Napier Servicing Structure Plan

Three Waters

Napier City Council

05 May 2023

→ **The Power of Commitment**

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The Power of Commitment

Executive Summary

The Napier region is expected to see notable population growth over the next 10 years. To plan for this, and to meet the requirements of the National Policy Statement: Urban Development (2020), Napier City Council are undertaking a series of planning works to assess the impact, and likely locations, of this growth. As part of this proactive approach, NCC have prepared the "Napier Spatial Picture" (NSP).

NCC have engaged GHD to produce a 3 Waters Servicing Structure Plan, this report, to build on previously undertaken Masterplans / Long List Programme of Works, utilising NCC's latest population growth understanding, as identified in the NSP.

This report seeks to achieve this by:

- Utilising the most recent growth data and applying it to the latest Masterplan upgrade models
- Assessing the impact of these changes on the existing 3 Waters Networks
- Identifying additional upgrades to achieve the Masterplan Level of Service (LoS)
- Assessing the rough order costs, risks and resilience associated with these upgrades

Application of the latest growth data showed multiple areas fail the existing water supply and wastewater LoS requirements, even when incorporating the masterplan upgrades. In particular, the Bay View area, where a trigger point assessment has been undertaken given the magnitude of growth potential within this area.

Water supply and wastewater upgrades for the Napier City area have been identified, for those networks to meet the required LoS. These are summarised in the tables below.

Water supply upgrades are required to service any of the development areas (excluding Bay View). These upgrades and are not subject to specific phasing or geographic development triggers.

Wastewater network upgrades are linked to specific geographic development triggers, these are identified within Table 2 below.

Table 1 Additional Growth Upgrade Requirements Summary

Water Supply	
Location	**Upgrade**
Willowbank Avenue	Upgrade DN200 pipe to 300 mm ID (1,465 m)
Chambers Street to Ellison Street	Upgrade DN100, and DN150 to 300 mm ID (1,075 m)
	Replace 10 fire hydrants on new 300 mm pipe upgrade
Ellison Street/Georges Drive	Upgrade DN100 to 300 mm ID (20 m)
Ellison Street to Vigor Brown Street through Nelson Crescent	Upgrade DN50, DN100, and DN150 to 300 mm ID (920 m)
	Replace 13 fire hydrants on new 300 mm pipe upgrade
Sanders Avenue to Carnell Street	Upgrade DN50, DN100, and DN150 to 300 mm ID (665 m). Add an additional pipe of 300 mm ID (70 m) between Sanders Avenue and Taradale Road
	Replace 10 fire hydrants on new 300 mm pipe upgrade
Hyderabad Road to Lever Street through Battery Road	Upgrade DN150 to 300 mm ID pipe (815 m)
	Replace 8 fire hydrants on new 300 mm pipe upgrade
Battery Road to Marine Parade through Breakwater Road	Upgrade DN100, DN150, and DN200 to 300 mm ID (2,065 m)
	Replace 20 fire hydrants on new 300 mm pipe upgrade
	Upsize two Pressure Reducing Valves (PRVs) to 300 mm ID
	Upsize two meters to 300 mm ID

Wastewater		
Location	**Upgrade**	**Related Growth Area**
Frickleton Street/Kauri Street, Murphy Road and Meeanee Road	Upgrade DN225 pipes to DN300 (1,065 m)	Taradale (Western Hills)
Gloucester Street	Upgrade DN450 pipes to DN525 (775 m)	Taradale (Western Hills)
Neeve Road	Upgrade DN300 pipes to DN375 (565 m)	Taradale (Western Hills)
Kent Terrace	Upgrade DN150 pipes to DN225 (295 m)	Taradale (Western Hills)
Trinity Crescent	Upgrade DN375 pipes to DN450 (350 m) – *only required if the developments at South Pirimai are connected into the existing gravity network*	South Pirimai
South of McNaughton Place	2 Upgrade Options New pump station connecting developments at South Pirimai to the Taradale pressure main with a secondary connection to the Greenmeadow pressure main (for operational resilience) Or, new pump station connecting developments at South Pirimai to the existing gravity network coupled with upgrading DN375 pipes to DN450 pipes (570 m) and upgrade the pumps at the Bill Hercock PS from 72 L/s to 130 L/s	South Pirimai
Northwest of The Loop	New pump station connecting developments at Riverbend to the Taradale pressure main	Riverbend
Northeast of The Loop	New pump station connecting developments at The Loop to the Taradale pressure main (combined connection with the Riverbend connection)	The Loop

The Rough Outturn Cost Estimate for undertaking these upgrades has been estimated to be:

- Water Supply $6,665,000
- Wastewater $9,815,000

No additional upgrades have been proposed for the stormwater network, given that significant modelling works are currently ongoing and the imperviousness of catchments within the model are still aligned with the latest documentation. Rather, a flood map has been produced using the latest HBRC model and the 100 year ARI rainfall event, to enable a comparison against the Masterplan mapping, and to facilitate a flooding assessment for the following greenfield development sites:

- Wharerangi Road
- Parklands
- The Loop
- South Pirimai

The Loop is the only greenfield development area the modelling has predicted negligible flooding. From a stormwater perspective, The Loop, ranks highest for development potential. It should be noted that a sizable area of the site will still need to be set aside for a stormwater detention basin to manage the stormwater volume generated by the proposed development area.

This report is subject to, and must be read in conjunction with, the limitations set out in Section 1.4 and the assumptions and qualifications contained throughout this report.

Contents

Table index

Figure index

Appendices

Attachments

No table of contents entries found.

1. Introduction

1.1 Background

The Napier region is expected to see notable population growth over the next 10 years. To plan for this, and to meet the requirements of the National Policy Statement: Urban Development (2020), Napier City Council are undertaking a series of planning activities to assess the impact, and likely locations, of this growth. As part of this proactive approach, NCC have prepared the “Napier Spatial Picture” (NSP), an illustration of Napier’s residential and employment growth opportunities based on key high-level information, analysis, and stakeholder insights. The NSP therefore provides an indication of potential greenfield and brownfield/intensification growth across Napier City.

GHD Limited (GHD) has been commissioned by Napier City Council (NCC) to support these planning activities through the development of a 3 Waters (water supply, wastewater, and stormwater) Servicing Structure Plan, this report, for the potential growth areas within Napier City.

The 3 Waters Servicing Structure Plan is to build on previously undertaken Masterplans / Long List Programme of Works, utilising NCC’s latest population growth understanding, as identified in the NSP.

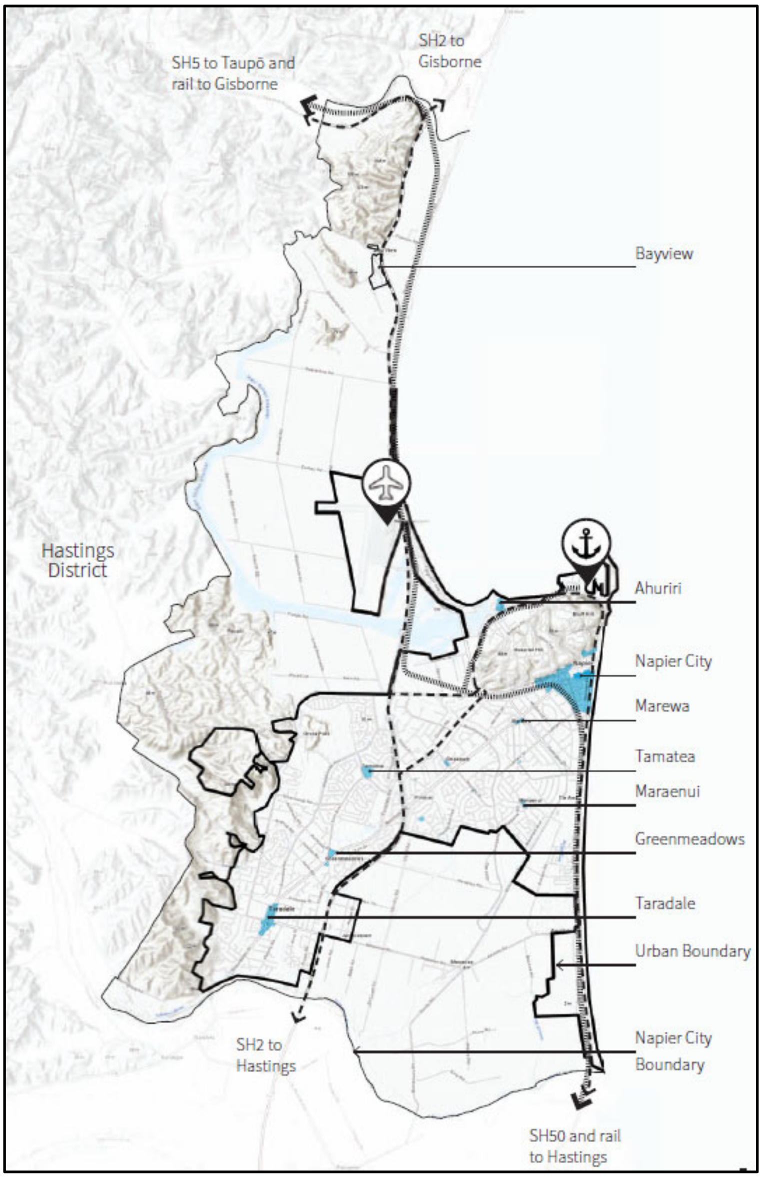


Figure 1 Locality Plan extract from Napier Spatial Picture

1.2 Purpose of this report

The key objective of this report is to enable robust decision making on the growth outlined within the NSP, including identifying which growth area(s), or sub-areas

1. should be prioritised for rezoning / intensification in the proposed District Plan (2022-23) as servicing requirements are aligned with existing Masterplans and/or are more easily serviced through cost effective and practical three waster servicing solutions
2. identify any areas Council should not pursue – due to incompatibility with the existing masterplans, uneconomic, unreliable, impractical, or high-risk servicing requirements.

This report seeks to achieve this by:

- Utilising the most recent growth data and applying it to the latest Masterplan upgrade models
- Assessing the impact of these changes on the existing 3 Waters Networks
- Identifying additional upgrades to achieve the Masterplan Level of Service
- Assessing the rough order costs, risks and resilience associated with the changes

1.3 Assumptions

The following key assumptions apply to this report:

– The selected models are suitable for use in their provided state for the purposes of this project. Any limitations within these models are deemed by NCC to be acceptable for the purposes of producing this report.
– All assets are currently operating as shown within the models.
– Any required modifications to the models, to enable simulations to be undertaken, are minor and quick to make.
– All masterplan upgrades will eventually be implemented.
– Growth is to only be assigned to residential properties, leaving non-residential customers unaffected.
– Growth data provided is sufficient for the purposes of producing this report. Future revisions of the growth data will require the findings of this report to be reassessed to confirm if they remain valid.
– Identified upgrades are in addition to the masterplan upgrades already within the model.
– Existing greenfield development areas are assumed to be fully pervious with a run-off coefficient of 0.3 for the pre-development case.
– Only one large stormwater detention basin is required for each greenfield development area, rather than multiple basins.
– The size of each large stormwater detention basin is the greater of the development related volume increase (24 hour event) or the site flooded volume (as predicted by the model), for a 100 year ARI event.
– Small scale onsite stormwater detention facilities will be incorporated within brownfield intensification developments to mitigate the volume of stormwater leaving the site.

1.4 Limitations

This report: has been prepared by GHD for Napier City Council and may only be used and relied on by Napier City Council for the purpose agreed between GHD and Napier City Council as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Napier City Council arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section 1.3 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared the preliminary Rough Order Cost Estimates set out in Section 9 of this report ("Cost Estimate") using information reasonably available to the GHD employee(s) who prepared this report; and based on assumptions and judgments made by GHD.

The Cost Estimate has been prepared for the purpose of identifying points of deference between developing different growth areas, and must not be used for any other purpose.

The Cost Estimate is a preliminary estimate only. Actual prices, costs and other variables may be different to those used to prepare the Cost Estimate and may change. Unless as otherwise specified in this report, no detailed quotation has been obtained for actions identified in this report. GHD does not represent, warrant or guarantee that the works can or will be undertaken at a cost which is the same or less than the Cost Estimate.

Where estimates of potential costs are provided with an indicated level of confidence, notwithstanding the conservatism of the level of confidence selected as the planning level, there remains a chance that the cost will be greater than the planning estimate, and any funding would not be adequate. The confidence level considered to be most appropriate for planning purposes will vary depending on the conservatism of the user and the nature of the project. The user should therefore select appropriate confidence levels to suit their particular risk profile.

GHD has prepared this report on the basis of information provided by Napier City Council and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD has made updates to the Wastewater, Water Supply and Stormwater models that have been provided by HDC and Stantec. These updates have been limited to those required to enable an assessment to be made on the impact of growth changes, and are not intended as a review of the existing models. It is anticipated that data from these models may be copied into the original models, by others, at a later date. The models have been used for the purpose of high level planning and large scale upgrades. They are not sufficiently calibrated to enable a more granular assessment of the network and optimisation of individual pipe sizes. Limitations associated with the models can be found in the previously completed masterplans and supporting documents.

This report excludes considerations of the Awatoto Wastewater Treatment Plant, including the associated masterplan, as well as the water supply for commercial buildings/areas where they are self-supplied for daily demand or fire flow.

An assessment of whether previous masterplan upgrades are still required, or any staging involving previous or additional upgrades, is excluded from the scope of this report.

A time gap exists between when the masterplans were created, and when the revised growth has been identified. During this time, dwellings, considered as part of the masterplan future growth, may have been built. These would likely be considered by the revised growth data as being 'existing dwellings' and therefore not included in the revised growth numbers. Any such dwellings, such as those at Te Awa, will not have been captured within this project. As Te Awa wastewater connects directly into the under capacity Taradale Pressure Main, the omission of Te Awa dwellings from the model will not have a major impact on the wastewater network.

Accessibility of documents

If this report is required to be accessible in any other format, this can be provided by GHD upon request and at an additional cost if necessary.

2. Existing Data

Over the past decade, several documents and models have been produced focussing on the different wastewater, water supply and stormwater systems within Napier. The most notable of these are outlined in Table 2 and Table 3.

Table 2 Existing Documentation

Document Name	Date Issued	Author	Alias
Water Supply			
Napier Water Supply Network Model Development	October 2017	Stantec	Model Build Report
Water Supply Network Master Plan	November 2019	Stantec	Masterplan
Water Network Model Calibration	February 2020	Stantec	Calibration Report
Wastewater*			
Wastewater Collection System Preliminary Calibration Report	December 2019	Stantec	Calibration Report
Napier Wastewater Masterplan 2020-50	July 2020	GHD	Masterplan
Stormwater			
NCC Stormwater Model Build Report	September 2020	Stantec	Model Build Report
Napier City Stormwater Master Plan	September 2020	Stantec	Masterplan

* The Awatoto Wastewater Treatment Plan Masterplan has not been used in the production of this report

Table 3 Existing Models

Simulation / Model	Scenario	Design Horizon	Demand / Design Flow / Rainfall	Software
Water Supply – single model				
Simulation 1	Baseline (Current Day)	2017	Average Day Demand (ADD)	Infoworks WS Pro 2021.4
Simulation 2	Baseline (Current Day)	2017	Peak Day Demand (PDD)**	Infoworks WS Pro 2021.4
Simulation 3	Future Day + future network improvements	2047	Average Day Demand (ADD)	Infoworks WS Pro 2021.4
Simulation 4	Future Day + future network improvements	2047	Peak Day Demand (PDD)**	Infoworks WS Pro 2021.4
Wastewater – single model***				
Simulation 1	Baseline	2020	Dry Weather Flow (DWF)	Mike Urban 2019 17.0.12300
Simulation 2	Baseline	2020	Wet Weather Flow (WWF)	Mike Urban 2019 17.0.12300
Simulation 3	Future Day + future network improvements	2050	Dry Weather Flow (DWF)	Mike Urban 2019 17.0.12300
Simulation 4	Future Day + future network improvements	2050	Wet Weather Flow (WWF)	Mike Urban 2019 17.0.12300
Stormwater – multiple models*				
Napier Masterplan – 3-Way Coupled	Baseline	2020	50 year (100 year not run)	Mike Zero 2020 Update 1
Bay View Masterplan – 3-Way Coupled	Baseline	2020	50 year	Mike Zero 2019
Napier Masterplan – 2-Way Coupled****	Future Day + future network improvements	2050	50 year (100 year not run)	Mike Zero 2020 Update 1
Bay View Masterplan – 3-Way Coupled	Future Day + future network improvements	2050	50 year	Mike Zero 2019
Hawkes Bay Regional Council (HBRC) Model – 3-Way Coupled	Future Day + HBRC model amendments + future network improvements	2050	50 year	Mike Zero 2020 Update 1

* It should be noted that many other model rainfall events have been modelled previously, however as they do not specifically relate to the scope of this report, and therefore have not been referred to

** Peak Day Demand was modelled as a multiplier of the Average Day Demand

*** The wastewater reticulation network is the only wastewater model that has been used in the production of this report

**** The 2-Way Coupled Model does not include the Surface Model

As a three-way model was never created for the 2050 with upgrades masterplan scenario, NCC have agreed that the latest HBRC Model is to be used, with the following parameters:

- Rainfall data is to be changed to the NCC 1% AEP (100 year) rainfall event (NIWA RCP8.5 dataset, 2081-2100). previous models have used a synthetic 24-hour design storm based on the NCC CoP in 2019 (this showed values ranging between the RCP6.0 and RCP8.5 datasets)
- Sea Level rise of 0.5 m between the 2020 model and the 2050 models
- Imperviousness as per existing models

Refer to Appendix A for a high-level comparison between the existing documentation and listed models.

2.1 Existing Masterplan Upgrades

The masterplan upgrades cover wide areas of Napier City and Bay View, and were included within the upgrade models, except for the Stormwater HBRC model, which also included additional upgrades.

These upgrades have been left untouched in the models and form the structure plan base case, with only additional upgrades identified to resolve issues arising from the revised growth data.

A summary of the Masterplan upgrades for the water supply and wastewater networks are visually represented in sections 2.1.1 and 2.1.2 respectively. It is assumed that all upgrades will eventually be made, although, as the masterplans span a period of 30 years, it's anticipated that the timing of the upgrades will vary in order to align with growth realisation.

2.1.1 Masterplan Upgrades - Water Supply

The masterplan upgrades for the water supply network were designed to create a resilient network that:

- Provides safe and clean drinking water to customers at a sufficient pressure,
- Maintains sufficient fire-fighting pressure, and
- Includes dedicated main to the water reservoirs.

Implementation of the masterplan upgrades was divided into nine work packages, some of which could be undertaken concurrently. The proposed water supply network, incorporating masterplan upgrades, is shown in Figure 2.

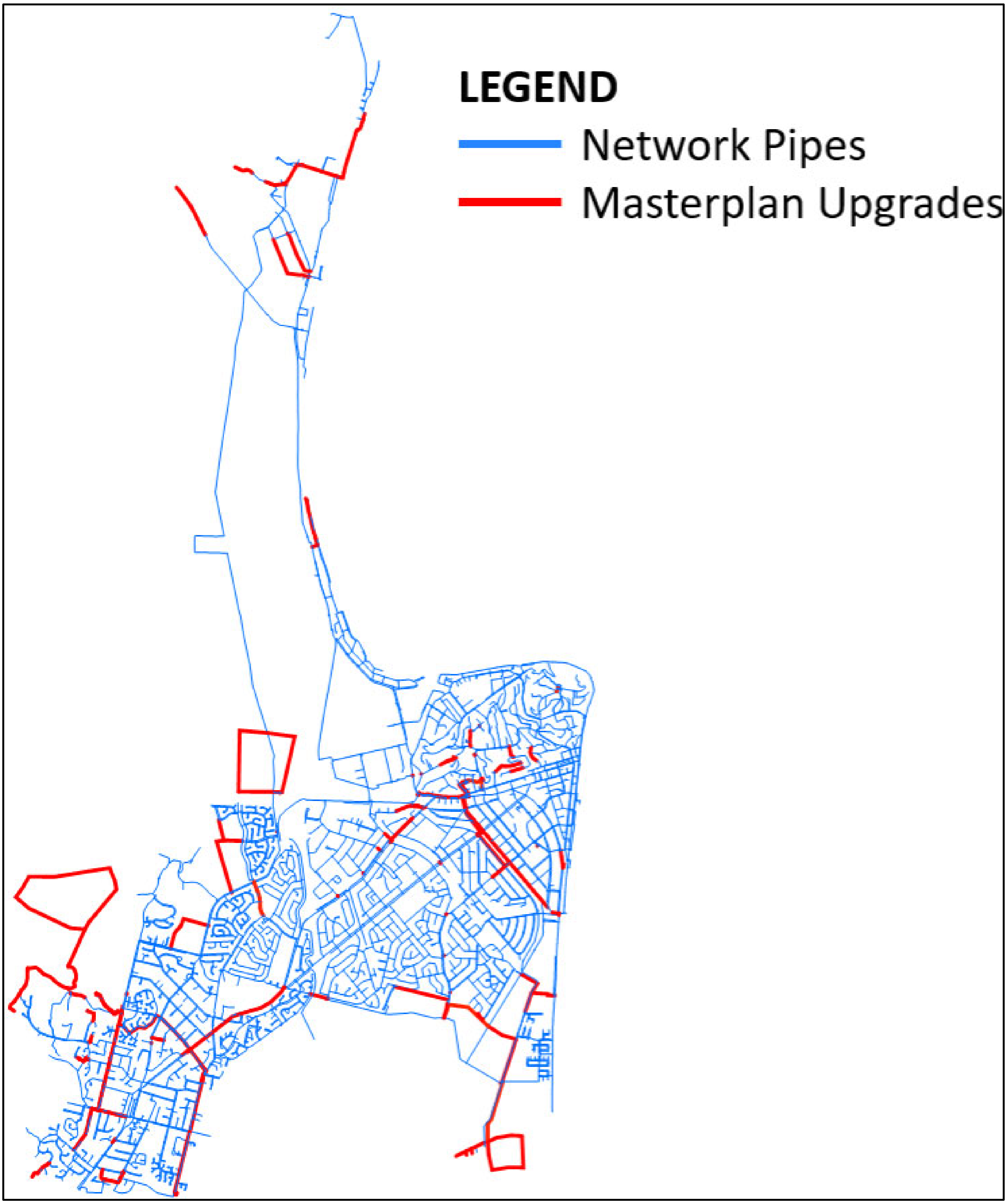


Figure 2 Bay View and Napier City Water Supply Masterplan Network – model extract

2.1.2 Masterplan Upgrades - Wastewater

The masterplan upgrades for the wastewater network were designed to create a resilient network, meet Level of Service targets and minimise overflows. Implementation of the masterplan upgrades were divided into Fundamental Upgrades and Ancillary Upgrades.

The fundamental masterplan upgrades were determined by considering three primary catchments within the network - Greenmeadows, Taradale and Latham. Upgrades for these three catchments were identified by treating Greenmeadows as a standalone catchment and Taradale/Latham in conjunction with each other (as they are within the same overall catchment), as shown in Table 4.

