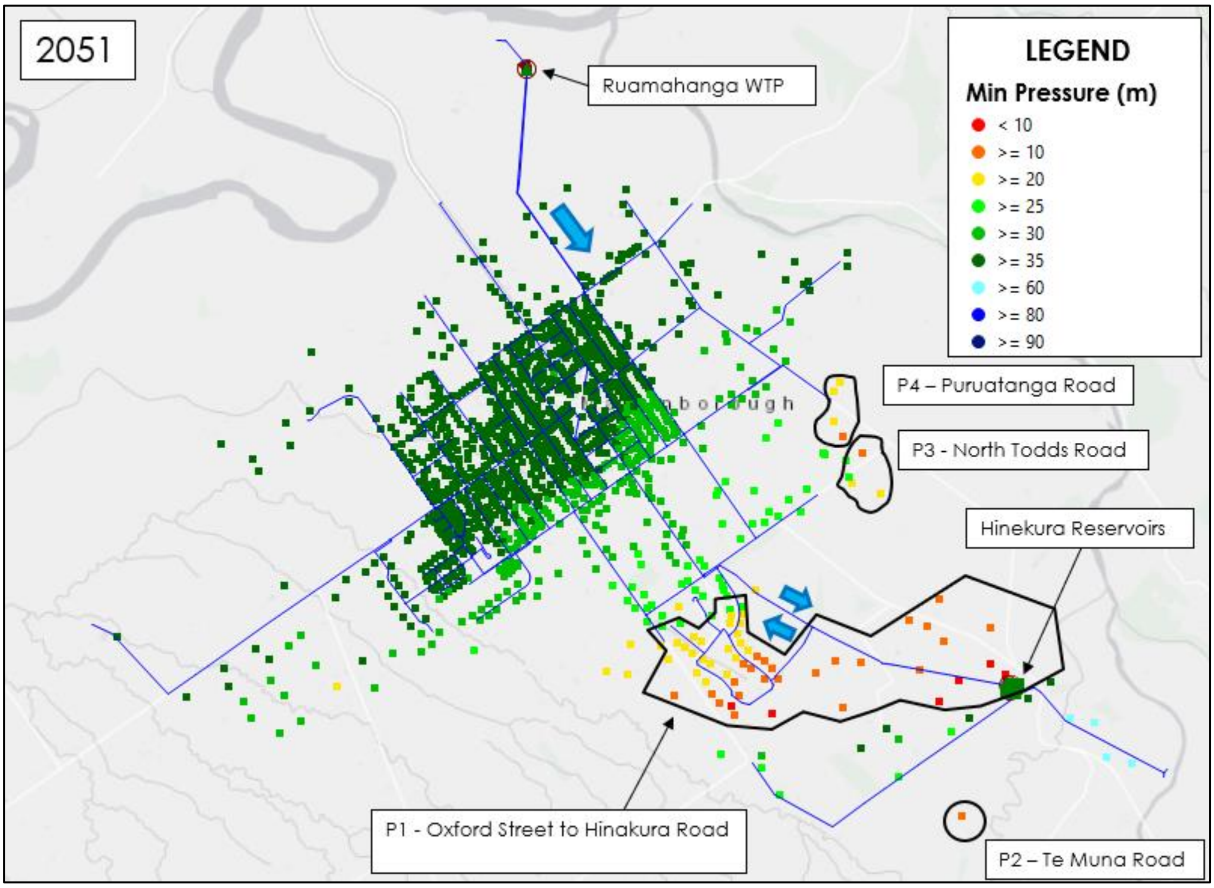


Figure 8-9: Martinborough minimum pressures in the 2051 planning horizon

In the 2071 planning horizon, the predicted growth in demand leads to a peak flow of approximately 40 l/s out of Ruamahanga WTP and the Hinekura Reservoirs. Head loss has increased throughout most of the network and pipes to the south of the town have dropped in pressure but are mostly still above acceptable levels. There is another small area of concern at Shooting Butts Road – P5 but this is too minor to seek any upgrade (Figure 8-9).

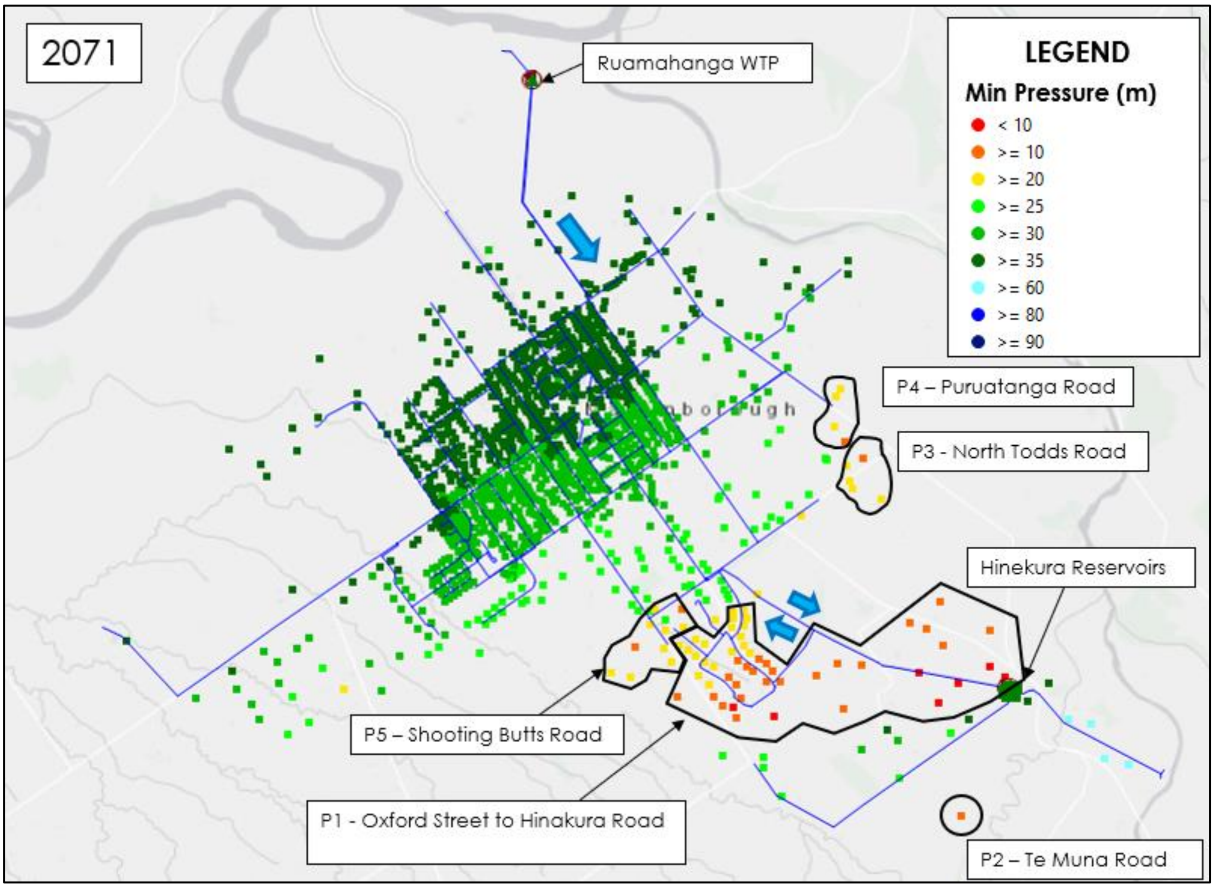


Figure 8-10: Martinborough minimum pressures in the 2071 planning horizon

8.8.2 Fire Compliance

Figure 8-11 shows the assumed building fire classes as previously discussed in section 7.5.2.

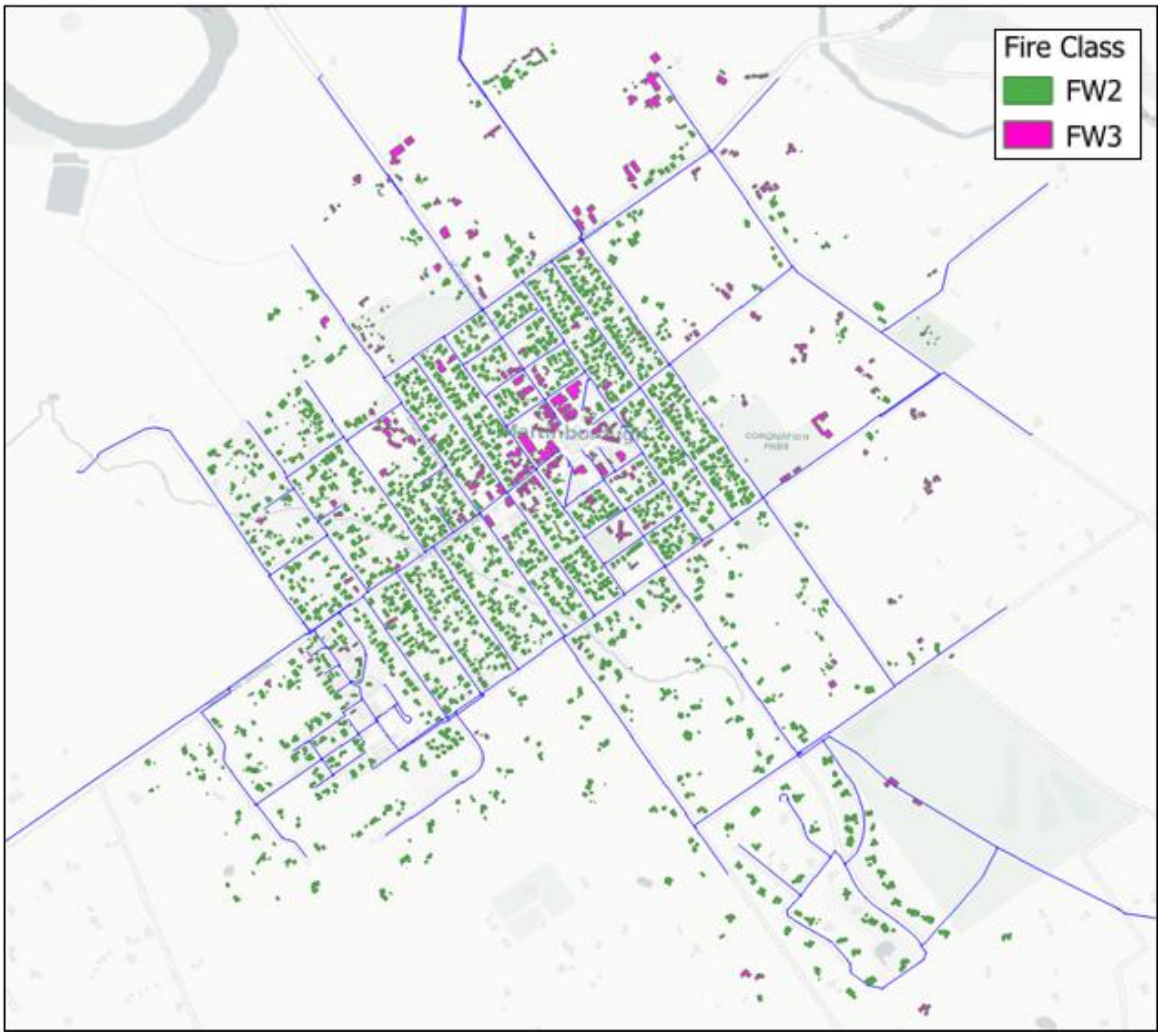


Figure 8-11: 2021 Martinborough Building Fire Classes

Figure 8-12 shows the fire compliance under current peak day conditions and areas identified for fire flow upgrades. Individual fire flow upgrades are summarized in Table 8-5 and discussed in more detail in 8.9.2. Some non-compliant areas have not been recommended for upgrades; this is explained in section 8.9.2.7

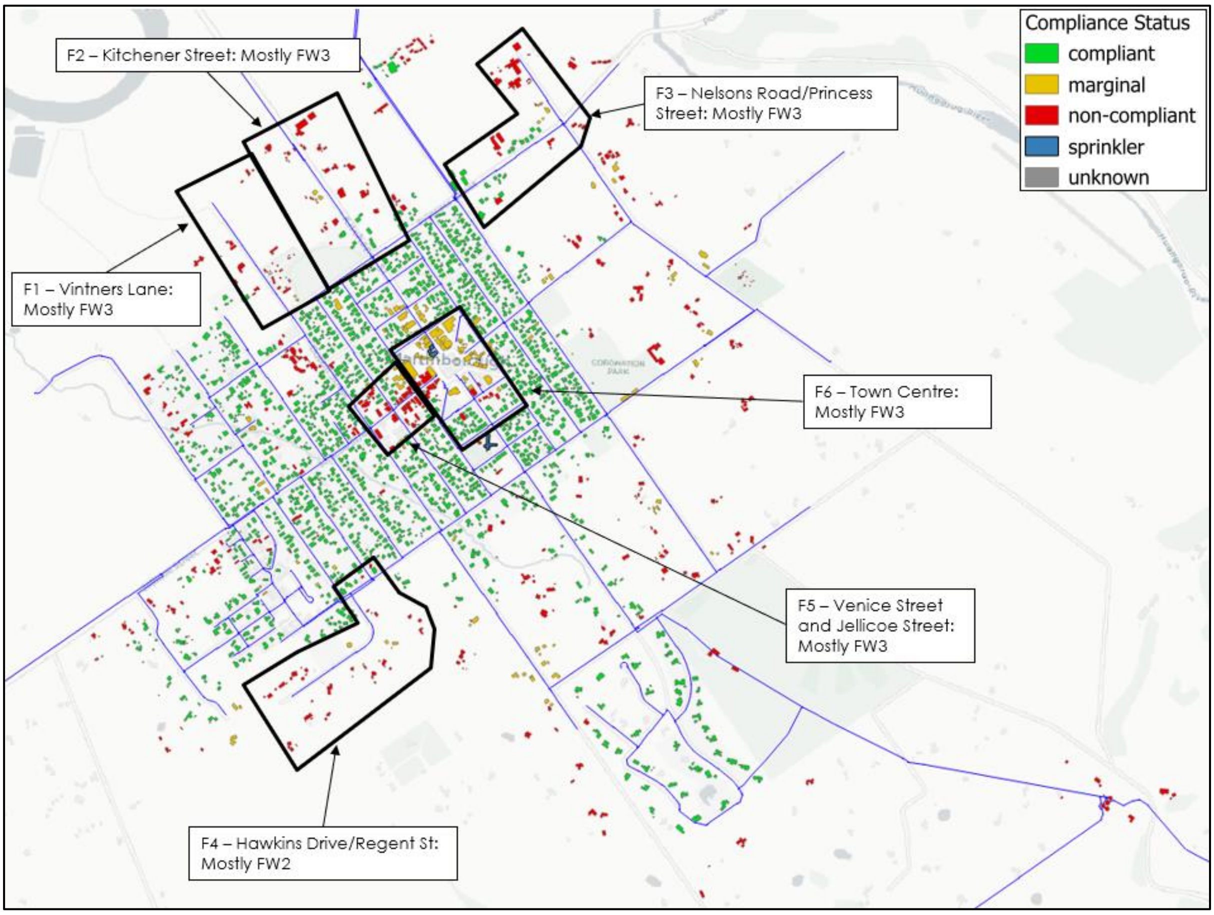


Figure 8-12: 2021 Martinborough Fire Flow Compliance

8.9 SYSTEM DEFICIENCIES AND UPGRADES

This section summarises the key 'deficiency' areas in the network with respect to minimum pressure, fire flow availability and storage in Martinborough.

Minimum pressure and fire flow availability deficiencies are summarized in Table 8-4 and Table 8-5 respectively. The location of each fire flow deficiency in the network is encircled with associated reference number and shown in Figure 8-13.

The details of each key deficiency and corresponding proposed upgrades are outlined in sections 8.9.1 and 8.9.2.

All recommended pipe diameters for upgrades are specified as minimum required internal diameter, for example "150mm ID". This is because the material of the proposed pipe is unknown at this stage.

Storage calculations and related deficiencies in Martinborough are set out in 8.9.3

Table 8-4: Summary of Martinborough low-pressure deficiencies

No.	*Location*	*DMA*	*Approx. no. of properties affected*	*Comment*	*Min. pressure range (current Scenario)*	*Year*	*Severity*	*Associated upgrade*
P1	**Oxford Street to Hinakura Road**	Martinborough	49 which increases to 51 by 2051 then again in 2071 to 57	Low pressures due to relative height of the supplying Hinekura Reservoir. Log pressures match the model. Head loss also increases in future scenarios with the increase in demand across the area.	2.5-24m	2021	Potentially severe but to be confirmed	As no customer complaints received for this area, it is assumed properties here have alternative supplies and/or property counts have been overestimated. No upgrade proposed.
P2	**Te Muna Road**	Martinborough	1	Low pressures due to relative height of the supplying Hinekura Reservoir and pipe diameter.	16-24m	2021	Minor	No upgrade triggered for minor deficiency.
P3	**North Todds Road**	Martinborough	3, increasing to 6 by 2071	Low pressure due to higher elevation and long driveways.	19-24m	2051	Minor	No upgrade triggered for minor deficiency.
P4	**Puruatanga Road**	Martinborough	4	Low pressure due to pipe diameter.	19-24m	2051	Minor	No upgrade triggered for minor deficiency.
P5	**Shooting Butts Road/South Todds Road**	Martinborough	8	Low pressure due to pipe diameter.	21-24m	2071	Minor	No upgrade triggered for minor deficiency.

Table 8-5: Summary of Martinborough Fire Flow deficiencies

No.	Location	DMA	Approx. no. of properties affected	Fire Class	Reason	Severity	Comment	Upgrade	UPG Ref
F1	Vintners Lane	Martinborough	8	FW2/3	Insufficient flow available from hydrants	Medium	Many FW3 buildings non-compliant with regulations	Vintners Lane 75mmID PVC main to be upgraded to 150mmID.	**F-UPG01**
F2	Kitchener Street	Martinborough	17	FW2/3	Insufficient flow available from hydrants	Severe	Many FW3 buildings non-compliant with regulations	Kitchener Street 100mmID AC main to be upgraded to 150mmID.	**F-UPG02**
F3	Nelsons Road/Princess Street	Martinborough	5	FW2/3	Insufficient flow available from hydrants	Medium	Many FW3 buildings non-compliant with regulations	Nelsons Road 100mmID AC to be upgraded to 150mmID.	**F-UPG03**
F4	Hawkins Drive/Regent St	Martinborough	22	FW2/3	Insufficient flow available from hydrants	Severe	Mainly FW2 buildings and some FW3 buildings along Hawkins Drive and Regent Street are non-compliant with regulations	Hawkins Drive 100mmID PVC and Regent Street 100mmID AC to be upgraded to 150mmID.	**F-UPG04**
F5	Venice Street/Jellicoe Street	Martinborough	40	FW2/3	Insufficient flow available from hydrants	Severe	Many properties west of the town centre are non-compliant	Cross connection between the two 100mmID mains on Venice and Jellicoe Street	**F-UPG05**
F6	Cross connections in town centre	Martinborough	50	FW2/3	Insufficient flow available from hydrants	Medium	Many properties in the town centre are non-compliant	Cross connections to be field checked and implemented if not cross connected already	**F-UPG06**

8.9.1 Low Pressure Deficiencies and upgrades

As outlined in Table 8-4, there are no upgrades proposed for low pressure deficiencies as they are considered to be minor.

8.9.2 Fire Flow Deficiencies and upgrades

This section covers the fire flow deficiencies as outlined in Table 8-5 and describes the upgrades proposed for each of them. An overview of fire flow upgrades can be seen in Figure 8-13 and an overview of fire flow compliance can be seen in Figure 8-12.

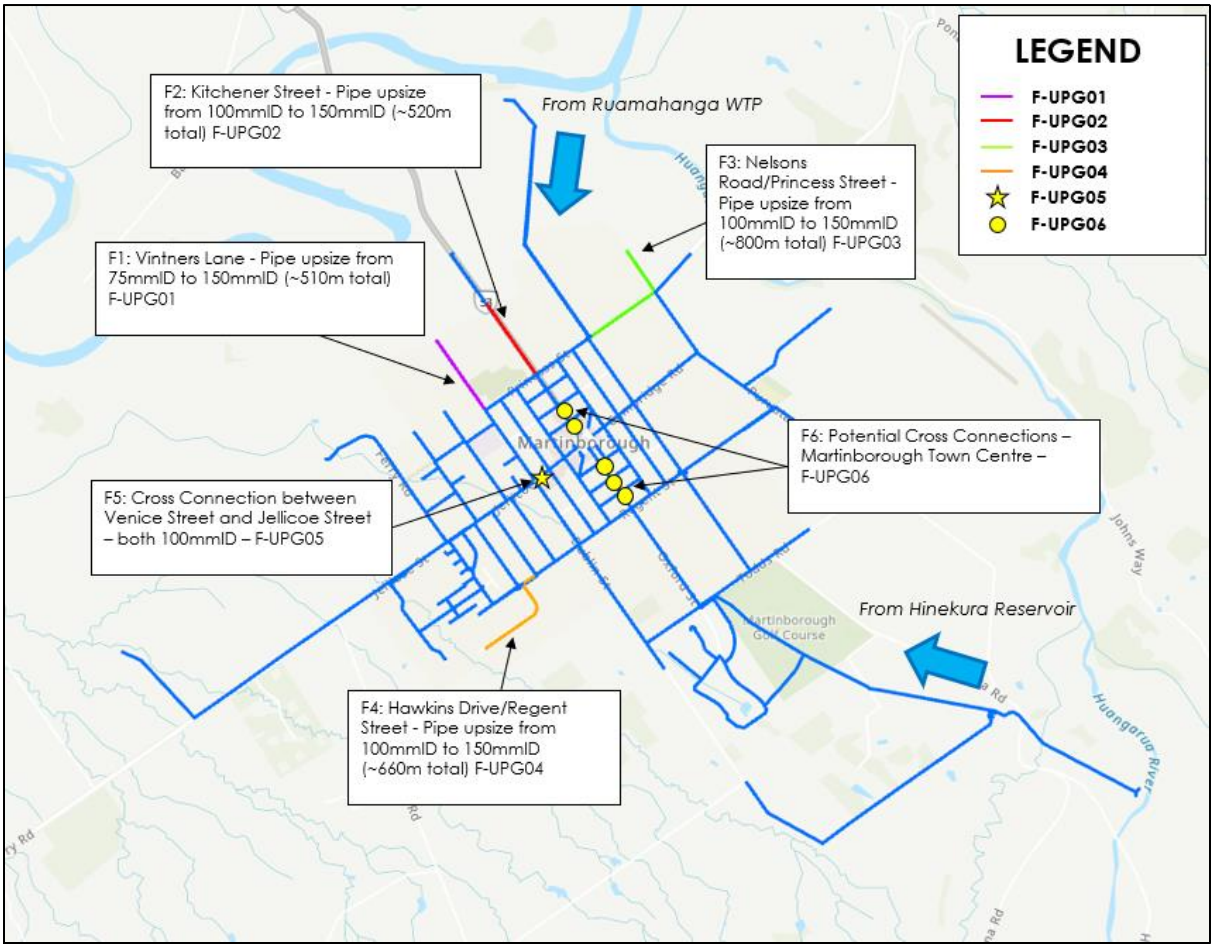


Figure 8-13: Fire Flow upgrades overvie

8.9.2.1 F1 Vintners Lane

FW3 properties along Vintners Lane do not meet the requirements of the Fire Code. Hydrant flows fall as low as 9 l/s at the end hydrant (Figure 8-14).

Upgrading the existing 75mmID UPVC pipe to 150mmID along Vintners Lane from Princess Street to No39 will resolve fire flow issues in the area up to FW3.

It is recommended the fire class of these buildings should be confirmed before commissioning upgrades.