Table 4 Fundamental wastewater masterplan upgrades

Catchment	Preferred Upgrade Option
Greenmeadows	Upgrade Greenmeadows Pump Station (PS) and associated pressure mains to direct Western Hills Growth directly to the Greenmeadows PS using a trunk gravity network*
Taradale and Latham	Divert catchment flows to Taradale PS rather than Latham PS, with localised PS, pressure mains and gravity network upgrade

*Note that viability of a satellite treatment plant should be considered based on the progress of developments across the broader Western Hills area.

The ancillary upgrades covered the remainder of the wastewater network and were developed based on the above fundamental masterplan upgrades (Table 4). These consisted of:

- Pump Station Upgrades (other than Greenmeadows PS, Taradale and Latham PS)
- Pressure Main Upgrades
- Gravity Reticulation Upgrades
- Wastewater Storage

The proposed wastewater network, incorporating masterplan upgrades, is shown in Figure 3.

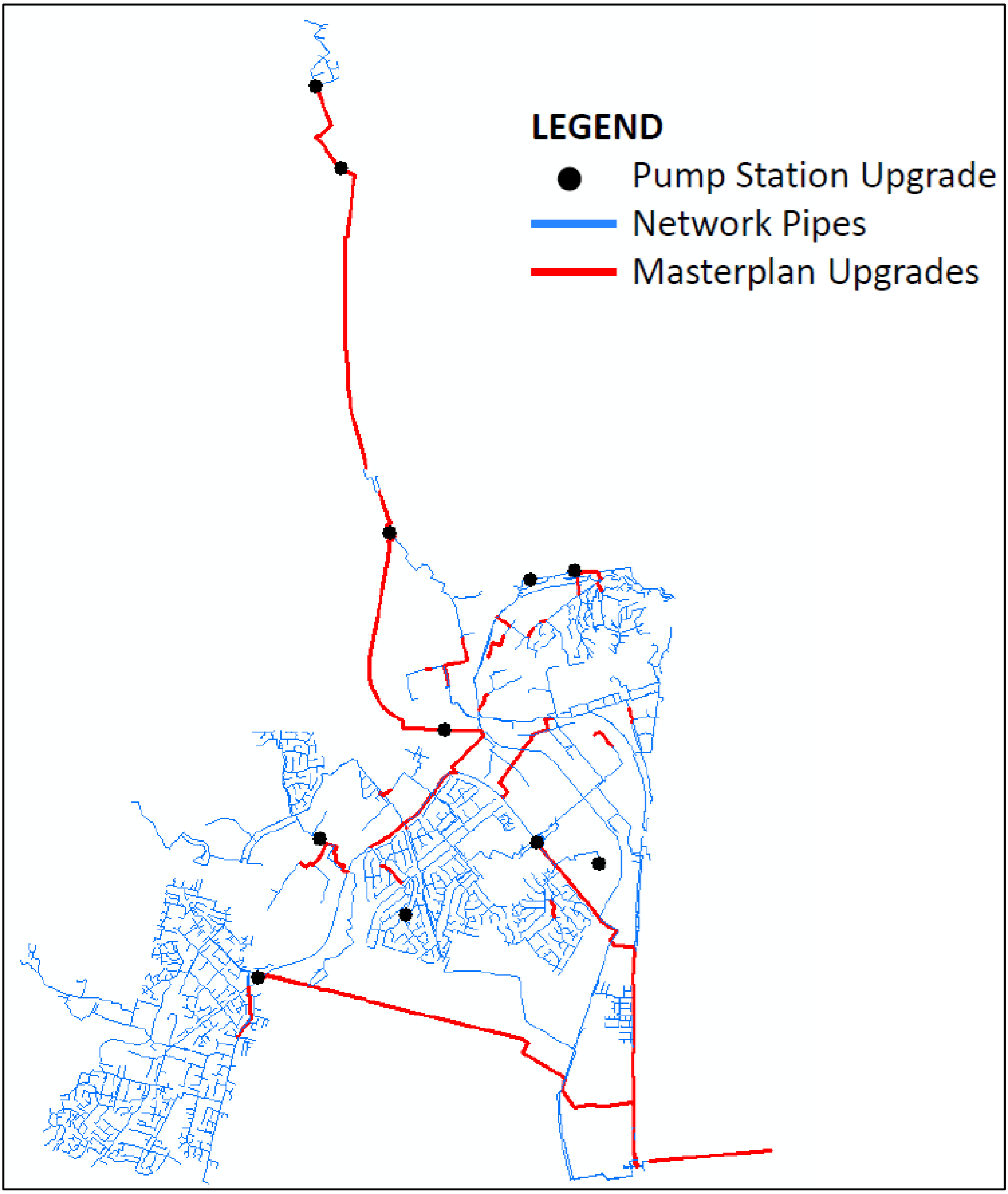


Figure 3 *Bay View and Napier City Wastewater Masterplan Network – model extract*

3. Growth Overview

NCC previously engaged Barker & Associates (B&A)[1] and Market Economics Consulting (M.E)[2] to estimate the NSP's allowable growth for the greenfield and brownfield growth areas respectively, these areas are visually represented in Figure 4.

In addition to the growth areas within the NSP, further growth areas of Mission Hills, Parklands and Riverbend have been included, as summarised below in Table 5.

Table 5 Napier Spatial Picture (NSP) Growth Areas

Brownfield Intensification (M.E)	Greenfield Growth (B&A)
Ahuriri	Bay View
Greenmeadows	Wharerangi Road
Maraenui	Heretaunga Plains Urban Development Strategy (HPUDS)
Marewa	Mission Hills*
Napier Central	Parklands*
Napier Hills	Riverbend*
Napier South	
Onekawa	
Pirimai	
Tamatea	
Taradale	
Rural	

* Non NSP growth areas that have been added

[1] Napier City Structure Plans – indicative yields Memorandum (6th May 2022)
[2] Development Capacity Assessment: Intensification Areas (4th February 2022)

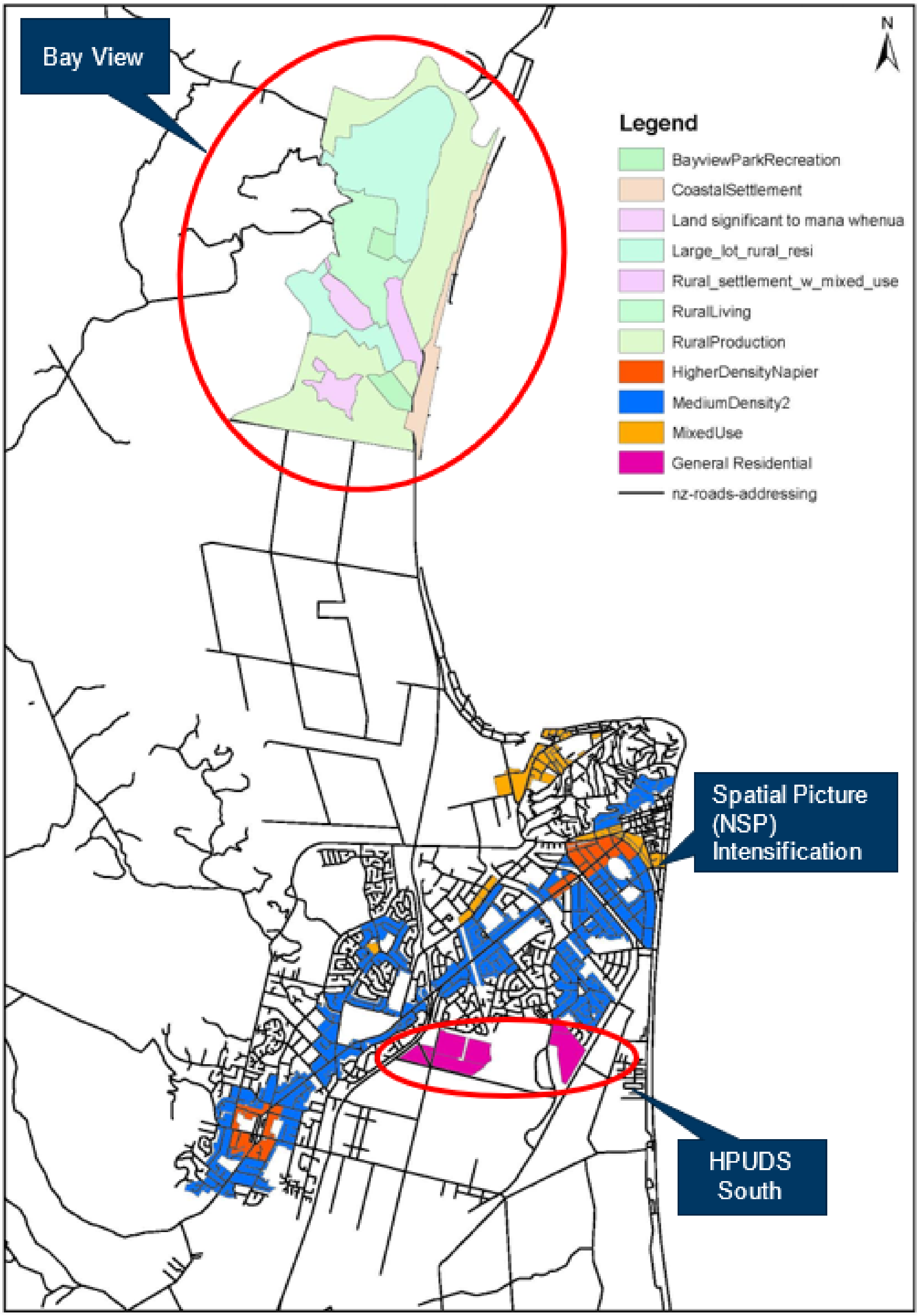


Figure 4 *Napier Spatial Picture Growth Areas*

The growth numbers associated with these greenfield and brownfield areas, as provided by M.E, B&A and NCC, are summarised in Table 6 and Table 7. For background information regarding the growth numbers, refer to Appendix B.

Table 6 Brownfield Growth Data

Brownfield Intensification Area*	Number of Additional Dwellings (compared to current day WS and WW models)
Ahuriri	75
Greenmeadows	180
Maraenui	790
Marewa	335
Pirimai	140
Napier Central	90
Napier Hills	15
Napier South	90
Onekawa	135
Tamatea	95
Taradale	310
Rural	80
Total	2,335

* It is assumed that brownfield intensification is only to be applied to residential areas and not to commercial areas

Table 7 Greenfield Growth Data

Greenfield Area	Number of Additional Dwellings (compared to current day WS and WW models)
Bay View*	1,462 *(2,232 ultimate development - 770 existing, 254 in existing WW model, 1,978 would need to be added)*
The Loop	631
Mission Hills**	1,200
Parklands***	310
South Pirimai	1,170
Riverbend**	655 + 0.5 Ha of commercial area *(2,384 eqv population derived from dwellings/number of bedrooms)*
Wharerangi Road	520 + 0.97 Ha of commercial area
Total	**5948 + 1.47 Ha of commercial area**

* It should be noted that the 122 dwellings listed for the 33 hectares of land of significance to mana whenua, have not been included in these totals, as they were noted as already developed in the supplied B&A data (July 2022). As neither model currently show this level of development, this approach should be re-assessed if likely to be critical to decision making.

** Additional dwelling / equivalent population data have been provided by NCC/developers, rather than by B&A

*** Additional dwelling data have been provided by M.E in the 'High Level Assessment of Appropriate Commercial Land Areas for Wharerangi Road and Tamatea Structure Plan Areas' Memorandum (8th April 2022)

Whilst this growth data is applicable to the water supply and wastewater models, there is no specific growth data relating to Stormwater, other than the impact that development will have upon the imperviousness percentages assigned to the different sub-catchments.

4. Application of Revised Growth

Brownfield Intensification and Greenfield Growth data was previously incorporated into the latest Masterplans for the 2047 design horizon (water supply) and the 2050 design horizon (wastewater and stormwater). For the water supply and wastewater models, growth was assigned to sub-catchments within area boundaries, refer to Appendix C for a summary description.

4.1 Data Comparison

The revised growth data, supplied by ME, B&A and NCC, was represented in large geographic parcels (aligning with the Napier Statistical Areas). These parcels were not directly compatible with the 28,892 customer data points in the water supply model, the 5,282 sub-catchments in the wastewater model or the intensification polygons noted within the Napier Spatial Picture.

To resolve this, a two-step process was undertaken to enable a growth data comparison, as depicted in Figure 5 and Figure 6

- The intensification polygons within the NSP were grouped by Napier Statistical Area, providing a link between the NSP and the growth values provided.

- For the water supply model, the customer points were assigned to the polygons and thus the Napier Statistical Area. Whilst for the wastewater model the sub-catchments were converted to centroid points before being assigned to the polygons and thus the Napier Statistical Area.

This process enabled the revised intensification growth data to be compared against the previous growth data within the models, as shown in Table 8 and Table 9.

A more direct comparison was possible for Greenfield growth, as the modelled control points / sub-catchments covered larger land areas, thus enabling a simpler comparison with the supplied growth data.

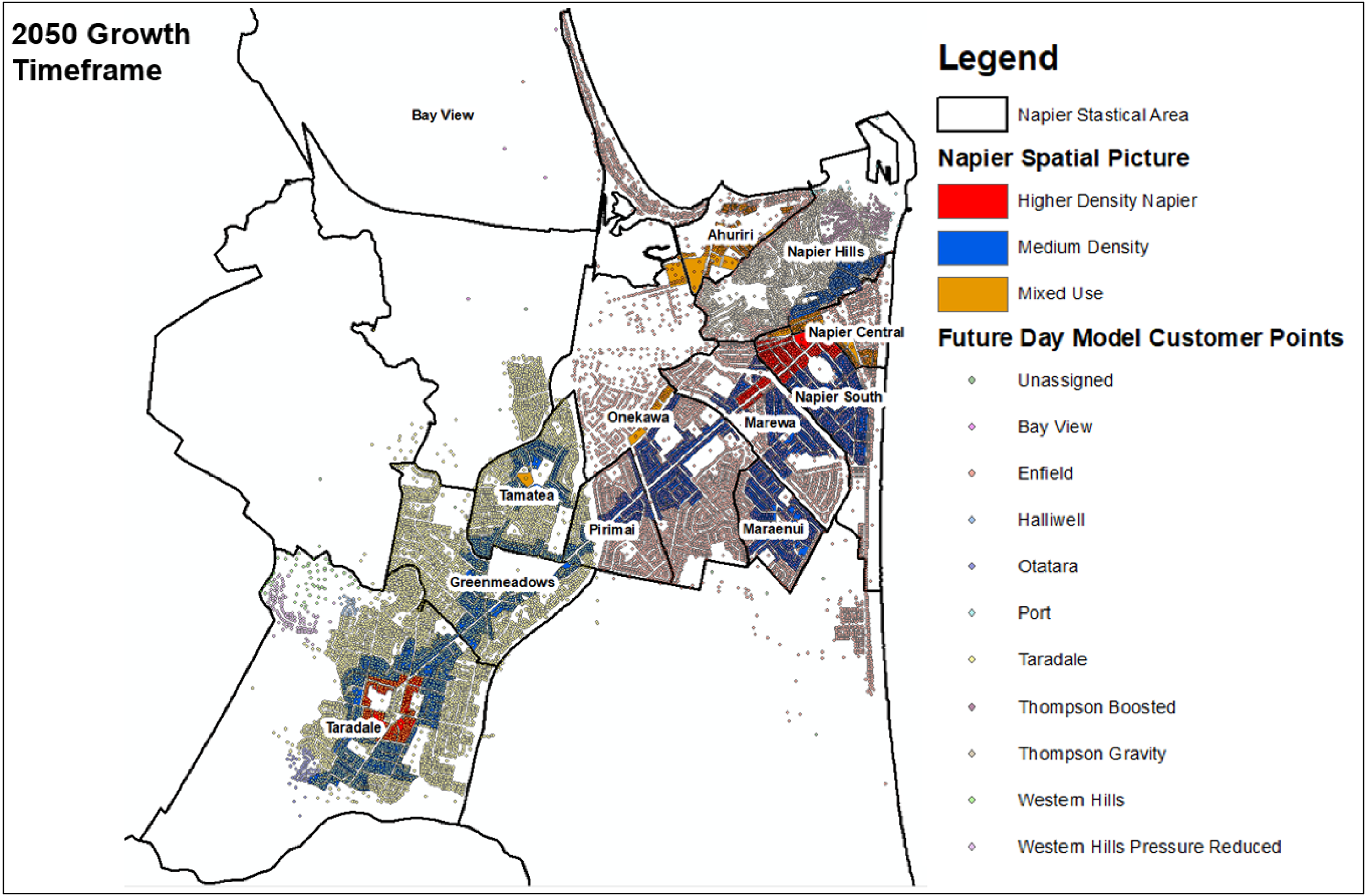


Figure 5 *Identification of Customer Points Within the Napier Spatial Picture (NSP)*

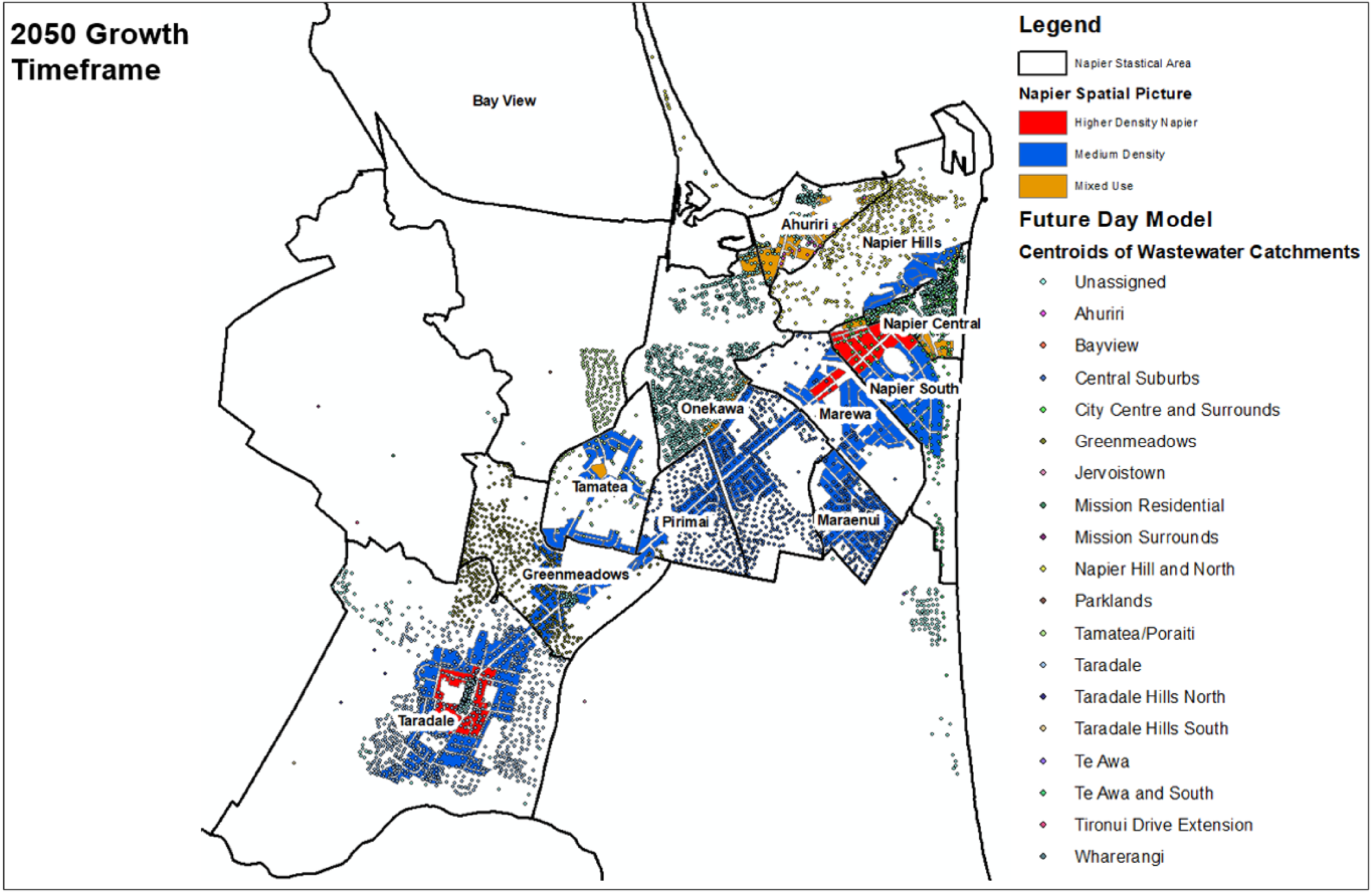


Figure 6 *Identification of Wastewater Catchment Centroids Within the Napier Spatial Picture (NSP)*

Table 8 Comparison of Future Day Water Supply Growth Data

Area	Number of Properties			
Water Supply Model Areas	**Current Day Model**	**Future Day Model***	**Equivalent Growth (Masterplan Model)**	**Latest Revised Growth Data *****
Intensification				
Bay View	770	847	77	-
Enfield	14,148	15,563	1,415	1,655
Taradale	11,000	12,100	1,100	585
Thompson Boosted	324	357	33	15**
Thompson Gravity	2,338	2,572	234	-
Western Hills/The Terraces	226	249	23	-
Otatara	85	94	9	-
Total	**28,891**	**31,782**	**2,891**	**2,255**
Greenfield				
Bay View	-	90	90	1,462
Parklands	142	345	203	310
Park Island	-	10	10	
Riverbend	-	300	300	655
The Loop	-	300	300	630
Te Awa	-	830	830	****
Western Hill aka Mission Hills	-	600	600	1,200
South Pirimai	-	-	-	1170
Wharerangi Road	-	-	-	520
Total	**142**	**2,475**	**2,333**	**5,947**

*Calculated by factoring up properties in the current day model by 10%. The number of properties calculated is not reflected within the model, as infill intensification is represented by an increase in demand.

**Includes the Napier Hills growth that sits within the Thompson Gravity catchment

***Greenfield commercial growth and Rural (80 population equivalent) not included in this table

**** The previously identified Te Awa growth is either a victim of the time gap between masterplan and revised growth data or it has been accounted within the other growth areas. As water supply upgrades are not location specific this is not likely to have a major impact on the water supply network.

Table 9 Comparison of Future Day Wastewater Growth Data

Areas	**Number of Properties**	
Wastewater Masterplan Areas	Document Anticipated Dwellings – 2050	Latest Revised Growth Data* and **
Infill Intensification		
Jervoistown	226	0
Ahuriri	400	75
Taradale	1,725	310
Greenmeadows	881	180
Tamatea / Poraiti	130	95
Central Suburbs	580	1,400
Te Awa and South	314	90
Napier Hill and North	650	15
City Centre and Surrounds	800	90
Total	**5,706**	**2,255**
Greenfield Development		
Parklands	440	310
Te Awa	970	-***
Mission Residential	650	1,200
Wharerangi Road	170	520
Bay View	190	1,915
Taradale Hills South	600	-
Taradale Hills North	150	
Tironui Drive Extension	900	-
Mission Surrounds	550	-
The Loop		630
South Pirimai		1,170
Riverbend		655
Total	**4,620**	**6,400**

* Growth best fit based on Spatial Picture Areas

** Greenfield commercial growth and Rural (80 population equivalent) not included in this table

*** As Te Awa wastewater connects directly into the under capacity Taradale Pressure Main, the omission of Te Awa dwellings from the model will not have a major impact on the wastewater network.