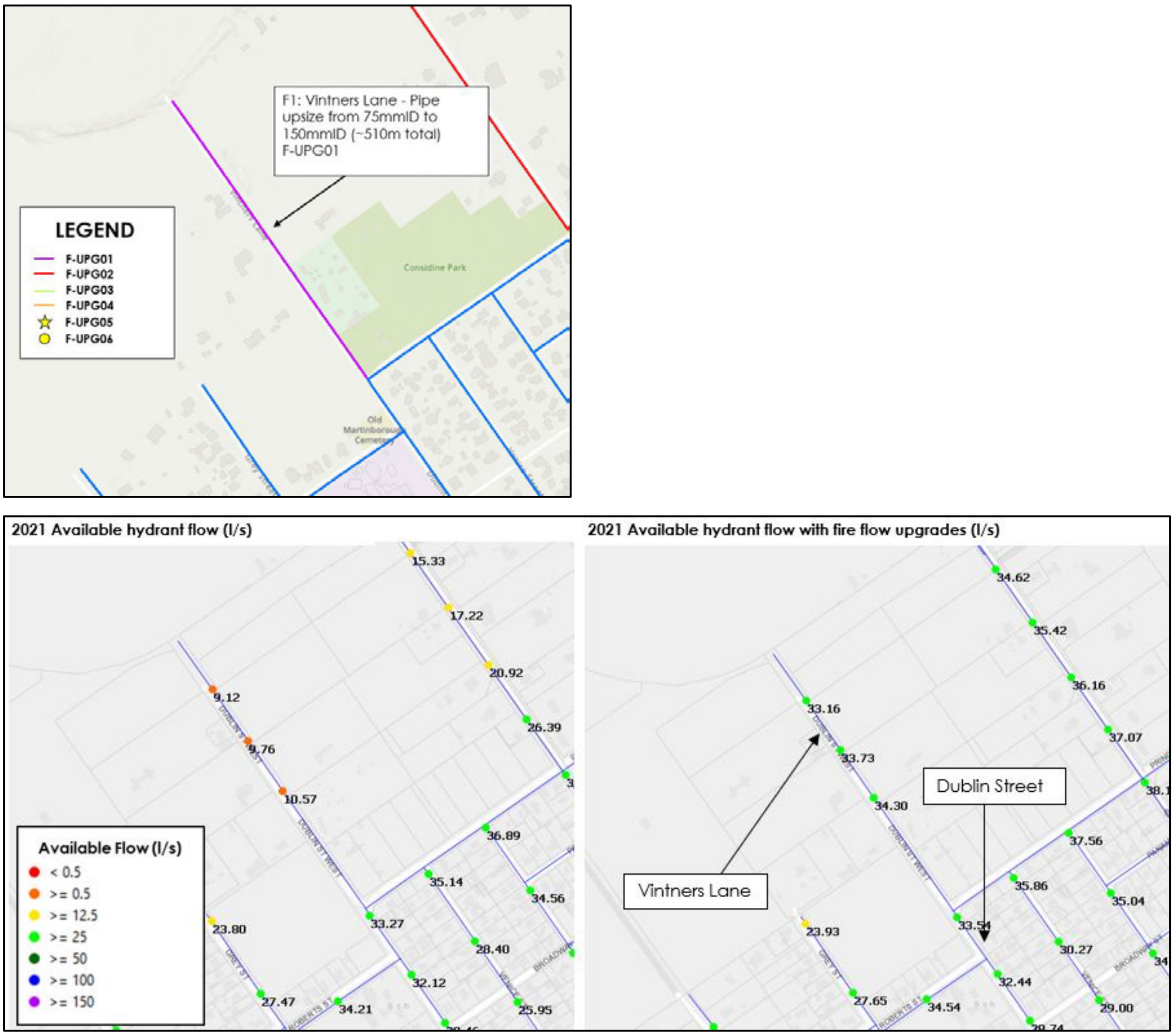


Figure 8-14: F1 Vintners Lane current fire flow and upgrades

F1 – Upgrade 510m of 75mmID mains to 150mm ID as detailed in Table 8-5.

8.9.2.2 F2 Kitchener Street

FW3 properties along Kitchener Street do not meet the requirements of the Fire Code. Hydrant flows are as low as 14l/s at the last hydrant (Figure 8-15). Upgrading the existing 100mmID PE80 pipe to 150mmID will resolve fire flow issues in the area up to FW3.

It is recommended the fire class of these buildings should be confirmed before commissioning upgrades.

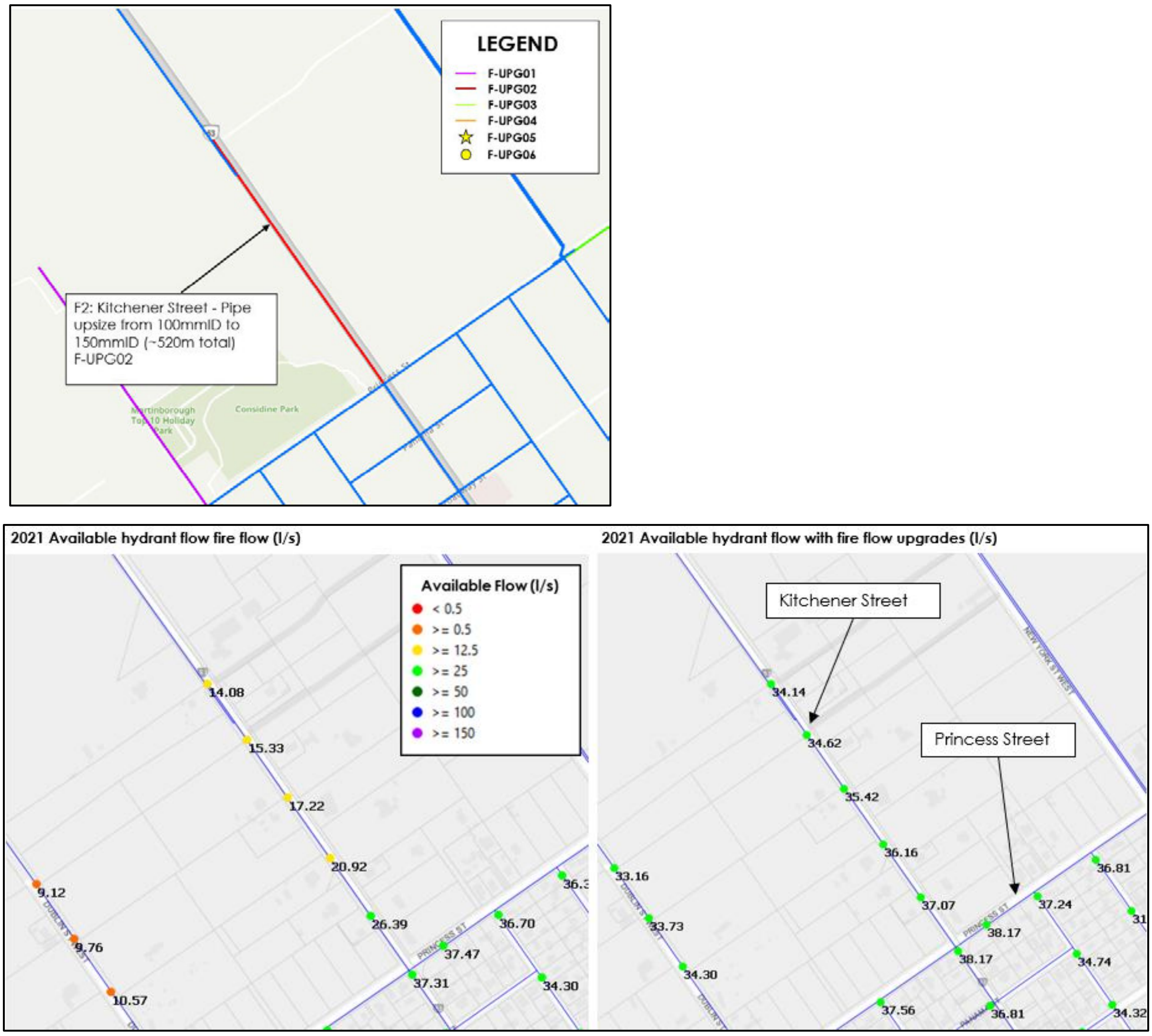


Figure 8-15: F2 Kitchener Street current fire flow and upgrades

F2 – Upgrade 520m of 100mmID mains to 150mm ID as detailed in Table 8-5.

8.9.2.3 F3 Nelsons Road/Princess Street

FW3 buildings along Nelsons Road and Princess Street do not meet the requirements of the Fire Code. Hydrant flows are as low as 18l/s at the last hydrant (Figure 8-16). Upgrading the existing 100mmID AC pipe to 150mmID will resolve fire flow issues in the area up to FW3.

It is recommended the fire class of these buildings should be confirmed before commissioning upgrades.

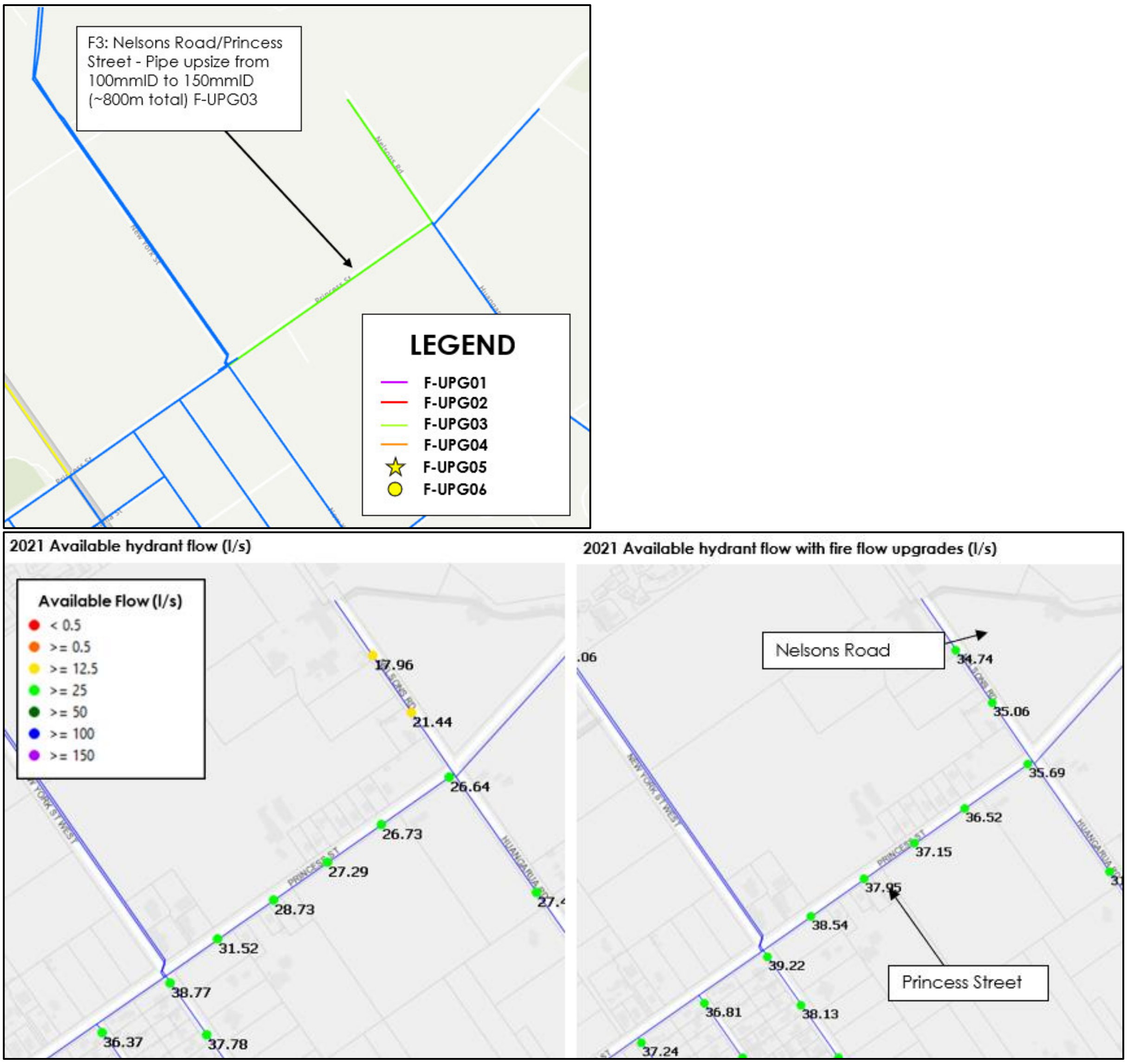


Figure 8-16: F3 Nelsons Road/Princess Street current fire flow and upgrades

F3 – Upgrade 800m of 100mmID mains to 150mm ID as detailed in Table 8-5.

8.9.2.4 F4 Hawkins Drive/Regent Street

FW2 buildings and one FW3 building along Hawkins Drive do not meet requirements of the Fire Code. Hydrant flows are as low as 15 l/s at the last hydrant (Figure 8-17). Upgrading the existing 100mmID PVC pipe to 150mmID will resolve fire flow issues in the area up to FW3. The upgraded 150mmID should be connected into the existing 150mmID AC down Regent Street at the junction with Daniel Street.

It is recommended the fire class of these buildings should be confirmed before commissioning upgrades.

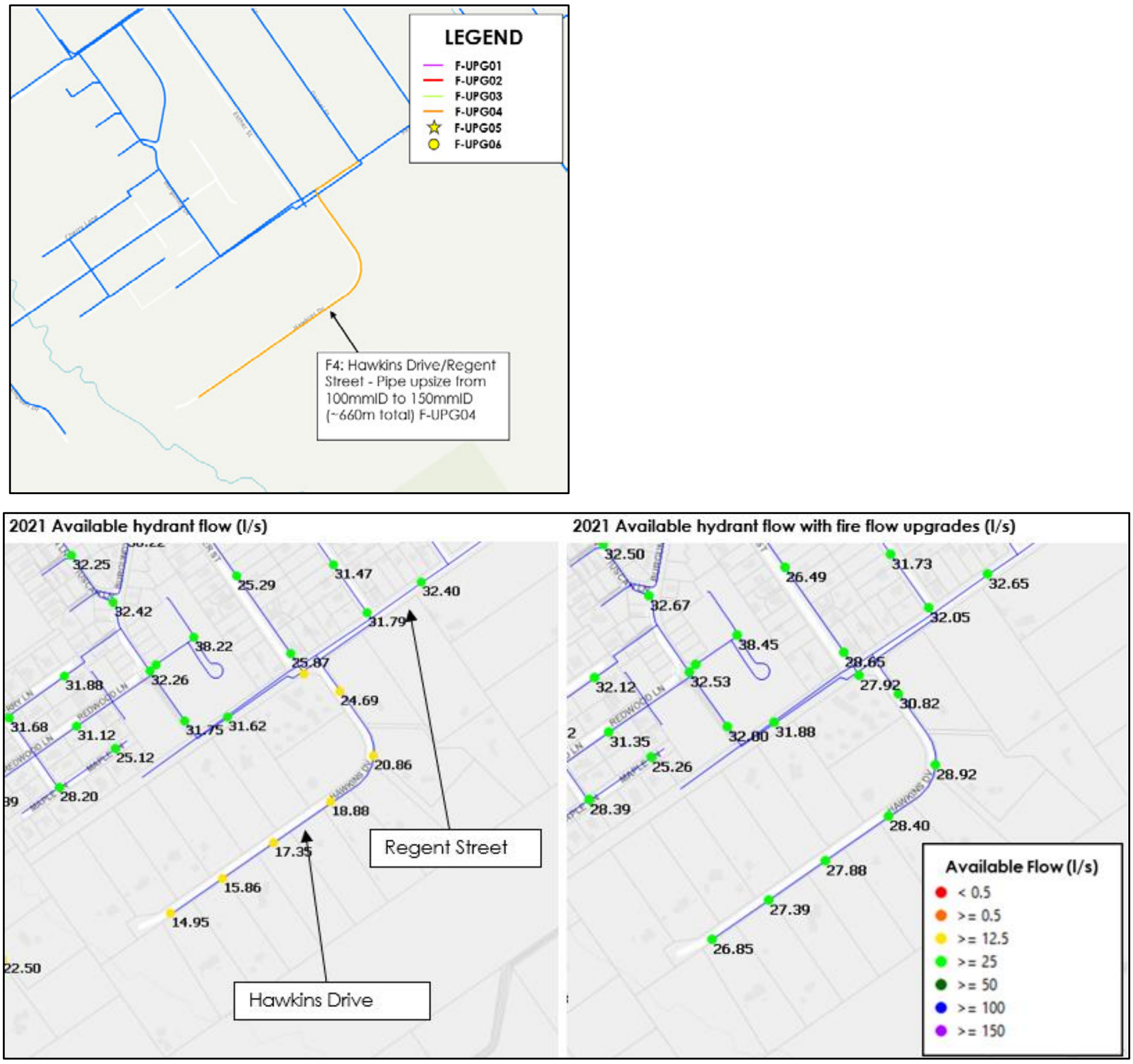


Figure 8-17: F4 Hawkins Drive/Regent Street current fire flow and upgrades

F4 – Upgrade 660m of 100mmID mains to 150mm ID as detailed in Table 8-5.

8.9.2.5 F5 Venice Street/Jellicoe Street

Several properties across the town centre cannot meet FW2 and FW3 requirements. The flow available at a hydrant is in order of 25l/s or just below at present, which is predicted to worsen with increased demand in future planning horizons (Figure 8-18).

A cross connection between Venice Street and Jellicoe Street will help improve fire flow availability for the residential properties in the west of the town centre which are currently showing as non-compliant

These pipes are not connected in the model as well as in the GIS. However, it is suspected that they are connected based on the network plans. It is recommended to do a field check to confirm their connectivity and install a cross-connection if there are not connected already.

It is recommended the fire class of these buildings should be confirmed before commissioning upgrades.

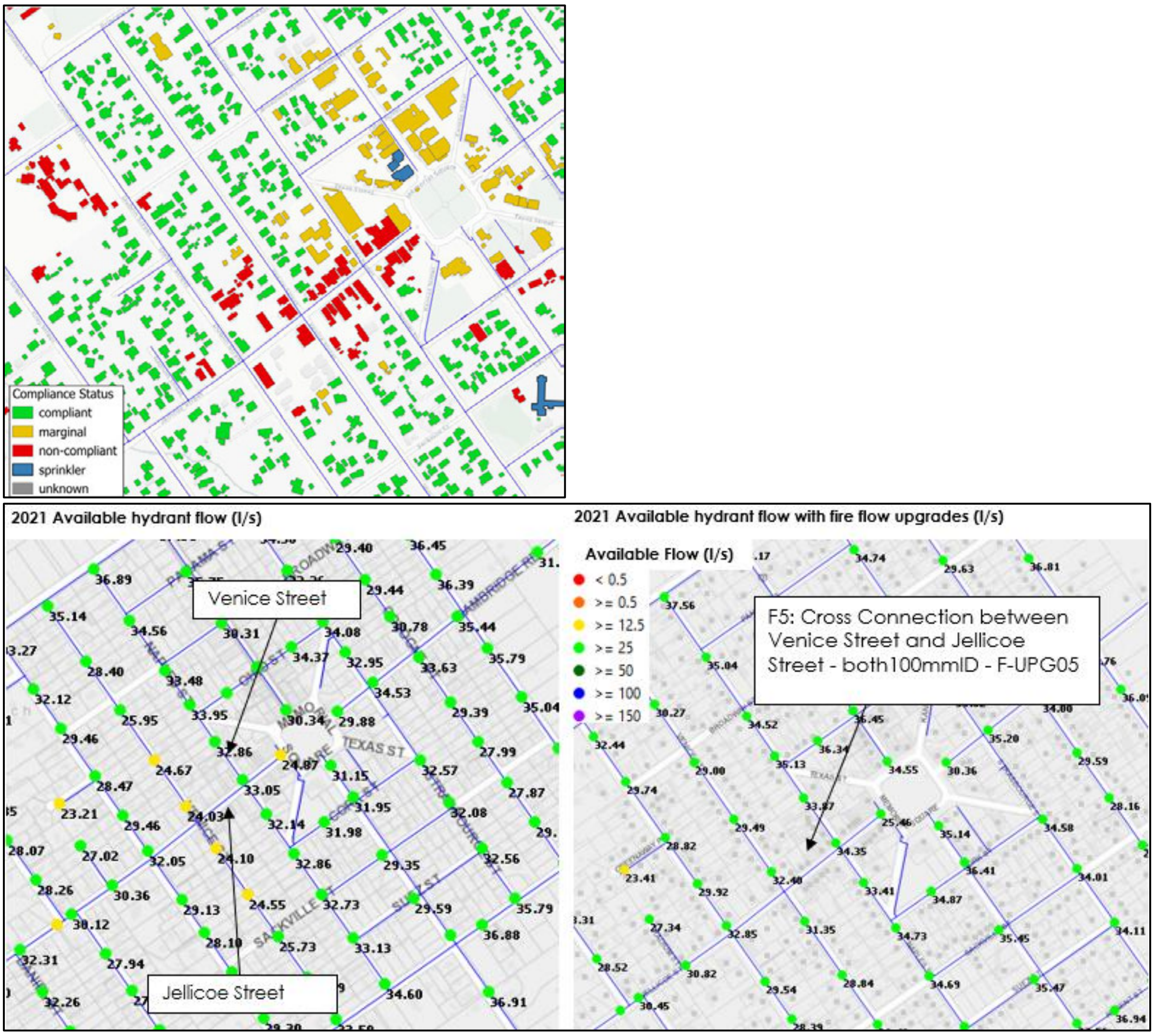


Figure 8-18: F5 Venice Street/Jellicoe Street current fire flow compliance and upgrades

F-5 – Cross Connection between Venice Street and Jellicoe Street as detailed in Table 8-5.

8.9.2.6 F6 Town Centre Cross Connections

There are a few more FW3 properties in the town centre which are currently shown as marginal failures. These could be improved by the proposed cross-connections at five other locations in the area where the model shows pipes crossing but are not connected (figure ref).

Results show that if these pipes were cross connected, fire flow around the town square would be improved by ~5l/s at certain hydrants which is not a significant improvement in supply from a single hydrant, however, could help by using multiple hydrants. It is recommended that these locations are checked in the field to see if they are cross connected or not already.

It is recommended the fire class of these buildings should be confirmed before commissioning upgrades.

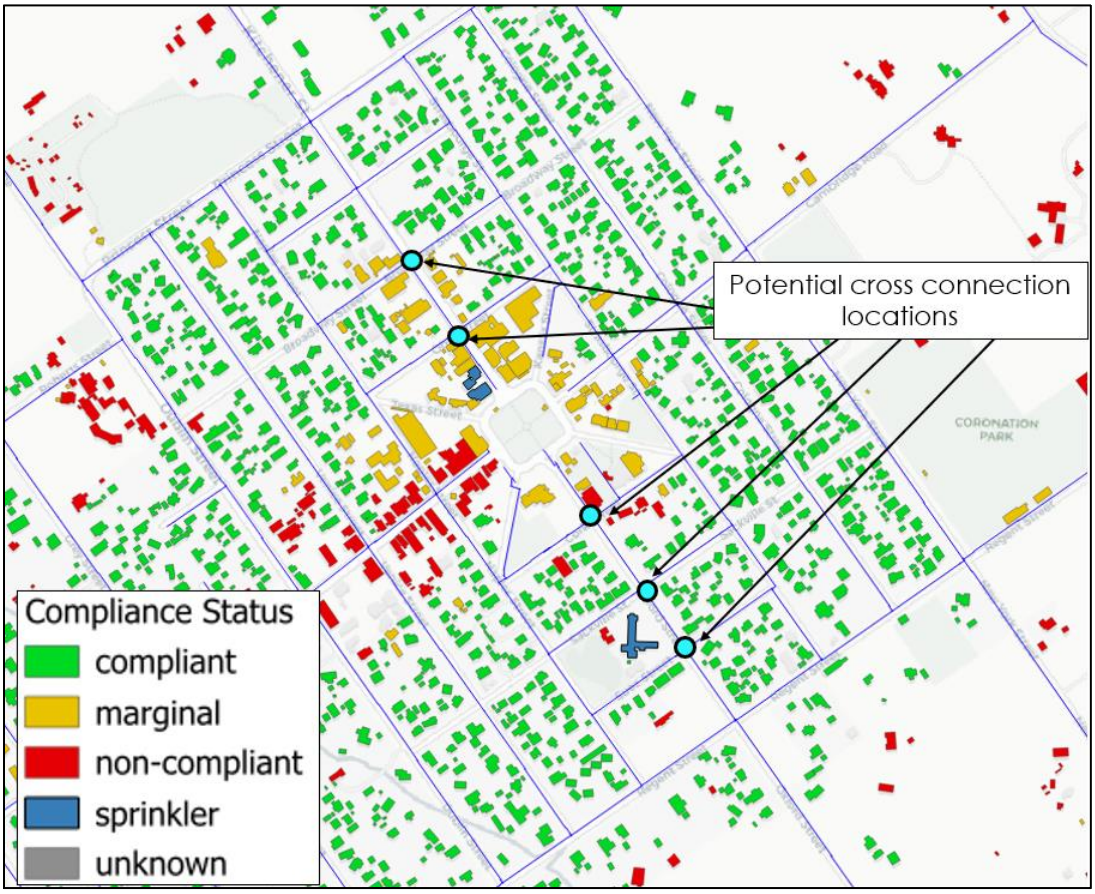


Figure 8-19: F6 Town Centre current fire flow compliance and possible new cross connection locations

F –6 Possible cross connections in town centre as detailed in Table 8-5.

The possible cross connections are on the crossing of the following roads:

- Ohio Street & Kitchener Street
- Broadway Street & Kitchener Street
- Cork Street & Oxford Street
- Sackville Street & Oxford Street
- Suez Street & Oxford Street

8.9.2.7 Hydrant installs

There are many areas where buildings cannot meet the Fire Code due to a lack of sufficient hydrants within 135m and 270m from properties rather than the network itself being insufficient to provide flow (Figure 8-20).

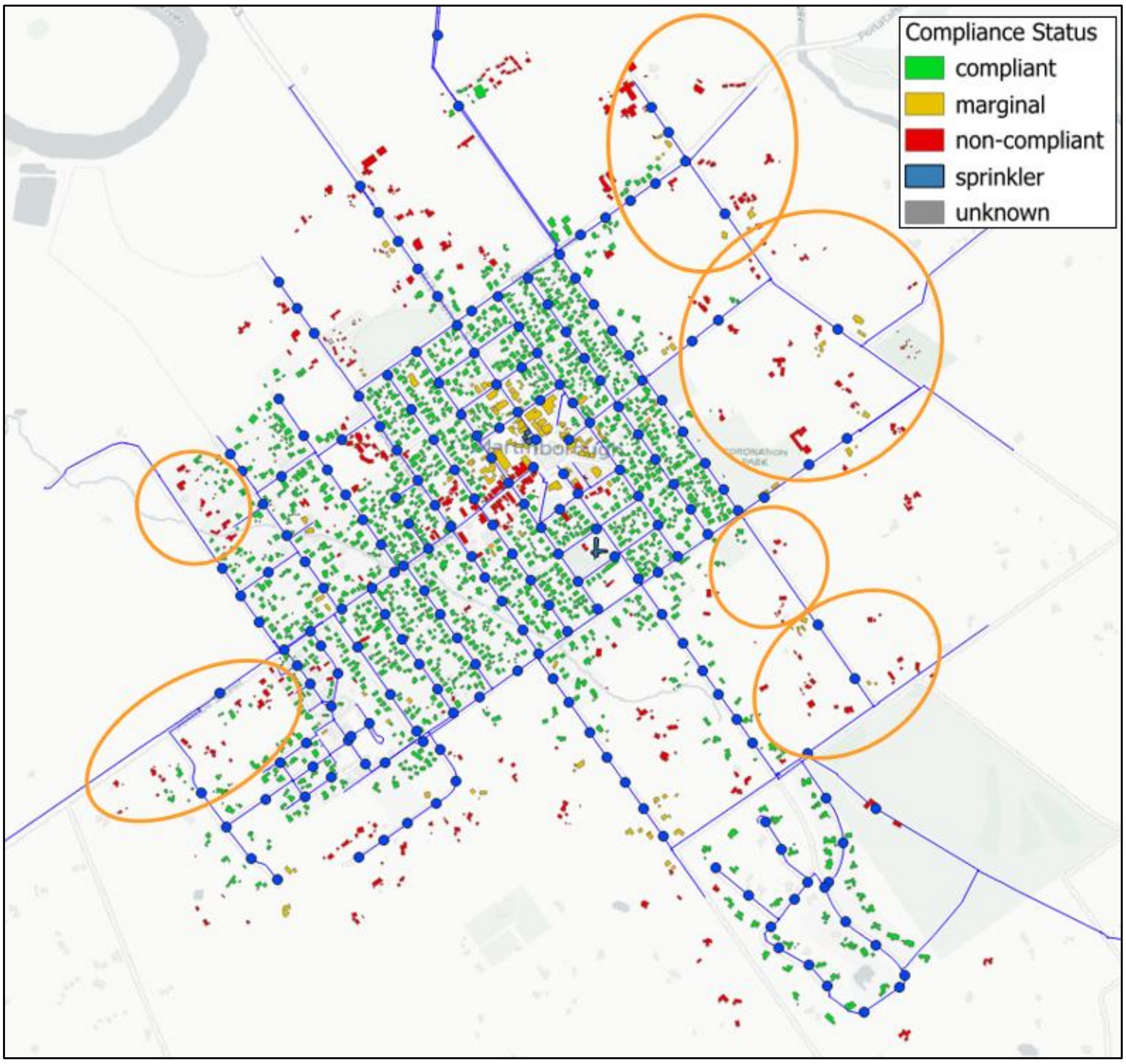


Figure 8-20: Areas of fire flow non-compliance

Some of these buildings could meet the requirements of the Fire Code if new hydrants were installed. Figure 8-21 shows a high-level plan of suitable locations for new hydrants.

Some locations, especially to the west of the town centre, do not have appropriately sized pipes (100mm ID or greater) to install hydrants. It is recommended that pipe upsizing in these areas should be considered when pipes are due for renewal or if pipes require upsizing due to a new housing/commercial development.

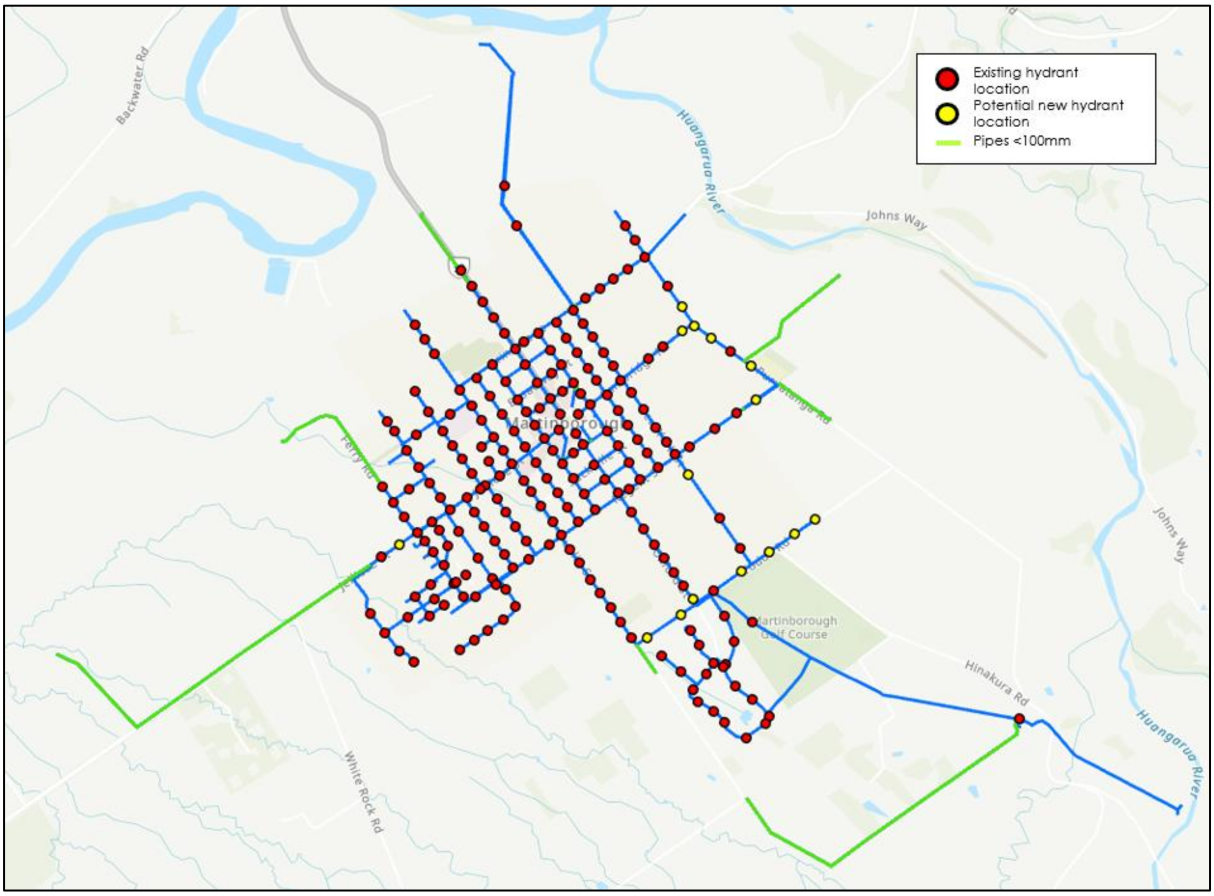


Figure 8-21: Potential locations for new hydrants on existing mains

8.9.3 Storage

8.9.3.1 Water Storage Areas (WSA)

Shortfalls were identified on a WSA level, where the area supplied by a reservoir is considered in calculations for the required volume of storage in the reservoir.

Martinborough consists of a single WSA supplied by four reservoirs with a total storage of 3560 m^3, as summarized in Table 8-6.

Table 8-6: Martinborough WSA Summary

No.	WSA	Associated Reservoirs	Available Storage (m3)	DMAs supplied
1	Martinborough	Hinekura No 1	860	Martinborough
		Hinekura No 2	860	
		Hinekura No 3	920	
		Hinekura No 4	920	

Table 8-7 details the storage assessment for each planning horizon by WSA and for each of the criteria as described in Section 7.5.3.

Table 8-7: Martinborough Storage shortfall

WSA	Martinborough WSA 2021	Martinborough WSA 2031	Martinborough WSA 2051	Martinborough WSA 2071
Sum of Peak Day MLD	2.4	2.6	3.0	3.5
Sum of total population	1,987	2,532	3,741	4,950
ADD (m3/day)[3]	1,261	1,373	1,598	1,831
Required volume 2 x ADD (m3)	2,522	2,746	3,196	3,663
PDD (m3/day)	2,382.0	2,592	3,021	3,462
Max fire class	FW3	FW3	FW3	FW3
Required volume for fire (m3)	180	180	180	180
Required volume 1.2 x PDD + fire (m3)	3,038	3,290	3,806	4,334
Public volume required (m3/day)	40	51	75	99
Critical user cat 1 (m3/day)	20.0	20.0	20.0	20.0
Critical user cat 2 (m3/day)	6.0	6.0	6.0	6.0
Critical user cat 3 (m3/day)	10.0	10.0	10.0	10.0
Required volume seismic (m3)	2,252	2,609	3,404	4,199
Max required volume (ML)	3.0	3.3	3.8	4.3
Driver	Peak Day	Peak Day	Peak Day	Peak Day
Existing Storage m3/day	3,560	3,560	3,560	3,560
Storage Shortfall m3/day	-522	-270	246	774
Storage Shortfall ML	**-0.5**	**-0.3**	**0.2**	**0.8**

[3] Current ADD demand is calculated based on the methodology outlined in the Martinborough ADD memo, included in Appendix F. Future ADD have been calculated based on the ADD/PDD factor calculated for the current scenario.

Table 8-8 summarises the shortfall by WSA in each planning horizon and populates the main criteria driving each shortfall.

Table 8-8: Martinborough Storage shortfall summary

WSA	2021		2031		2051		2071	
	Shortfall (ML)	Driver	Shortfall (ML)	Driver	Shortfall (ML)	Driver	Shortfall (ML)	Driver
Martinborough WSA	-0.5	Peak Day	-0.3	Peak Day	0.2	Peak Day	0.8	Peak Day

8.9.3.2 Storage Upgrades

The table indicates that the Martinborough WSA has a current surplus of 0.5 MLD which turns into a shortfall of 0.8MLD with population growth by 2071.

The WSA is solely supplied by the Hinekura reservoirs (3,560 m^3). The future shortfall is mostly driven by peak day criteria. The future shortfall is within ~20% of the current storage, even by 2071. The shortfall is predicted from 2051 planning horizon, therefore we have included the costing for the ultimate shortfall of 800 m3 under 2051.

Aerial imagery indicates there is space next to the existing Hinekura reservoirs which could be used for a new reservoir (Figure 8-22). To overcome the shortfall, this new storage should be at least 0.8MLD.

Figure 8-22: Proposed additional storage at existing Hinekura Reservoirs

Although much more costly, there is also an opportunity to relocate existing and future storage south of the present Hinekura Reservoirs somewhere with higher elevation to increase available head (Figure 8-23). Both the suggestions will require further investigations which is not covered as part of this study.

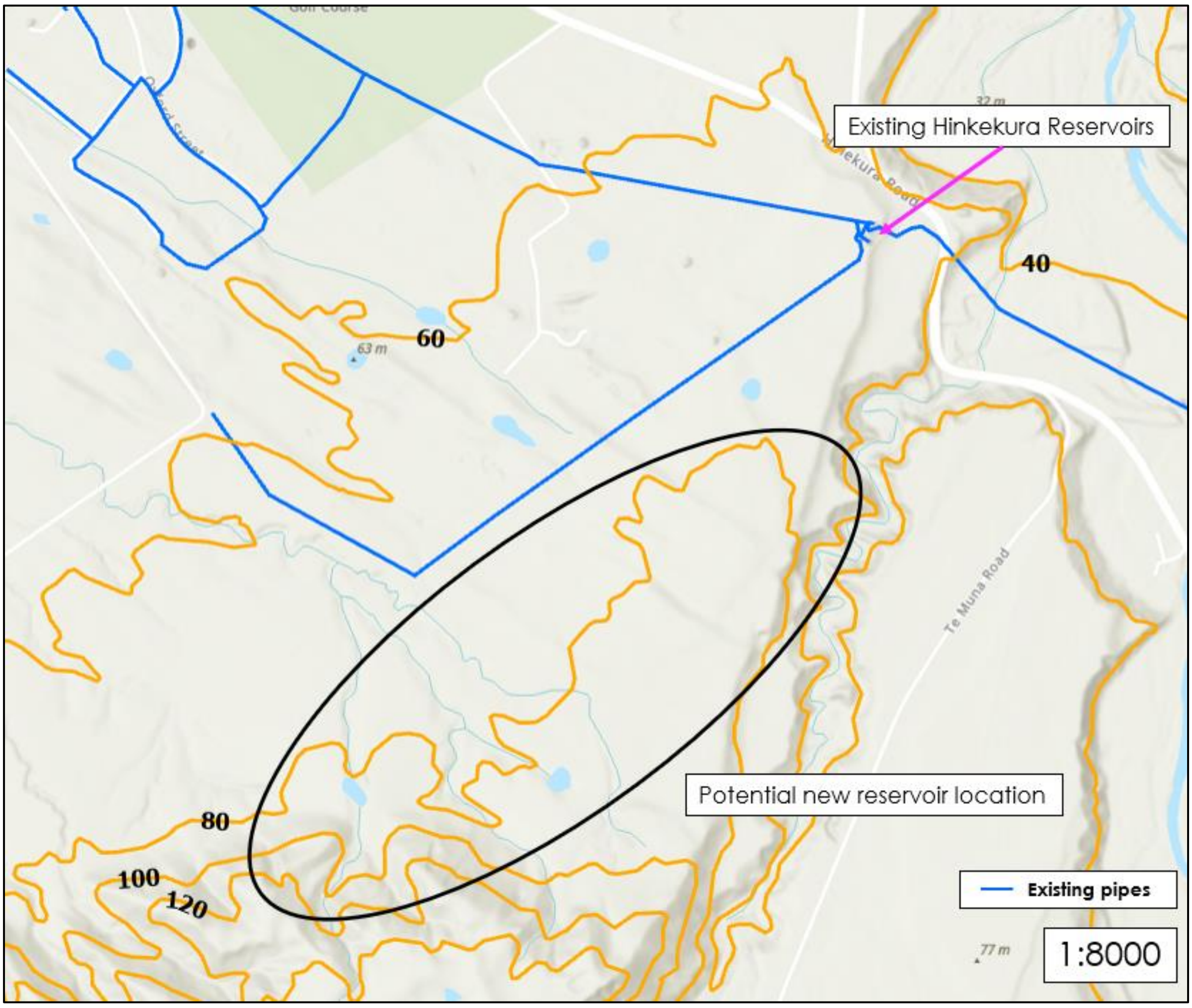


Figure 8-23: Potential alternative new reservoir location

8.9.3.3 Reservoir Circulation Issues and Recommendations

The four Martinborough reservoirs are poorly designed to enable water circulation/turnover, which at times results in at low FAC readings requiring chlorine dosing of the tanks. Each tank is configured with an individual rising/failing main (combined inlet/outlet pipe), resulting in water entering and exiting the tanks at the same location within the tank floor (rather than positioning the outlet pipe on the opposite side of the tank to enable circulation of water). This results in the same water that enters the tank during filling, being sucked back out during demand periods, while the water at the top of the tank does not get circulated.

This situation is exacerbated by the control logic used to operate these tanks with the top water level being maintained as high as possible. As shown in Figure 8-24 below, there is only around 2-3% fluctuation in the reservoir top water level (compared to a typical reservoir filling at 85% and stopping at 100%, which allows 15% turnover per fill). Reasons for this control logic may include:

The surrounding properties have very low pressure and require the top water level to be maintained as high as possible.

Historically the Ruamahanga WTP may not have been as reliable, resulting in regular outages. It is advantageous to maximise the volume of stored water available to maintain supply during any outages.

Recommended solutions as discussed with WWL:

1. Reconfigure the pipework of the 4 Martinborough reservoirs by:
    a. Install a dedicated inlet pipe discharging into the top of each reservoir on the opposite side from the outlet pipe. Install a non-return valve on the outlet pipe of each reservoir.
    b. Change the configuration of the 4 reservoirs to be in series, rather than in parallel so that water cycles through all 4 tanks.
2. Review the control logic and WTP run hours for filling the reservoirs. Shutting down supply from the Martinborough WTP for several hours per day will allow the reservoir top water to cycle by 15% of more, enabling turnover. However, upgrade of the Ruamahanga WTP may be required to enable recharge of the reservoirs under reduced running hours.
3. Install a dedicated inlet rising main from the Ruamahanga WTP to the 4 Martinborough reservoirs to allow all water supplied to Martinborough township to first circulate through the reservoirs.

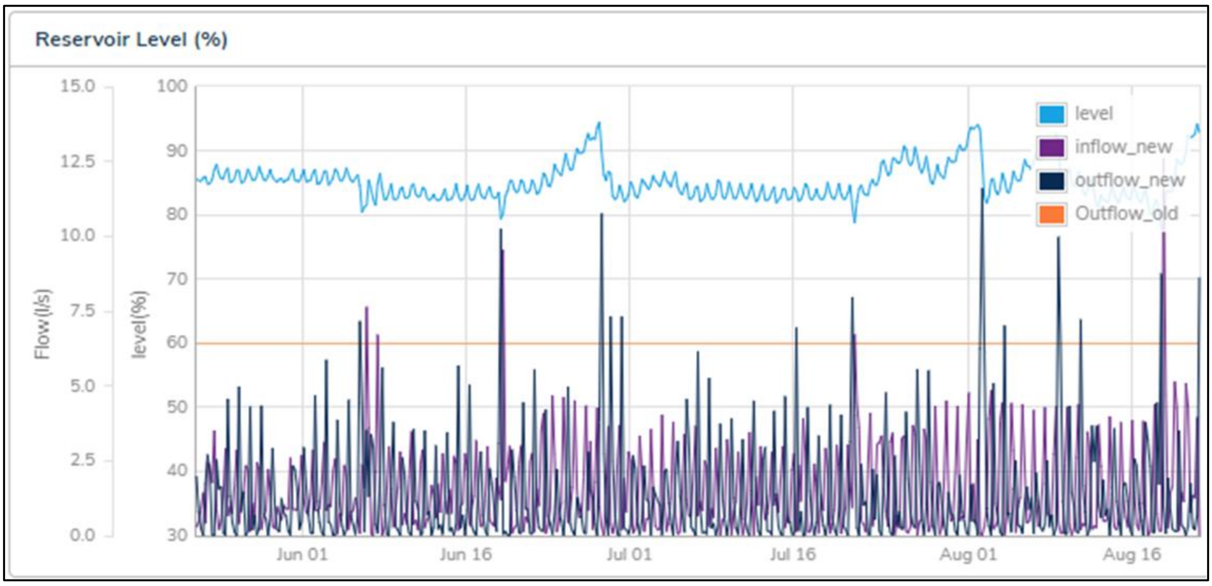


Figure 8-24: Top water level of the Martinborough Reservoirs over a 3-month period, showing only 2-3% fluctuation between fills.

8.9.4 Security of Supply

Although there are no set performance criteria for this in the specifications the study has identified the effects of taking each reservoir out of service, and potential alternative means of supply in the event of a reservoir outage.

The Peak Day 2021 model was used to assess the continuity of supply to the Martinborough WSA in the scenario where the Hinekura reservoirs were shut, either for planned maintenance or in an operational emergency.

Simulations were run for 72 hours for each scenario to make sure the area affected can be provided with water supply for at least 3 days. To facilitate this, the pumps at Ruamahanga WTP will need to be run at variable speed, delivering up to 40l/s to the network at maximum flow with a delivery head of 60m.

A summary of effects of outage of each reservoir and all possible options for alternative supply are shown in Table 8-9.

Table 8-9: Martinborough reservoir resilience options

Reservoir	Effects	Option	Solution	Useful
Hinekura Reservoir	Complete loss of supply to Martinborough and loss of supply to customers on the main coming from the Hinekura Res.	Option 1	Supply from the Ruamahanga WTP only	Yes

9.0 UPGRADES COST AND CAPITAL WORKS REGISTER

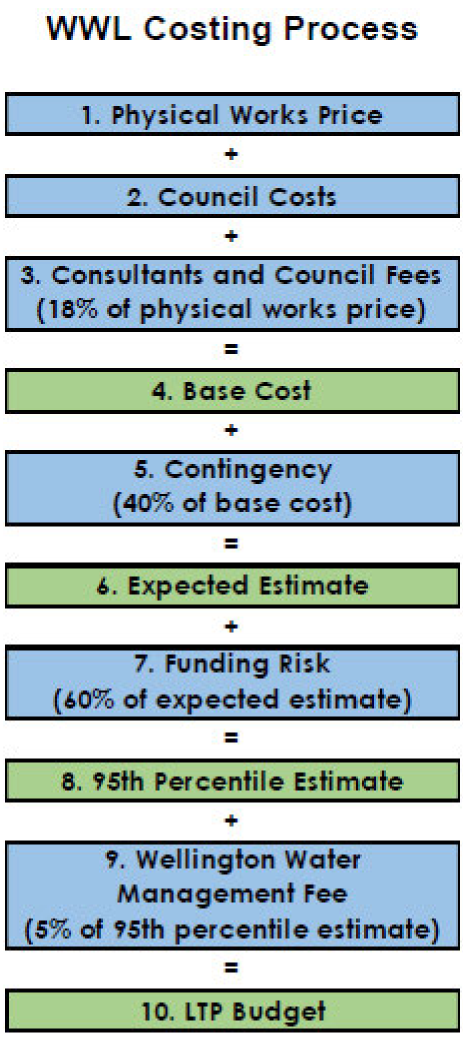
Level one costs have been developed for the upgrades, in line with the Wellington Water cost estimation manual and previous ZMPs.

9.1 CAPITAL COST ESTIMATION METHODOLOGY

Master Plan stage capital cost estimates were prepared under the instructions provided by Wellington Water.

This is explained below and is illustrated in the figure to the right.

1. Physical works price: Covers costs and associated with construction activities, environmental management, commissioning, requirements or historic places, service protection or diversion and contaminated land mitigation.
2. Council Costs: Land and property purchase of non-council land.
3. Consultants and Council Fees: Development, consenting, detailed design, procurement and MSQA. The base estimate for these fees is 18% of the physical works price.
4. The sum of physical works price, council costs and consultants and council fees is the Base Cost.
5. Contingency: The financial provision for the known and unknown risks, 40% of the base cost.
6. The base cost with contingency added is the Expected estimate.
7. Funding Risk: An additional 60% on top of the expected estimate, to cover the difference between the statistical mean and the 95th Percentile Estimate of threats and opportunities.
8. The expected estimate with the funding risk added is the 95th Percentile Estimate.
9. Wellington Water Management Fee: Fee value varies by council and year; here, it was taken to be 5% of the 95th Percentile Estimate.
10. The final cost with the Wellington Water Management Fee added is the LTP Budget.



The pipe and reservoir estimates may be classed as a **Level One** estimate.

The WWL Cost Estimation Manual requires these be based on:

- Risk Register outputs
- No site investigations
- Estimate land requirements
- Estimated consent conditions

- Possibility of scope change
- A range of options that may be developed and delivered

Note that land costs have been excluded from the cost estimation process, as no land unit rates are available for the study area.

9.2 PIPES

Pipe lengths were exported directly from the model, and internal diameters were checked and converted to nominal diameters for costing. It is assumed that all new pipes will be built in alignment with the road.

Costs were therefore taken from the GHD Table of Unit Rates (rev.11), assuming for costing purposes that all pipes will be installed in the berm (no road excavation or reinstatement costs), and at a depth of 1.5-2.5m. PN16 PE pipe was assumed for all pipes.

The rates supplied in the Table of Unit Rates include Preliminary and General costs and on-costs. The rates used for physical works costs are therefore shown in **Table 9-1**

Table 9-1: Unit Rates used for WS Pipe Estimate

DN (mm)	ID (PN16) mm	Cost ($/m)
63	51.4	$809
125	102.2	$979
180	147.2	$1,085
250	204.6	$1,378
315	257.8	$1,775
355	290.6	$1,927
400	327.4	$2,141
560	458.4	$3,240

9.3 PUMP STATIONS

There is no reliable unit rate estimation methodology available for pump stations. An indicative range of rates was supplied by Wellington Water operations staff based on the maximum power requirement, this has been used as a placeholder until a site investigation and preliminary design can be undertaken.