Similar to the water supply and wastewater models, the sub-catchments within the Stormwater Masterplan do not align with the more recently completed Spatial Picture.

Therefore, in keeping with the principles of the Stormwater Masterplan, the following imperviousness percentages have been assigned to the greenfield growth areas:

- Wharerangi Road (80%, Park Island in the Masterplan)
- Parklands (80%, Parklands in Masterplan)
- Mission Hills (40%, Mission in Masterplan)
- The Loop (80%)
- Riverbend (80%)

- South Pirimai (80%)

As the existing imperviousness percentages in the model, for the brownfield intensification and greenfield growth areas, still align with the latest NCC CoP, no changes have been made to the imperviousness of sub-catchments currently within the model.

Note that the following areas are excluded from any further stormwater assessment within this report:

- Missions Hills – due to topography, with the majority of the development draining away from the Napier stormwater network.
- Bay View – due to the extreme level of projected growth potential in the area, no further assessment will be undertaken unless the wastewater and water supply assessments demonstrate a viable solution.
- The Riverbend Development - design to mitigate the stormwater impact of the Riverbend development is near completion with liaison ongoing between the developer and NCC.

With no modification to the imperviousness of sub-catchments, the stormwater assessment part of this report will focus on the flooding impacts associated with the 100-year Average Recurrence Interval (ARI) event within the HRBC model.

4.2 Water Supply and Wastewater Model Update – Growth Data

In essence, the update involved removing the existing growth data from the models, and replacing it with the revised growth data.

The water supply model was updated with the latest growth data through the following steps:

1. Removal of the existing brownfield intensification by factoring down residential consumption by 10%.
2. Removal of the greenfield growth on the greenfield customer points by assigning zero properties to them.
3. Application of the revised growth numbers to the customer points within the model, with creation of customer points for any greenfield growth areas that are not currently in the model.

In addition to incorporating the revised growth data within the model, Franklin reservoir was also modified, as it was observed to rapidly empty and not refill adequately for the following day. It is understood NCC will implement operational measures such as flow monitors or level sensors, to prevent the reservoir from emptying, prior to growth occurring in the area. The reservoir in the model has therefore been altered to include pressure sustaining valves (PSV) to maintain a reservoir depth of 2 m. As a result, outflow from the reservoir stops when the reservoir depth drops below 2 m. The reservoir then begins to refill to ~60% capacity by the end of the day.

The wastewater model was updated through the following steps:

1. Identify the residential catchments within the wastewater model.
2. Replace the population equivalent at the residential catchments with those of the baseline model. This resulted in a future day model with current day residential population, future day non-residential growth and the masterplan upgrades.
3. Remove the greenfield growth from the greenfield polygons by assigning zero people to polygons.
4. Divide the infill growth for each area by their respective number of residential catchments.
5. Assign brownfield intensification evenly across the residential catchments within each area of the NSP.
6. Assign greenfield growth to any existing greenfield polygons. Create new greenfield polygons for any outstanding growth areas.

For further details of the growth assignment process, refer to Appendix D.

Simulations for each model was then run to assess the impact of the revised growth data on the existing network and masterplan upgrades.

5. Network Impact

A simulation was undertaken for all three models, with general parameters noted in Table 10.

Table 10 Model details

Water Type	Design Horizon	Notes
Water Supply	2047	• Peak Day Demand • Includes masterplan modifications and upgrades • Stantec's growth information altered with the revised data
Wastewater	2050	• Wet Weather Flow • Includes masterplan modifications and upgrades • GHD's growth information altered with the revised data
Stormwater	2050	• HBRC model used, including modifications and upgrades • NCC 2050 1% AEP (100 year) rainfall event • 0.5 m sea level increase compared to 2020 model • No alteration to imperviousness of sub-catchments

5.1 Water Supply Simulation

The results seen from the model simulation have been compared against both the masterplan 2017 (current day) and 2047 (future model) scenarios. A comparison has been made of the minimum pressures across the water supply network, as shown in Figure 7, and the maximum headloss, per km of water main, across the water supply network, as shown in Figure 8.

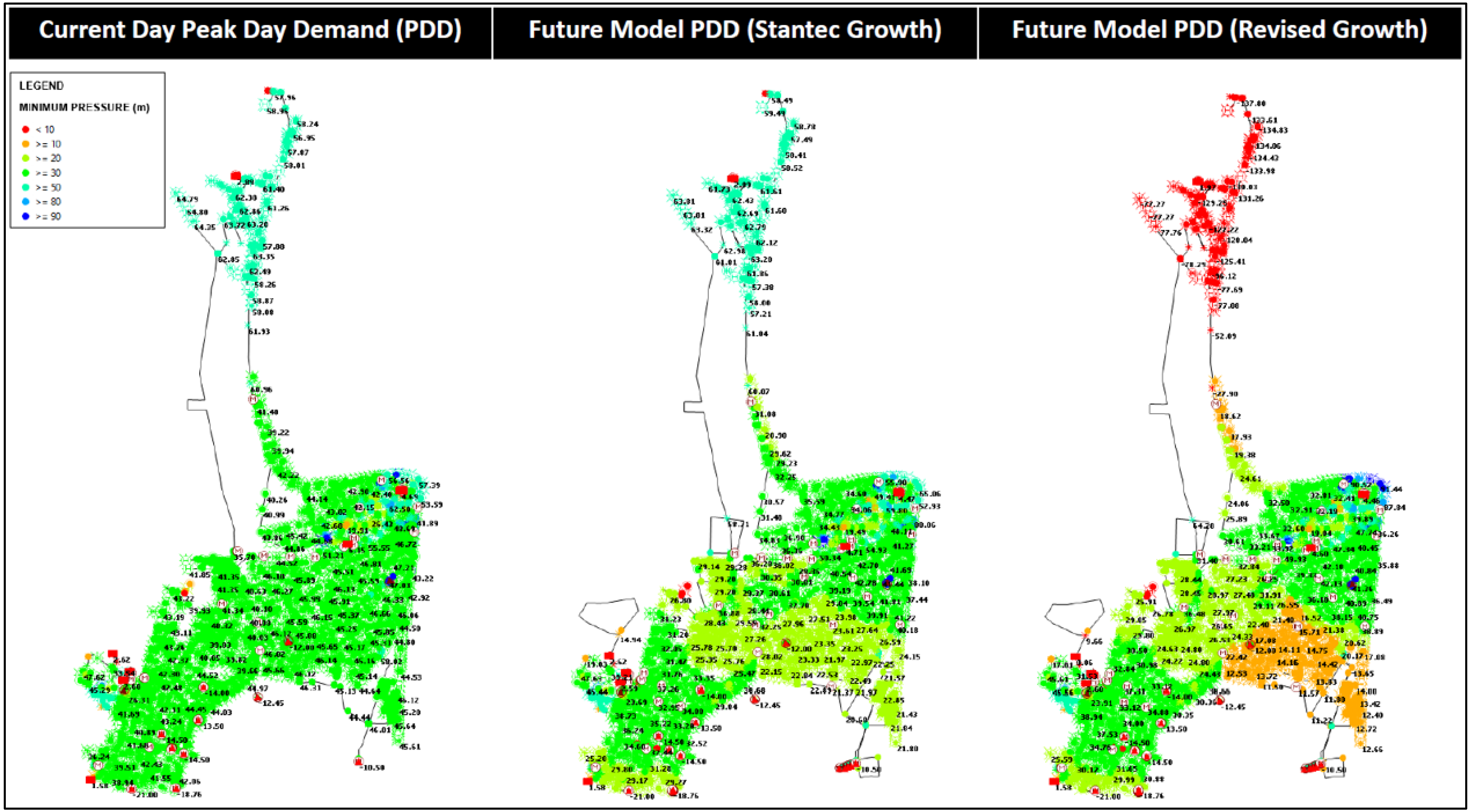


Figure 7 Minimum pressure (m) comparison of the water supply network

Figure 8 Maximum headloss per kilometre (m/km) for future model with updated growth data

Key observations are summarised below:

- The recent model simulation shows a worse situation compared to Stantec's future model, which was anticipated given the higher growth numbers within the most recent simulation.
- Minimum pressures at Bay View reduce dramatically with the addition of the Bay View greenfield growth as the existing reservoir has insufficient capacity to refill for the following day without the introduction of pressure sustaining valves (PSV's)
- Portions of Napier South, Marewa, Maraenui and Onekawa show minimum pressures between 10 m and 20 m, although most of the network shows pressures > 20 m (the minimum allowed within the NCC CoP is 20 m).
- Napier South properties are supplied from a combination of Thompson Reservoir and Enfield Reservoir. High headlosses are observed within these zones, indicating that the network is at capacity in these areas.
- There are significant areas of the network experiencing high headloss (greater than 5 m/km)
- The areas with < 20 m of minimum pressure do not correlate with the network areas experiencing high headloss, i.e. whilst these areas feel the impact, they are not necessary the cause
- The Westshore and Tannery booster pumps operates at fixed speed and are set to turn on when the depth of the Franklin reservoirs drop to 2.9 m in Reservoir 1 (Tannery booster pump trigger) and 2.8 m in Reservoir 2 (Westshore booster pump trigger). These booster pumps do not turn on in the initial model simulation. The booster pumps feed the Bay View network as well as the Franklin reservoir, however with the revised growth data and the Franklin reservoir modifications, the pumps do turn on, but capacity is exceeded by the demand.

5.1.1 Fire-Fighting Assessment

A fire-fighting assessment with revised growth of the hydrants within the future model was undertaken, as depicted in Figure 9. This process was aligned with the masterplan assessment, undertaken by Stantec, and was in accordance with SNZ PAS 4509:2008 New Zealand Fire Fighting Water Supplies Code of Practice. The assessment was hazard-based and focused on the customer points to assess where hydrants could be insufficient to meet FW2 requirements. The flow rates were measured whilst a pressure of 10 m was maintained at the hydrant, in line with the masterplan.

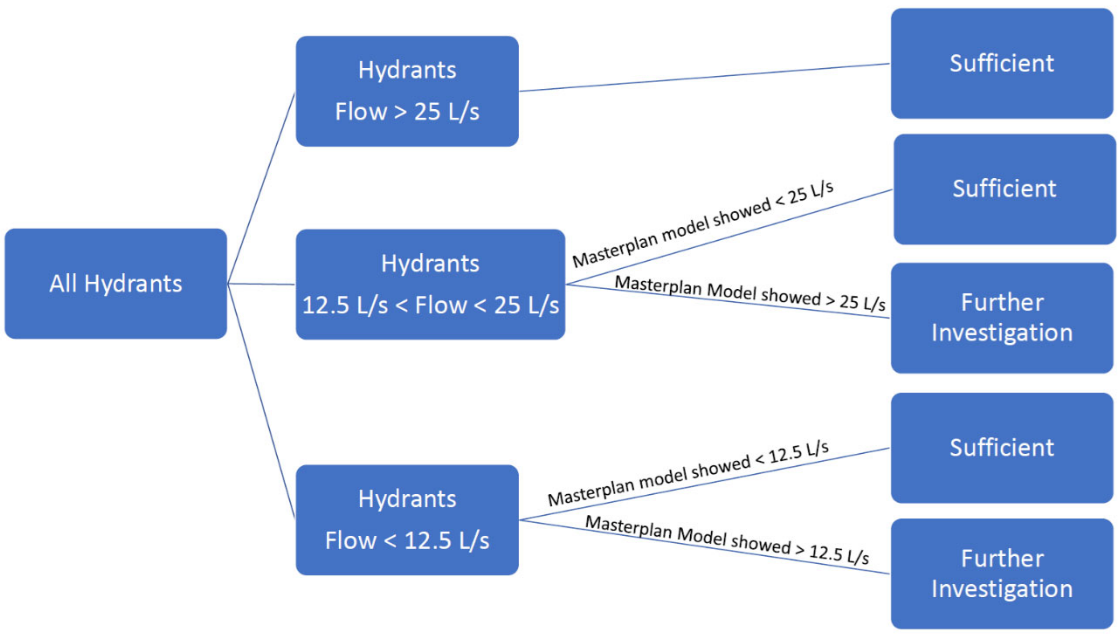


Figure 9 Hydrant Fire Flow Assessment Flow Diagram

Figure 9 flow diagram can be summarised as follows:

- Fire Hydrants capable of providing 25 L/s or greater are considered sufficient to provide FW2.
- Hydrants providing between 12.5 L/s and 25 L/s were considered sufficient if they had the same situation within the masterplan model. Where the flow rate had exceeded 25 L/s in the masterplan, the hydrant was assessed in relation to affected customer points (buildings) and other nearby hydrants.
- Despite not meeting the firefighting code of practice, hydrants unable to provide 12.5 l/s were similarly considered sufficient, if the situation had not changed when compared to the masterplan model.

It should be noted that all hydrants at Bay View were excluded from this assessment as they would return negative pressures, caused by PSV's at Franklin reservoir preventing the reservoir from emptying. They would not be able to meet and maintain 10 m of pressure at the hydrant.

Based on the Figure 9 flow diagram, only one existing hydrant warranted investigation. This was located at 802 Marine Parade (hydrant W-HYD-000127) and returned a result of 12.36 L/s (marginally below the 12.5 L/s requirement).

Given that the result was just below an acceptable target, and that there were other suitable hydrants across Marine Parade that would provide sufficient flow in the event of a fire, no upgrades are recommended.

5.2 Wastewater Simulation

The results seen from the model simulation have been compared against the 2050 (future model) scenario. In the absence of defined national standards or local regulatory requirements, the wastewater model wet weather capacity aspirations were based on the recent Cyclone Debbie wet weather flow event, occurring from 02/04/17 to 05/04/17. This event is a long duration low intensity rainfall event of 2-5 years ARI, which accounted for a total rainfall depth of 121 mm. Wet weather events of this nature are known to stress the existing network and cause overflows, that are perceived to be unacceptable.

Comparisons of manhole spillage (where the flow level within the network rises to above the manhole cover level) and pipe surcharge (where pipe capacity in the network is exceeded) are shown in Figure 10 and Figure 11 respectively.

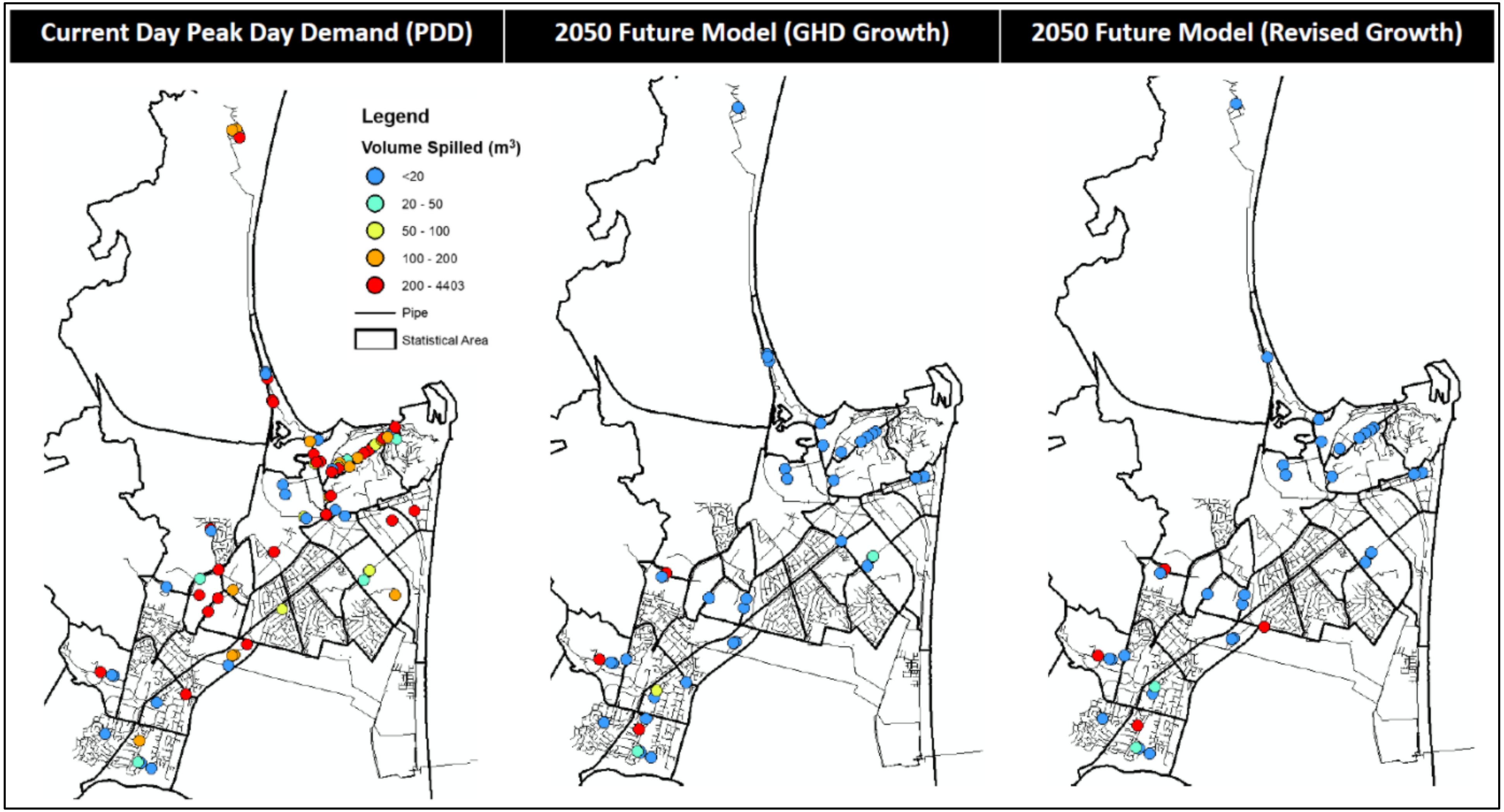


Figure 10 Wastewater discharge from the network – volume comparison of manhole spillage

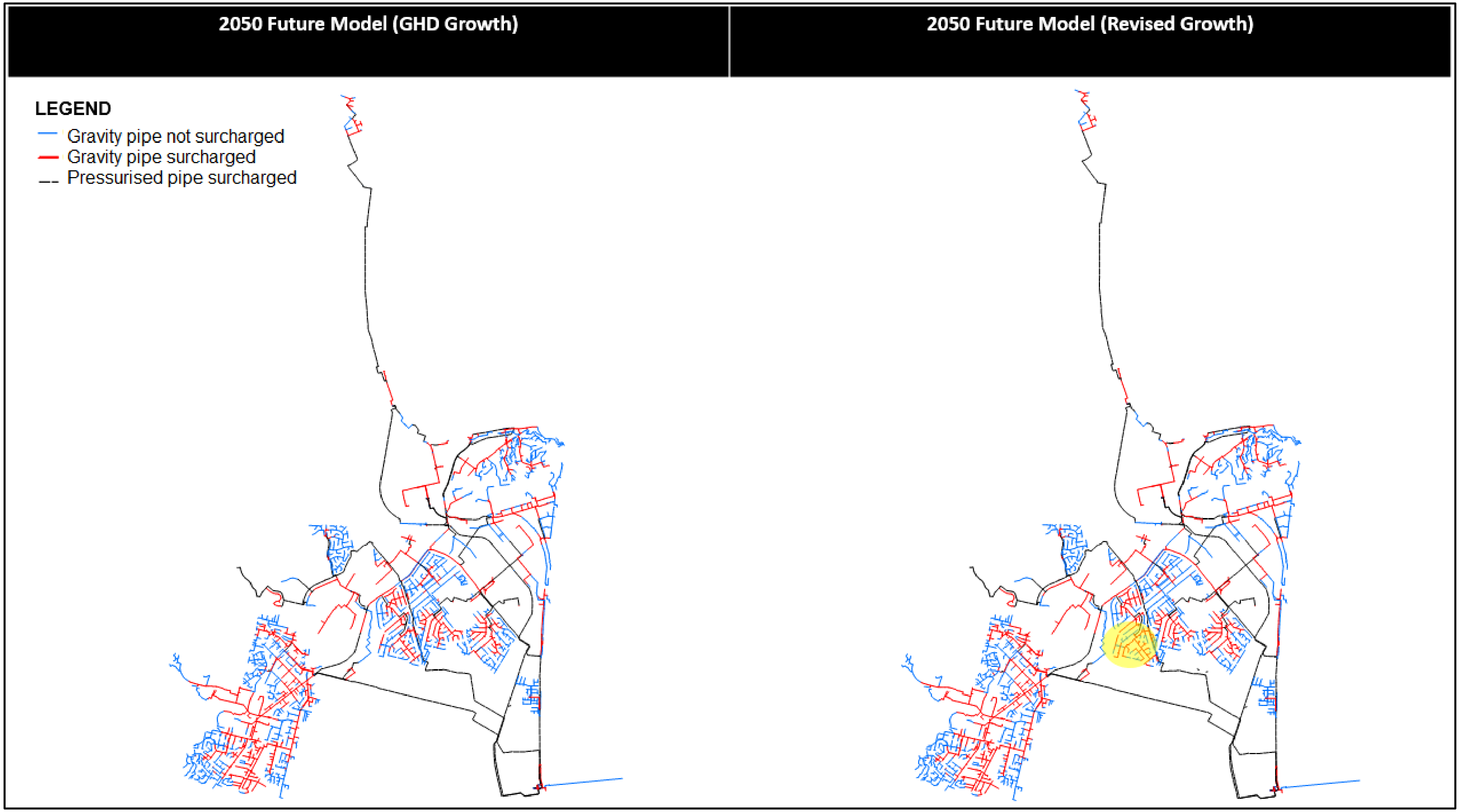


Figure 11 Surcharge comparison of the wastewater network (notable area of change highlighted)

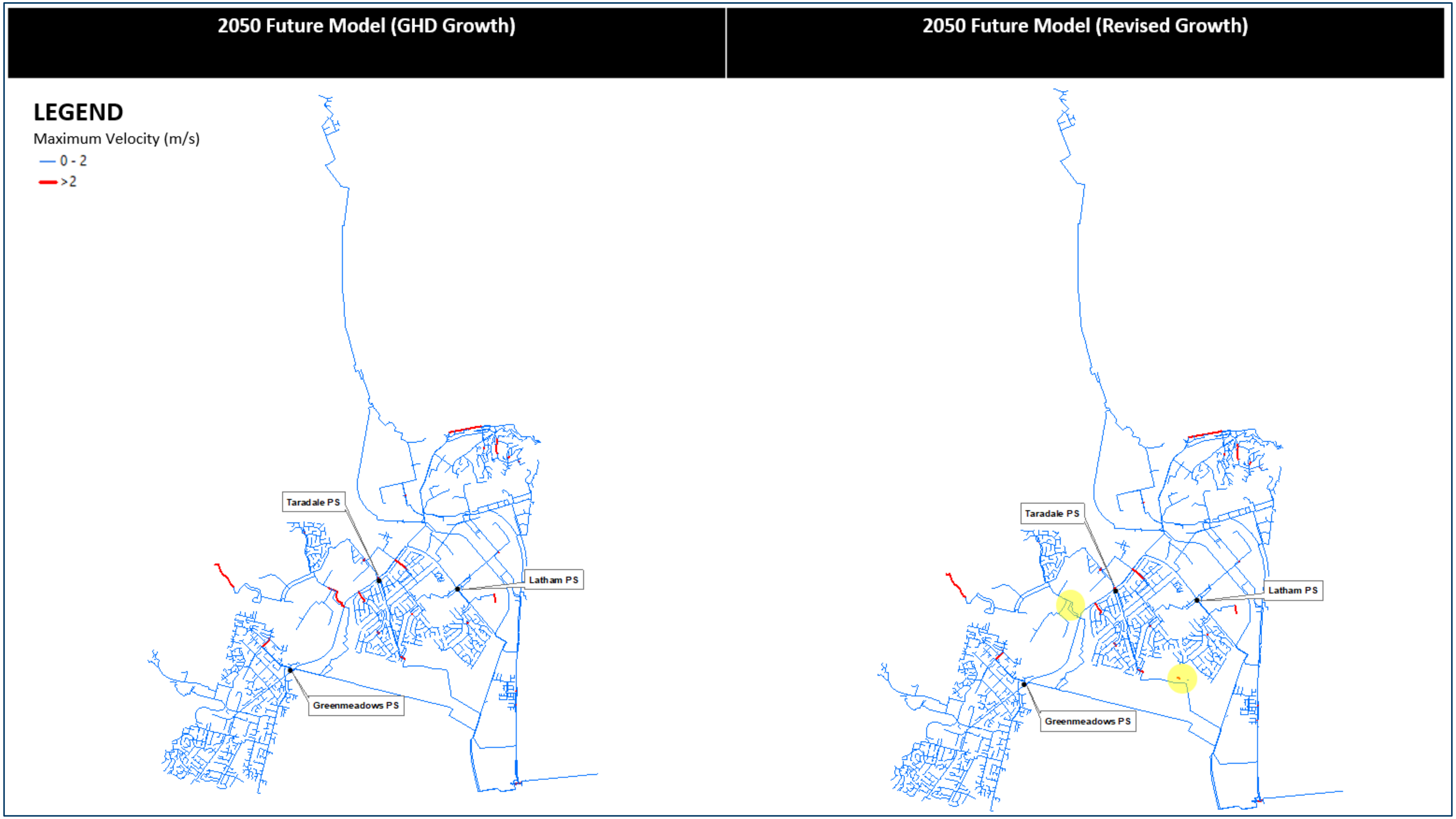


Figure 12 Velocity comparison of the wastewater network

Key observations are summarised below:

- The recent model simulation shows a slightly better situation compared to GHD's future model, which was anticipated given the lower growth numbers within the most recent simulation.
- Model results show that whilst 36 manholes spill, the majority of these (30) are spilling less than 20 m^3 (defined in the masterplan as being within the model margin of error).
- The remaining 6 manholes are situated at Bill Hercock Street (South Pirimai), Merlot Drive (Mission Hills), Kent Terrace, Elbourne Street, Gebbie Road, and Frickleton Street
- Spillages at all manhole locations, except Bill Hercock Street, also existed in the masterplan model.
- The spillage at Bill Hercock Street is a result of the development at South Pirimai, with flows from the greenfield site directed into the gravity network.
- The spillage noted near the Pinotage PS, is a result of the Mission Hills related upgrades, not yet being incorporated into the model. These upgrades were developed after the wastewater masterplan.
- Pipe surcharge occurs in the localised network and are generally similar to that seen in the masterplan modelling.

5.3 Stormwater Simulation

A model simulation was undertaken for the 100-year ARI, 1% AEP (Annual Exceedance Probability) rainfall event, using the HBRC 2050 stormwater model (which contains a significant number of upgrades). This enabled a comparison to be produced between the Stormwater Masterplan scenarios (2020 and 2020 with upgrades) and the HBRC 2050 model, as depicted in Figure 13. It should be noted that some differences exist between the upgrades in the 2020 and 2050 models, and that the 2020 model simulations covered the 50-year ARI. For further details on the 2020 upgrades refer to the Stormwater Masterplan, however as the HBRC 2050 model upgrades are not currently documented, Stantec should be contacted for comment.

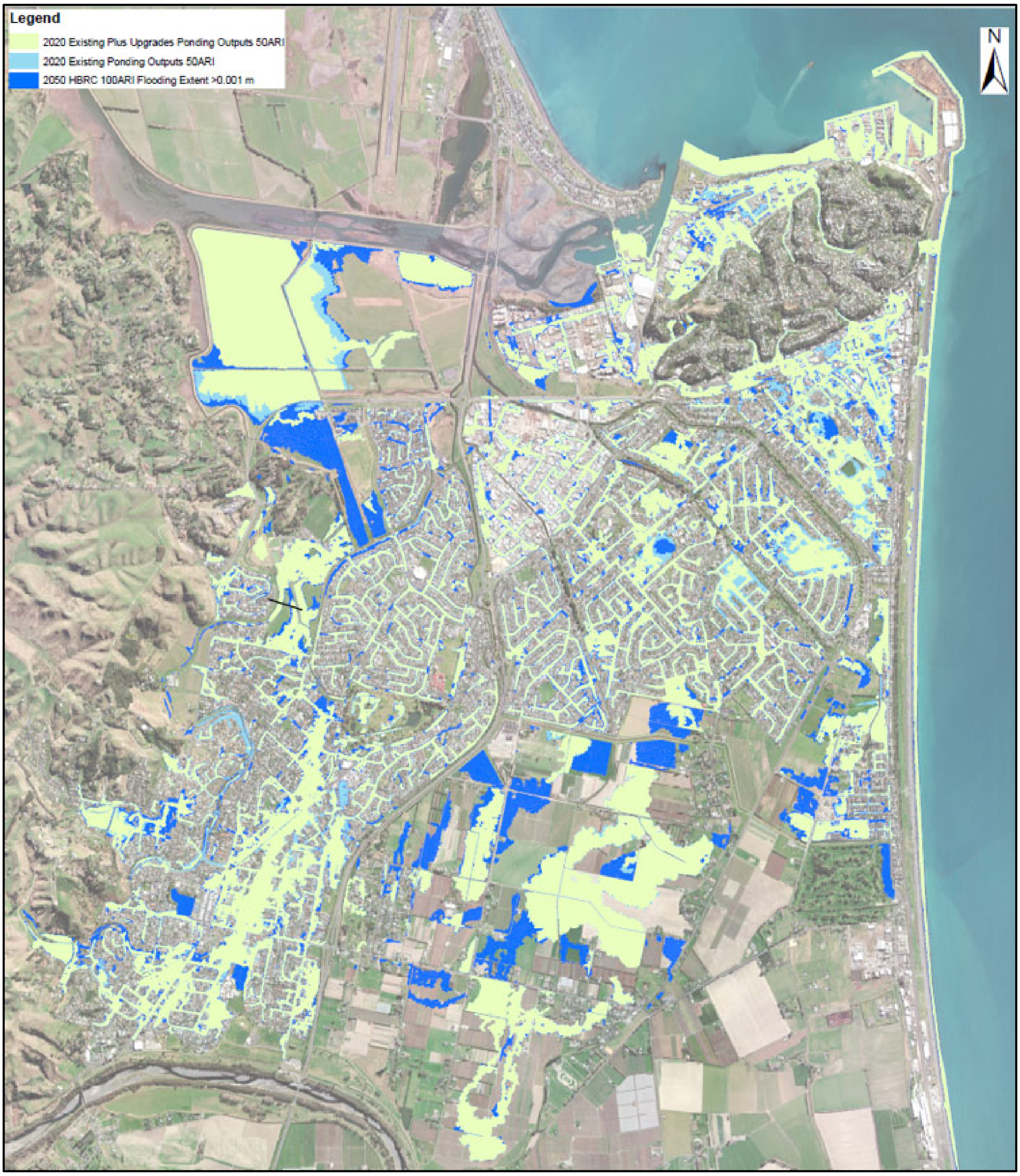


Figure 13 *Flooding Extent Comparison Between 2020 Scenarios (with and without upgrades) and the 2050 HBRC Model*

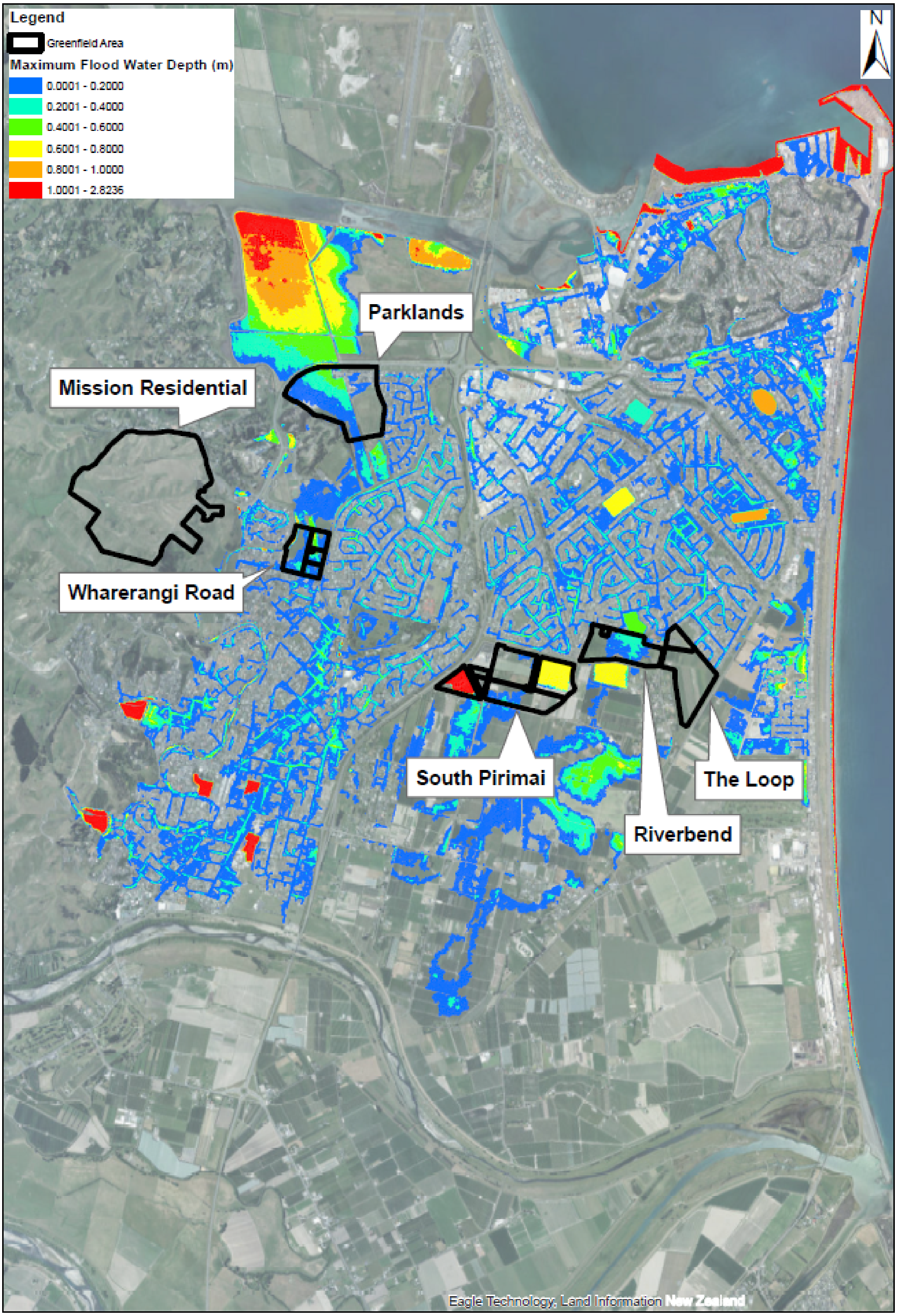


Figure 14 Flooding Extent of the HBRC 2050 Upgrades Model – With Proposed Greenfield Development Areas Highlighted

Key observations are summarised below:

- These results show that flooding is widespread throughout the city.
- The port and coastal areas are heavily impacted by the sea level increase within the model, resulting in notable surface water increases in these areas.
- The least amount of flooding occurs in the 2020 upgrades scenario, with additional flooding in the 2020 existing and 2050 HBRC scenarios. This shows that the 2020 upgrades have a positive impact upon the system.
- In general, most of the predicting flooding in the HBRC 2050 model is relatively shallow. This is displayed in Figure 14.
- There are numerous areas with a notably greater flood depth compared to the surrounding areas, these tend to be in open spaces. Overlaying the location of proposed Stormwater Management Facilities within the model (as provided by Stantec), refer to Figure 15, show that most of these align with the deeper flooding, with several within proposed greenfield development areas. If these facilities are constructed, they will impact upon the potential housing yield of the affected areas.
- The majority of roads receive some flooding, which is expected as they are often overland flow routes.
- The watercourse corridors are excluded from the shown flood extents.

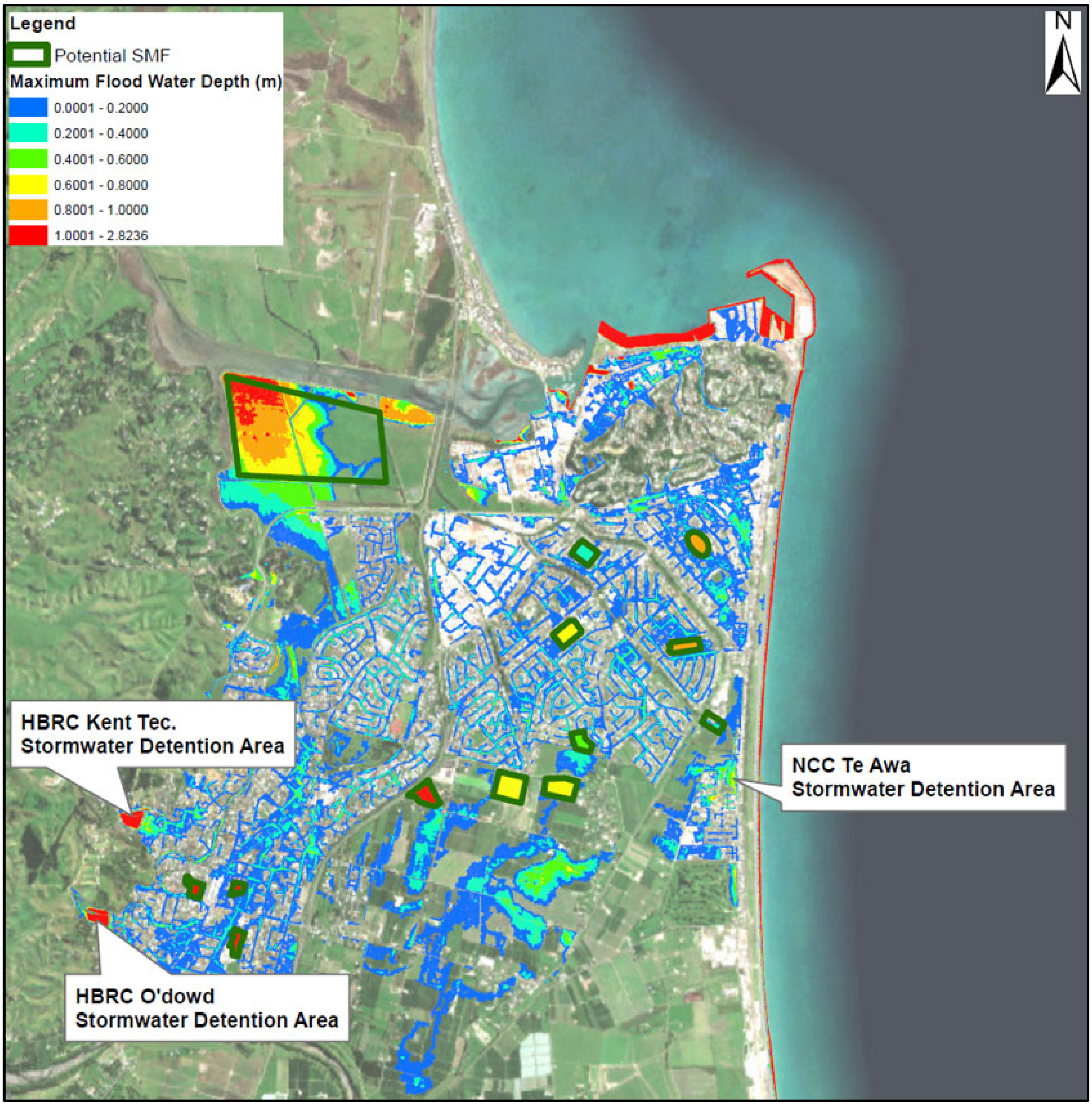


Figure 15 Flooding Extent of the HBRC 2050 Upgrades Model – with potential Stormwater Management Facilities highlighted

5.4 Growth Management

Introduction of the latest growth data has altered wastewater and water supply network flow rates and geographic distribution. It has led to a very different situation between the Bay View area (where residential growth data shows an increase of approximately 1650% by 2050) and the wider Napier City area (where residential growth data shows an increase of approximately 25 – 30% by 2050). Given this disparity, the requirements around upgrades in each area has taken different approaches.

For the Bay View area, no new upgrades have been proposed. Instead, a modelling assessment has been undertaken to ascertain what percentage of growth would result in the existing network (with masterplan upgrades included) being overwhelmed - 'the tipping point'.

For the Napier City area, additional upgrades have been proposed to account for the new growth data, with wastewater upgrades also proposed for the Greenmeadows catchment (this area was not fully resolved during the masterplan process due to uncertainty around the potential future Western Hills flows).

It should be noted that the additional network upgrades, identified within this report, are in addition to the masterplan upgrades. An assessment of whether all the masterplan upgrades are still required or not, given the redistribution of growth geographically, has not been undertaken.

6. Bay View Trigger Point Assessment

6.1 Water Supply

The Bay View water supply network is supplied by the Franklin reservoir and is connected to the Napier City network by two PVC pipes on Beacon Road and Main North Road. There is also the Tannery Booster in Lagoon farm, and the Westshore booster pump on Main North Road, that both supply additional water pressure.

Whilst no significant modifications were undertaken on the existing water supply model, a couple of minor alterations were made to the original model. This was to gain a better representation of network operation.

6.1.1 Model Modifications

The main modifications were made to the Franklin reservoirs. When examining the model, it was identified that the Franklin reservoirs were emptying rapidly and not refilling adequately for the following day. It is understood from NCC that operational measures such as flow monitors or level sensors will be put in place to prevent the reservoirs from emptying. The reservoirs in the model have therefore been altered to include pressure sustaining valves (PSV's) to maintain a reservoir depth of 2 m. As a result, outflow from the reservoir stops when the reservoir depth drops below 2 m. The reservoir then begins to refill to about 60% capacity by the end of the day.

Note that the customer point representing 32 Kaimata Road is associated with highly elevated land, causing pressures to be much lower at that location. It is expected that 32 Kaimata Road and the surrounding area would have its own booster pump system, therefore the trigger point assessment excludes this property.

6.1.2 Growth Trigger Point

Using the latest version of the model, with the modifications specified in Section 6.1.1, multiple model simulations were undertaken with incremental changes in the extent of Bay View growth numbers. The intention of this approach was to identify the 'trigger point' at which the demands from the Bay View greenfield growth resulted in the capacity of the existing network being exceeded. An exceedance of capacity was defined as less than 30 m pressure across the network, unless stated otherwise.

Model results indicate that the existing system can accommodate 69% of the Bay View greenfield growth, the equivalent of 1,054 dwellings, within the defined Bay View area. At 70% of the Bay View greenfield growth, the model shows that pressures drop below 30 m, and therefore exceeds the capacity of the existing system, as shown in Figure 16.

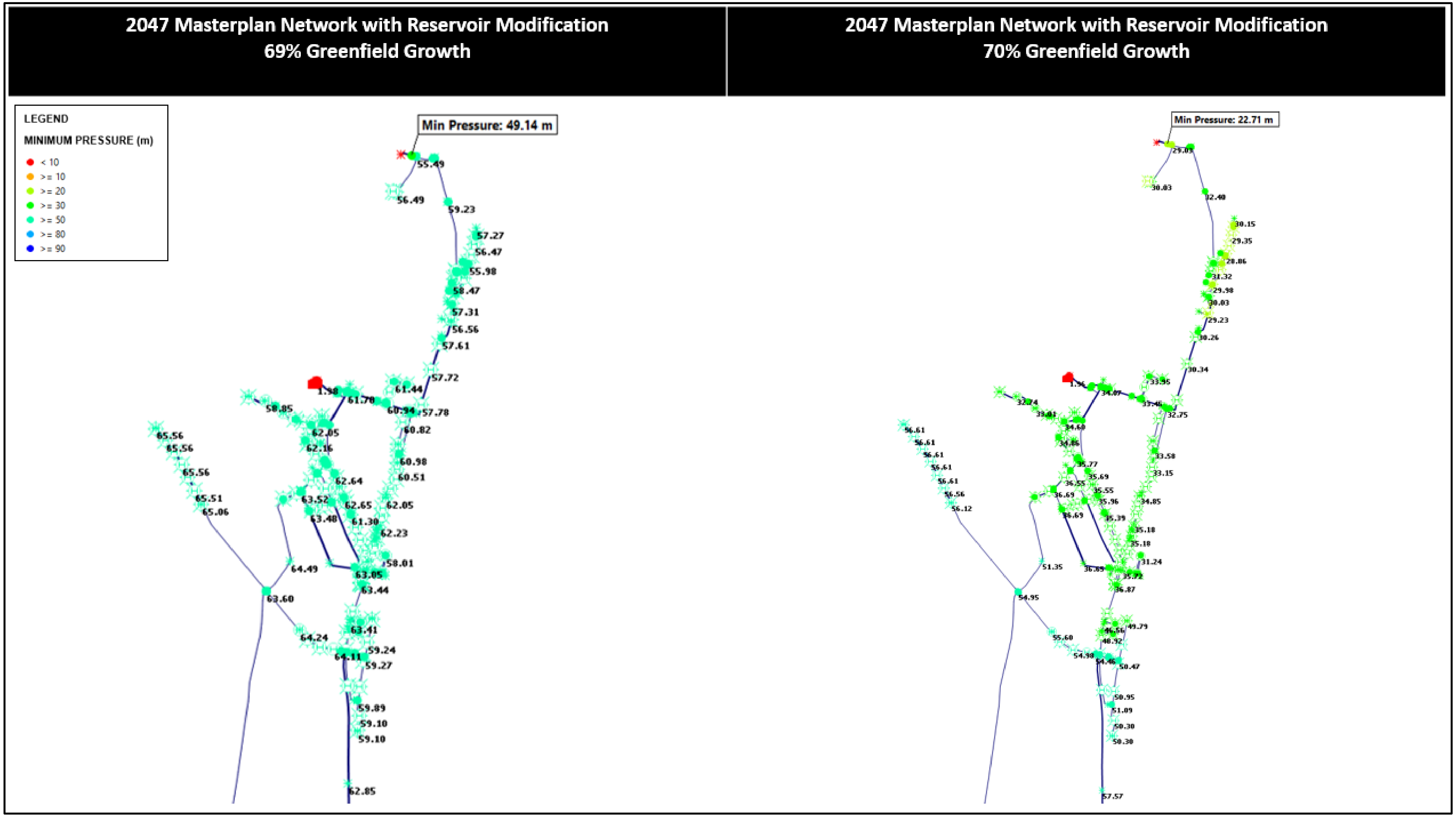


Figure 16 Bay View Water Supply Trigger Point

6.2 Wastewater

Bay View growth has been connected to the Bay View PS in the south. From the pump station, wastewater flows are pumped south towards Napier City through pressure and gravity mains.