- <15 KW - $250k to purchase and install
- 15 – 30 KW - $450k to purchase and install
- 30 – 40 KW - $700k, plus a likely major power upgrade at site

9.4 RESERVOIRS

A formula to estimate the physical cost of reservoirs has been developed by Three Waters Ltd consulting. The formula provides a basic estimate for the reservoir cost based on the volume of the reservoir.

This rate has been developed from previous reservoir projects to represent contractor costs, including onsite and offsite overheads. The Three Waters Ltd. formula is as follows:

Contractor_Cost_Estimate [$million] = 2.37*capacity [MLD]^0.55

In addition to physical works for the reservoir itself, the physical works cost should include an allowance for construction of an access road. A unit rate of $500/m for reservoir access roads has been used, based on a 5m wide metaled (gravel) access track that would be formed to allow construction traffic and then be graded to allow occasional access for 4WD light operational traffic.

Land cost unit rates are not available and therefore not included in the cost estimates for reservoirs.

9.5 OTHER MINOR WORKS

For some minor works, unit rates are not appropriate and will not provide a reasonable estimate of total project cost. As the scale of these works is small, minor works have each been assigned a nominal lump sum cost for physical works which is intended to be very conservative, but still a small total cost in the scheme of the total ZMP capital works.

- Minor works, such as rezoning or other operational changes, field investigations, installation of valves etc. have been assumed to have a nominal physical works cost of $50,000.
- Slightly more complex works such as flow meters, PRVs, cross connections or pipework 50m or less in length have been assumed to have a nominal cost of $100,000.

9.6 CAPITAL WORKS REGISTER

Table 9-2 to Table 9-5 show summaries of costs by upgrade type and by planning horizon in all three areas. The majority of upgrade costs for Featherston and Greytown are required to address poor pressures and fire flow requirements. All upgrades in Martinborough are for fire flow requirements and storage shortfalls.

Most upgrades are required as soon as possible; an upgrade of the Waiohine bore and rising main is required in 2051 (S-UPG-07). At the same time, the Waiohine Treatment Plant may also need to be upgraded. This has not been included in the estimate.

The storage upgrade for Martinborough is required for the 2051 planning horizon.

Also in 2051 or earlier, the capacity between the TWR and the Greytown Reservoir will need to be increased. Investigations to clarify the local hydraulics have been included in S-UPG-08 (assumed cost of $100,000).

Table 9-2: Featherston/Greytown capital works cost summary

Upgrade category	2021	2031	2051	2071	Total
Fire	$16.0				$16.0
Pressure (including growth) and Fire	$12.3				$12.3
Strategic (maintain reservoir replenishment)			$4.2		$4.2
Total	**$28.2**	**$0.0**	**$4.2**	**$0.0**	**$32.5**

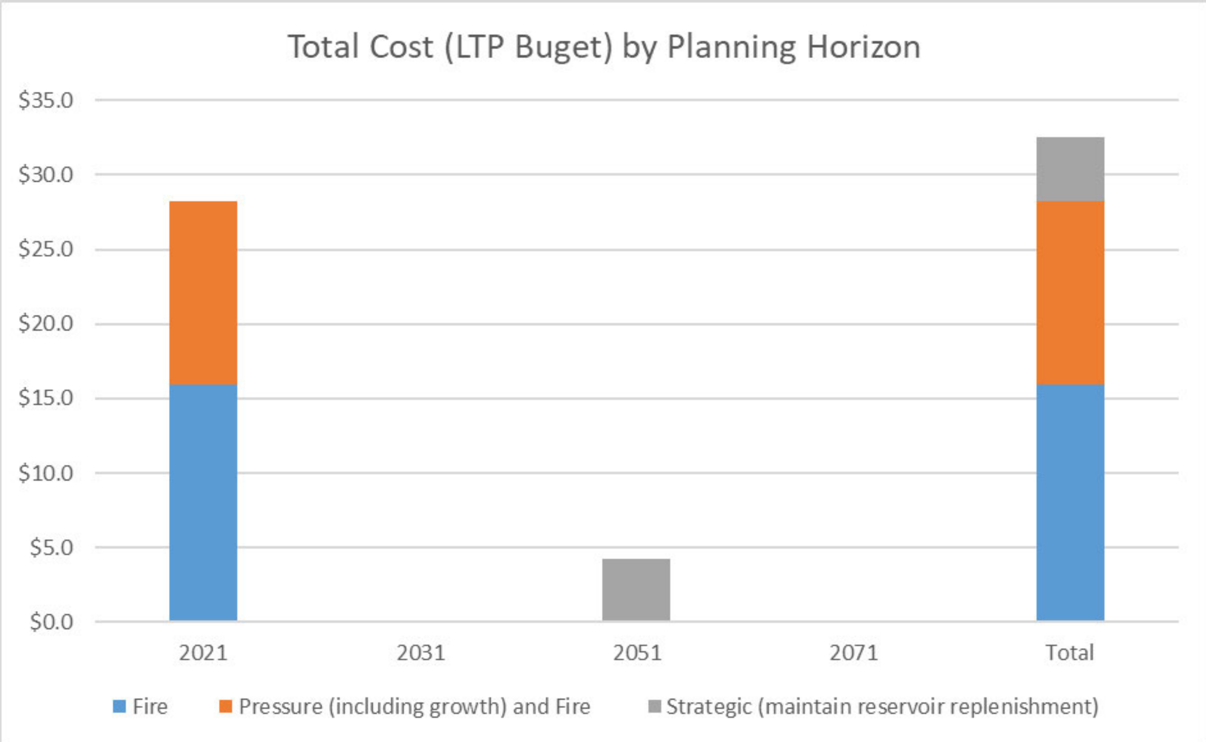


Figure 9-1: Featherston/Greytown total cost of upgrades by planning horizons

Table 9-3: Martinborough capital works cost summary

Upgrade category	2021	2031	2051	2071	Total
Fire	$8.3				$8.3
Pressure					$0.0
Storage			$5.8		$5.8
Total	**$8.3**	**$0.0**	**$5.8**	**$0.0**	**$14.1**

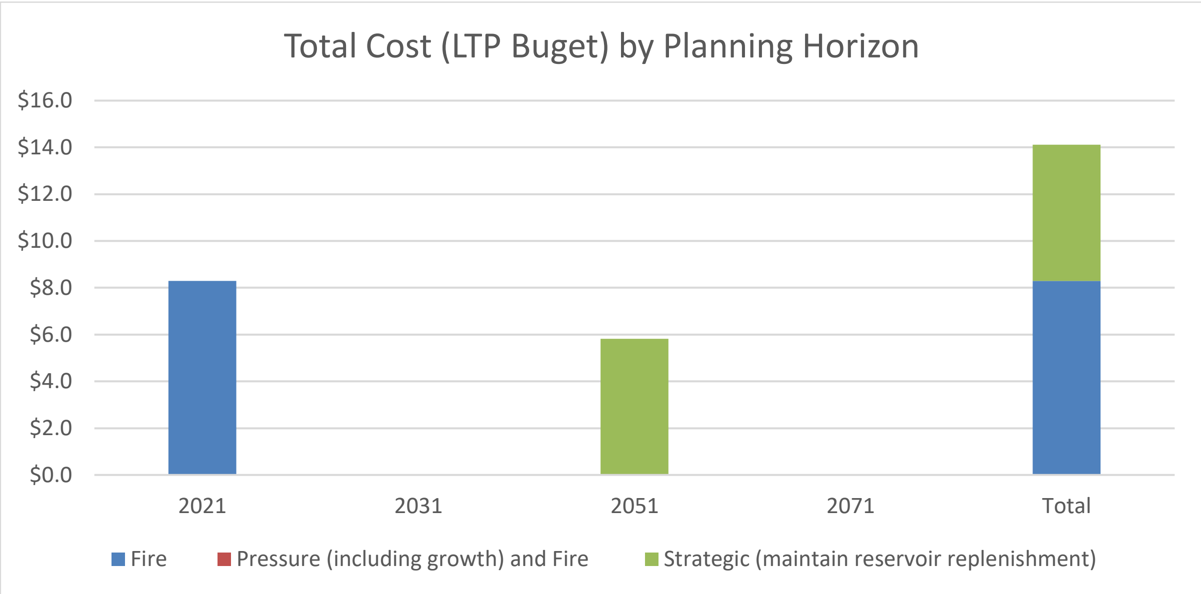


Figure 9-2: Martinborough total cost of upgrades by planning horizons

Table 9-4: Featherston/Greytown detailed list of cost and upgrade

Planning Horizon	Upgrade Ref	Upgrade Description	Upgrade Category	Capital Works	Cost ($) (physical works estimate)	Cost ($M, LTP Budget)	No. of properties benefited	Section Reference	Comments
2021	UPG-01	Churchill Cres Upgrades	Pressure, Fire	Pipe upgrades	$525,989	$1.46	55	7.10.1	
2021	UPG-01a		Pressure, Fire	New booster pump station	$250,000	$0.69			Low priority
2021	UPG-02	Boar Bush Gully Road - Reservoir outlet ugprade	Pressure, Fire	Pipe upgrades	$3,646,939	$10.12	1175	7.10.2	Site may be challenging
2021	F-UPG-03	Crawford, Waite and Fitzherbert Street pipe upgrade	Fire	Pipe upgrades	$925,872	$2.57	120	7.11.1	
2021	F-UPG-03a		Fire	New Pipes	$147,303	$0.41			
2021	F-UPG-04	Kuratawhiti Street Pipe upgrades	Fire	Pipe upgrades	$1,955,334	$5.43	244	7.11.2	
2021	F-UPG-04a		Fire	New Pipes	$38,542	$0.11			May create a contact time issue
2021	F-UPG-04b		Fire	Pipe upgrades	$656,885	$1.82			
2021	F-UPG-05	West Street and East Street pipe upgrades	Fire	Pipe upgrades	$1,271,482	$3.53	194	7.11.3	
2021	F-UPG-05a		Fire	New Pipes	$288,726	$0.80			
2021	F-UPG-06	Jellicoe Street pipe upgrade	Fire	Pipe upgrades	$591,320	$1.64	85	7.11.4	
2051	S-UPG-07	Waiohine Booster Pump Station upgrade	Strategic	Booster pump station ugprades	$700,000	$1.94	All of Featherston and Greytown	7.4	
2051	S-UPG-07a		Strategic	New Pipes	$230,465	$0.64			

Planning Horizon	Upgrade Ref	Upgrade Description	Upgrade Category	Capital Works	Cost ($) (physical works estimate)	Cost ($M, LTP Budget)	No. of properties benefited	Section Reference	Comments
2051	S-UPG-08	Waiohine Reservoir Complex booster pump upgrades, including feasibility and implementation strategy	Strategic	New booster pump station incl. investigation	$300,000	$0.83	All of Featherston and Greytown	7.4.3.4 Option 2a	Site and elevation survey, confirm hydraulics and implementation options
2051	S-UPG-08a		Strategic	New booster pump station incl. investigation	$300,000	$0.83			

Table 9-5: Martinborough detailed list of cost and upgrade

Planning Horizon	Upgrade Ref	Upgrade Description	Upgrade Category	Capital Works	Cost ($) (physical works estimate)	Cost ($M, LTP Budget)	No. of properties benefited	Section Reference	Comments
2021	F-UPG01	Vintners Lane	Fire	Pipe upgrades	$553,231	$1.54	8	8.9.2.1	
2021	F-UPG02	Kitchener Street	Fire	Pipe upgrades	$563,182	$1.56	17	8.9.2.2	
2021	F-UPG03	Nelsons Road/Princess Street	Fire	Pipe upgrades	$853,916	$2.37	5	8.9.2.3	
2021	F-UPG04	Hawkins Drive/Regent Street	Fire	Pipe upgrades	$722,493	$2.01	22	8.9.2.4	
2021	F-UPG05	Venice Street/Jellicoe Street	Fire	Cross Connection	$50,000	$0.14	40	8.9.2.5	
2021	F-UPG06	Martinborough Town Centre	Fire	Cross Connection	$250,000	$0.69	50	8.9.2.6	
2051	ST-UPG01	Additional Reservoir	Storage	Storage	$2,096,273	$5.82	All of Martinborough	8.9.3.2	

10.0 CONCLUSION

10.1 FEATHERSTON/GREYTOWN

The ZMP work for Featherston and Greytown has identified significant deficiencies under current and future planning horizons. Some require significant and / or complex solutions which will necessitate further investigations.

Key points to note from the ZMP are:

- The Waiohine WTP may require an upgrade to deliver additional flow. This is not covered in this study and has not been priced. It should be upgraded to support demand in the ultimate 2071 scenario while the upgrade will be needed in 2051.
- The pipework around the TWR, especially between the TWR and the Greytown Reservoir, will require a significant overhaul, most likely including pump stations to each of the Greytown Reservoir and Boar Bush Reservoir. This is likely a complex design and has not been covered in full in this study. A summary of the works required is discussed in Section 7.4.
- The Memorial Park WTP contributes significantly to the fire flow availability in Greytown. If it is out of service, a large number of FW3 buildings fail to comply with the Fire Code.
- Upgrade F-UPG-04 may result in a reduction in the contact time of the Memorial Park WTP as well as increase the need for regular flushing. This needs to be investigated further.
- The Boar Bush Reservoir outlet pipe (UPG-02) is on unstable ground. Further investigations should be undertaken to confirm location suitability.

10.2 MARTINBOROUGH

The ZMP work for Martinborough has identified fire flow deficiencies under the current planning horizons. Most solutions should be relatively straight forward with upgrades concentrated mainly to dead ends.

Key points to note from the ZMP are:

- Most fire flow upgrades are down dead legs with FW3 buildings where pipe diameter is restricting flow.
- It is recommended that many new hydrants are installed on existing mains, when possible, to ensure all buildings in the area meet fire flow requirements.
- Several locations in the town centre need to be checked for existing cross connections and it is recommended to install the cross connections installed if no existing cross connection is found (F-UPG05-06).
- The costliest works will be the additional reservoir required to cover the shortfall in storage. If this additional storage can be built next to existing reservoirs, then disruption should be at a minimum and save land acquisition cost. If it needs to be built in a new location this will require further investigations.

10.3 SUMMARY OF TOTAL COSTS

Table 10-1and Figure 10-1 show a summary of total costs of upgrades proposed for Martinborough, Featherston and Greytown.

Table 10-1: Summary of total costs

Upgrade category	2021	2031	2051	2071	Total
Fire	$24.3				$24.3
Pressure (including growth) and Fire	$12.3				$12.3
Storage (Strategic/Additional)			$10		$10
Total	**$36.6**	**$0.0**	**$10**	**$0.0**	**$46.6**

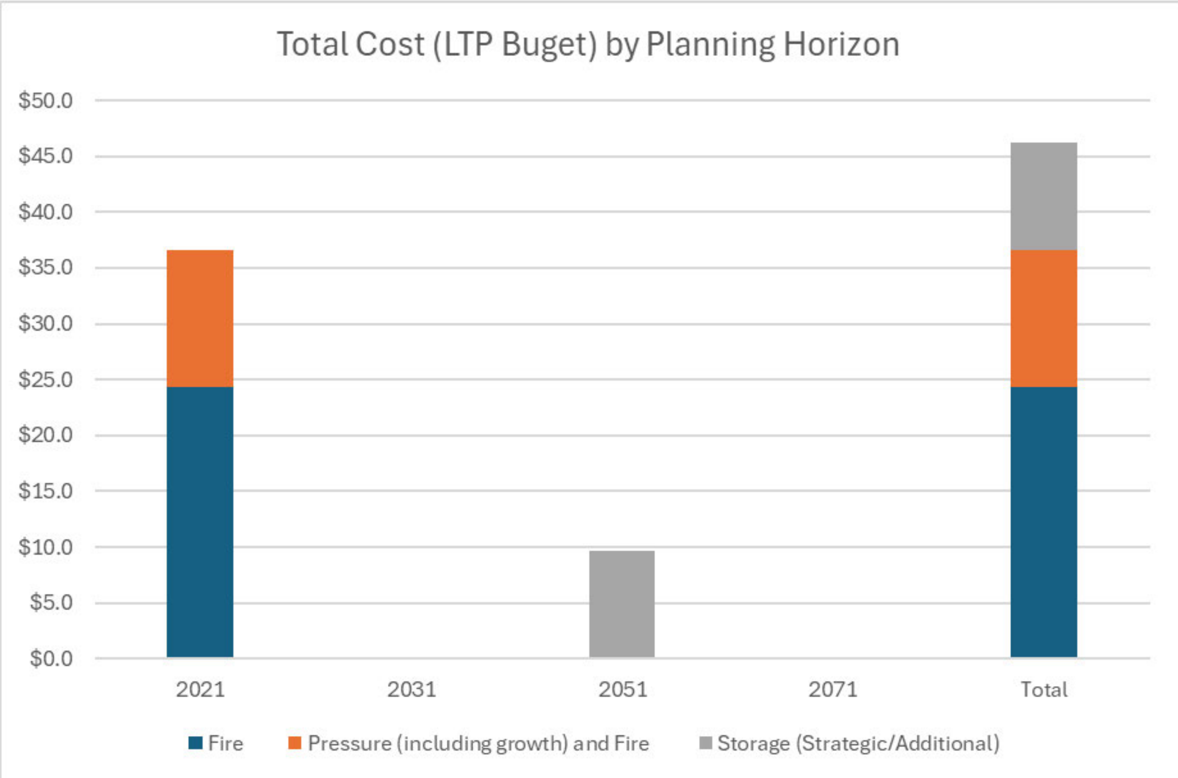


Figure 10-1: Summary of total costs

Appendices

We design with community in mind

Appendix A PIPE NETWORK CHARACTERISTICS

Pipe lengths by DMA and diameter

DMA	< 50	50 to 100	100 to 150	150 to 200	200 to 250	250 to 300	300 to 350	350 to 400	Grand Total
Greytown DMA	1,206	11,714	10,658			6,984			30,562
Featherston Trunk					2,739	3,782	6,427		12,948
Featherston DMA	3,742	13,793	4,996	3,544	1,588		6		27,669
Martinborough DMA	1,420	18,645	16,170		5,084	2,790			44,109
Grand Total	6,368	44,152	31,824	3,544	9,411	13,556	3,427		115,288

Pipe lengths by material and diameter

Material	< 50	50 to 100	100 to 150	150 to 200	200 to 250	250 to 300	300 to 350	350 to 400	Grand Total
AC	127	26,625	5,686	1,358	2,719	5,940			42,455
CU	225	92							317
DICL					43				43
GS	930								930
PE	4,513	9,162	318	189		637	45		14,864
PVC	100	556	8,649		1,850	6,523			17,678
RC		2,528	224						2,752
ST	52	118	43	12	4		5,113		5342
STCL		2,348		2,295	3,266	1,083	1,558		10,550
UPVC	420	2,724	16,911		1,614	553			22,222
Grand Total	6,367	44,153	31,831	3,854	9,496	14,736	6,716		117,153

Grand Total difference between tables is due to bulk mains not included in DMAs

Appendix B RESERVOIR ASSET DATA CARDS

Reservoir:	Timber Tank Reservoir	
Details		
Year:	*Unknown*	
Operational Name:	Timber Tank	
Location:	Waiohine Valley Road	
Asset ID:	SWDC_PW009713	
Owner:	SWDC	
Specifications	Physical	Modelled
Capacity:	700m³	700m³
Top Water Level:	*Unknown*	118.65m
Reservoir Bottom Level:	*Unknown*	112.65m
Full Depth:	*Unknown*	6.00m
Inlet and Outlet pipes:	200 PVC, 200 PVC	
Notes:		
SCADA Tags		
Level (%)	M001007	
Instantaneous Outflow:	M001013	
Instantaneous Inflow:	*Unknown*	
Comments:	Has been taken out of service – as discovered during ZMP phase	

Reservoir:	Greytown Reservoir	
Details		
Year:	*Unknown*	
Operational Name:	Greytown Reservoir	
Location:	Waiohine Valley Road	
Asset ID:	SWDC_PW009712	
Owner:	SWDC	
Specifications	Physical	Modelled
Capacity:	750m³	750m³
Top Water Level:	*Unknown*	113.20m
Reservoir Bottom Level:	*Unknown*	107.20m
Full Depth:	*Unknown*	6.60m
Inlet and Outlet pipes:	300 AC, 300 UPVC	
SCADA Tags		
Level (%)	M001009	
Instantaneous Outflow:	M001014	
Instantaneous Inflow:	*Unknown*	
Comments:		

Reservoir:	Boar Bush 1 Reservoir	
Details		
Year:	1965	
Operational Name:	Boar Bush 1	
Location:	Boar Bush Gully Road	
Asset ID:	SWDC_PW009714	
Owner:	SWDC	
Specifications	**Physical**	**Modelled**
Capacity:	81m³	Not Modelled
Top Water Level:	*Unknown*	
Reservoir Bottom Level:	*Unknown*	
Full Depth:	*Unknown*	
Inlet and Outlet pipes:	300 STCL, 200 AC	
SCADA Tags		
Level (%)	*Unknown*	
Instantaneous Outflow:	*Unknown*	
Instantaneous Inflow:	*Unknown*	
Comments:	Boar Bush 1 and Boar Bush 2 Reservoirs modelled as single reservoir.	

Reservoir:	Boar Bush 2 Reservoir	
Details		
Year:	1965	
Operational Name:	Boar Bush 2	
Location:	Boar Bush Gully Road	
Asset ID:	SWDC_PW009719	
Owner:	SWDC	
Specifications	**Physical**	**Modelled**
Capacity:	455m³	455m³
Top Water Level:	*Unknown*	97.29m
Reservoir Bottom Level:	*Unknown*	94.09m
Full Depth:	*Unknown*	3.20m
Inlet and Outlet pipes:	300 STCL, 200 AC	
SCADA Tags		
Level (%)	M046000	
Instantaneous Outflow:	M046001	
Instantaneous Inflow:	*Unknown*	
Comments:	Boar Bush 1 and Boar Bush 2 Reservoirs modelled as single reservoir.	

Reservoir:	Hinekura 1 Reservoir	
Details		
Year:	2009	
Operational Name:	Martinborough 1	
Location:	Hinekura Road	
Asset ID:	SWDC_PW009715	
Owner:	SWDC	
Specifications	**Physical**	**Modelled**
Capacity:	920m³	Not Modelled – see comments
Top Water Level:	*Unknown*	
Reservoir Bottom Level:	*Unknown*	
Full Depth:	*Unknown*	
Inlet and Outlet pipes:	250 AC (Single Inlet/Outlet)	
SCADA Tags		
Level (%)	M045012	
Instantaneous Outflow:	M045001	
Instantaneous Inflow:	M045002	
Comments:	All (four) Hinekura Reservoirs modelled as single reservoir – represented as Hinekura 2 Reservoir in model. Other reservoirs isolated.	

Reservoir:	Hinekura 2 Reservoir	
Details		
Year:	2000	
Operational Name:	Martinborough 2	
Location:	Hinekura Road	
Asset ID:	SWDC_PW009716	
Owner:	SWDC	
Specifications	**Physical**	**Modelled**
Capacity:	920m³	3560m³
Top Water Level:	*Unknown*	71.57m
Reservoir Bottom Level:	*Unknown*	67.07m
Full Depth:	*Unknown*	4.50m
Inlet and Outlet pipes:	250 AC (Single Inlet/Outlet)	
SCADA Tags		
Level (%)	M045012	
Instantaneous Outflow:	M045001	
Instantaneous Inflow:	M045002	
Comments:	All (four) Hinekura Reservoirs modelled as single reservoir – represented as Hinekura 2 Reservoir in model. Other reservoirs isolated.	

Reservoir:	**Hinekura 3 Reservoir**	
Details		
Year:	1956	
Operational Name:	Martinborough 3	
Location:	Hinekura Road	
Asset ID:	SWDC_PW009717	
Owner:	SWDC	
Specifications	**Physical**	**Modelled**
Capacity:	850m³	Not Modelled – see comments
Top Water Level:	*Unknown*	
Reservoir Bottom Level:	*Unknown*	
Full Depth:	*Unknown*	
Inlet and Outlet pipes:	250 AC (Single Inlet/Outlet)	
SCADA Tags		
Level (%)	M045012	
Instantaneous Outflow:	M045001	
Instantaneous Inflow:	M045002	
Comments:	All (four) Hinekura Reservoirs modelled as single reservoir – represented as Hinekura 2 Reservoir in model. Other reservoirs isolated.	

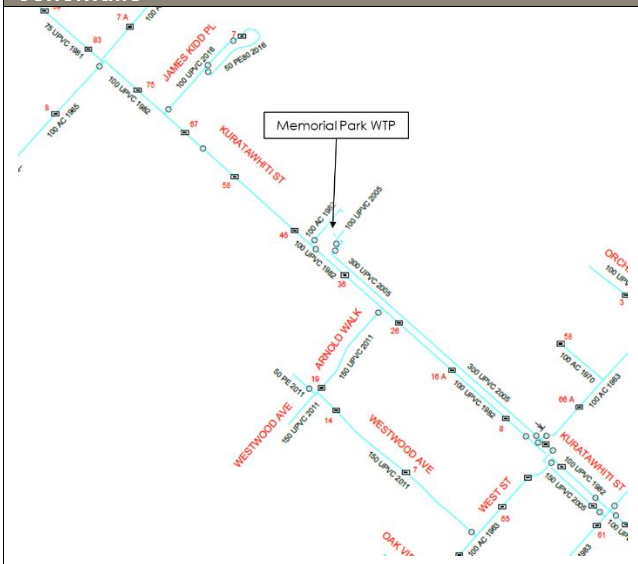
Reservoir:	**Hinekura 4 Reservoir**	
Details		
Year:	1965	
Operational Name:	Martinborough 4	
Location:	Hinekura Road	
Asset ID:	SWDC_PW009718	
Owner:	SWDC	
Specifications	**Physical**	**Modelled**
Capacity:	850m³	Not Modelled – see comments
Top Water Level:	*Unknown*	
Reservoir Bottom Level:	*Unknown*	
Full Depth:	*Unknown*	
Inlet and Outlet pipes:	250 AC (Single Inlet/Outlet)	
SCADA Tags		
Level (%)	M045012	
Instantaneous Outflow:	M045001	
Instantaneous Inflow:	M045002	
Comments:	All (four) Hinekura Reservoirs modelled as single reservoir – represented as Hinekura 2 Reservoir in model. Other reservoirs isolated.	

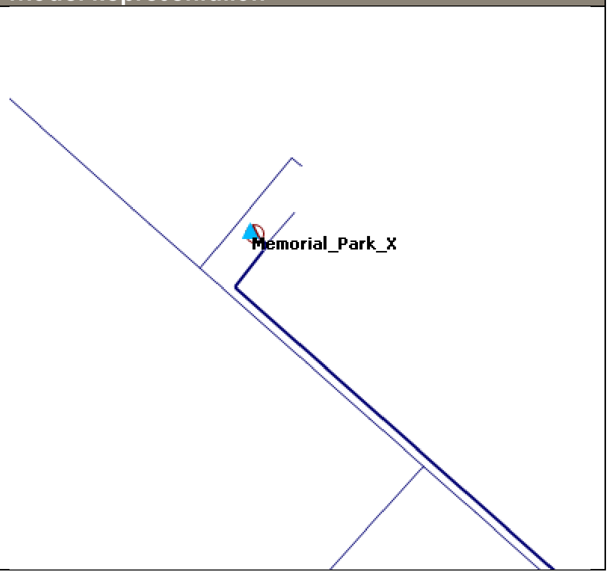
Appendix C PUMP STATION ASSET DATA CARDS

Pump Station:	Memorial Park WTP
Details	
Operational Name:	Memorial Park Outlet
Location:	11 Kuratawhiti Street, Greytown
Asset ID:	*Unknown, not in GIS*
No. of Pumps	*Unknown*
Pump Specifications	**Physical**
Make:	*Unknown*
Model:	*Unknown*
Year:	*Unknown*
Design Duty Flow:	*Unknown*
Design Duty Head:	*Unknown*
RPM:	*Unknown*
Control Settings	
Control Type:	Set outlet pressure – 42.5m
SCADA Tags	
Outflow Meter Instantaneous:	M043021
Delivery Pressure:	*Unknown*
Suction Pressure:	*Unknown*
Operational Philosophy	
Operation:	Controlled by VSD, delivering an outlet pressure of ~42.5m directly into distribution. Maximum flow from Memorial Park is approximately 32l/s, with any additional demand supplied from Greytown Reservoir via Humphries Street PRV.
Comments:	

Location	

Schematic	Model Representation

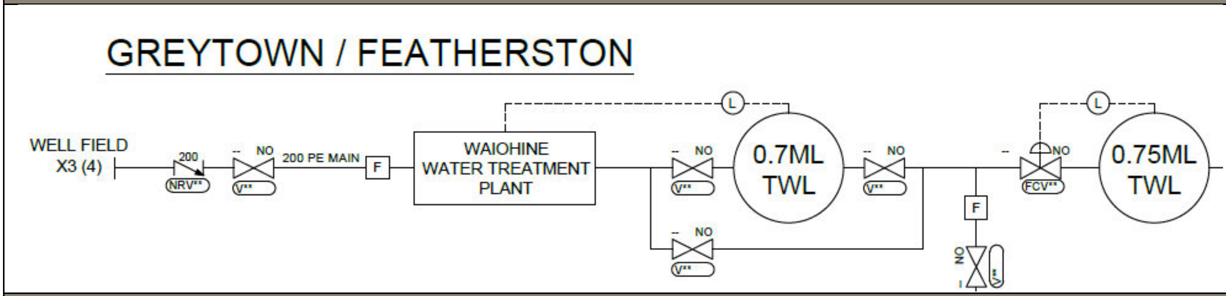




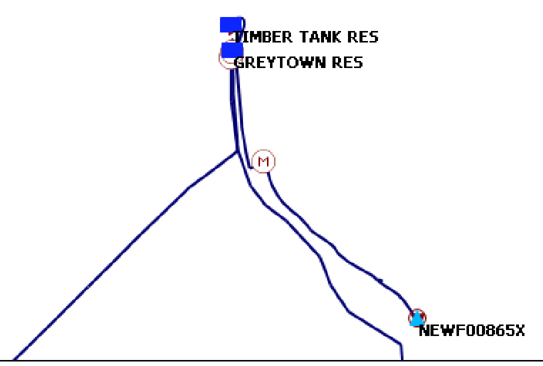
Pump Station:	Waiohine WTP
Details	
Operational Name:	Waiohine Outlet
Location:	157 Waiohine Valley Road, Greytown
Asset ID:	SPW000008
No. of Pumps	*Unknown*
Pump Specifications	
Make:	*Unknown*
Model:	*Unknown*
Year:	*Unknown*
Design Duty Flow:	*Unknown*
Design Duty Head:	*Unknown*
RPM:	*Unknown*
Control Settings	
Control Type:	Timber Tank Reservoir Level
On:	5.30m
Off:	5.90m
SCADA Tags	
Outflow Meter Instantaneous:	M001001
Delivery Pressure:	*Unknown*
Suction Pressure:	*Unknown*
Operational Philosophy	
Operation:	Set to refill Timber Tank Reservoir at rate of approximately 25 l/s. On/Off operation.
Comments:	

Location

Schematic



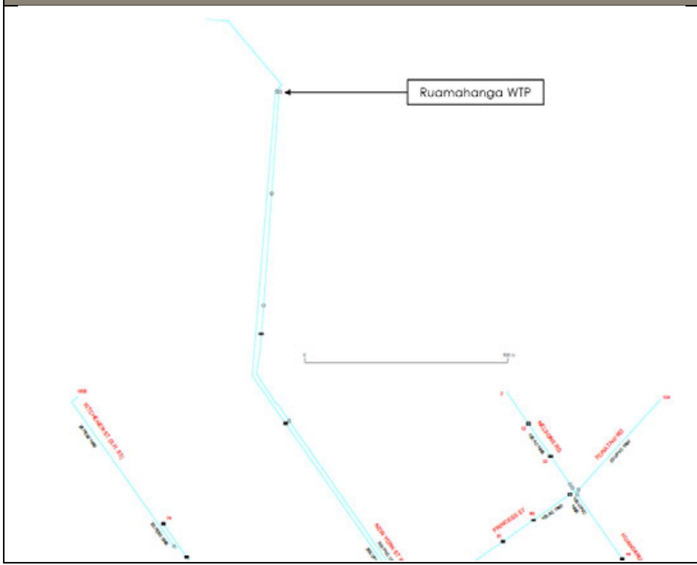
Model Representation

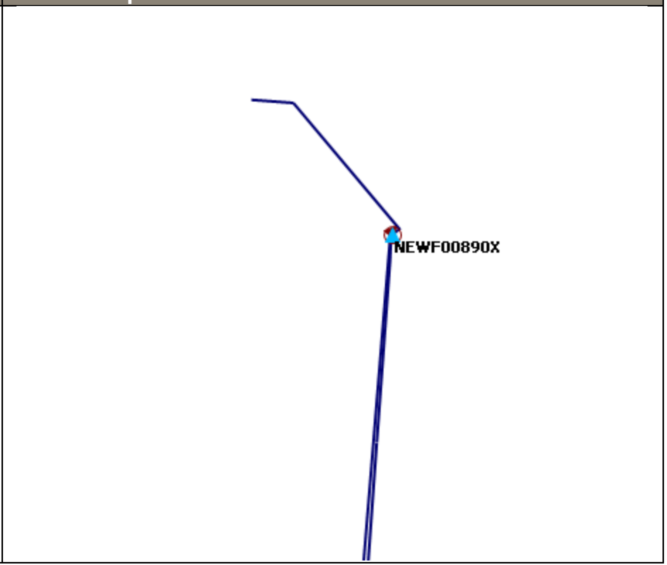


Pump Station:	Ruamahanga WTP
Details	
Operational Name:	Ruamahanga Outlet
Location:	Near 1579 State Highway 53
Asset ID:	*Unknown*
No. of Pumps	1
Pump Specifications	
Make:	Grundfos
Model:	CR 95-3 A-F-A-E-HQQE
Year:	*Unknown*
Design Duty Flow:	26l/s
Design Duty Head:	50m
RPM:	2960
Control Settings	
Control Type:	Hinekura Reservoirs Level
Set Depth:	4.00m
SCADA Tags	
Outflow Meter Instantaneous:	M04031
Delivery Pressure:	*Unknown*
Suction Pressure:	*Unknown*
Operational Philosophy	
Operation:	Controlled by VSD and set to maintain a constant level in the Hinekura Reservoirs. Usually on, with a minimum flow of approximately 11l/s.
Comments:	

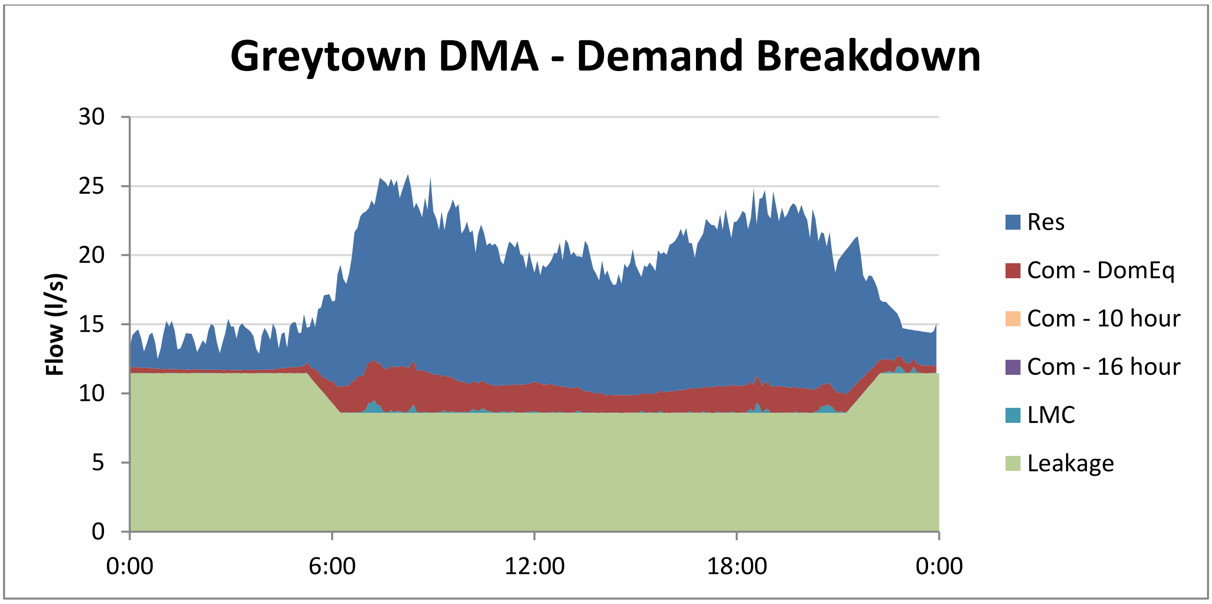
Location	

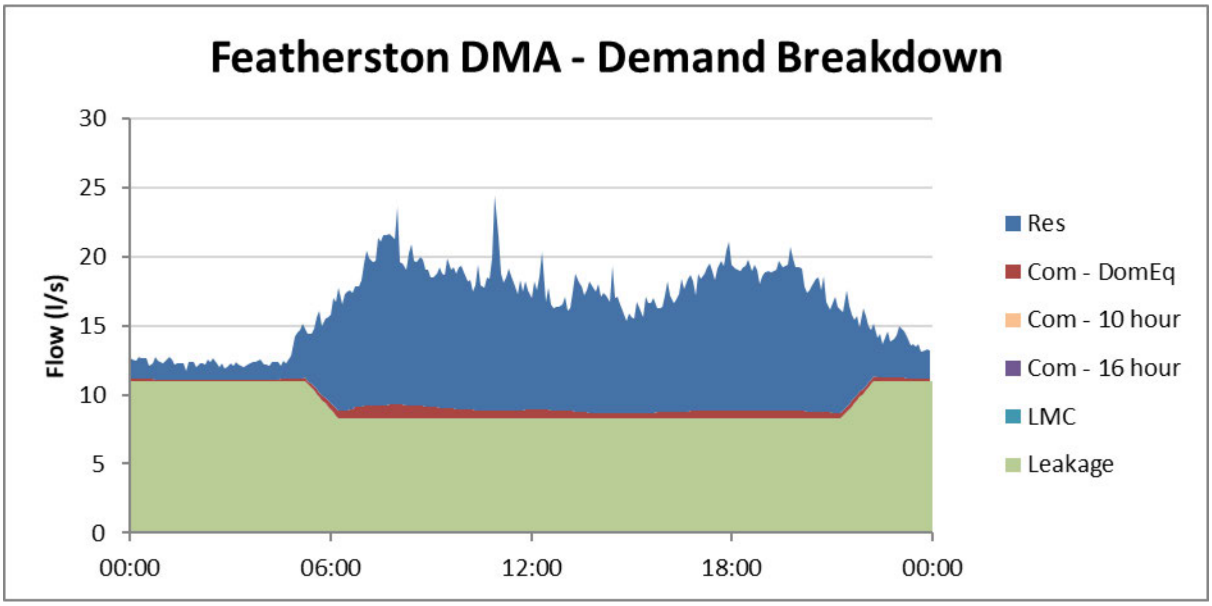
Schematic	Model Representation

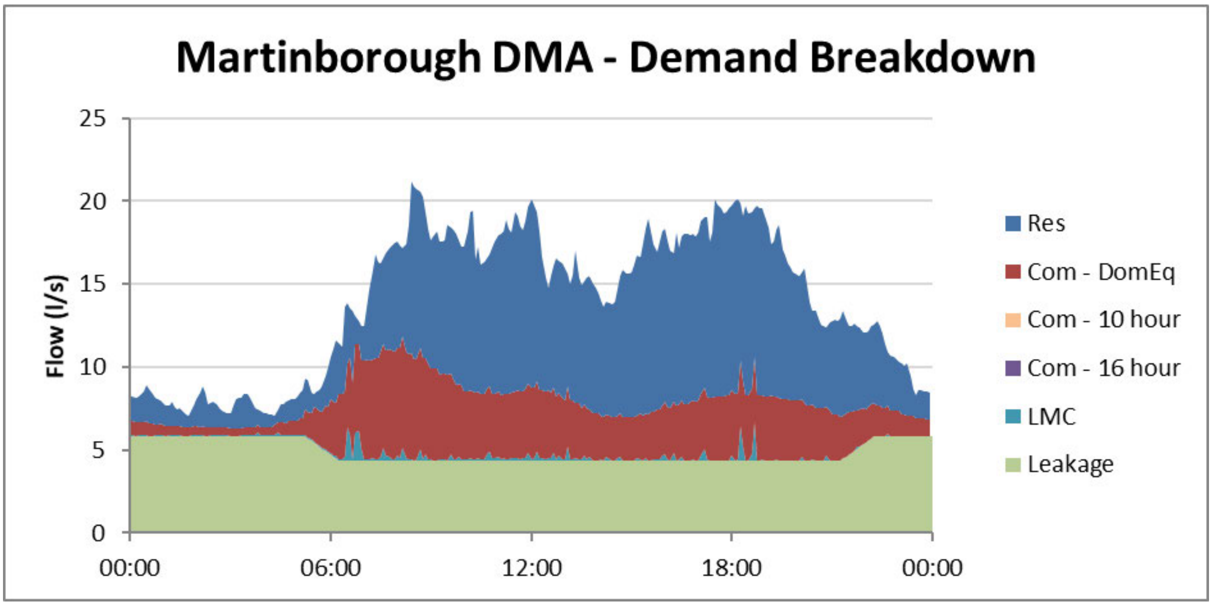




Appendix D CALIBRATION DAY DEMAND ANALYSES



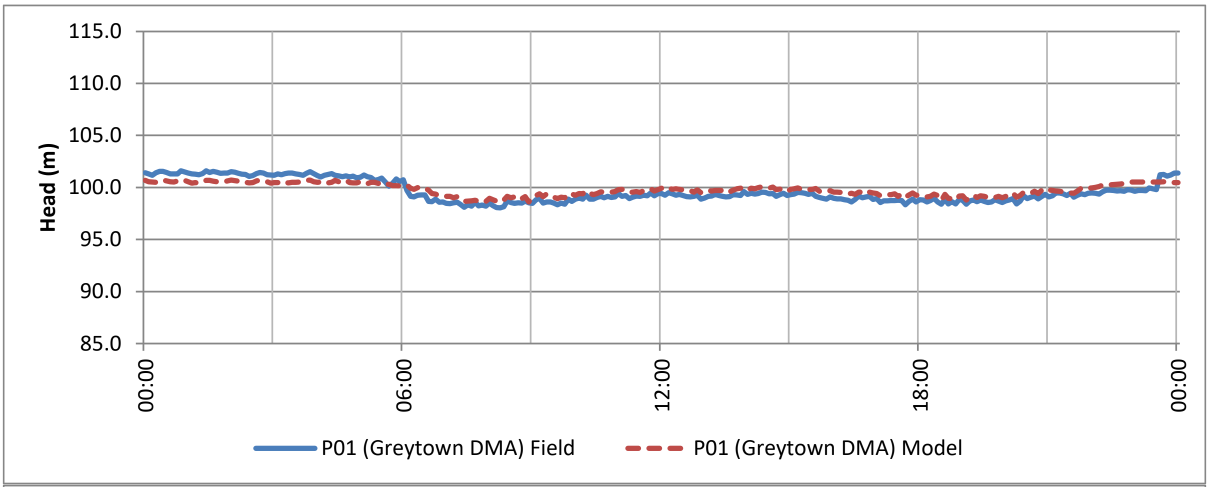


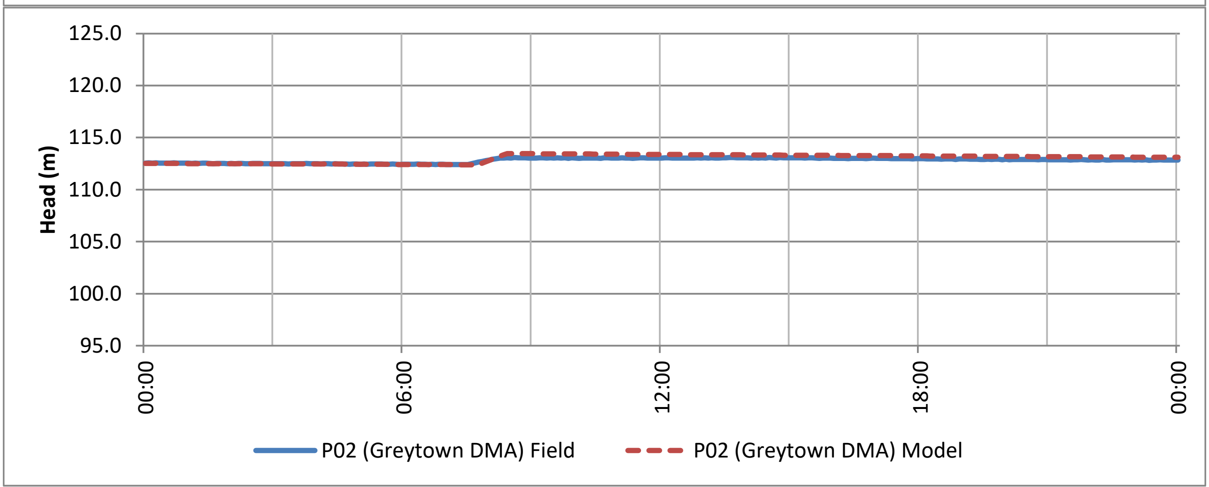

Martinborough DMA - Demand Breakdown
Flow (l/s)
25
20
15
10
5
0
00:00
06:00
12:00
18:00
00:00
Res
Com - DomEq
Com - 10 hour
Com - 16 hour
LMC
Leakage

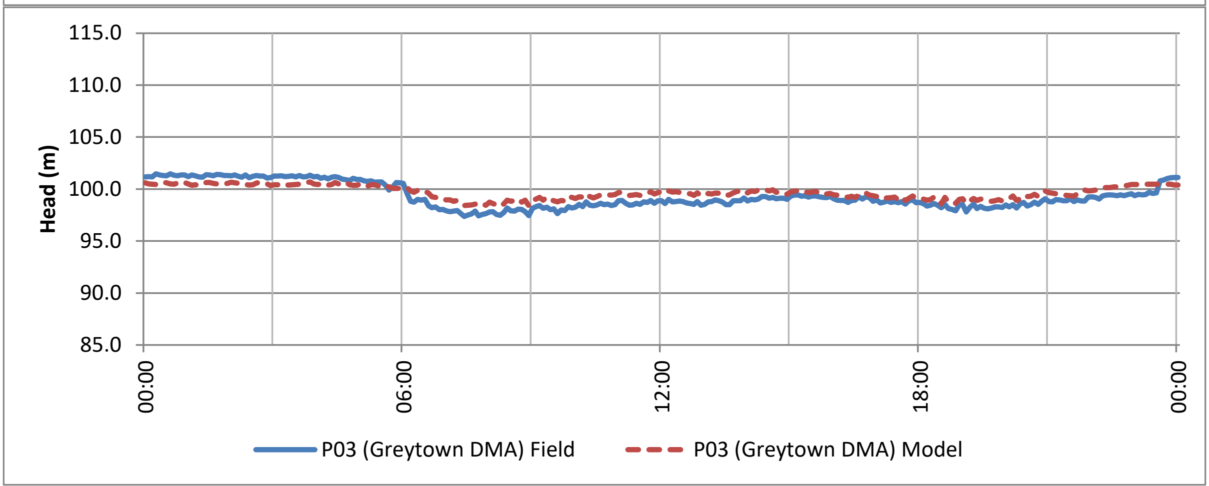
Calibration Day Demand Analysis Summary

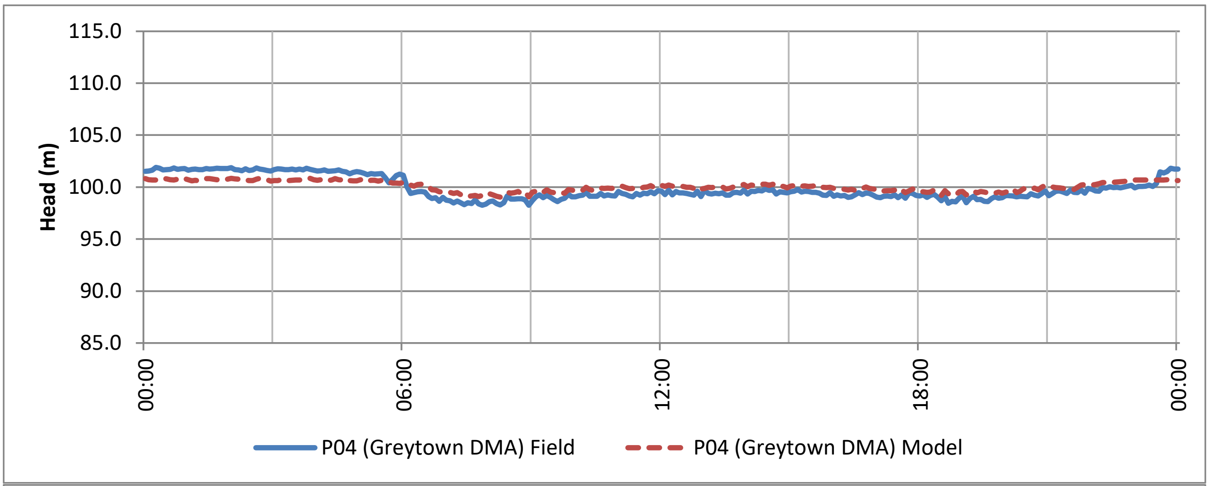
DMA	No. of Residential Connections	No. of Non-Residential Connections	Avg. residential demand per res. Property (l/prop/day)	Average Total Demand (l/s)	(m3/day)	Non-Revenue Water (m3/day)	Comment
Greytown DMA	1282	237	545	19.1	1,654	825	No issues.
Featherston DMA	1190	134	508	16.5	1,429	792	Number of connections includes Featherston DMA and Featherston trunk. Demand calculations based on Featherston DMA only
Martinborough DMA	1189	223	438	13.9	1,205	419	No issues.