6.2.1 Model Modifications

Post masterplan model upgrades, associated with recent assessments around Mission Hill / Pinotage PS and the Riverbend Development connection into the Taradale PM, were incorporated into the model.

6.2.2 Growth Trigger Point

Using the latest version of the model, the trigger point, where the flows from the Bay View greenfield growth exceeded the capacity of the existing network, was identified. This was taken at the point where the model was able to successfully complete the simulation run (with further growth increases resulting in failure).

Model runs indicate that the existing system can accommodate at least 10% of the greenfield growth, the equivalent of 212 dwellings, within the defined Bay View area, but no more than 15% (318 dwellings). At this level of growth, the pressure mains have insufficient capacity (resulting in the model crashing and the simulation not running to completion).

7. Napier City Additional Upgrades

7.1 Level of Service (LoS)

The additional upgrades have been identified in accordance with the following design parameters and standards, sourced from NCC's Code of Practice for Land Development and Subdivision Infrastructure, May 2022 (CoP). The CoP is based on NZS 4404:2010 Land Development and Subdivision Infrastructure, and amended to suit Napier City. Firefighting requirements are taken from SNZ PAS4509:2008 "Firefighting Water Supplies Code of Practice, for the residential fire water classification.

Table 11 Water Supply Demand Parameters

Design Parameter	Value	Unit	Code of Practice
Residential Demand			
Occupancy Rate for all dwellings	2.5	People/Lot	Section 6.3.5.3 a)
Average Demand on Maximum Day	900	Litres/Head/Day	Section 6.3.5.3 a)
Peak Demand on Maximum Day	$0.061D + 0.45D^{0.45}$ for less than 800 dwellings 38 +0025D for more than 800 dwellings	Litres/Head/Day	Section 6.3.5.3 a)
Non-Residential Demand			
	Taken based on best available demand records or assessments. Specific metering may be required to assess daily and peak demands.		Section 6.3.5.3 b)

Table 12 Water Supply Design Standard

Design Parameter	Napier CoP Design Standard	Code of Practice	Water Supply Model
Colebrook-White Coefficient	0.3 mm for all new pipes Best practice values for existing pipes	Section 6.3.5.4.1	
Minimum Pressure	>20 m at point of supply	Section 6.3.5.10	Minimum pressures across the current and future peak day demand models are generally above 20m.
Maximum Pressure	<80 m	Section 6.3.5.9	Maximum pressures across the current and future peak day demand models are generally below 80m.
Maximum Headloss	<2 m/km for Principal and Trunk Main pipes (>=DN100)	Section 6.3.5.4 a)	Many pipes within the model don't meet the current design standard.
Maximum Headloss	<20 m/km for Rider Main pipes (<DN100)	Section 6.3.5.4 b)	Many pipes within the model don't meet the current design standard.
Velocity	0.5 – 2.0 m/s, with up to 3.0 m/s potentially allowable but dependent on acceptance by NCC	Section 6.3.7	Velocities are generally either too low or too high within the model.

Table 13 Firefighting Flow Requirements

Design Parameter	Standard	Firefighting Flow Requirement
Residential Classification	FW2 (Fire Water Classification)	25 L/s
Design shall allow for fire flow plus 60% of the peak demand on maximum day (NCC CoP) while maintaining 10 m residual pressure at any point along the mains (SNZ PAS4509)		

Table 14 Wastewater Design Parameters

Design Parameter	Value	Code of Practice
Residential		
Average Dry Weather Flow (ADWF)	220 Litres/Person/Day x 2.5 Persons/Household x No. of Households	Section 5.3.5.1 a)
Peak Dry Weather Flow (PDWF)	ADWF x Peaking Factor (Peaking Factor of 2.5, unless agreed otherwise)	Section 5.3.5.1 a)
Peak Wet Weather Flow (PWWF)	ADWF x Peaking Factor (Peaking Factor of 5.0, unless agreed otherwise)	Section 5.3.5.1 a)
Non-Residential		
Commercial and Light Industrial Flow PWWF*	0.70 Litres/Second/Hectare	Section 5.3.5.1 b)
Heavy Industrial PWWF	1.30 Litres/Second/Hectare	Section 5.3.5.1 c)
Retail and Suburban Commercial Areas PWWF	0.40 Litres/Second/Hectare	Section 5.3.5.1 d)

*Where possible, flows from industrial areas shall be assessed by measurement or knowledge of the process being served. Where information is unavailable the heavy industrial flow shall be used.

Table 15 Wastewater Design Standards

Design Parameter	Napier CoP Design Standard	Code of Practice	Wastewater Model
Colebrook-White Coefficient	0.6 mm for full PE pipes Colebrooke-White or Manning – Dependent on pipes and material	Table 16	
Minimum Velocity	0.7 m/s	Section 5.3.5.5	Many pipes within the model don’t meet the current design standard
Maximum Velocity	3.0 m/s	Section 5.3.5.6	A limited number of pipes show a velocity exceeding 3 m/s during peak WWF
Minimum Cover	500 mm – 750 mm for Gravity Pipes (Dependent on Location) 750 mm to 900 mm for Rising Mains (Dependent on Location)	Section 5.3.7.5	Many pipes within the model don’t meet the current design standard given the local topography
Minimum Pipe Size	DN100 for connections. Connections shall not service more than one lot. DN150 minimum for gravity wastewater main	Section 5.3.5.3	The majority of the network meets the current design standard
Minimum Grade	As per Table 17 of the NCC CoP	Section 5.3.5.5	Many pipes within the model don’t meet the current design standard given the local topography

Table 16 Stormwater Design Parameters / Standards

Design Parameter	Napier CoP Design Standard	Code of Practice
Colebrook-White Coefficient	0.3 mm for full uPVC pipes Colebrook-White or Manning – Dependent on pipes and material	Section 4.3.5.4.3
Minimum Velocity	0.6 m/s	Section 4.3.5.4.3
Minimum Pipe Size	DN225 for stormwater mains DN225 for catch pit leads to a single catch pit. DN300 for leads to double catchpits. Double DN100 RHS kerb connection to each lot or direct DN150	Section 4.3.9.2 Section 4.3.5.4.1 Section 4.3.9.3
Minimum Grade	As per Table 13 of the NCC CoP	Section 4.3.5.4.3
Minimum Cover	As per Table 15 of the NCC CoP	Section 4.3.9.4
Surface Runoff Coefficients	As per Table 10 of the NCC CoP, or as per NZBC E1 if impervious surface area > 50% or slope > 5-10%	Section 4.3.5.1.1
Rainfall Depth (not intensity)	As per Table 9 of the NCC CoP	Section 4.3.5.1
System Design Rainfall Event	2% AEP	Section 4.3.4.1

7.2 Water Supply

7.2.1 Proposed Upgrades

Proposed upgrades to improve system performance of the water supply network, have been identified by NCC and incorporated into the model by GHD. These are in addition to the upgrades identified within the masterplan and are summarised in Figure 17 and shown in Table 17. Refer to Section 9 for the Rough Order Cost (ROC) Estimates associated with these upgrades.

Table 17 Proposed Upgrades – Water Supply

Upgrade Number	Location	Upgrade
1	Willowbank Avenue	Upgrade DN200 pipe to 300 mm ID (1,465 m)
2	Chambers Street to Ellison Street	Upgrade DN100, and DN150 to 300 mm ID (1,075 m)
2.1		Replace 10 fire hydrants along new 300 mm pipe upgrade
3	Ellison Street/Georges Drive	Upgrade DN100 to 300 mm ID (20 m)
4	Ellison Street to Vigor Brown Street through Nelson Crescent	Upgrade DN50, DN100, and DN150 to 300 mm ID (920 m)
4.1		Replace 13 fire hydrants along new 300 mm pipe upgrade
5	Sanders Avenue to Carnell Street	Upgrade DN50, DN100, and DN150 to 300 mm ID (665 m). Add an additional pipe of 300 mm ID (70 m) between Sanders Avenue and Taradale Road
5.1		Replace 10 fire hydrants along new 300 mm pipe upgrade
6	Hyderabad Road to Lever Street through Battery Road	Upgrade DN150 to 300 mm ID pipe (815 m)
6.1		Replace 8 fire hydrants along new 300 mm pipe upgrade
7	Battery Road to Marine Parade through Breakwater Road	Upgrade DN100, DN150, and DN200 to 300 mm ID (2,065 m)
7.1		Replace 20 fire hydrants along new 300 mm pipe upgrade
7.2		Upsize two Pressure Reducing Valves (PRVs) to 300 mm ID
7.3		Upsize two meters to 300 mm ID

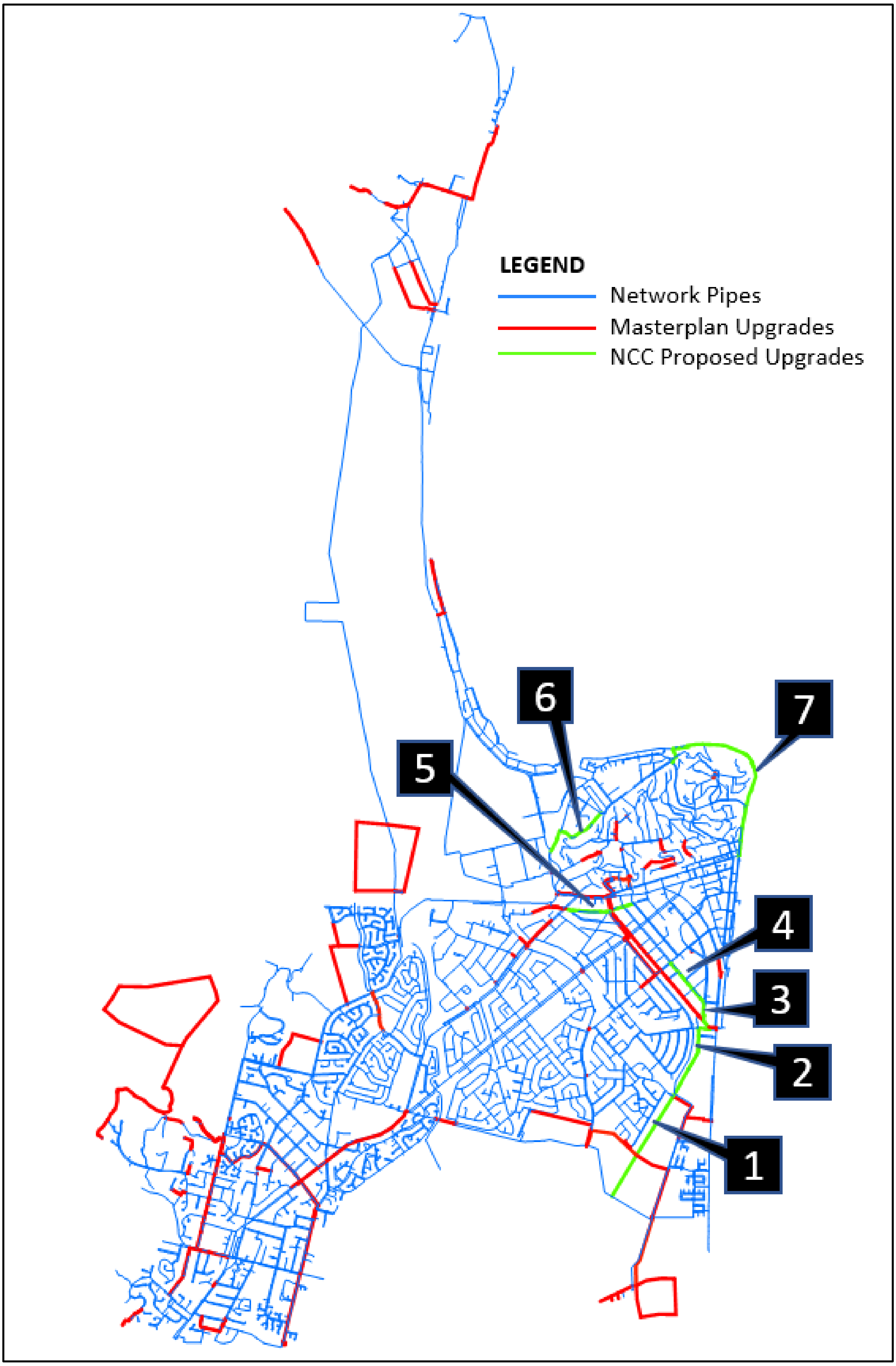


Figure 17 Plan of water supply model masterplan upgrades and proposed additional upgrades

7.2.2 Upgraded Model Results

Figure 18 and Figure 19 show the effect of the proposed upgrades in section 7.2.1.

The model shows that the upgrades proposed by NCC have resolved many of the pressure issues, particularly at Napier South, Marewa, Maraenui, and Onekawa.

Pockets of local pressure issues still exist throughout the network. However, these are a result of high elevation and should be addressed on a specific case by case basis beyond this scope of this project.

Minimum pressures remain very low at Bay View due to the modification as outlined in section 6.1.1. This is to be expected, as the modification allows the Franklin reservoir to refill, though not adequately before the following simulation day. Model results suggest that the DN150 pipes on Woolshed Road and Main North Road have insufficient capacity to deliver water from Napier City to the Bay View area.

Headloss per km has generally been reduced in the Napier South, Marewa, Maraenui, and Onekawa areas.

Model results show there are several high velocity (>3 m/s) pipes even with the proposed upgrades. Velocity issues are indicated in short sections of pipes, trunk mains in the raw network and pipes where a large flow exists for short periods of time.

A notable issue is at Mission Hills where 1200 greenfield properties are expected. Given the amount of expected growth, the network struggles to deliver water to the Mission Hills customers. The Mission Hills reservoir (Tironui Reservoir but named Western Hills Reservoir in the existing model) can only provide approximately 16 l/s in the model but the customers at Mission Hills require 40 l/s. This causes the Mission Hills reservoir depth to drastically drop by the end of the simulation day. This is a known issue, and NCC with the developer are currently identifying the required size for a second reservoir. This will consider whether the new reservoir would service solely the development, or whether some flow would also be taken from the existing Mission Hills reservoir.

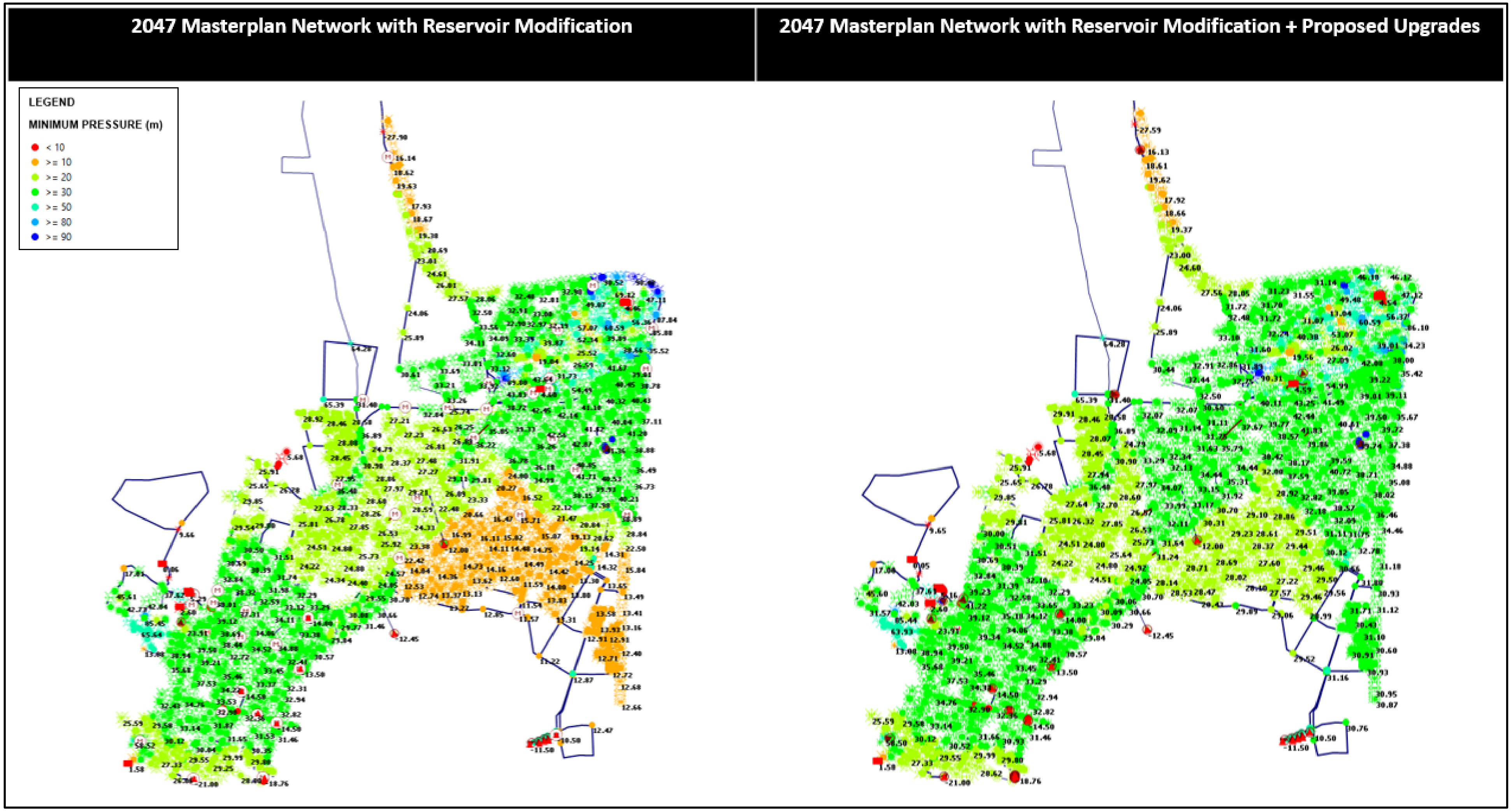


Figure 18 Comparison of the water supply network before and after proposed upgrades – Minimum Pressure (m)

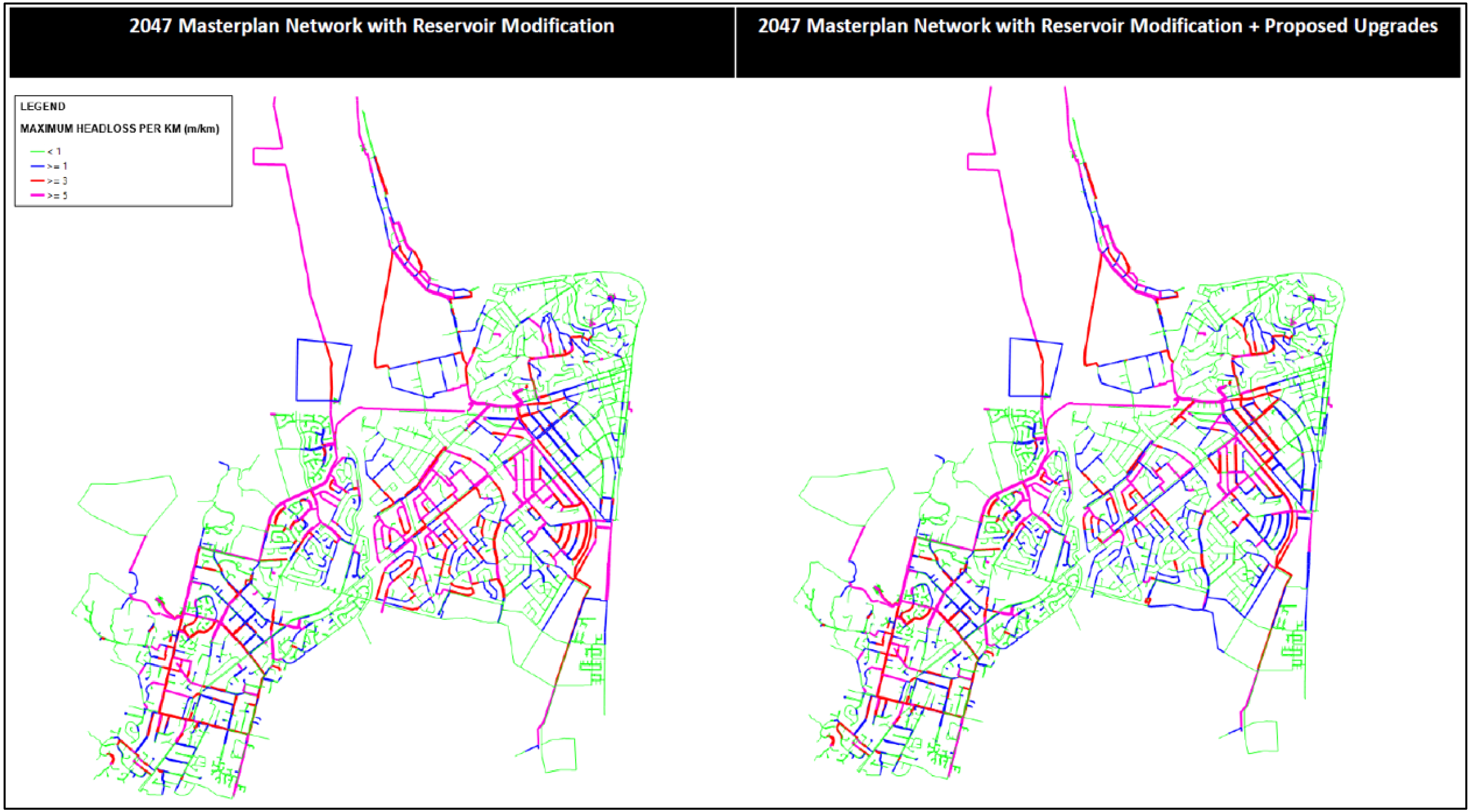


Figure 19 *Comparison of the water supply network before and after proposed upgrades – Maximum headloss per km (m/km)*

7.3 Wastewater

7.3.1 Proposed Upgrades

Proposed upgrades to improve system performance of the wastewater network, through the reduction of manhole flooding, has been identified and incorporated into the model. These are in addition to the upgrades identified within the masterplan and are summarised in Table 18 and shown in Figure 20. Refer to Section 9 for the Rough Order Cost (ROC) Estimates associated with these upgrades.

Table 18 Proposed Upgrades – Wastewater

Upgrade Number	Location	Upgrade (assuming existing manholes can be retained)	Related Growth Area
1	Frickleton Street/Kauri Street, Murphy Road and Meeanee Road	Upgrade DN225 pipes to DN300 (1,065 m)	Taradale (Western Hills)
2	Gloucester Street	Upgrade DN450 pipes to DN525 (775 m)	Taradale (Western Hills)
3	Neeve Road	Upgrade DN300 pipes to DN375 (565 m)	Taradale (Western Hills)
4	Kent Terrace	Upgrade DN150 pipes to DN225 (295 m)	Taradale (Western Hills)
5*	Puketitiri Road to Merlot Drive	New DN225 pipes (1,690 m)	Mission Hills
6*	Mission Hills	New pumpstation and associated rising main at the intersection of Prebensen Drive and Merlot Drive	Mission Hills
7*	End of Pinotage Drive	Upgrade pump rate to 70 l/s	Mission Hills
8*	Between Merlot Drive and Westminster Avenue	Upgrade rising main pipeline from DN150 to DN200 (550 m)	Mission Hills
9	Trinity Crescent	Upgrade DN375 pipes to DN450 (350 m) – *only required if the developments at South Pirimai are connected into the existing gravity network*	South Pirimai
10	South of McNaughton Place	2 Upgrade Options New pump station connecting developments at South Pirimai to the Taradale pressure main with a secondary connection to the Greenmeadow pressure main (for operational resilience) Or, new pump station connecting developments at South Pirimai to the existing gravity network coupled with upgrading DN375 pipes to DN450 pipes (570 m) and upgrade the pumps at the Bill Hercock PS from 72 L/s to 130 L/s	South Pirimai
11	Northwest of The Loop	New pump station connecting developments at Riverbend to the Taradale pressure main	Riverbend
12	Northeast of The Loop	New pump station connecting developments at The Loop to the Taradale pressure main (combined connection with the Riverbend connection)	The Loop

*Note at finalisation of this report upgrades 5 – 8 identified had been superseded by the developer of the Mission Hills growth area adopting an alternative wastewater servicing approach utilising a pressure sewer system.

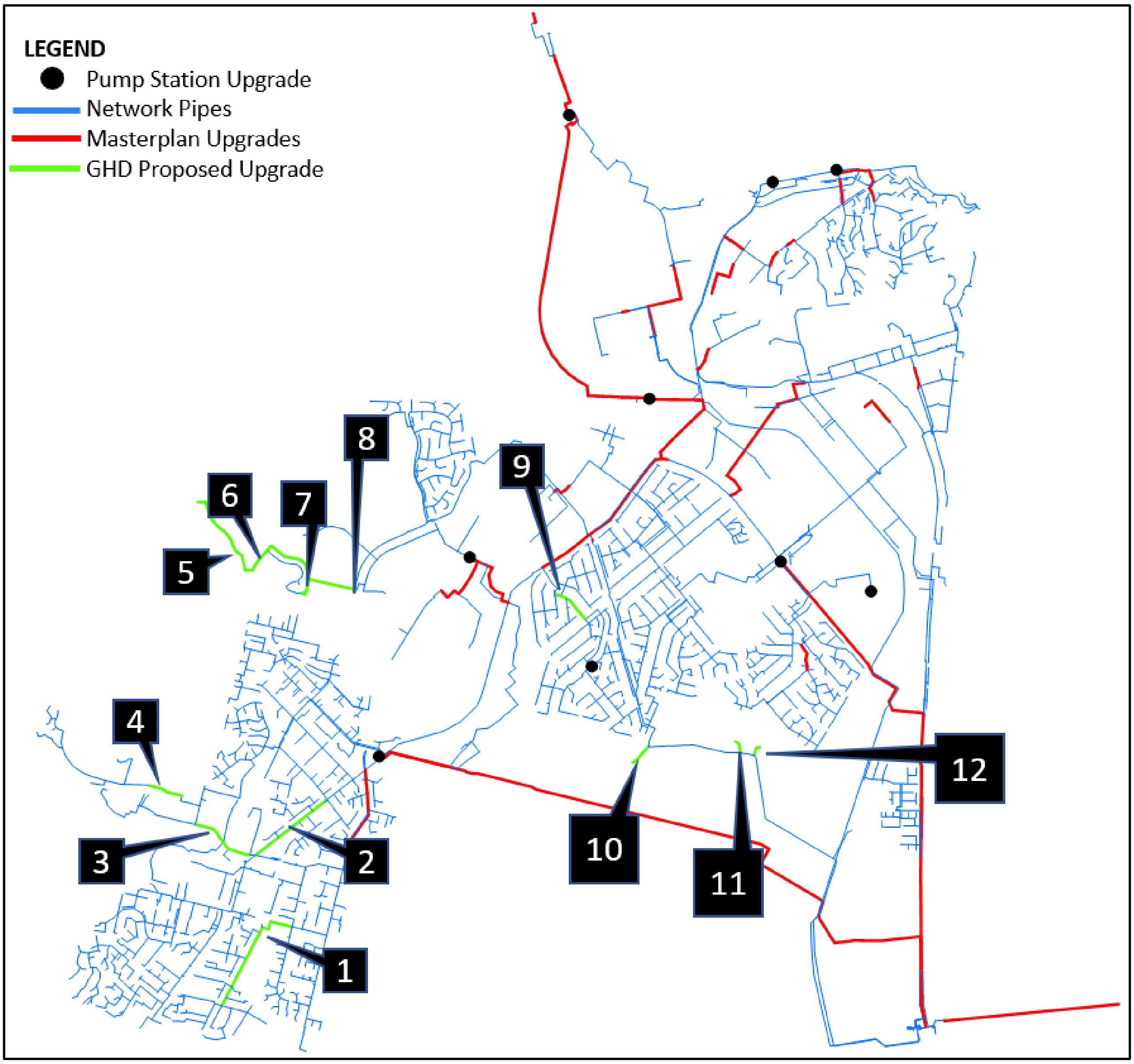


Figure 20 Plan of wastewater model masterplan upgrades and proposed upgrades

One upgrade option was identified for each area except for South Pirimai, where two options were identified. An option to split wastewater flows across two gravity connections was discounted as both ultimately discharged to the Bill Hercock PS.

7.3.2 Upgraded Model Results

Figure 21 and Figure 22 show the effect of the proposed upgrades in Section 7.3.1.

Except for one manhole on Latham Street, model results show that the proposed upgrades have reduced all manhole spills to below 20 m^3. Model results indicate that the manhole on Latham Street spills 27 m^3. Given that this location is isolated from the rest of the growth areas, and the potential future upgrades proposed around Latham PS in the masterplan, no additional upgrades have been proposed for this location.

The extent of pipe surcharge within the wastewater network has reduced, however it is generally similar when compared to the masterplan results, see Figure 22. The increase in flow within the pressure mains, associated with the upgrades, is reflected through the additional pressure main sections with a velocity greater than 2 m/s, as shown in Figure 23.

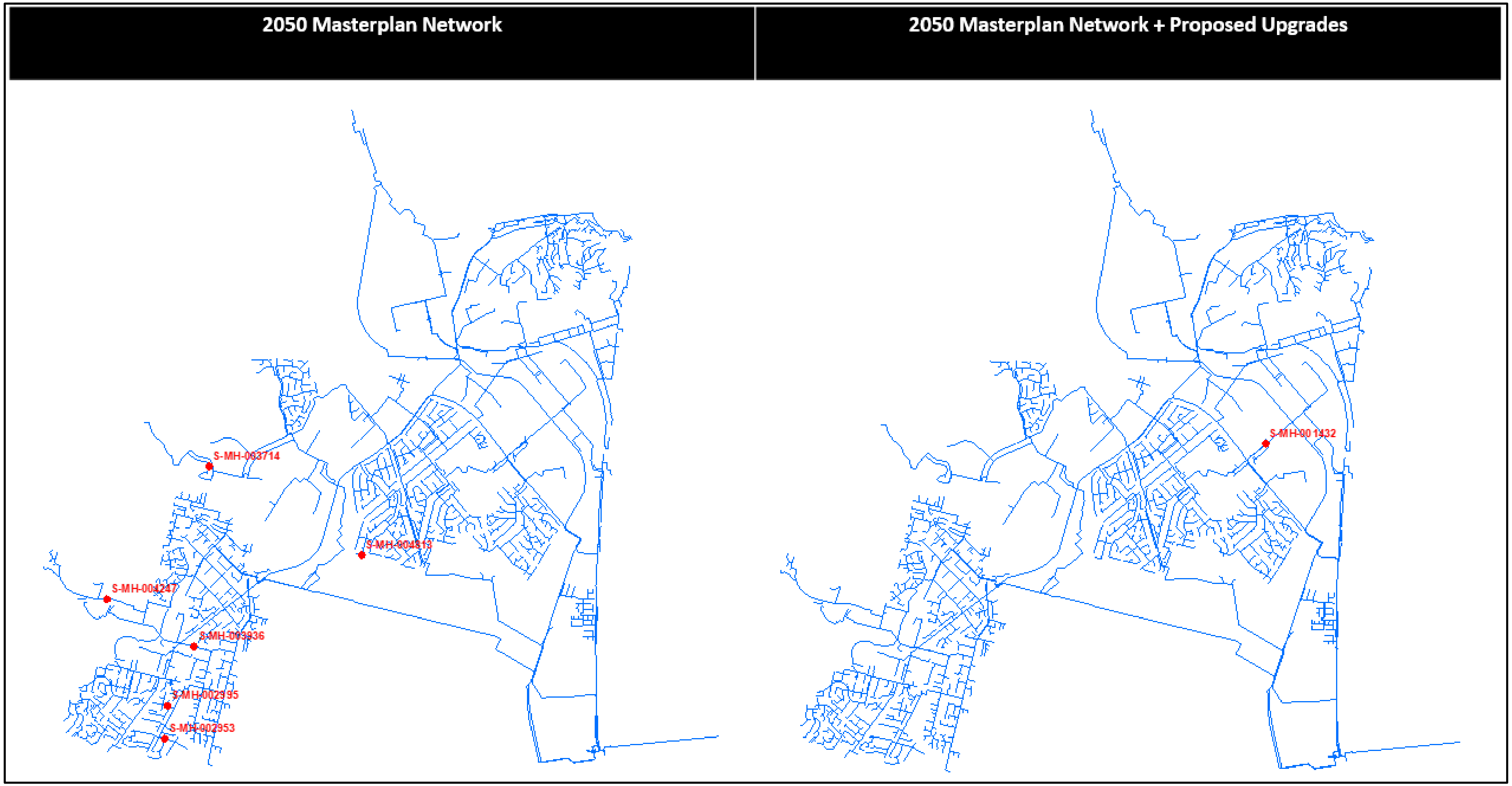


Figure 21 Comparison of the wastewater network before and after proposed upgrades – Manhole Spills (>20 m3)

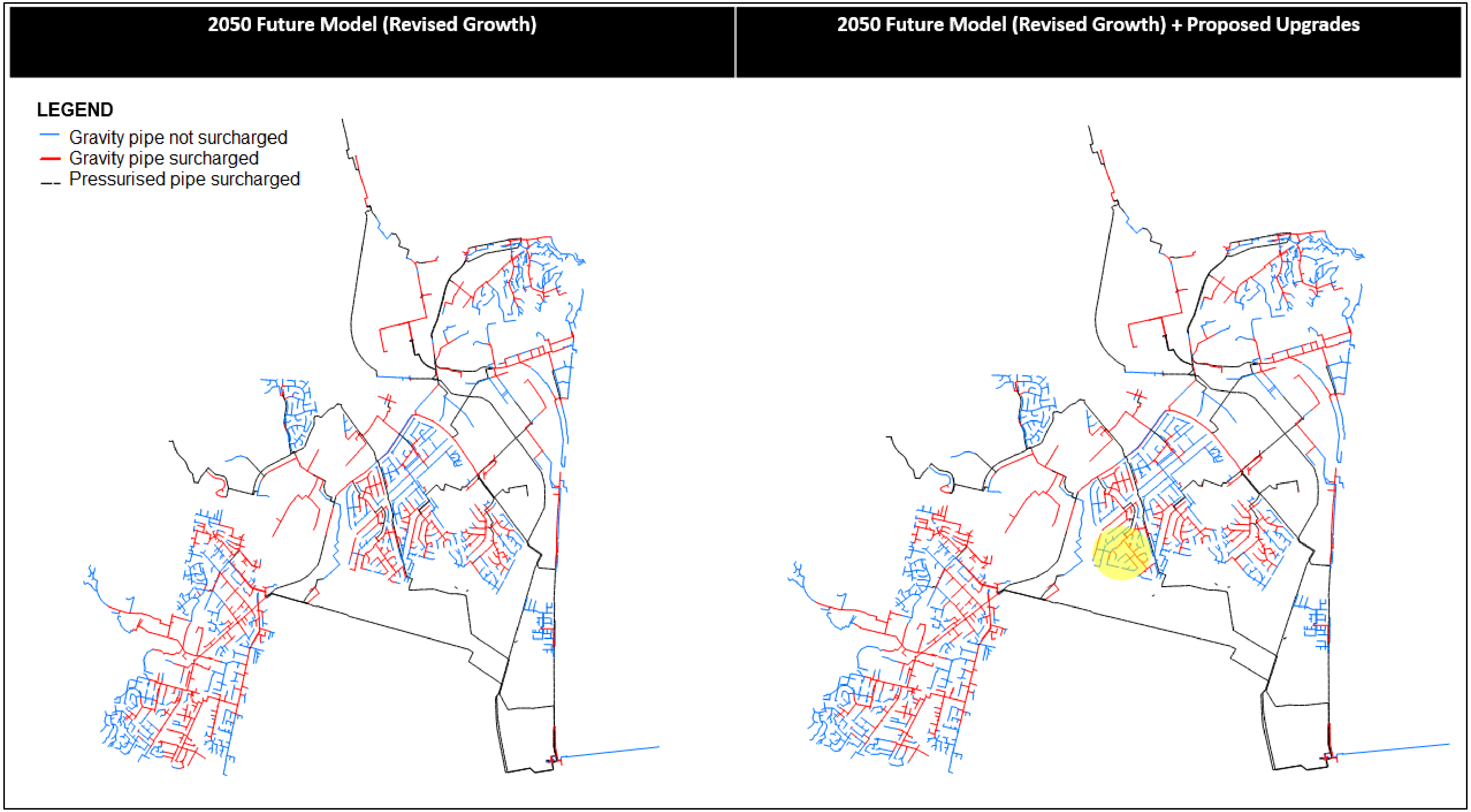


Figure 22 Comparison of the wastewater network before and after proposed upgrades – Pipe Surcharge (notable area of change highlighted)

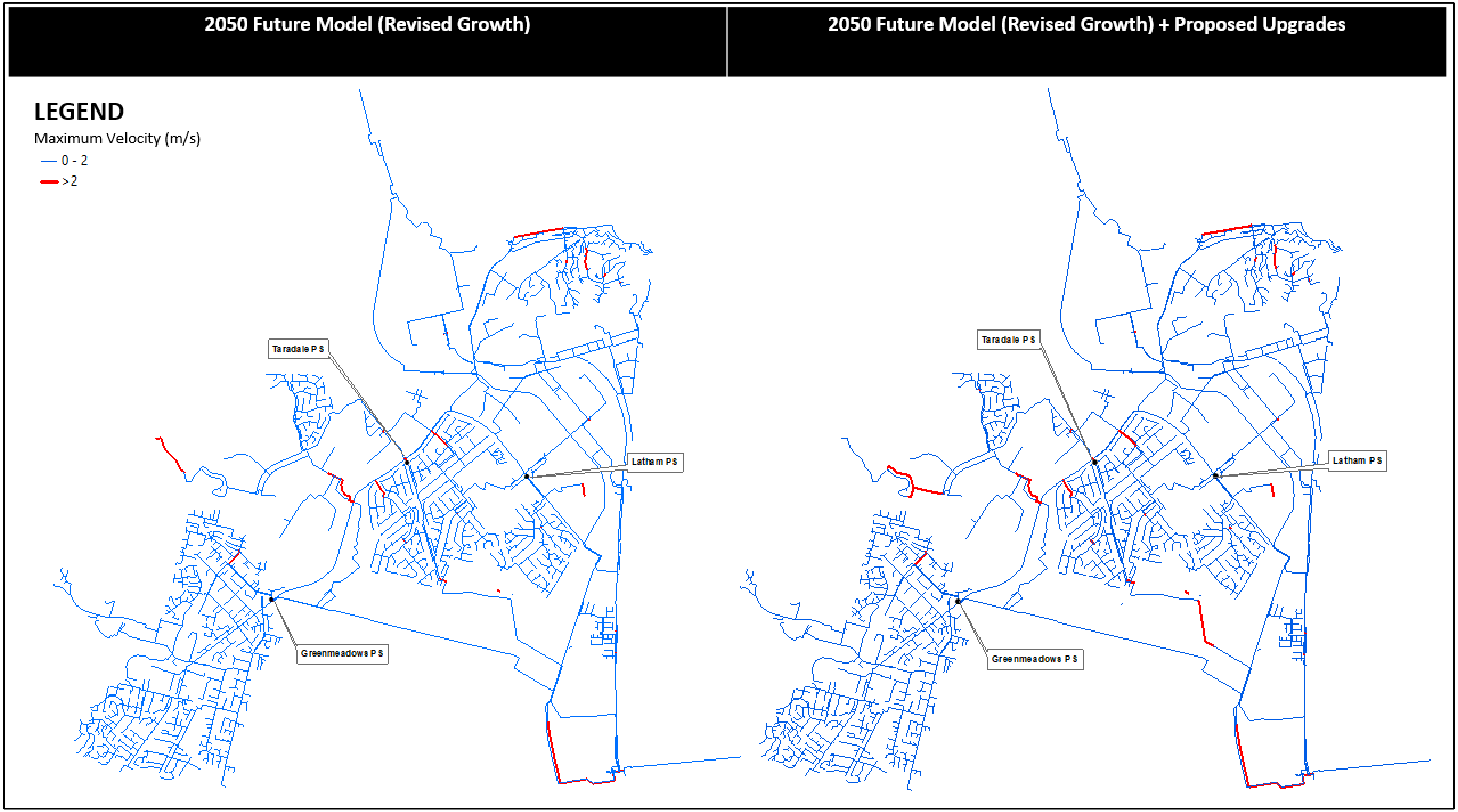


Figure 23 Comparison of the wastewater network before and after proposed upgrades – Pipe Velocity

8. Stormwater Assessment

An assessment has been undertaken, using the 100-year Average Recurrence Interval (ARI) event within the HRBC model, to understand the impact of stormwater on greenfield developable land. This is a more extreme event than was considered within the Stormwater Masterplan. As the extent of growth (number of dwellings and commercial premises that can be constructed), is dependent upon the land area available, this involved:

- Calculating the area of land available (and no longer available) due to flooding.
- Identifying the pre and post development run-off volume from each greenfield growth location based on the imperviousness in Table 45, and the pervious and impervious run-off coefficients (the amount of stormwater run-off generated by the surface type).
- Comparing the two different volumes for each site.
- Identifying (at a high level), the likely indicative size of an onsite detention basin to contain the difference in the volumes (conservatively including any ponding volumes to account for any stormwater flow onto the sites.
- Comparing the indicative detention basin size against total site area.

As the extent of impervious area has not been changed in the brownfield intensification areas, the stormwater in these areas has not been considered further (flooding across the city in general is shown on the 2050 flood map). It is anticipated that any stormwater mitigation measures associated with developments, such as multi-story, will comply with the District Plan requirements and be managed by onsite detention devices such as tanks.

8.1 Parameters

A 1 in 100-year rainfall event (1% AEP) was modelled to identify the extent of flooding within the proposed greenfield areas, as shown on the respective figures. This event covered a duration of 24 hours with rainfall values taken from the NIWA RCP8.5 dataset (2081-2100).

To undertake an analysis of the stormwater generated, the following common parameters have been applied across each site, with rainfall intensities and depths taken from NIWA RCP8.5 dataset (2081-2100):

- Pre-development imperviousness percentage – 0% (percentage of the site that has an impervious surface)
- Post-development imperviousness – 80% (percentage of the site that has an impervious surface)
- Pervious area run-off coefficient – 0.3 (as representative of a mainly grassed reserve, as per NZBC E1/VM1 Table 1 respectively)
- Impervious area run-off coefficient – 0.9 (as representative of a fully sealed development as per NZBC E1/VM1 Table 1 respectively)
- All areas are assumed to be fully pervious prior to development with a run-off coefficient of 0.3
- 10 min rainfall intensity – 167 mm/hr
- 1 hour rainfall intensity – 60.8 mm/hr
- 24 hour rainfall intensity – 8.61 mm/hr
- 1 hour rainfall depth – 55.6 mm
- 24 hour rainfall depth – 220 mm
- Minimum volume retention depth – 20 mm (as per NCC CoP Clause 4.3.7)

8.2 Volume Estimations

To provide a high-level assessment of the stormwater generated by each greenfield area, two methods have been used:

- Method 1 – Area multiplied by rainfall depth and by run-off coefficient (areal reduction factor not included)
- Method 2 – Rational Method (Q = 2.78 * C * I * A), where Q is discharge (L/s), C is run-off coefficient, I is average rainfall intensity (mm/hr) and A is area (Ha). This is generally suitable for smaller catchments.

A third volume has been calculated to represent a minimum volume retention (as per 4.3.7 of the NCC CoP and as noted within the proposed District Plan) which captures the first part of the rainfall event and either drains it into the sub-soil or stores it for other uses. It does not however relate to any specific storm event or duration. Clause 4.3.7 of the NCC CoP also identifies that the difference between the post and pre-development flow rates from the site may need to be retained on site.

Given the size of the Greenfield Areas, these methods should only be used for a high-level assessment, with modelling undertaken to provide results for the basis of further design. Note that the depth of water and flooding within and immediately adjacent to major watercourses is not visible as the model blocks out this information.

A standard basin design has been used to estimate the percentage of land required to accommodate stormwater for each greenfield area, refer to example in Figure 24.

- 0.5 m deep
- 1 in 4 side slopes (vertical to horizontal)
- 2 m buffer around the top edge of the basin for maintenance access

Further analysis should be undertaken during concept designs for the developments, including assessment of groundwater levels, the prospect of multiple basins and consideration of which rainfall duration to use for the pre/post development assessment. It is anticipated that developments will minimise the number of detention basins in order to maximise the housing yield within a development.

Figure 24 Typical Stormwater Basin – Example

8.3 Wharerangi Road

The Wharerangi Road area is bounded by Saltwater Creek to the east and Taipo Stream to the west, with flooding of the area occurring during the 100-year rainfall event.