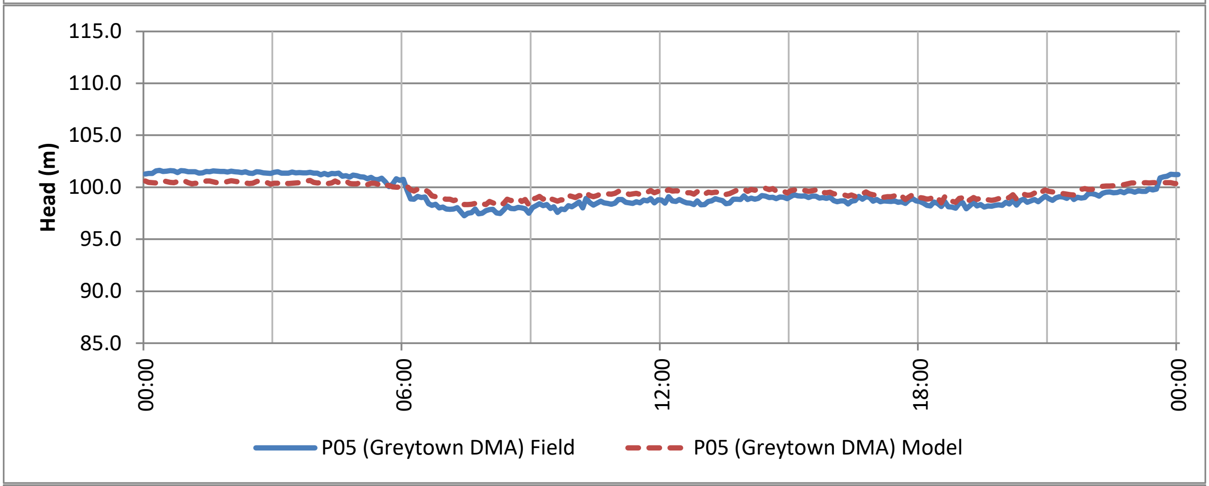
Appendix E CALIBRATION PLOTS

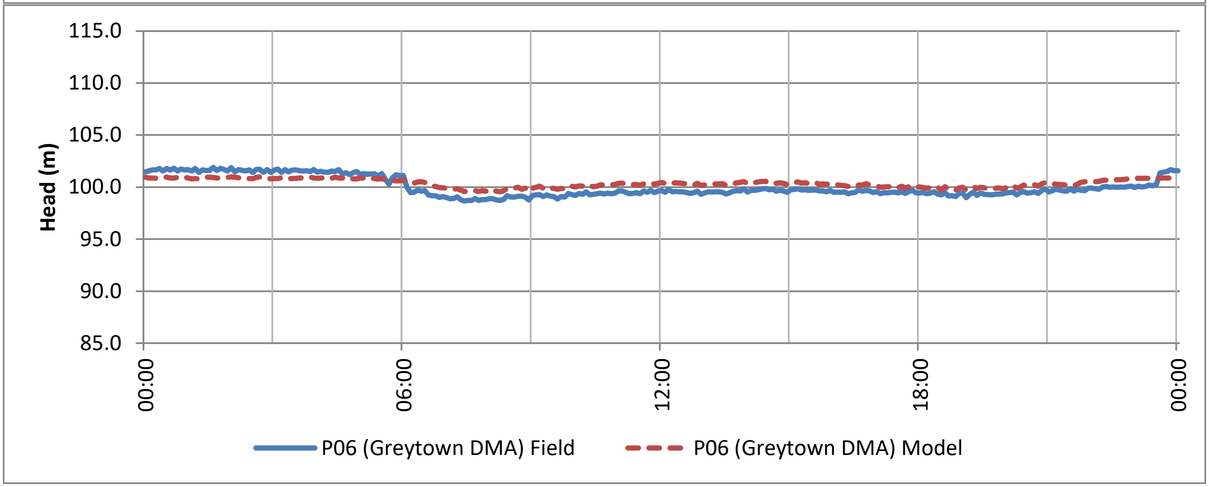


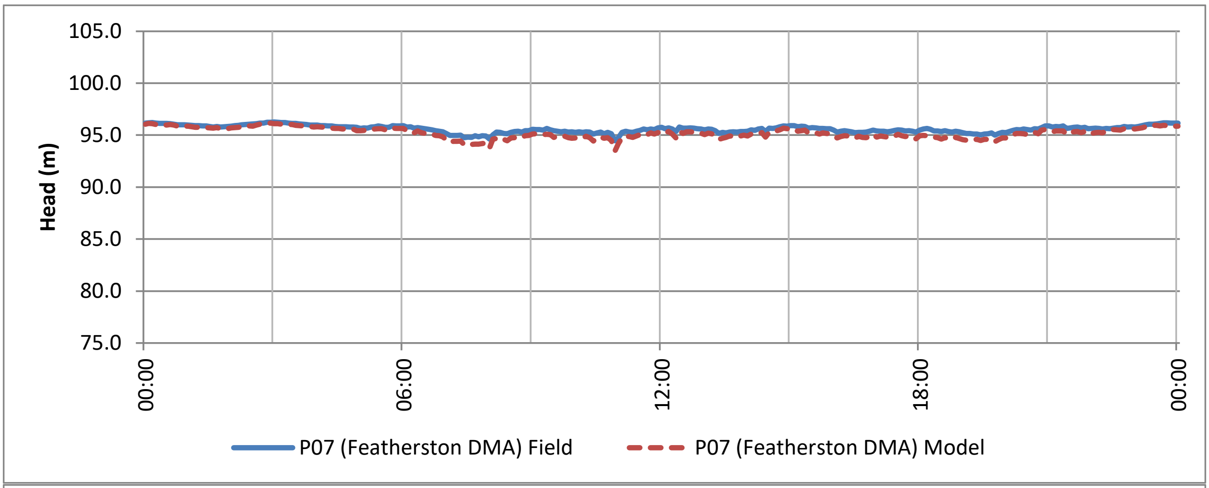


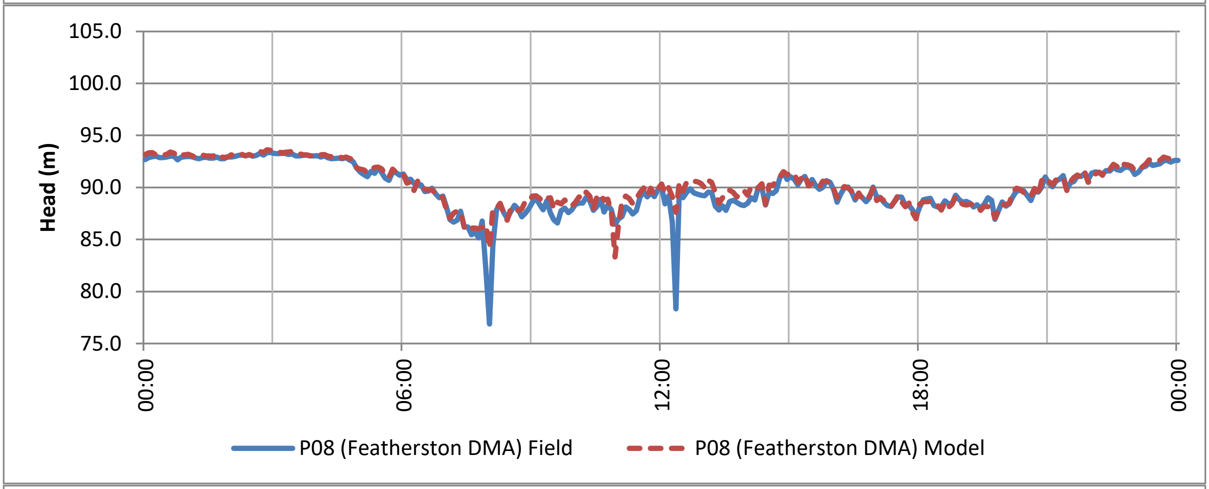


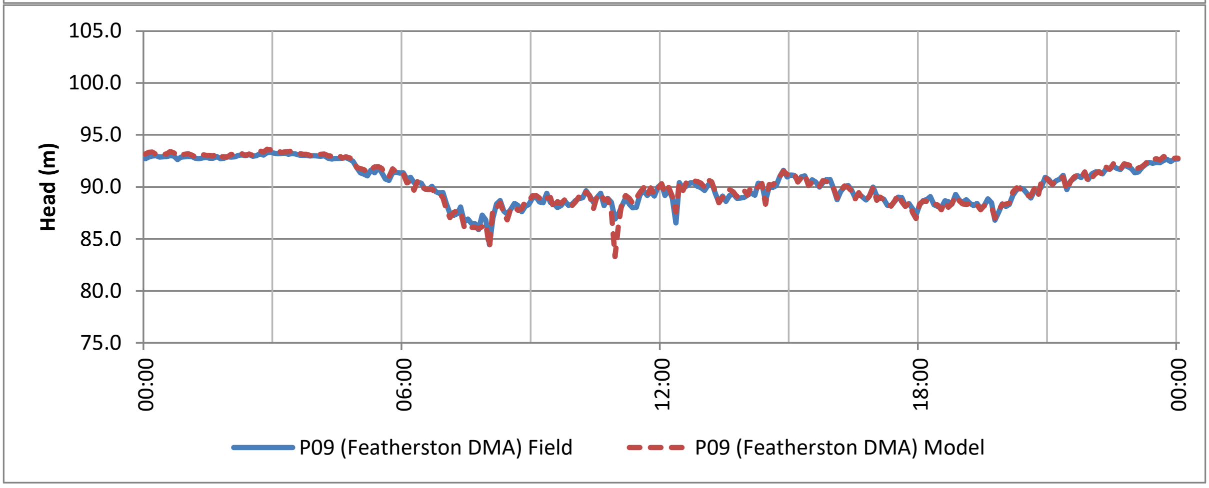

Head (m)
115.0
110.0
105.0
100.0
95.0
90.0
85.0
00:00
06:00
12:00
18:00
00:00
P04 (Greytown DMA) Field
P04 (Greytown DMA) Model

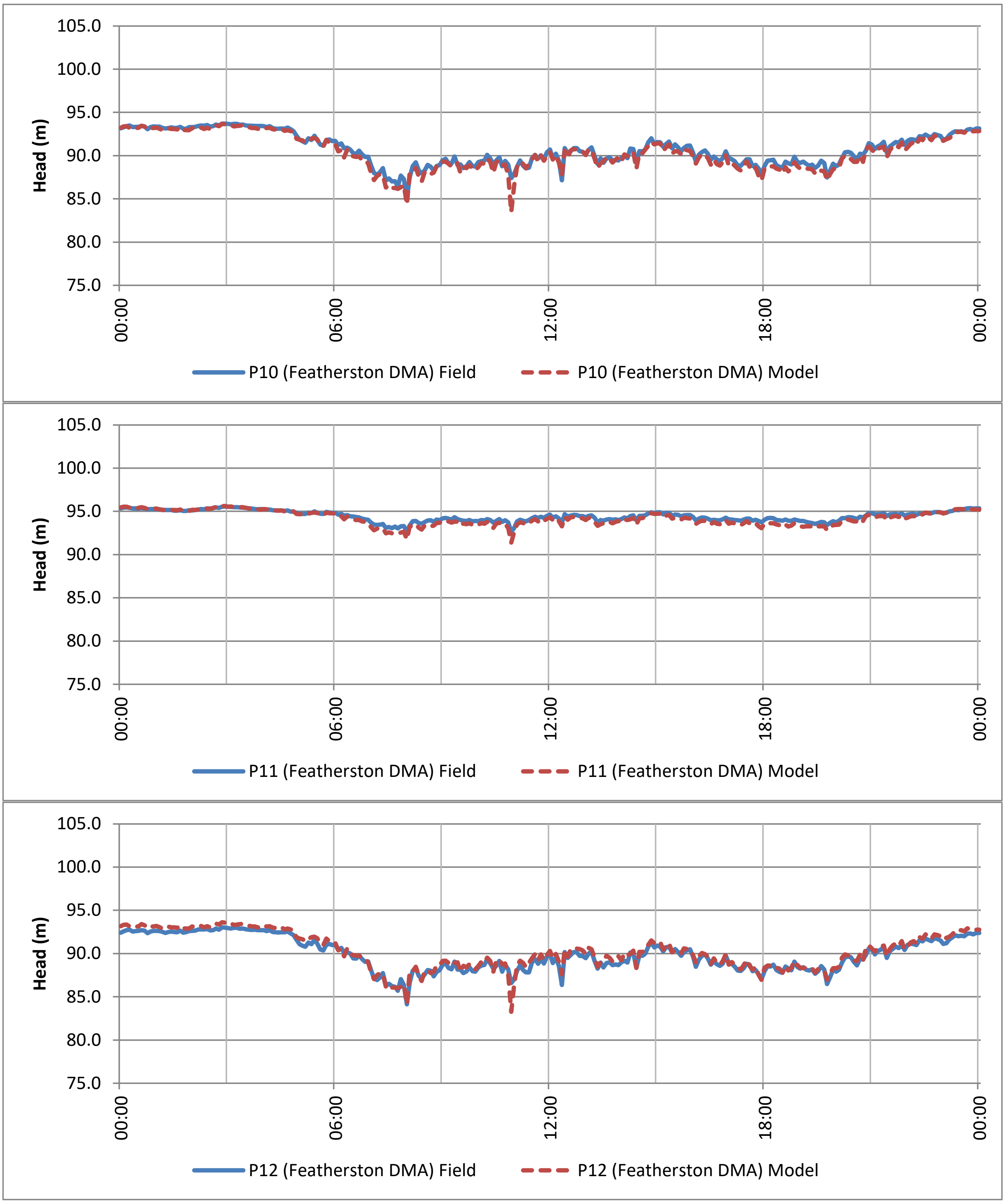

Head (m)
115.0
110.0
105.0
100.0
95.0
90.0
85.0
00:00
06:00
12:00
18:00
00:00
P05 (Greytown DMA) Field
P05 (Greytown DMA) Model

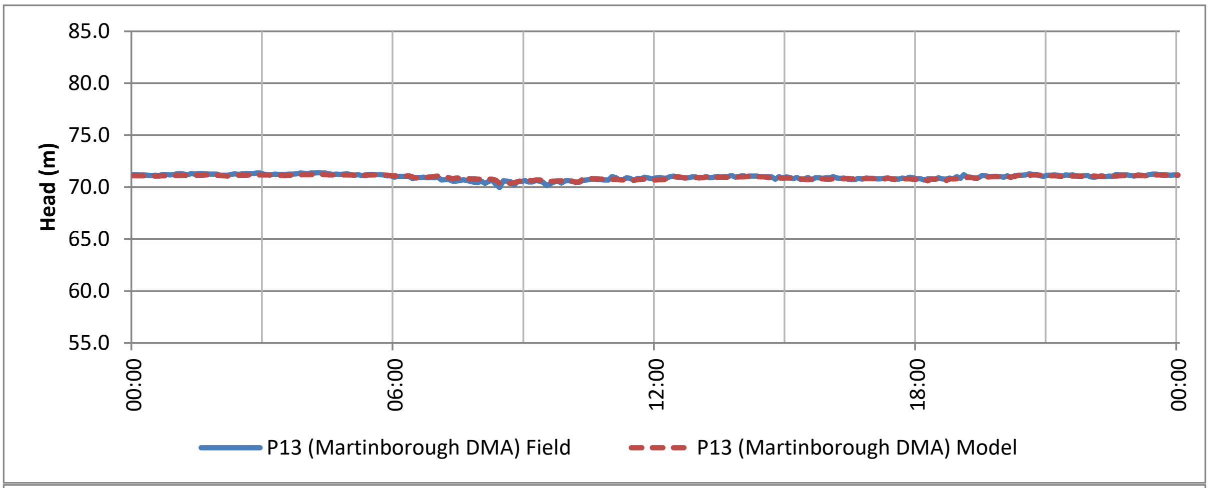

Head (m)
115.0
110.0
105.0
100.0
95.0
90.0
85.0
00:00
06:00
12:00
18:00
00:00
P06 (Greytown DMA) Field
P06 (Greytown DMA) Model

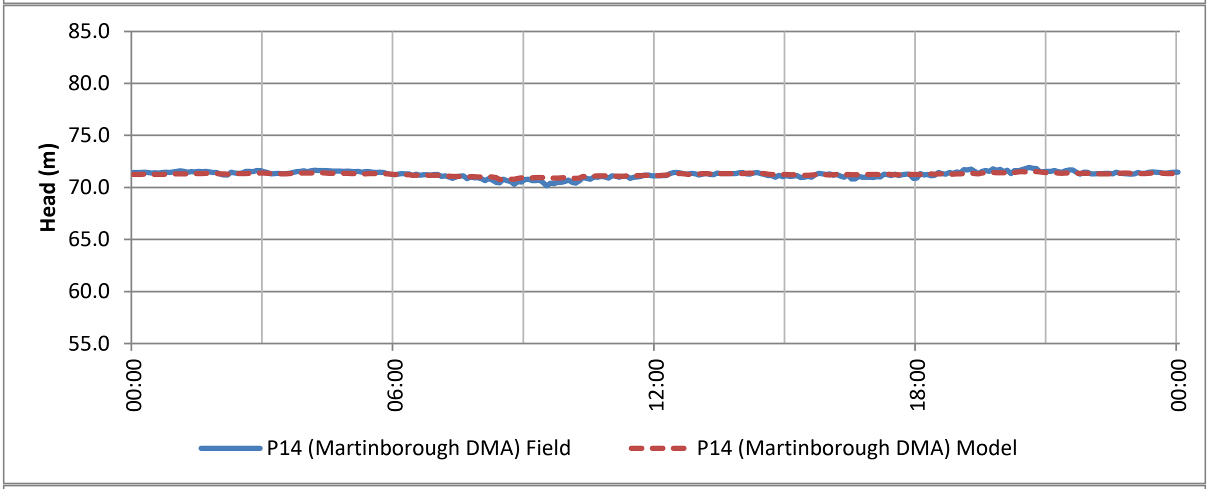

105.0
100.0
95.0
90.0
85.0
80.0
75.0
Head (m)
00:00
06:00
12:00
18:00
00:00
P07 (Featherston DMA) Field
P07 (Featherston DMA) Model

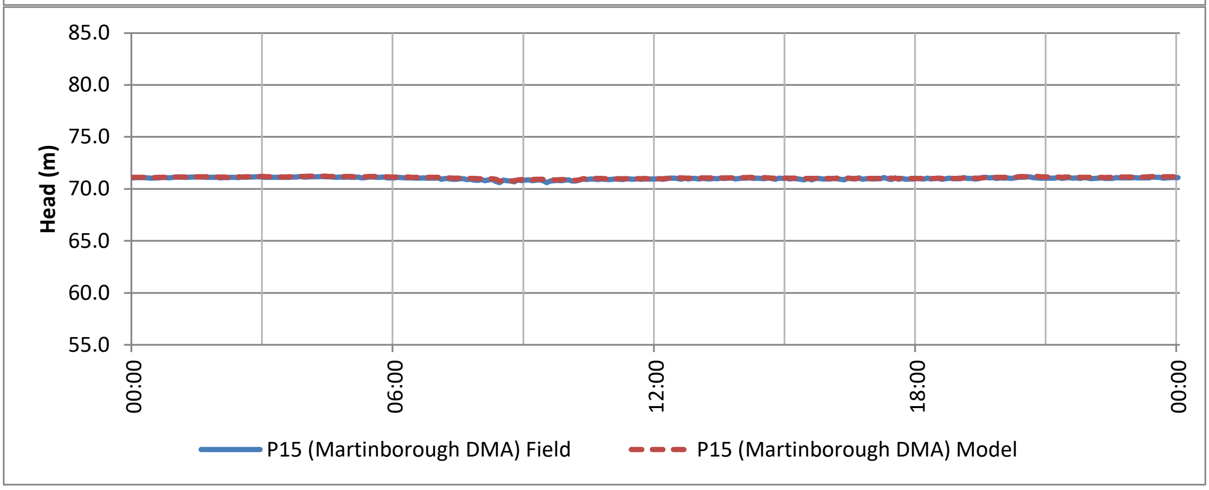

105.0
100.0
95.0
90.0
85.0
80.0
75.0
Head (m)
00:00
06:00
12:00
18:00
00:00
P08 (Featherston DMA) Field
P08 (Featherston DMA) Model

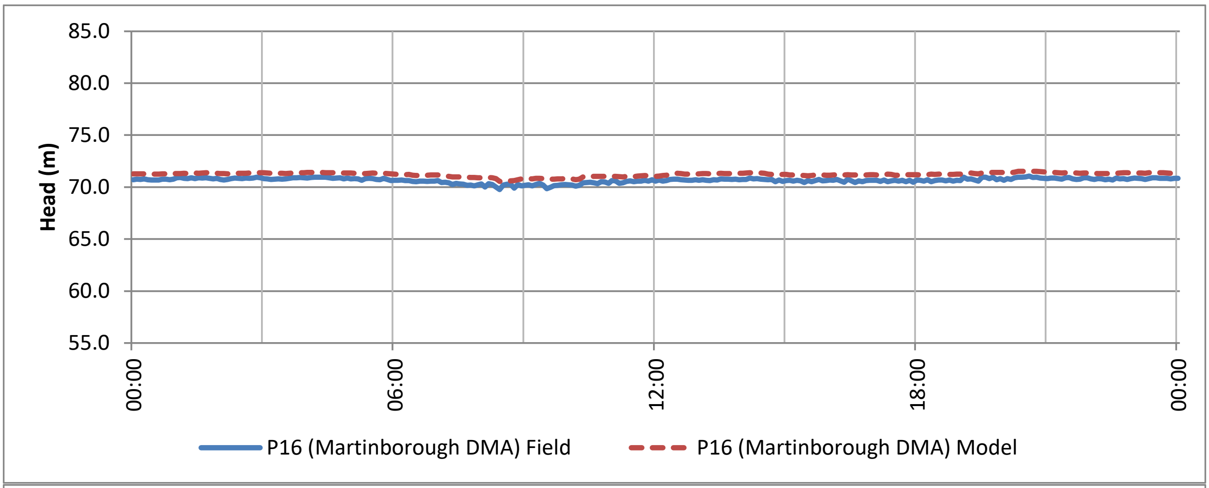

105.0
100.0
95.0
90.0
85.0
80.0
75.0
Head (m)
00:00
06:00
12:00
18:00
00:00
P09 (Featherston DMA) Field
P09 (Featherston DMA) Model

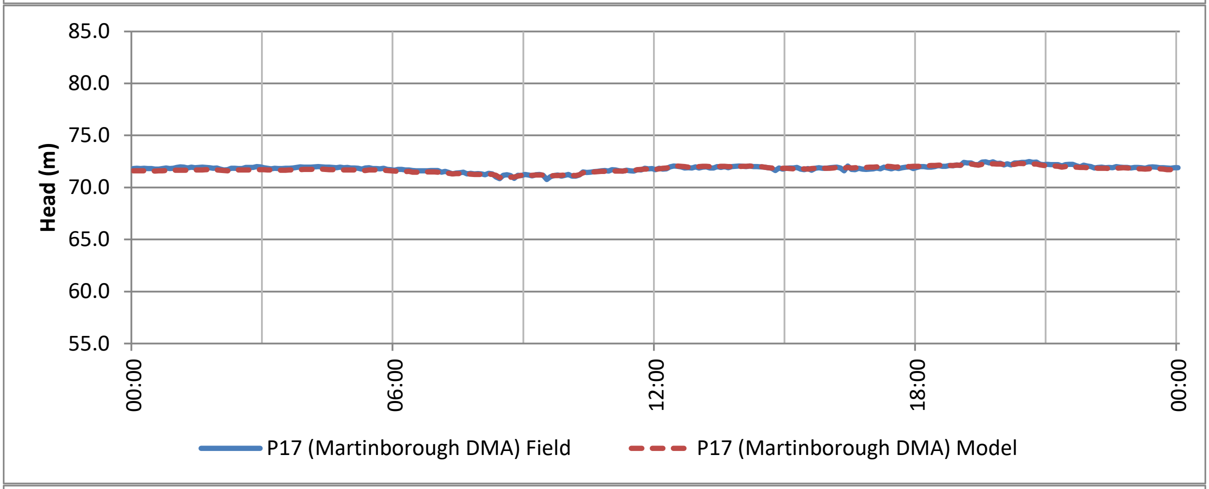

Head (m)
105.0
100.0
95.0
90.0
85.0
80.0
75.0
00:00
06:00
12:00
18:00
00:00
P10 (Featherston DMA) Field
P10 (Featherston DMA) Model
Head (m)
P11 (Featherston DMA) Field
P11 (Featherston DMA) Model
Head (m)
P12 (Featherston DMA) Field
P12 (Featherston DMA) Model

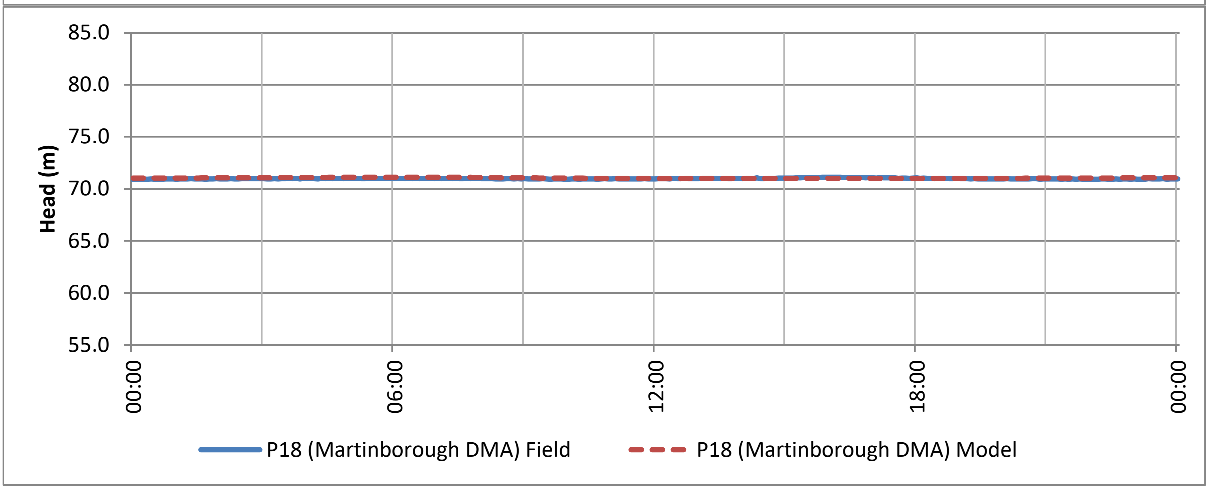

85.0
80.0
75.0
70.0
65.0
60.0
55.0
Head (m)
00:00
06:00
12:00
18:00
00:00
P13 (Martinborough DMA) Field
P13 (Martinborough DMA) Model

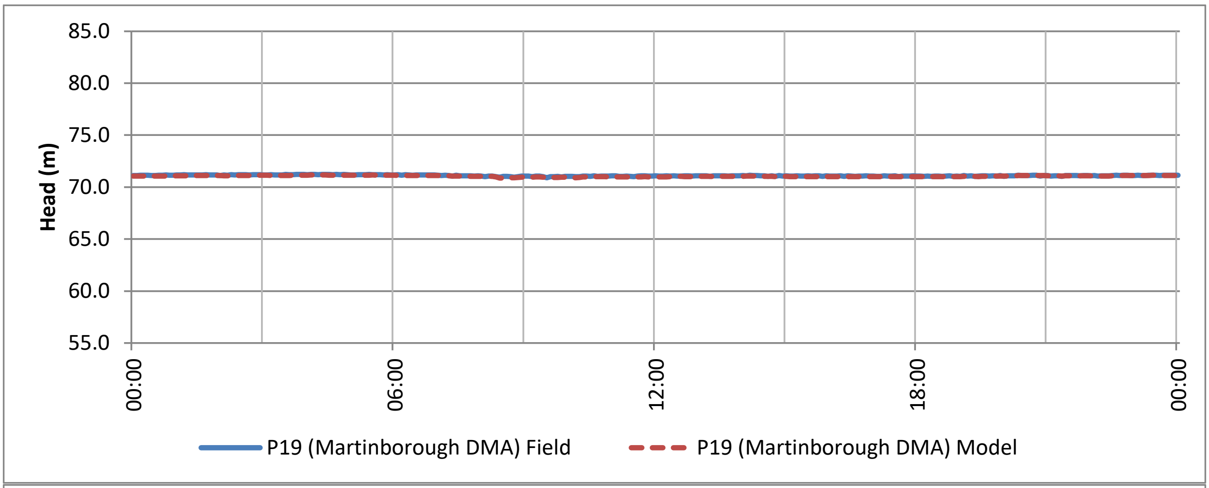

85.0
80.0
75.0
70.0
65.0
60.0
55.0
Head (m)
00:00
06:00
12:00
18:00
00:00
P14 (Martinborough DMA) Field
P14 (Martinborough DMA) Model

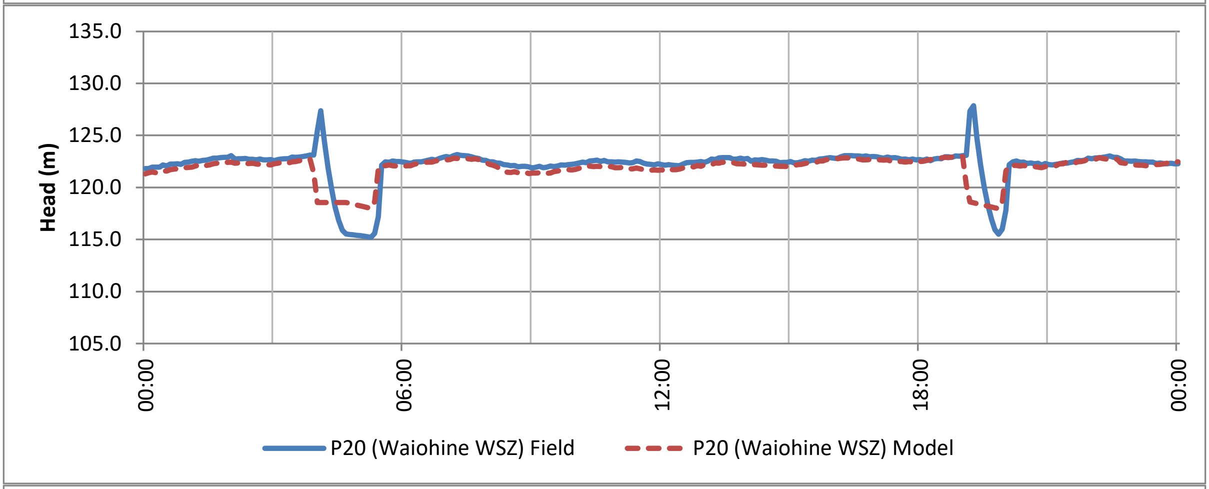

85.0
80.0
75.0
70.0
65.0
60.0
55.0
Head (m)
00:00
06:00
12:00
18:00
00:00
P15 (Martinborough DMA) Field
P15 (Martinborough DMA) Model

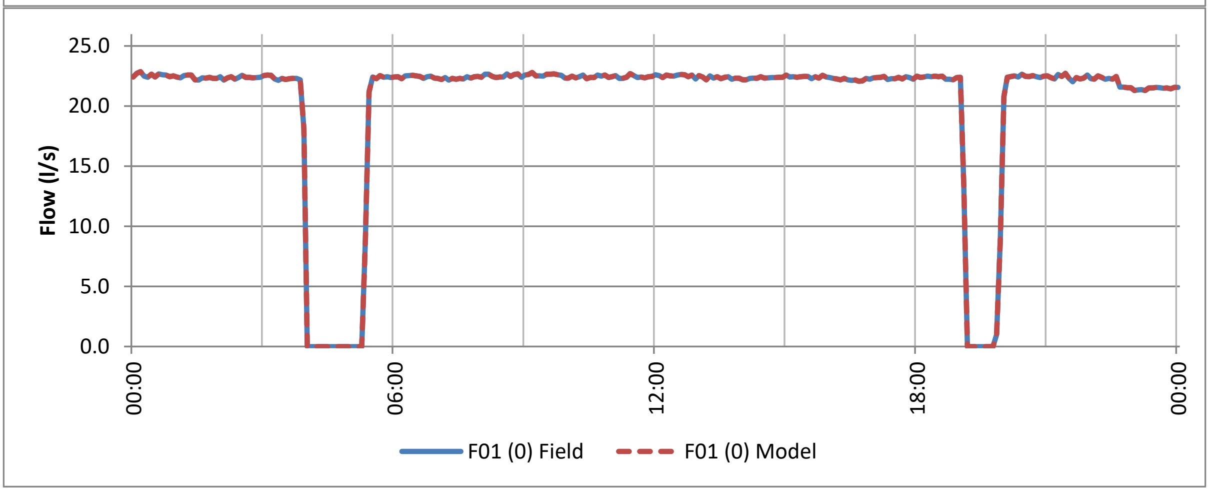

85.0
80.0
75.0
70.0
65.0
60.0
55.0
Head (m)
00:00
06:00
12:00
18:00
00:00
P16 (Martinborough DMA) Field
P16 (Martinborough DMA) Model

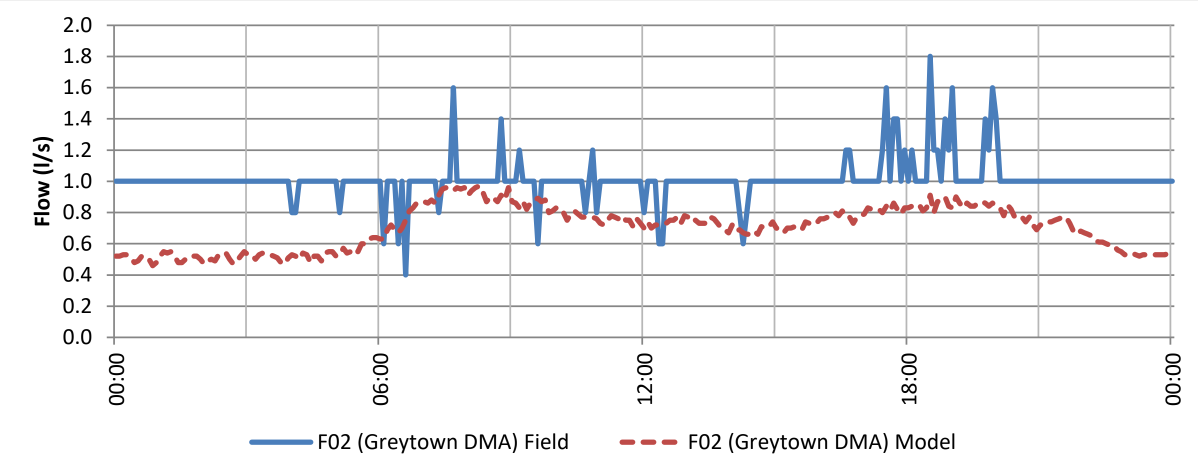

85.0
80.0
75.0
70.0
65.0
60.0
55.0
Head (m)
00:00
06:00
12:00
18:00
00:00
P17 (Martinborough DMA) Field
P17 (Martinborough DMA) Model

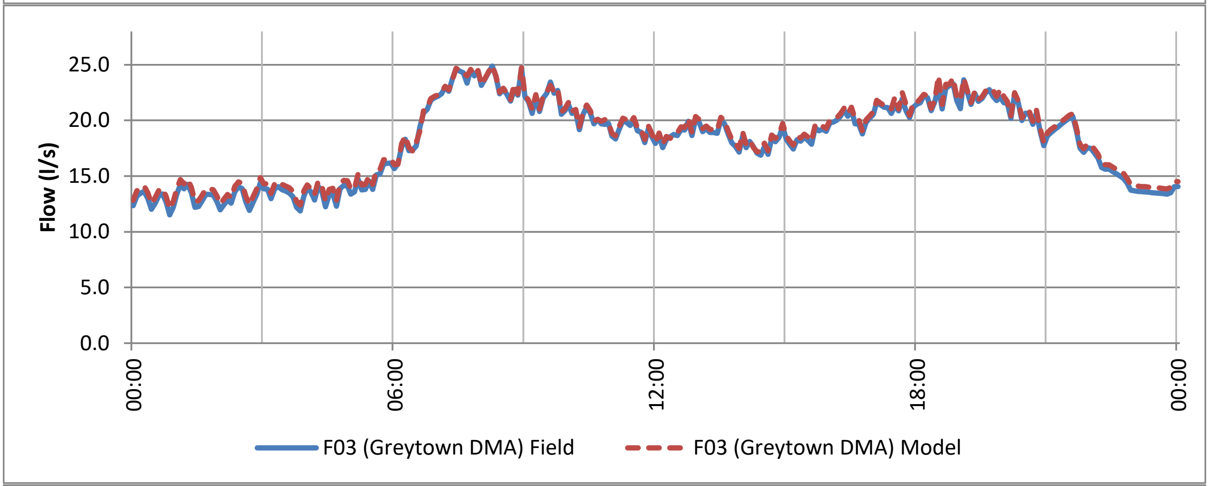

85.0
80.0
75.0
70.0
65.0
60.0
55.0
Head (m)
00:00
06:00
12:00
18:00
00:00
P18 (Martinborough DMA) Field
P18 (Martinborough DMA) Model

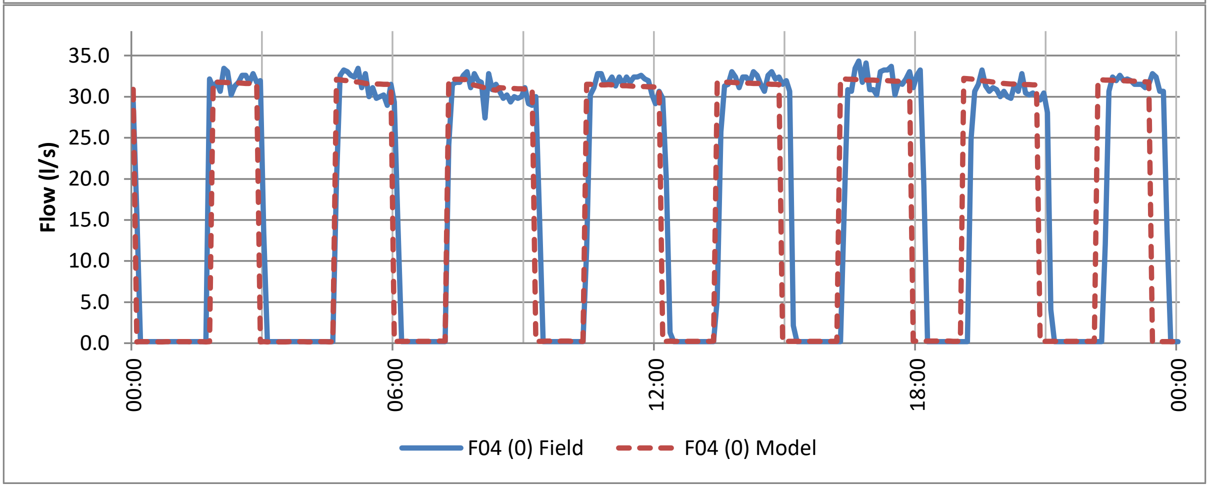

Head (m)
85.0
80.0
75.0
70.0
65.0
60.0
55.0
00:00
06:00
12:00
18:00
00:00
P19 (Martinborough DMA) Field
P19 (Martinborough DMA) Model

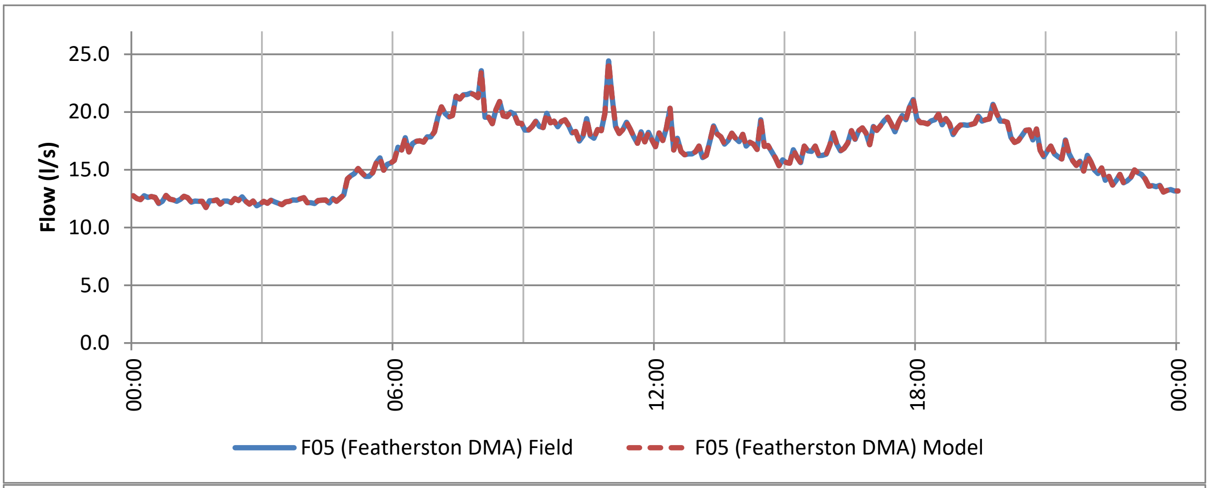

Head (m)
135.0
130.0
125.0
120.0
115.0
110.0
105.0
00:00
06:00
12:00
18:00
00:00
P20 (Waiohine WSZ) Field
P20 (Waiohine WSZ) Model

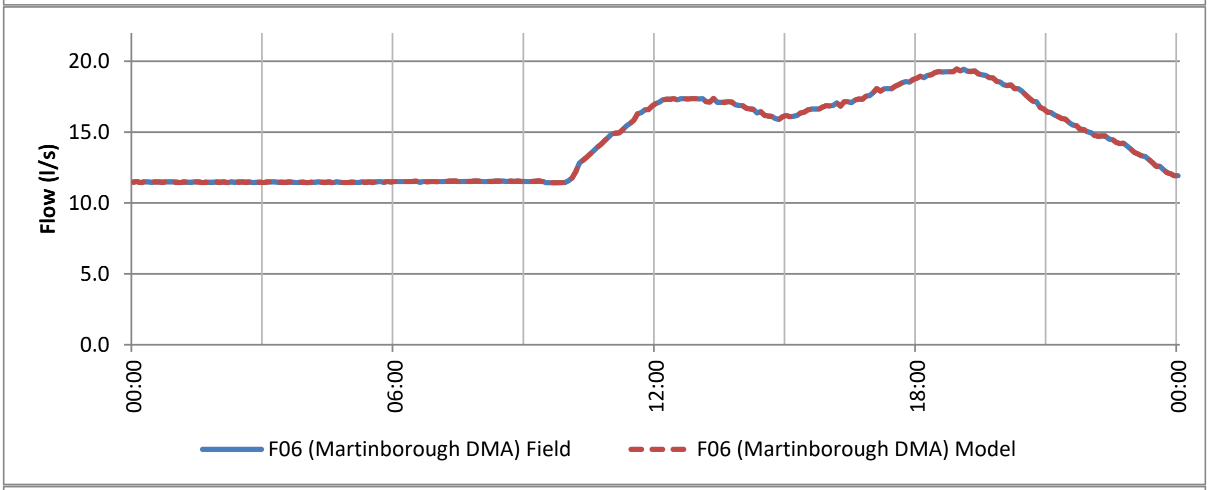

Flow (l/s)
25.0
20.0
15.0
10.0
5.0
0.0
00:00
06:00
12:00
18:00
00:00
F01 (0) Field
F01 (0) Model