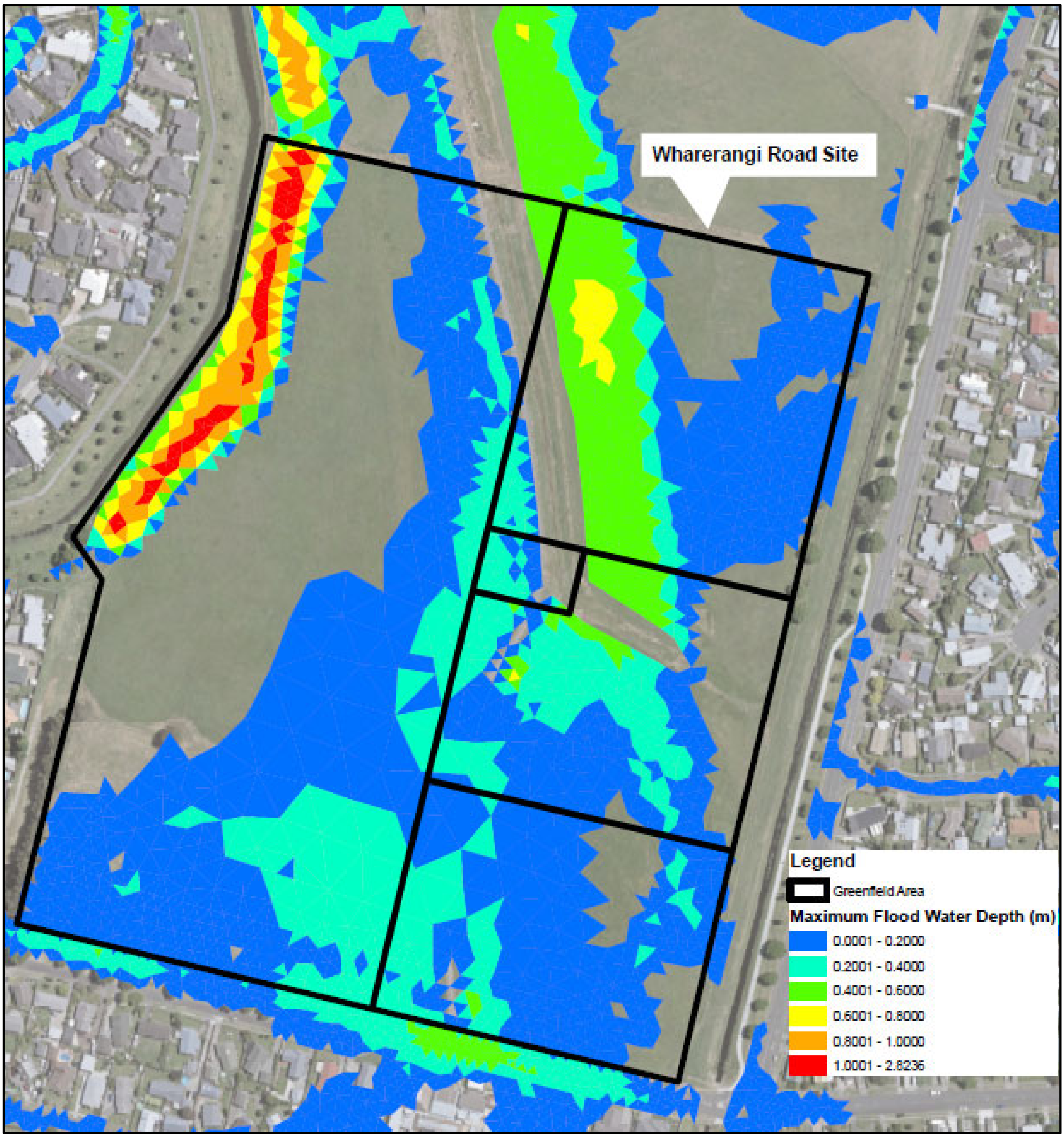
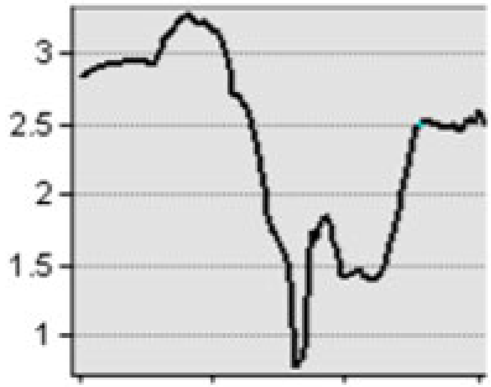


Figure 25 100 Year Flooding Extent – Wharerangi Road Site

The extent of flooded areas within the Wharerangi Road site (as predicted by the model) are as shown in Table 19.

Table 19 Flooded Extent - Wharerangi Road Area

Flood Depth Brackets (m)	Area (m^2)
< 0.2	72,215
0.2 – 0.4	28,213
0.4 – 0.6	10,960
0.6 – 0.8	3,181
0.8 - 1	2,990
> 1.0	1,795



Topographical cross-section acrbss Taipo Stream

Whilst the area of flooding on the left of the site could be interpreted as the Taipo Stream itself, an assessment of the topography around the stream has shown the flooding to be within the adjacent low-lying area, as shown above

Table 20 Stormwater Analysis – Wharerangi Road Site

Descriptions	Values
Site Area	176,680 m^2
Minimum Volume Retention (20 mm depth)	3,530 m^3
Pre-Development Generated Run-off (10 min duration)	2,460 L/s
Post-Development Generated Run-off (10 min duration)	6,400 L/s
Pre-Development Generated Run-off (1 hour duration)	896 L/s
Post-Development Generated Run-off (1 hour duration)	2,330 L/s
Site Flooded Volume (predicted by model, based on the extents shown in Figure 25 and Table 19)*	26,670 m^3

* Note that this is conservative as it assumes simultaneous max water depths across all sub-catchments in the area

Table 21 Pre/Post Development Stormwater Volumes - Wharerangi Road Site

Situations	Method 1	Method 2
Pre-Development Generated Volume (1 hour duration)	2,950 m^3	3,230 m^3
Pre-Development Generated Volume (24 hour duration)	11,660 m^3	10,960 m^3
Post-Development Generated Volume (1 hour duration)	7,660 m^3	8,386 m^3
Post-Development Generated Volume (24 hour duration)	30,320 m^3	28,500 m^3
Development Related Volume Increase (1 hour duration)	**8,710 m^3**	**7,730 m^3**
Development Related Volume Increase (24 hour duration)	**22,660 m^3**	**20,114 m^3**

Given the widespread nature of predicted flooding across the site, it is expected that ground levels will be raised, and the provision of onsite storage will be needed to accommodate the volume of site flooding. As it is unknown how much of this is generated by the shown site, it is assumed for the purpose of this structure plan, that onsite storage will need to be provided for the greater of:

- Development Related Volume Increase (24-hour duration), or
- Site Flooded Volume predicted by the model.

For the Wharerangi Road site, that equates to 26,670 m^3.

The storage area required within the site for this would need to be approximately 53,340 m^2 (a 500 m x 114 m space). This equates to approximately 30% of the entire site area.

8.4 Parklands

The Parklands site is bounded by Prebensen Drive to the north and the Park Island and Western Hills Lawn cemeteries to the west, with flooding of the site occurring during the 100-year rainfall event.

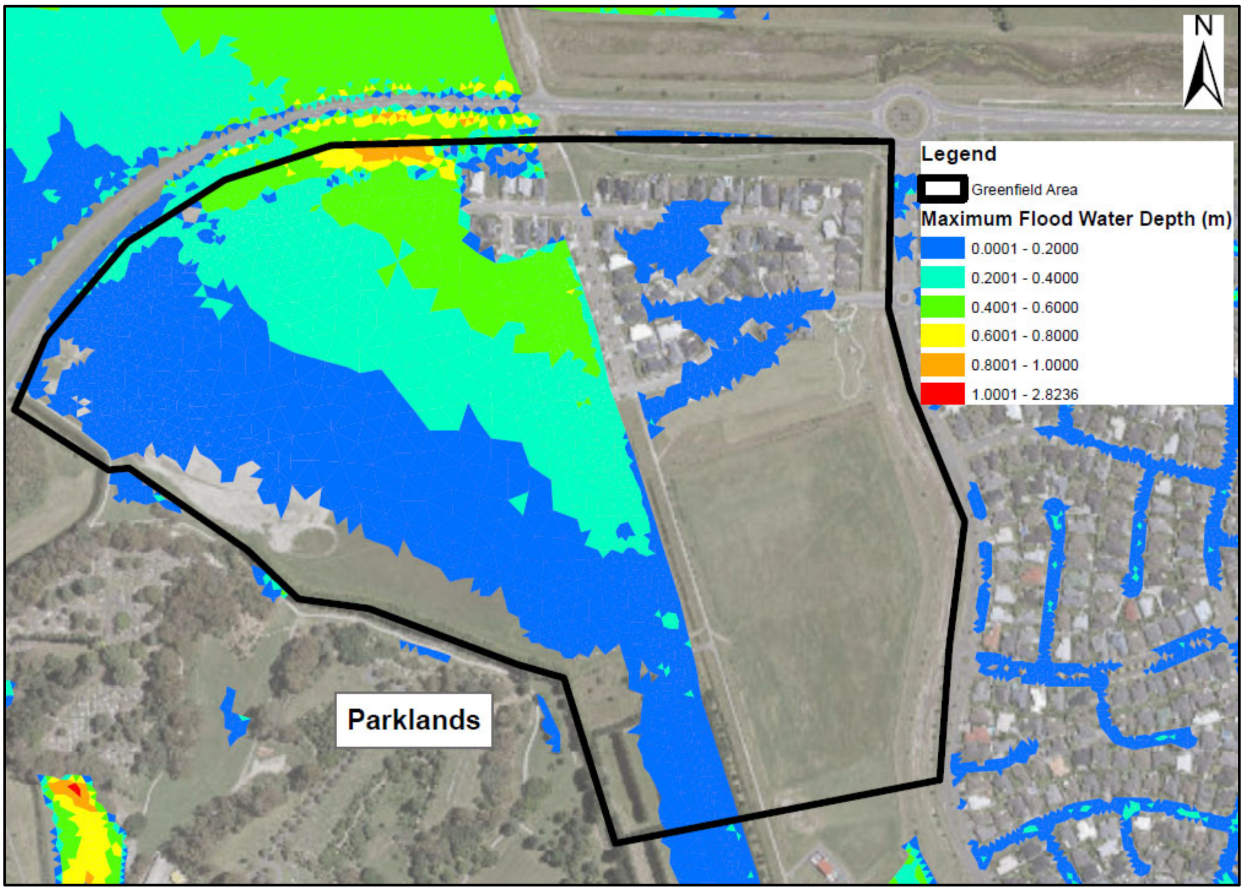


Figure 26 100 Year Flooding Extent – Parklands Site

The extent of flooded areas within the Parklands site (as predicted by the model) are as shown in Table 22.

Table 22 Flooded Extent – Parklands Site

Flood Depth Brackets (m)	Area (m^2)
< 0.2	145,235
0.2 – 0.4	71,854
0.4 – 0.6	30,180
0.6 – 0.8	2,272
0.8 - 1	1,256
> 1.0	0

Table 23 Stormwater Analysis – Parklands Site

Descriptions	Values
Site Area	510,320 m^2
Minimum Volume Retention (20 mm depth)	10,210 m^3
Pre-Development Generated Run-off (10 min duration)	7,110 l/s
Post-Development Generated Run-off (10 min duration)	18,480 l/s
Pre-Development Generated Run-off (1 hour duration)	2,590 l/s
Post-Development Generated Run-off (1 hour duration)	6,730 l/s
Site Flooded Volume (predicted by model, based on the extents shown in Figure 26 and Table 22)*	52,180 m^3

* Note that this is conservative as it assumes simultaneous max water depths across all sub-catchments in the area

Table 24 Pre/Post Development Stormwater Volumes - Parklands Site

Situations	Method 1	Method 2
Pre-Development Generated Volume (1 hour duration)	8,510 m^3	9,340 m^3
Pre-Development Generated Volume (24 hour duration)	33,680 m^3	31,660 m^3
Post-Development Generated Volume (1 hour duration)	22,130 m^3	24,220 m^3
Post-Development Generated Volume (24 hour duration)	87,570 m^3	82,320 m^3
Development Related Volume Increase (1 hour duration)	**25,170 m^3**	**22,320 m^3**
Development Related Volume Increase (24 hour duration)	**65,440 m^3**	**58,100 m^3**

A notable section of the Parklands site has been developed over the last few years, with surfaces and floor levels raised. The contours used in the modelling do not take this into account as they are based on pre-development contours. The flooded extent should therefore be taken as indicative only and will need to be reassessed once the model has been updated with post development contours (inclusive of internal roads).

A similar onsite storage comparison to the other sites has been completed for consistency, with the greater of the following used:

- Development Related Volume Increase (24 hour duration), or
- Site Flooded Volume predicted by the model

For the Parklands site, that equates to 65,440 m^3.

The storage area required within the site for this would need to be approximately 138,000 m^2 (a 1000 m x 138 m space). This equates to approximately 27% of the entire site area.

8.5 The Loop

The Loop site is bounded by Riverbend Road to the east and Willowbank Avenue to the west, with minor flooding of the site occurring during the 100-year rainfall event.

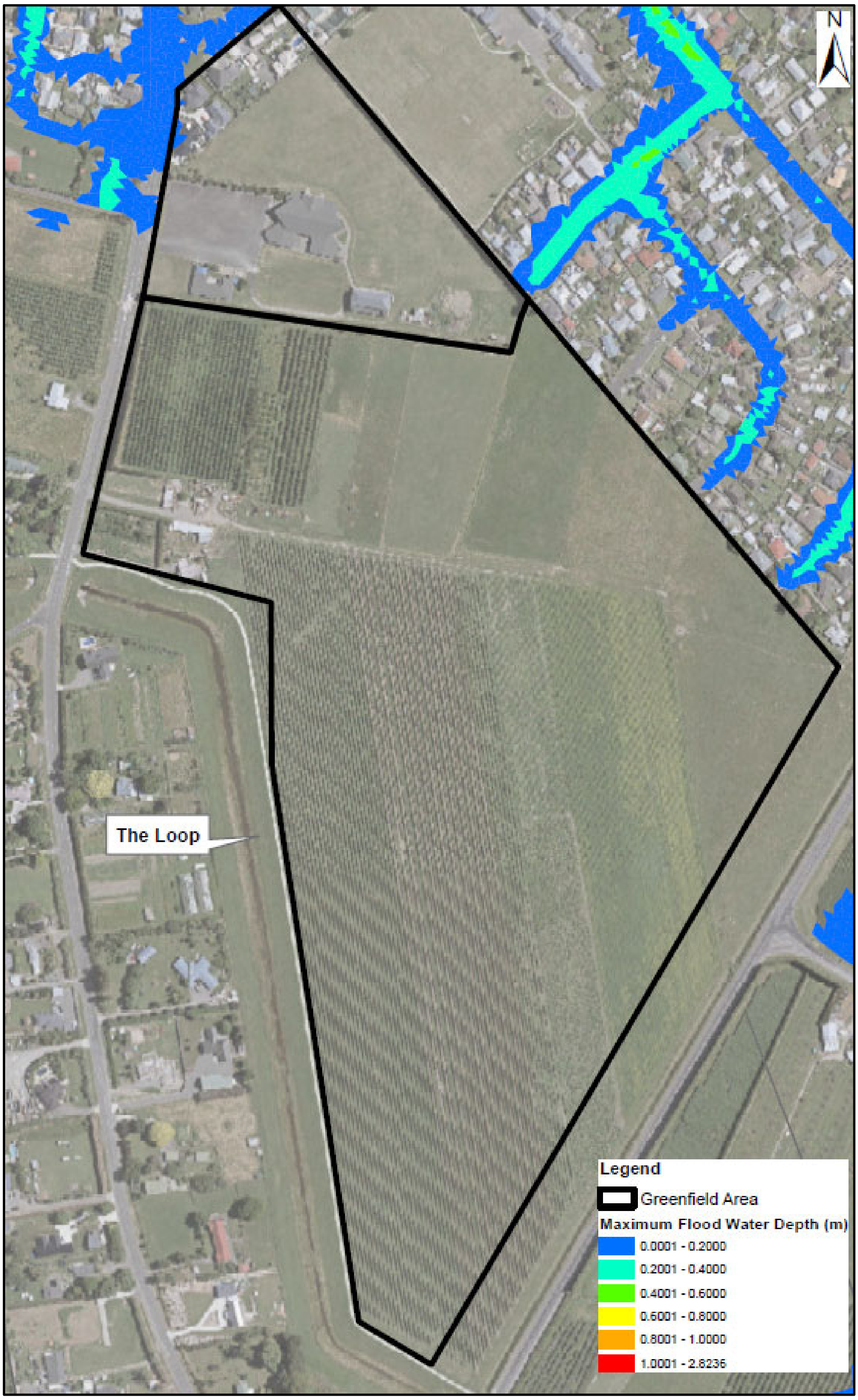


Figure 27 100 Year Flooding Extent – The Loop Site

The extent of flooded areas within The Loop site (as predicted by the model) are as shown in Table 25.

Table 25 Flooded Extent - The Loop Site

Flood Depth Brackets (m)	Area (m^2)
< 0.2	175
0.2 – 0.4	0
0.4 – 0.6	0
0.6 – 0.8	0
0.8 - 1	0
> 1.0	0

Table 26 Stormwater Analysis – The Loop Site

Descriptions	Values
Site Area	275,850 m^2
Minimum Volume Retention (20 mm depth)	5,520 m^3
Pre-Development Generated Run-off (10 min duration)	3,840 l/s
Post-Development Generated Run-off (10 min duration)	9,990 l/s
Pre-Development Generated Run-off (1 hour duration)	1,400 l/s
Post-Development Generated Run-off (1 hour duration)	3,640 l/s
Site Flooded Volume (predicted by model, based on the extents shown in Figure 27 and Table 25)*	10 m^3

* Note that this is conservative as it assumes simultaneous max water depths across all sub-catchments in the area

Table 27 Pre/Post Development Stormwater Volumes – The Loop Site

Situations	Method 1	Method 2
Pre-Development Generated Volume (1 hour duration)	4,601 m^3	5,040 m^3
Pre-Development Generated Volume (24 hour duration)	18,210 m^3	17,110 m^3
Post-Development Generated Volume (1 hour duration)	11,960 m^3	13,090 m^3
Post-Development Generated Volume (24 hour duration)	47,340 m^3	44,500 m^3
Development Related Volume Increase (1 hour duration)	**13,609 m^3**	**12,070 m^3**
Development Related Volume Increase (24 hour duration)	**35,380 m^3**	**31,410 m^3**

Even though there is little flooding across the site, it is expected that the provision of onsite storage will be needed to accommodate the volume of site flooding (predicted by the model). As it is unknown how much of this is generated by the site, it's assumed for the purpose of this structure plan, that onsite storage will need to be provided for Development Related Volume Increase (24 hour duration). For The Loop site, that equates to approximately 35,380 m^3.

The storage area required within the site for this would need to be approximately 39,000 m^2 (a 500 m x 78 m space). This equates to approximately 14% of the entire site area.

8.6 South Pirimai

The South Pirimai site is bounded by Tannery Stream to the east, an open drain to the north and the Hawkes Bay Expressway (SH50) to the west, with flooding of the site occurring during the 100-year rainfall event.

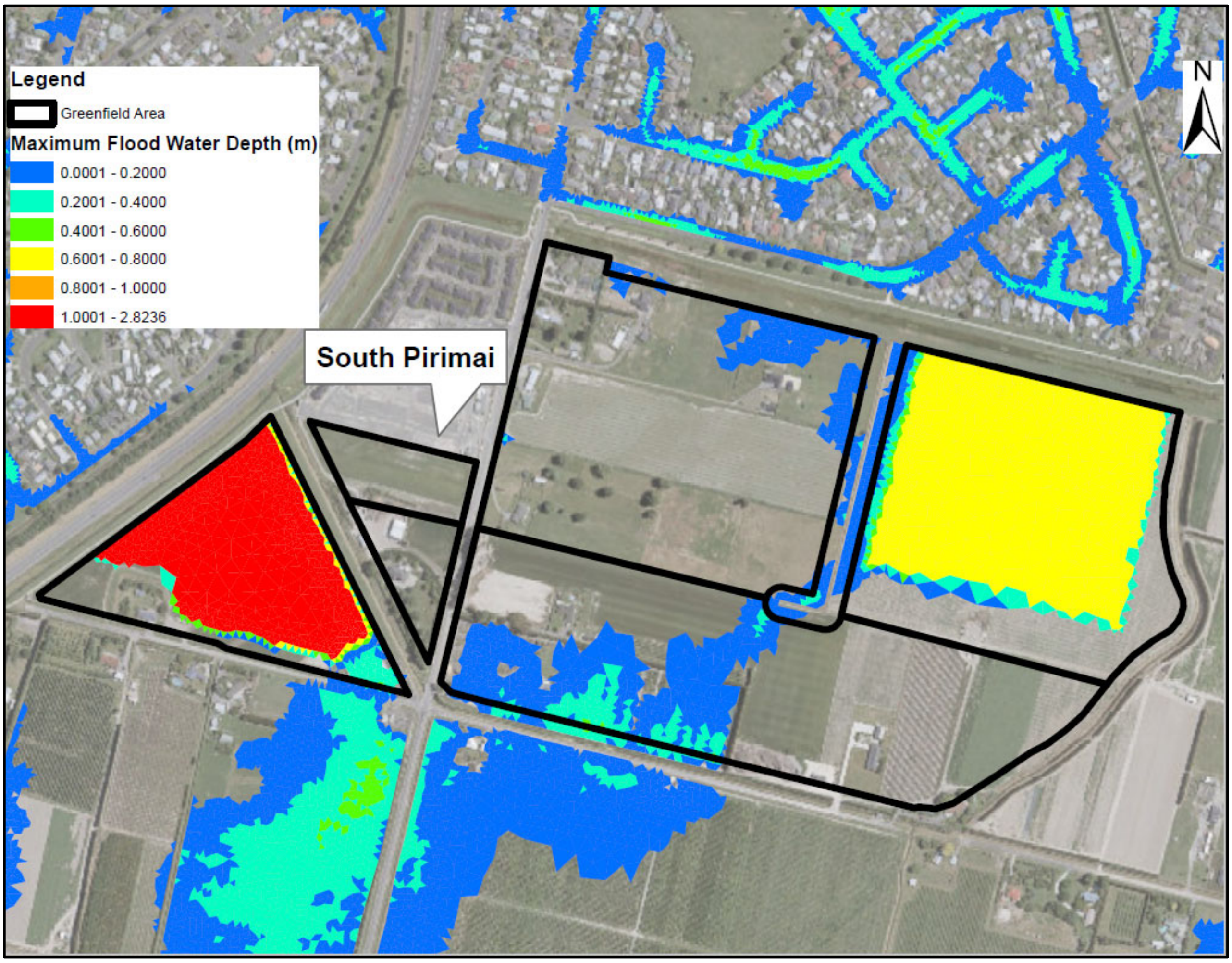


Figure 28 100 Year Flooding Extent – South Pirimai Site

The extent of flooded areas within the South Pirimai site (as predicted by the model) are as shown in Table 28.

Table 28 Flooded Extent - South Pirimai Site

Flood Depth Brackets (m)	Area (m^2)
< 0.2	47,455
0.2 – 0.4	16,887
0.4 – 0.6	2,822
0.6 – 0.8	85,592
0.8 - 1	0
> 1.0	46,760

Table 29 Stormwater Analysis – South Pirimai Site

Descriptions	Values
Site Area	511,780 m^2
Minimum Volume Retention (20 mm depth)	10,240 m^3
Pre-Development Generated Run-off (10 min duration)	7,130 l/s
Post-Development Generated Run-off (10 min duration)	18,530 l/s
Pre-Development Generated Run-off (1 hour duration)	2,590 l/s
Post-Development Generated Run-off (1 hour duration)	6,750 l/s
Site Flooded Volume (predicted by model, based on the extents shown in Figure 28 and Table 28)*	118,010 m^3

* Note that this is conservative as it assumes simultaneous max water depths across all sub-catchments in the area

Table 30 Pre/Post Development Stormwater Volumes – South Pirimai Site

Situations	Method 1	Method 2
Pre-Development Generated Volume (1 hour duration)	8,540 m^3	9,340 m^3
Pre-Development Generated Volume (24 hour duration)	33,780 m^3	31,750 m^3
Post-Development Generated Volume (1 hour duration)	24,290 m^3	22,190 m^3
Post-Development Generated Volume (24 hour duration)	87,820 m^3	82,550 m^3
Development Related Volume Increase (1 hour duration)	**15,750 m^3**	**12,850 m^3**
Development Related Volume Increase (24 hour duration)	**54,040 m^3**	**50,800 m^3**

There is some general flooding across the site with two distinct areas of significant flooding. Assessment of the topography in this area and liaison with Stantec, has revealed these two distinct areas to be proposed Stormwater Management Facilities. Whilst not currently constructed, and with modelling still ongoing, these two Stormwater Management Facilities are within the latest model and thus captured within the site flooded volume noted in Table 29.