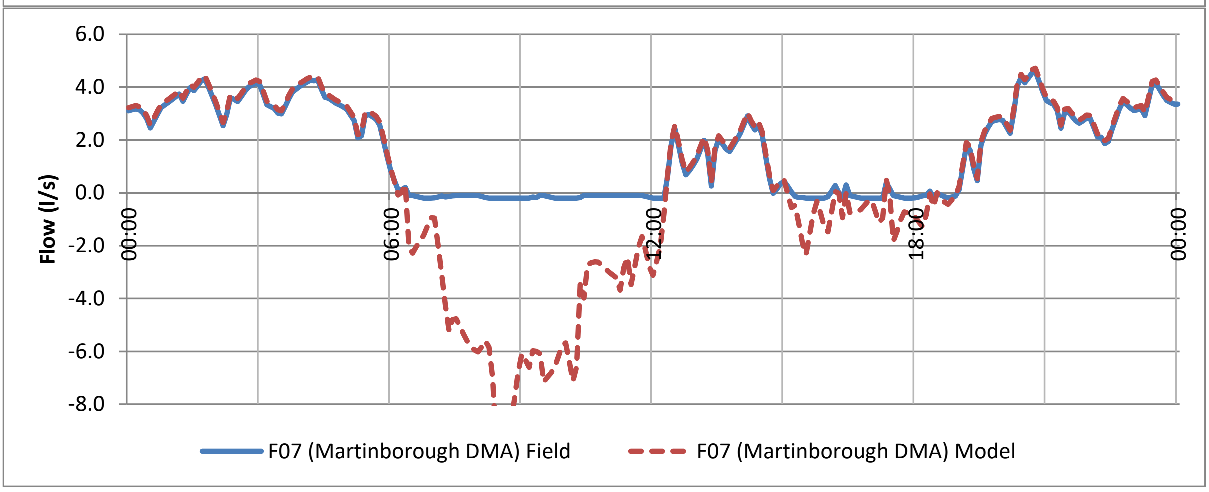

Flow (l/s)
F02 (Greytown DMA) Field
F02 (Greytown DMA) Model

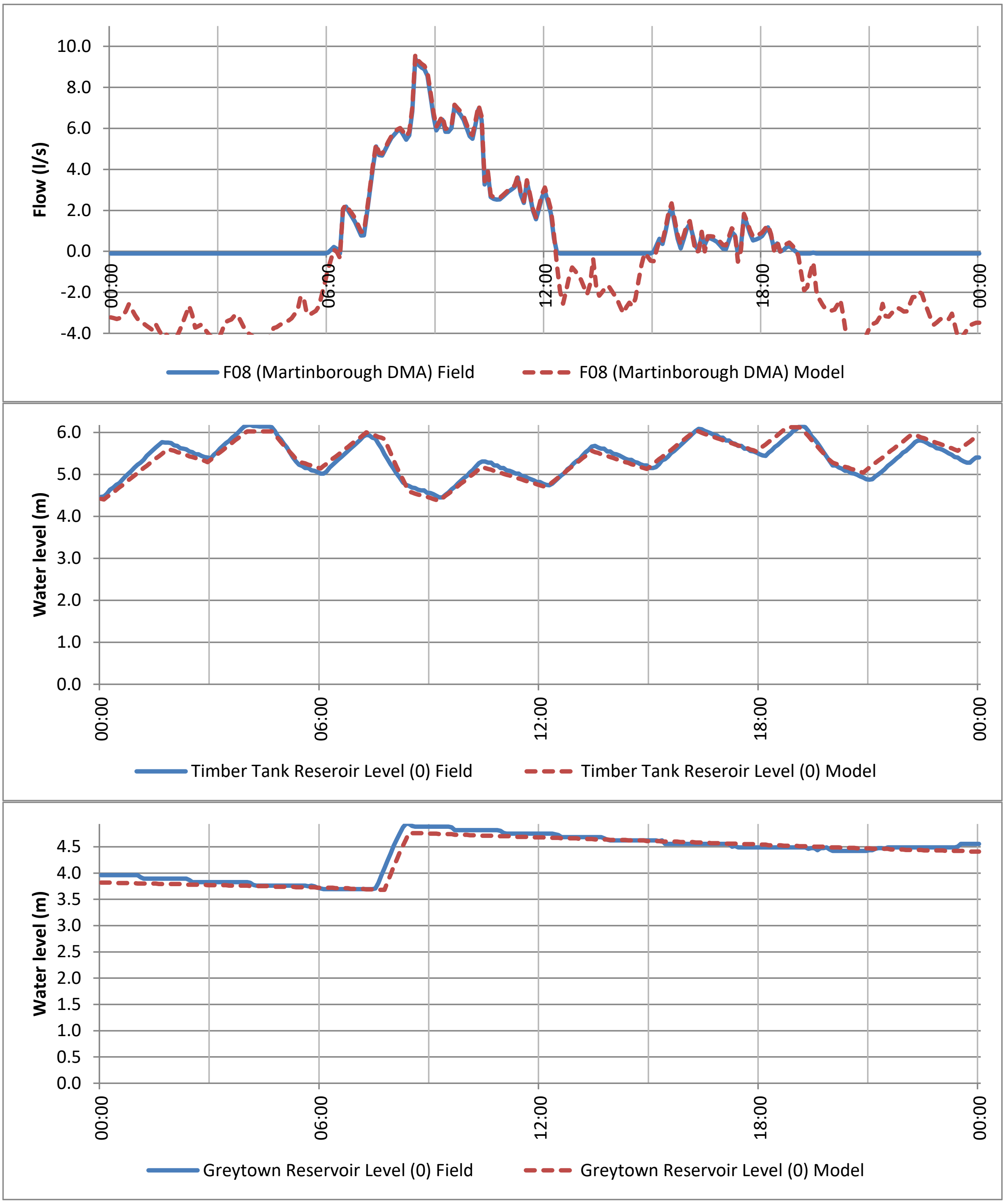

Flow (l/s)
F03 (Greytown DMA) Field
F03 (Greytown DMA) Model

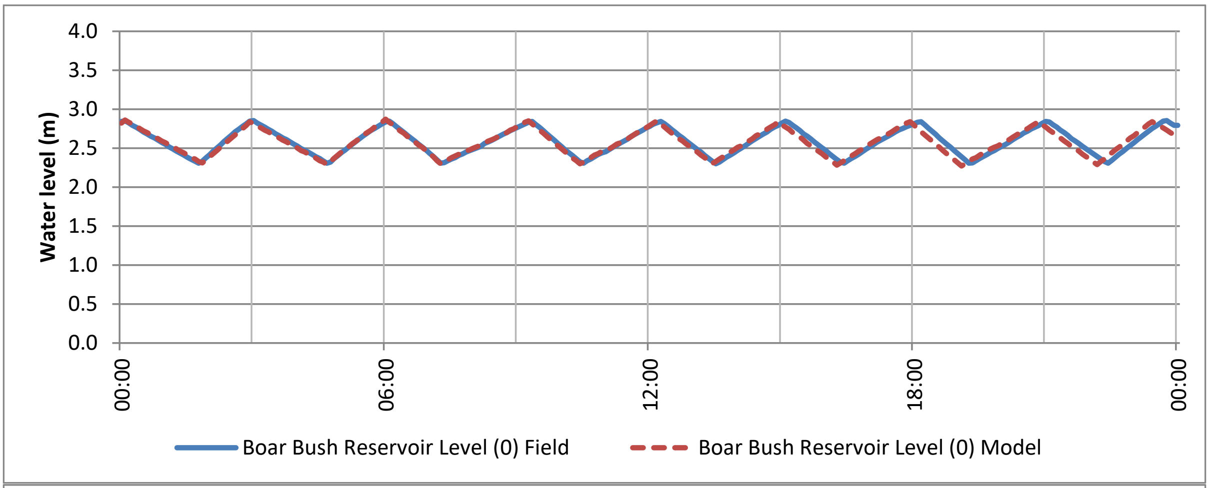

Flow (l/s)
F04 (0) Field
F04 (0) Model

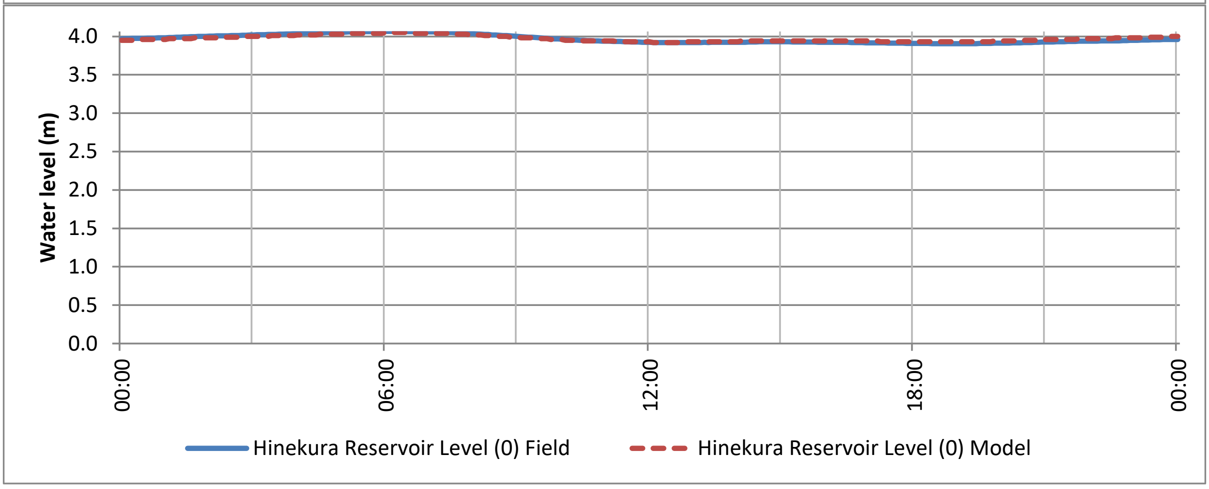

25.0
20.0
15.0
10.0
5.0
0.0
Flow (l/s)
00:00
06:00
12:00
18:00
00:00
F05 (Featherston DMA) Field
F05 (Featherston DMA) Model


20.0
15.0
10.0
5.0
0.0
Flow (l/s)
00:00
06:00
12:00
18:00
00:00
F06 (Martinborough DMA) Field
F06 (Martinborough DMA) Model


6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
-8.0
Flow (l/s)
00:00
06:00
12:00
18:00
00:00
F07 (Martinborough DMA) Field
F07 (Martinborough DMA) Model


Flow (l/s)
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
00:00
06:00
12:00
18:00
00:00
F08 (Martinborough DMA) Field
F08 (Martinborough DMA) Model
Water level (m)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Timber Tank Reseroir Level (0) Field
Timber Tank Reseroir Level (0) Model
Water level (m)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Greytown Reservoir Level (0) Field
Greytown Reservoir Level (0) Model


4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Water level (m)
00:00
06:00
12:00
18:00
00:00
Boar Bush Reservoir Level (0) Field
Boar Bush Reservoir Level (0) Model


4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Water level (m)
00:00
06:00
12:00
18:00
00:00
Hinekura Reservoir Level (0) Field
Hinekura Reservoir Level (0) Model

Appendix F MARTINBOROUGH ADD MEMO

Stantec

Memo

To:	Iman Aghamohammadi, Wellington Water	From:	Stantec Wellington
		Date:	25/11/2024

Reference: Martinborough ADD Demand

1 Introduction

This memo sets out a methodology to address inconsistencies between summer and average day water loss calculations.

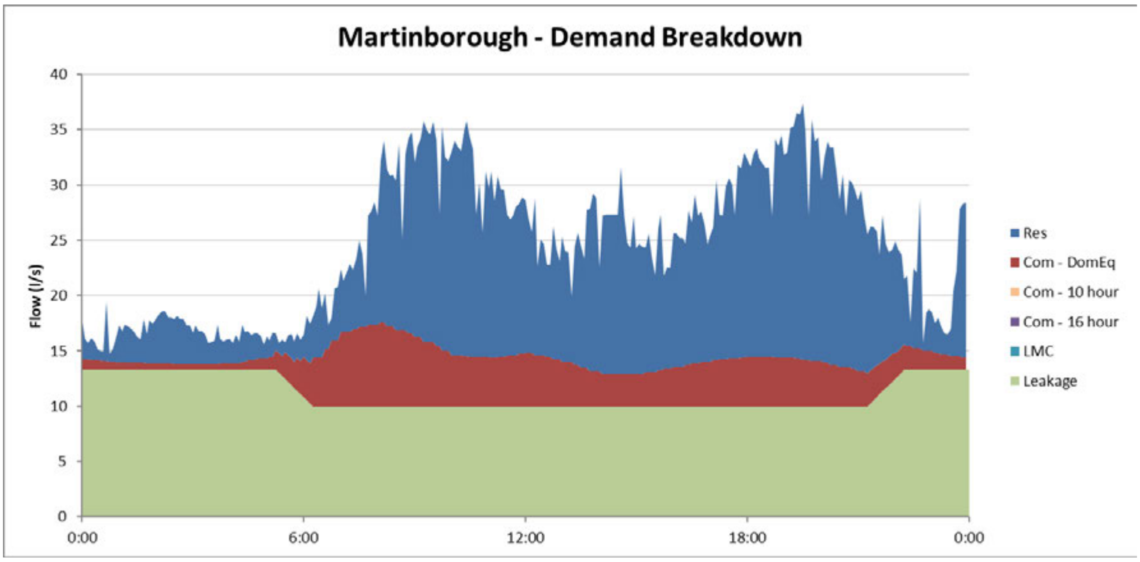
In the normal model build process model demand is usually built from summer data. For Average Day Demand, the residential demand is the only aspect considered seasonal, so scaling factors are applied to residential demand to bring total demand back to what the average annual demand observed from SCADA.

However, in some networks the assumption of non-seasonal commercial water use may not be valid. This memo sets out the issues encountered in Martinborough, and the methodology used to address the issue.

2 Martinborough case study

In Martinborough the February 2024 peak day demand was 2,412 m3/day, and average day demand over 2023/24 was 1,233 m3/day.

The summer time night flow was up around 15 l/s, and using the 2 l/prop/hour assumption for LNU in the Specs (which is based on the Water NZ water loss guidelines 2010), water loss is calculated at around 12 l/s. See screenshot of the demand analysis below.



Reference: 310104274

Normally to develop ADD we assume non-seasonal water loss and non-residential demand, and scale residential demand down to reflect measured ADD flow. However, with the ADD for the Martinborough system of 1,233 m3/day (equivalent to around 14.3 l/s), retaining the 12 l/s estimated water loss and 3.5 l/s non-residential leaves us with negative calculated residential demand.

3 Proposed methodology to address the issue

The standard assumption for water loss is that it is non-seasonal. While this is generally true, night flows can vary over the year due to night-time irrigation and general heavier water use in summer.

The relationship between night flow and overall demand can be reviewed by looking at minimum and average hourly flows over multiple years.

3.1 Confirm night flow seasonality

We looked at 3 years of hourly flow to investigate correlation between night flow and overall demand.

3 years of 1-hour instantaneous flow data was obtained from Wellington Water’s SCADA portal, and pivot-table analysis of the minimum and average hourly flow on each day over the last 3 years was plotted.

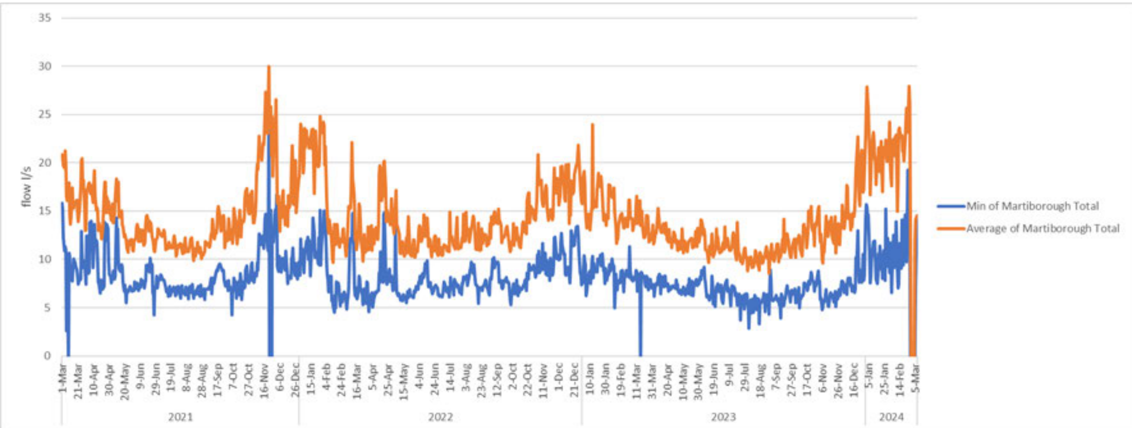


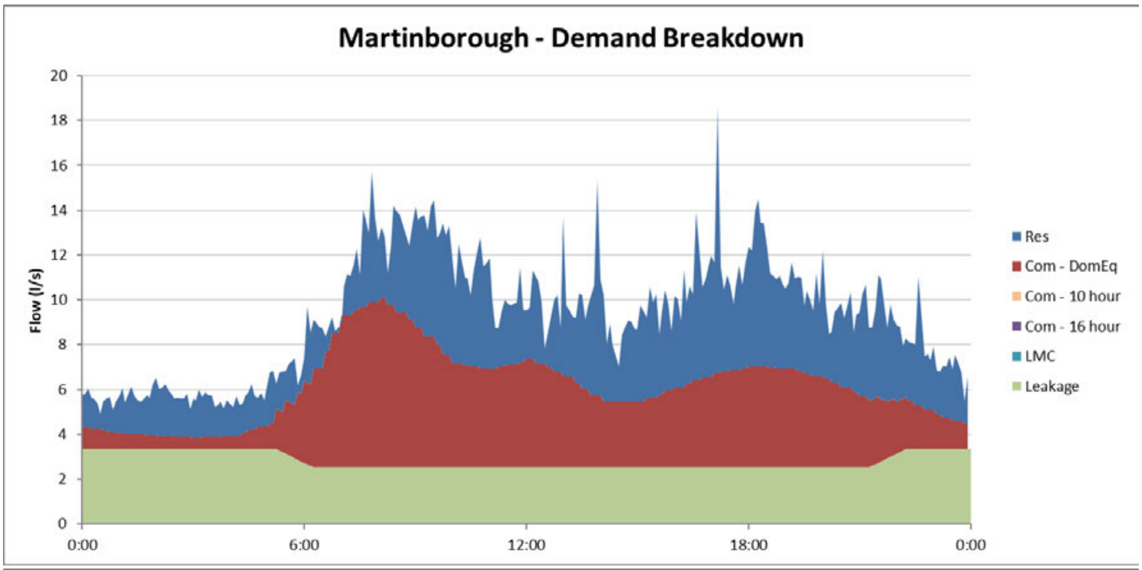
Figure1: Martinborough minimum and average flows

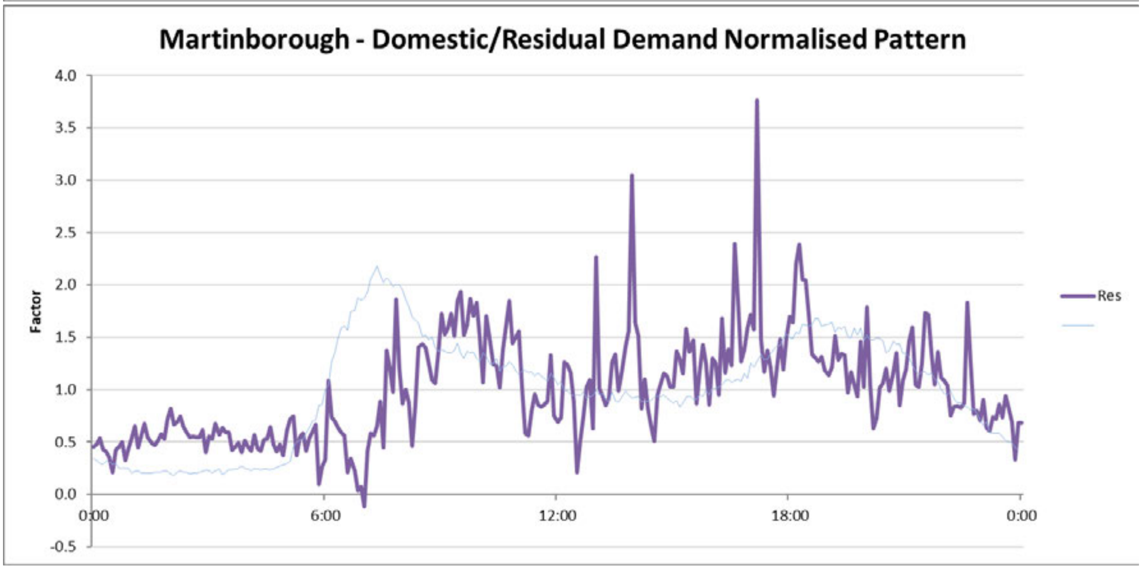
This shows that minimum hourly flow (assumed night flow) does rise and fall from summer to winter, closely in line with average daily flow. We note there are also periods where the night flow slowly rises and then suddenly drops back – likely indicative of leaks increasing in size before being found and fixed.

But from winter to winter, the data shows night flow is relatively stable at around 5 l/s. From this, we concluded that outside of leak repairs water loss can be considered relatively stable. A different explanation is required for the seasonality of the night flow.

3.2 Calculate water loss from the period of lowest use

We downloaded 2 weeks of 5-minute flow data in August 2023, and undertook demand analysis using the same 2 l/prop/hour assumption for LNU. This gave us the demand breakdown and derived residential demand pattern below.





Reference: 310104274

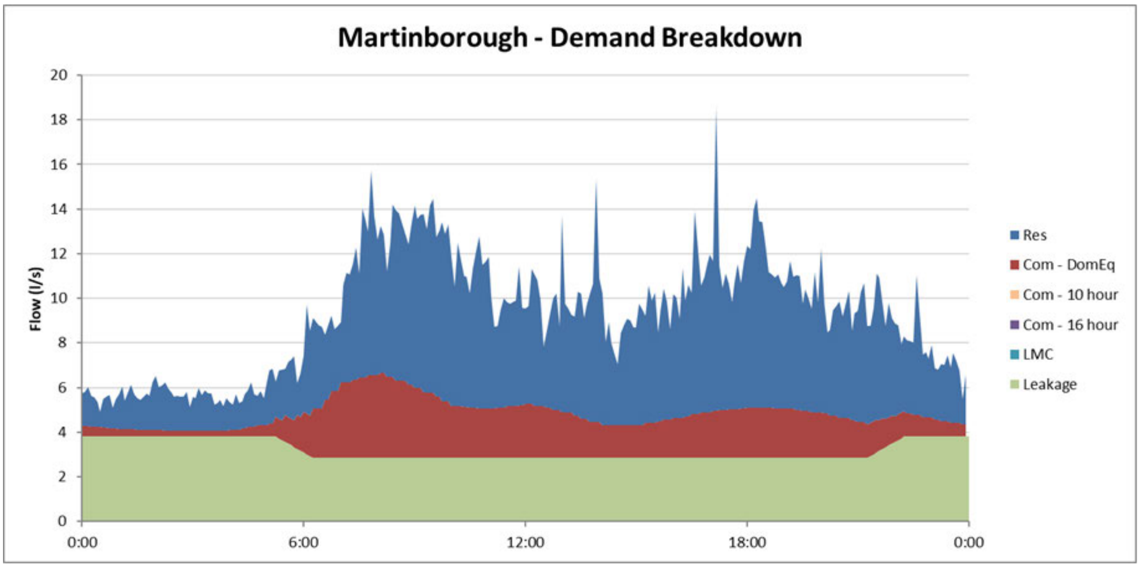
3.3 Review seasonality of non-residential demand

Although the water loss looks better, we note the non-residential water use now forms the majority of the genuine use, and the derived residential demand pattern drops below zero. Although there are other non-residential standard patterns to choose from in the Specs, it would be hard to select a standard pattern which gives us a reasonable derived residential demand pattern.

The residential demand was also very low, at around 230 l/prop/day.

Based on this, we concluded non-residential water use is likely seasonal in Martinborough.

As a starting point, we assumed winter non-residential use is 50% of the average annual non-residential use. This gave us the demand breakdown below.



From this, we calculated a water loss figure of 273 m3/day, 3.17 l/s. Residential demand is around 320 l/prop/day, still low but more realistic.

3.4 Use winter water loss to undertake PDD calculation

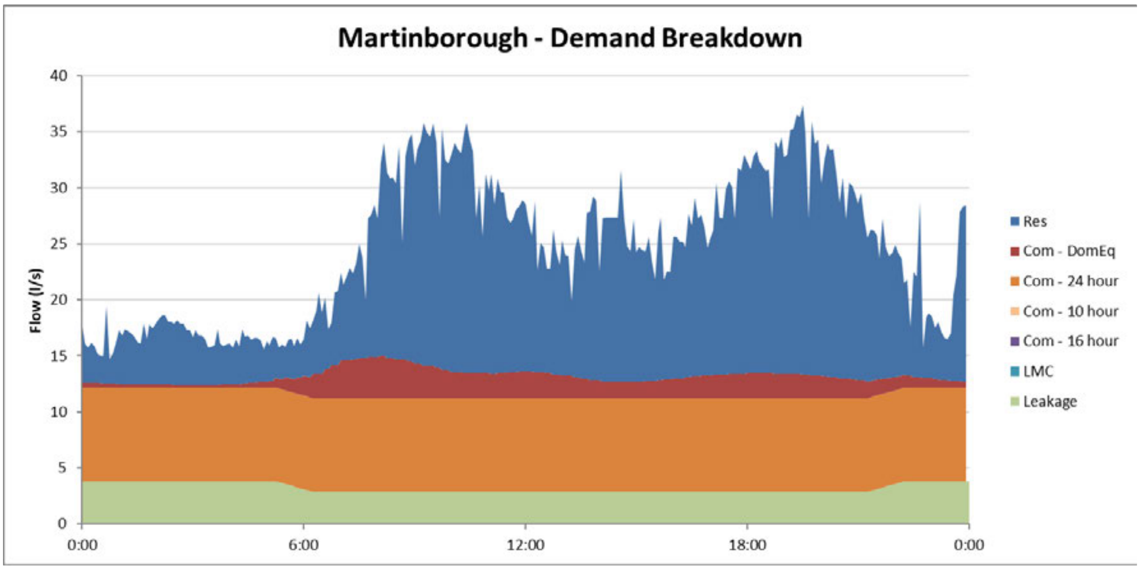
We used the assumed non-residential seasonality and the winter water loss in a demand analysis.

Peak day demand from February 2024 was 2,412 m3/day, with the overall pattern shown below.
As part of the assumption of seasonal non-residential water use outlined above, we assumed that in summer some of this was used as irrigation, with a 24-hour pattern.

For non-residential, if we assume billed use over the 9 non-summer months is 50% of the annual average, this leaves us with a multiplier of 250% of annual average use for the 3 summer months.

We then set up summer non-residential as two demand sets – we kept the 50% with the domestic-equivalent pattern as used in winter, and we then added the 200% as irrigation with a 24-hour pattern as a separate volume in the summer demand breakdown, as shown below.

Reference: 310104274



3.5 Outcomes

The daily volumes from the Peak Day Demand breakdown are:

- Non-residential non-seasonal component = 144 m3/day
- Non-residential seasonal component = 722 m3/day
- Water loss = 273 m3/day
- Summer residential = 991 m3/day (834 l/prop/day)
- Total demand 2,131 m3/day

The daily volumes from the Winter Demand breakdown are:

- Non-residential non-seasonal component = 144 m3/day
- Non-residential seasonal component = 0 m3/day
- Water loss = 273 m3/day
- Winter residential = 384 m3/day (323 l/prop/day)
- Total demand 801 m3/day

Resulting ADD volumes are as follows:

- Non-residential non-seasonal component = 144 m3/day
- Non-residential seasonal component = 0 m3/day
- Water loss = 273 m3/day
- ADD residential = 816 m3/day (686 l/prop/day)
- Total demand 1,233 m3/day

4 Discussion

The process above gives us a peak day residential demand and residential night flow similar to that initially calculated, and a water loss figure consistent with winter flows. However, there are a number of assumptions in this methodology which could be challenged. We have reviewed these with regards to the purpose of the ZMP, which is to anticipate future peak day demands on the network:

- **The balance between winter and summer non-residential use**

Reference: 310104274

This is very subjective. We used 50% for winter and 250% for summer, and assumed the seasonal use was 3 months through summer to give us the overall annual average matching billing data but there are other combinations which may work. This assumption gives us a breakdown which looks reasonable in both summer and winter. Without any information on how, where, and when non-residential supply is used there is no way to be more precise. However, in normal ZMP process, neither would be scaled with growth.

- **The split between water loss and non-residential**

We note that as only residential demand is scaled with future population growth, the split between non-residential and water loss has little effect on calculated future demands.

- **The split between seasonal non-residential and seasonal residential**

is more problematic as this could have more effect on future growth. It is likely that residential customers also irrigate at night through the summer months, but without any further information there is again no clear way to better determine the split.

However, one option to mitigate the unknowns is to state that even if some of the observed seasonal increase in night use is due to residential irrigation, <u>we assume that residential irrigation does not increase with infill growth</u> into the future, as the area of irrigable land will not increase with infill growth.

Prepared by:

[redacted]

Water Networks Specialist

Stantec

CREATING COMMUNITIES

Communities are fundamental. Whether around the corner or across the globe, they provide a foundation, a sense of belonging. That's why at Stantec, we always **design with community in mind**.

We care about the communities we serve—because they're our communities too. We're designers, engineers, scientists, and project managers, innovating together at the intersection of community, creativity, and client relationships. Balancing these priorities results in projects that advance the quality of life in communities across the globe.

New Zealand offices:
Alexandra, Auckland, Balclutha, Christchurch, Dunedin, Gisborne, Greymouth, Hamilton, Hastings, Napier, Nelson, Palmerston North, Queenstown, Tauranga, Wellington, Whangārei

Stantec
Level 15, 10 Brandon Street, Wellington, 6010
PO Box 13-052, Armagh, Christchurch, 8141
New Zealand: +64 3 816 7000 | www.stantec.com