It is not known if these detention facilities are intended to capture stormwater from the South Pirimai site only, or also from the wider catchment. For the purposes of this report, it is assumed that they have to store the greater of:

- Development Related Volume Increase (24 hour duration), or
- Site Flooded Volume predicted by the model

For the South Pirimai site, that equates to 118,010 m^3.

The storage area required within the site for this would need to be approximately 244,000 m^2 (a 1000 m x 244 m space). This equates to approximately 48% of the entire site area.

9. Cost Summary

A Rough Order Cost (ROC) Estimate has been applied to each of the water supply and wastewater upgrades, as shown in Table 31. This has been compiled utilising recent local tender rates where possible for the pipework, with pump station costs based on those used for the previous masterplan. These costs are in addition to the masterplan upgrade costs previously identified and are accurate to ± 50%.

The ROC Estimates include a Preliminary and General (P&G) factor of 20% and a Contingency factor of 15%. They are not based on any quotes, nor do they consider the impact of inflation.

The purpose of these estimates is to provide NCC with indicative costs for undertaking each individual upgrade. It is recommended that more refined cost estimates are produced during the upgrade concept design phase. Note that several of the water supply upgrades are in series and should be considered together during future design phases.

Table 31 ROC Estimates of the proposed upgrades

Water Supply		
Upgrade Number	**Location**	**Estimated Cost**
1	Willowbank Avenue	$1,190,000
2	Chambers Street to Ellison Street	$985,000
3	Ellison Street/Georges Drive	$20,000
4	Ellison Street to Vigor Brown Street through Nelson Crescent	$910,000
5	Sanders Avenue to Carnell Street	$710,000
6	Hyderabad Road to Lever Street through Battery Road	$755,000
7	Battery Road to Marine Parade through Breakwater Road	$2,095,000
	TOTAL	**$6,665,000**
Wastewater		
Upgrade Number	**Location**	**Estimated Cost**
1	Frickleton Street/Kauri Street, Murphy Road and Meeanee Road	$865,000
2	Gloucester Street	$785,000
3	Neeve Road	$500,000
4	Kent Terrace	$220,000
5, 6, 7,8	Mission Hills related	*$4,325,000**
9,10	South Pirimai – Gravity Main connection and Trinity Crescent	$2,895,000
10a	South Pirimai – Pressure Main connection	*$2,800,000***
11	Riverbend Development	$2,380,000
12	The Loop	$2,170,000
	TOTAL	**$9,815,000**

* Not included in the Total Estimated Cost as now superseded through the Mission Hills developer adopting an alternative pressure sewer servicing approach.

** Not included in the Total Estimated Cost as only one of the South Pirimai upgrade options will be required

It is assumed that costs for the Development Pump Stations and associated Pressure Mains, with connections into Taradale and/or Greenmeadow pressure mains, will be met by the Developer (although there are likely to be some costs to NCC). In the interests of providing a 'Total Cost' the size of the pump stations and size/length of the associated pressure mains have been estimated for the South Pirimai, Riverbend and Loop Developments.

Emergency Storage will be required at each pump station, alongside smart real time controls. This is to manage discharges into the wastewater network without creating preferential pumping regimes that inhibit the operation of other network pump stations.

10. Risks

Whilst this report does not seek to replicate items covered by the water supply, wastewater and stormwater masterplans, a number of key risk and resilience items have been identified.

10.1 Extreme Events

Lack of system resilience is one of the key risks facing all three networks. This has been exposed by the recent Cyclone Gabrielle in February 2023, alongside major impacts on power, communications and transport linkages. Although the water supply network coped relatively well, the stormwater systems failed in numerous places and the critical Awatoto WWTP was rendered inoperable for months, leading to significant untreated wastewater discharges.

Whilst this was an extreme rainfall event, it does highlight that these types of events do happen, and are often not considered during the design phase of projects. Designing projects to fully cater for extreme events (earthquakes, tsunami, extreme rainfall etc.) would generally be uneconomical and unsustainable, however undertaking a sensitivity assessment would help create a resilient system and lower the risk of system failure.

These assessments would provide valuable information to asset owners around what could occur during and after an extreme event. Potential resilience measures such as system redundancy, back-up generators/parts could be identified alongside potential low-cost risk reduction measures that could be built into projects, such as raising roads, material choice, liaison with other service providers, upsizing etc.

10.2 Inaccurate Growth Predictions

The additional upgrades recommended in this report are based on the revised growth that is predicted to occur in the Napier area. If the growth doesn't occur or occurs in unexpected locations, then this significantly affects not just the additional upgrades but also those within the masterplans. Whilst NCC can look to guide where development can occur, through the District Plan, there is less ability to affect the growth numbers beyond seeking to control how much development can occur and incentivising people to move to the area.

It is therefore important that predicted growth is regularly reviewed to check that it is still in line with expectations. Upgrades should be laid out along a trigger point road map, so that they can be undertaken when certain growth points are reached. Whilst some of this has already been set out within the masterplans, the intervals between the stages are limited and don't consider variance in growth scenarios.

10.3 Inaccurate Models

The models used for this report are not fully calibrated nor have they been updated following the recent peer review, with the stormwater model still being updated in conjunction with HBRC.

Without fully calibrated, up to date models, there is a notable risk that what is predicted is incorrect and that any upgrades that are identified as being required, based on model results, are not required or are insufficient. The models are the best available tools to undertake the upgrade assessment, but they will be significantly more accurate once updated following peer review and if additional network asset survey was undertaken, both level and flow data.

Model updates should also occur relatively frequently in order to capture all constructed work on the networks based on the as-builts. This would either be a new entry into the model of the over-riding of previous design data.

11. Recommendations

This report provides a snapshot of the potential network impacts that would result from implementation of the revised growth data supplied. The latest water supply and wastewater model networks are negatively impacted, whilst the potential 100-year ARI stormwater event affects the available yields from some of the greenfield development areas.

Water supply and wastewater network upgrades have been laid out within this report, to meet LoS, with water supply upgrades required irrespective of growth locations, and wastewater upgrades being location dependant. These upgrades exclude the Bay View area, were a trigger point assessment (where the existing network reaches capacity) has been assessed only. This was undertaken given the significant increase in the areas population resulting from incorporation of the proposed growth numbers. Any growth in Bayview is governed by the lower trigger point, which is wastewater at around 10%, assuming properties connect to both water supply and wastewater.

Within Napier City, only one location has more than one upgrade option identified. This is at South Pirimai, where it is recommended that the development, if it proceeds, is connected to both the Taradale and Greenmeadow pressure mains, to provide a more resilient system.

Stormwater flood mapping has shown significant levels of flooding within the following proposed Greenfield development areas:

- Wharerangi Road
- Parklands
- South Pirimai

Mitigating this flooding is likely to involve importing significant fill, in order to raise ground levels, with the potential dwelling yield of the development reduced due to the area required to manage the stormwater. Both impacts will have a negative weighting upon the feasibility of developing these areas.

In the case of South Pirimai, this proposed development area in the model contains two large Stormwater Management Facilities associated with potential HBRC upgrades (Stormwater Management Facilities). If these are constructed, they will notably reduce the available housing yield potential of the South Pirimai area.

The only assessed greenfield development area, predicted by the model to have negligible flooding, is The Loop. From a stormwater perspective, this greenfield area, would rank highest for development potential. It should be noted that a significant area of the site would still need to be set aside for a stormwater detention basin to manage the stormwater volume generated by the development of the area. Other greenfield growth areas, including Mission Hills and potentially the Western Hills are also expected to rank highly on development potential from a stormwater perspective.

Prior to undertaking the upgrades identified within this report, or allowing development within The Loop, or any of the other greenfield development areas, it is recommended that the following are undertaken:

- The revised growth data is reassessed and potentially development areas reconsidered based on proposed wider stormwater upgrades within the latest HBRC model.
- Staging of growth is further refined, at potentially 5–10-year increments for each of the areas
- The models are to be updated based on the findings from the recent peer reviews.
- Additional survey works are carried out and the models fully calibrated.

- The planning and funding horizons for each of the masterplan upgrades (as well as additional upgrades), alongside confirmation of which upgrades have been completed to date.
- Proposed Water Supply and Wastewater upgrades, within this report and the previous Masterplans, are reassessed based on growth staging and the latest understanding of growth distribution across Bay View and Napier City.
- A wide range of storm events are modelled for both the wastewater and stormwater models, including different durations and intensities, as well as long-time rainfall periods and sensitivity assessments using extreme events.
- NCC to confirm what design storm or ARI and duration, that should be used for establishing the volume of onsite storage required for new developments.
- Wider stormwater management measures to be considered at later design stages, such as rain gardens, permeable paving, rain harvesting and other low impact urban design measure to create holistic blue/green infrastructure
- The HBRC Model is updated to 2020 Lidar and further refined to account for recent developments.
- The HBRC Model becomes the single stormwater model used across HBRC and NCC.
- The proposed HBRC Model upgrades are discussed with NCC and not fully developed by HBRC in isolation.
- NCC to consider either compiling the requirements from the different policies and plans or creating a reference document so that it’s easier for developers, designers and Council staff to address all the requirements when undertaking developments or upgrades.

Appendices

Appendix A

Documentation/Model Comparison

Water Supply Comparison

The water supply model was checked at a high level against the "Water Supply Network Master Plan" report (Stantec Nov 2019) and the "Water Network Model Calibration" report (Stantec Feb 2020), both for Napier City Council. Areas of agreement and discrepancy are provided in Table 32 and Table 33 respectively.

Given that these documents were produced at different points in time, some discrepancies were anticipated. Table 32 and Table 33 shows some discrepancies, but the peer review process should be referred to for a full assessment. That work is outside the scope of the 3 Waters Structure Plan and is therefore not covered within this report.

NCC have however confirmed that the model is the best information currently available, for undertaking the Structure Plan scope, and will therefore be utilised for this purpose.

Table 32 Summary of Parameter Agreement – Water Supply

Parameter	Water Supply Documents	Water Supply Model	Comments
General Infrastructure*	Reservoirs Pump Stations Valves / Meters	Reservoirs Pump Stations Valves / Meters	All water infrastructure is generally represented in the model in one form or another.
Current Day PRVs	15	15	All Pressure Reducing Valves (PRV's) appear in the Current Day Scenario. However, the majority of the PRV settings are set differently to the "Napier Water Supply Network Model Development" report.
Future Day PRVs	16 (Model Build Report)	16	An additional PRV in Enfield
Water Demand and Residential Specific Consumption for the Current Day Design Horizon are in agreement between the Calibration Report and the Model			

*As per the Figure 2-3: Network Schematic in "Water Supply Network Master Plan" by Stantec November 2019

Table 33 Summary of Parameter Discrepancies – Water Supply

Parameter	Water Supply Documents	Water Supply Model	Comments
(Current Day) Number of Customer Points	26,117 (Masterplan)	28,892	Customer points within the water supply model represent connections to the network. Customer points can be assigned a property or multiple properties.
(Current Day) Number of Properties	28,891 (Calibration Report)	29,032	
(Future Day) Number of Customer Points	-*	28,899	
(Future Day) Number of Properties	34,069 (Calibration Report)	31,365	
Highest Property	105 m (Masterplan)	127.50 m	It is important to confirm the elevation of the highest property as this will affect pressures within the model.
Current Average Day Demand	-	21,745 m^3/day	Current average day demand was not provided in the water supply masterplan or model build report.
Current Peak Day Demand	42,466 m^3/day (Masterplan)	43,148 m^3/day	
Future Average Day Demand	-	24,269 m^3/day	Future average day demand was not provided in the water supply masterplan or model build report.
Future Peak Day Demand	53,830 m^3/day (Masterplan)	50,218 m^3/day	
Topography	0 m to 100 m (Masterplan)	2.73 m to 127.50 m	The model build report stated that ground elevations were sourced from LINZ. However, a review of the data showed that the elevations differed from elevations from NCC IntraMap. Differences are in the order of +/- 15 m. This may be a result of conflicting vertical datums.
Reservoir Top Water Levels			Comparison of top water levels between the water supply model and the "Napier Water Supply Network Model Development" report, prepared by Stantec (October 2017) were generally in agreement. Differences are in the order of 1 to 2 metres.
Current Day Bores**	11	18	Bores are represented as fixed heads within the water supply model. All bores are accounted for. The difference is a result of multiple bores being turned off, potentially representing future bores. Awatoto has multiple bores in the model, and the T6 bore is grouped with T8-T11 (with only one of these bores being active in the model).

*The future day number of customer points or connections could not be found in the water supply masterplan or model build report.

**As per Figure 2-2: Approximate Extent of the Heretaunga Plain Aquifer around Napier (based on NCC AMP) and Figure 2-3: Network Schematic in "Water Supply Network Master Plan" by Stantec November 2019

Wastewater Comparison

The wastewater masterplan does not provide network information to enable a comparison against what is in the wastewater model, e.g. length of pipes, number of connections, number of properties, flow rates etc. This is because the masterplan incorporated information from the model, and included a high level comparison against the previous Calibration Report.

Some discrepancies have been noted and shown in Table 34.

Table 34 Summary of Parameter Discrepancies – Wastewater

Parameter	Wastewater Documents	Wastewater Model	Comments
Pump Stations	46	51 (43 if WWTP infrastructure excluded)	There are a number of NCC pump stations not classified as 3 Waters as well as some private pump stations
Pipe Length	380 km of gravity and pressure wastewater pipelines	255 km	Not all of the wastewater assets in the network have been built into the model (NCC are aware of this)

Stormwater Comparison

The Napier Masterplan Baseline model was checked at a high level against documentation prepared by Stantec for Napier City Council. Areas of agreement and discrepancy are provided in Table 35 and Table 36. Note that it is unclear in the Masterplan whether the reported numbers in Table 35 and Table 36 contain data from the Bay View Model or not.

Table 35 Summary of Parameter Agreement – Stormwater

Parameter	Stormwater Documents	Stormwater Model	Comments
Pump Stations	12 Locations	12 Locations	The locations of the pump stations match-up between the stormwater model build report and the piped network and river models. Each pump station is modelled with at least two pumps.
Pipe Diameters	-		The stormwater model build report states pipes less than 300 mm were generally excluded from the piped network model. Less than 5% of the pipes in the piped network model are less than 300 mm.
Initial Water Depth	0.2 m	0.2 m	
Pipe Lengths	-	-	The stormwater model build report and pipe lengths for each pipe diameter are generally in agreement. The stormwater model has about 10% more pipe length than stated in the model build report.
Hydrodynamic Parameters	-	-	Other than the delta parameter, all parameters have been set to their default.
Tidal Boundary	Sinusoidal time series ranging from 9 m to 11 m.	Sinusoidal time series ranging from 9 m to 11 m.	

Table 36 Summary of Parameter Discrepancies – Stormwater

Parameter	Stormwater Documents	Stormwater Model	
LiDAR Data	-	-	The digital elevation model (DEM) data is based on LiDAR from 2014. Due to the age of this data, more recent changes may not be captured within the model. Note that NCC has a project to update the stormwater models with the 2020 LiDAR and change the datum to NZVD 2016.
Open Drain Alignments	-	-	The model build report states that some open drain data was not current, based on a Stantec review of aerial imagery. Due to the recency of the LiDAR data, some open drains could not be updated to reflect new alignments.
Culvert Data	-	-	Review of the open drain data showed that several culverts were either missing or missing information. Information on these had been either gathered through a field survey or assumed.
Pipe Data	-	-	Provided data of the pipe network did not include vertical information. Vertical information was assumed based on asset information.
Number of Pipes (Napier Model)	3,599	3,609	
Number of Outlets	323	105	Outlets in the model have been defined with a prefix of "D-OUT".

Discrepancies, similar to those in Table 36, were identified for the Bay View Baseline Model.

The initially provided models are those closest to the basis of the masterplan, and as such have been compared to the masterplan document. However, following completion of the stormwater masterplan, significant changes have been made to the stormwater model on behalf of NCC and HBRC, with different models created based on different parameters to suit each client. GHD have been provided with the latest version of the HBRC model from Stantec (28/11/22), which differs from the masterplan model in the following notable ways:

- 60 pipes less
- Differences of some pipe diameters
- Approximately 250 catchments less
- 3 pump station locations less
- 13 additional culverts
- 45 outlets less

Appendix B

Growth Data

Spatial Picture Intensification

M.E undertook a Plan Enabled Capacity (PEC) assessment followed by a commercially Feasible Capacity assessment, as documented in their “Development Capacity Assessment: Intensification Areas Report” (Feb 2022) for NCC. This report followed on from the “Housing Development Capacity Assessment Report” (2021) they previously undertook for NCC, Hastings District Council (HDC) and Hawke’s Bay Regional Council (HBRC).

Plan Enabled Capacity

The PEC assessment considered the theoretical maximum development within each parcel. A visual representation of these areas are shown in Figure 29.

The M.E assessment considered growth in terms of ‘Attached’ and ‘Detached’ dwellings. Whilst there is discussion around the type of dwellings likely to be developed in ‘Medium Density’ and High Density’ areas, the number of dwellings are not divided across these two areas, and there is no map outlining the distribution of the dwellings.

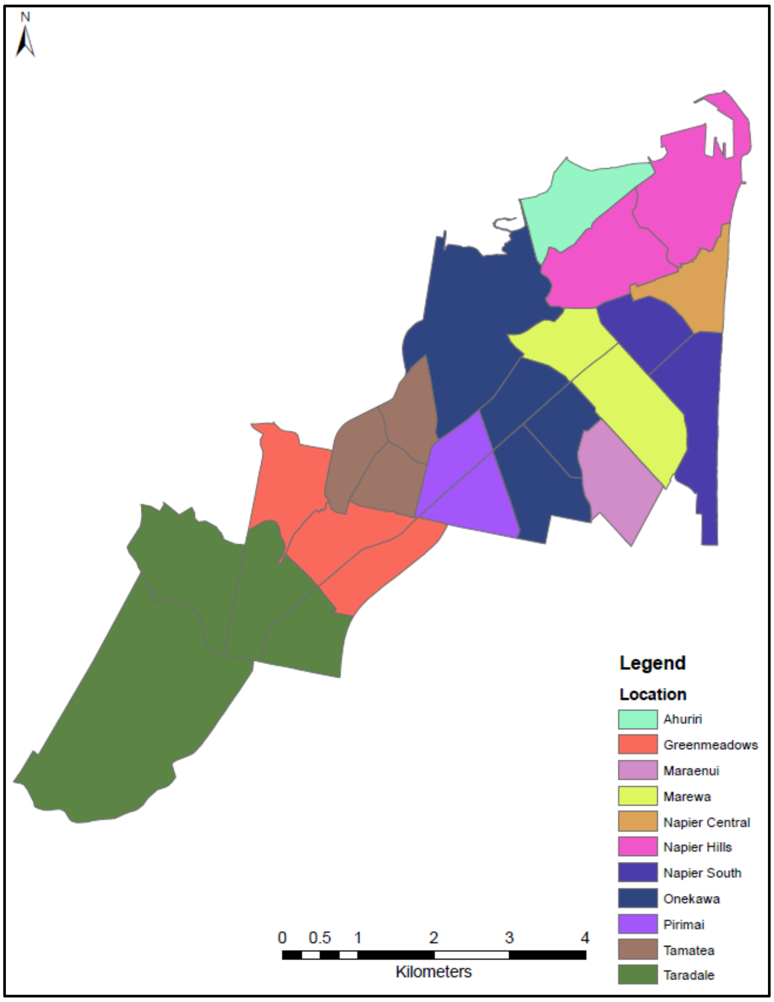


Figure 29 Napier Statistical Area Plan Enabled Capacity (PEC) Intensification Locations

Commercially Feasible Capacity

The Commercially Feasible Capacity is a percentage of the PEC, that excludes the portion that would be impractical to develop. M.E explored the two ends of the development spectrum (all small units/houses and all large units), with developments likely to fall somewhere between the two.

Potential Spatial Patterns

M.E combined the Commercially Feasible Capacity with the expected demand for several scenarios to more accurately gauge the number of dwellings that would likely be developed across the areas and different time periods.

Spatial Picture Yield Recommendation

The PEC is considered overly conservative for use in this study, with NCC instructing GHD to use the Potential Spatial Pattern data associated with M.E's 'Small-Large Mix'. This is represented in Table 3.3 in the "Development Capacity Assessment: Intensification Areas Report" (Feb 2022) and partially replicated in Table 37 below. Further scenarios may be investigated as additional scope later if required by NCC.

*Table 37 Spatial Picture Scenario: 'Small-Large Mix' – Table 3.3 extract**

Location	Short Term (2020-2023)		Medium Term (2020-2030)		Long Term (2020-2050)	
	Detached	Attached	Detached	Attached	Detached	Attached
Ahuriri	10	65	15	70	10	65
Pirimai	35	5	60	20	105	35
Maraenui	130	30	140	385	180	610
Napier Central	5	5	10	30	15	75
Napier Hills	15	5	10	5	10	5
Marewa	110	15	140	70	150	185
Napier South	15	5	35	20	75	15
Greenmeadows	85	10	100	35	145	35
Onekawa	80	5	90	25	100	35
Tamatea	45	5	50	20	85	10
Taradale	65	20	110	110	130	180
Rural	10	0	20	0	80	0
Total	**605**	**170**	**780**	**790**	**1,085**	**1,250**
*Unmatched Demand***	145		690		3,340	

*Greenfield sites are excluded from the table as they are covered separately

** Unmatched Demand is not included in the total as it doesn't cover expected dwellings and is not defined by area

Whilst it is not specified within the M.E report, M.E have confirmed to the project team that the numbers for the different time periods (Short, Medium, Long), are cumulative across the time periods, i.e. the growth up to 2050 is shown in the last two columns of Table 37, and is not the total across all six columns.

NCC have instructed GHD to use the total number of 'Attached' and 'Detached' dwellings and distribute them across the Medium Density and High Density areas using a 40:60 ratio (Medium:High). Mixed use polygons will be considered as medium density and have medium density growth distributed amongst them.

Table 38 Intensification Distribution Across Medium and High Density Areas

Location	Detached / Attached Total	Medium Density	High Density	Remaining Feasible Capacity
Ahuriri	75	30	45	1,205
Pirimai	140	56	84	680
Maraenui	790	316	474	165
Napier Central	90	36	54	985
Napier Hills	15	6	9	10
Marewa	335	134	201	150
Napier South	90	36	54	325
Greenmeadows	180	72	108	715
Onekawa	135	54	81	660
Tamatea	95	38	57	215
Taradale	310	124	186	2,805
Total	**2,255**	**902**	**1,353**	**7,915**

It should be noted that the M.E report identifies significant volumes of remaining feasible capacity. These numbers have been added to Table 37 to provide a holistic picture.

Note, rural brownfield intensification has been added as four new sub-catchments / customer points with 20 properties each, as shown in Figure 30, and has not been included in Table 38.

GHD's study will only include intensification numbers assigned to the named areas, and as such excludes the:

- Greenfield classification (covered separately)
- Unmatched Demand
- Remaining Feasible Demand

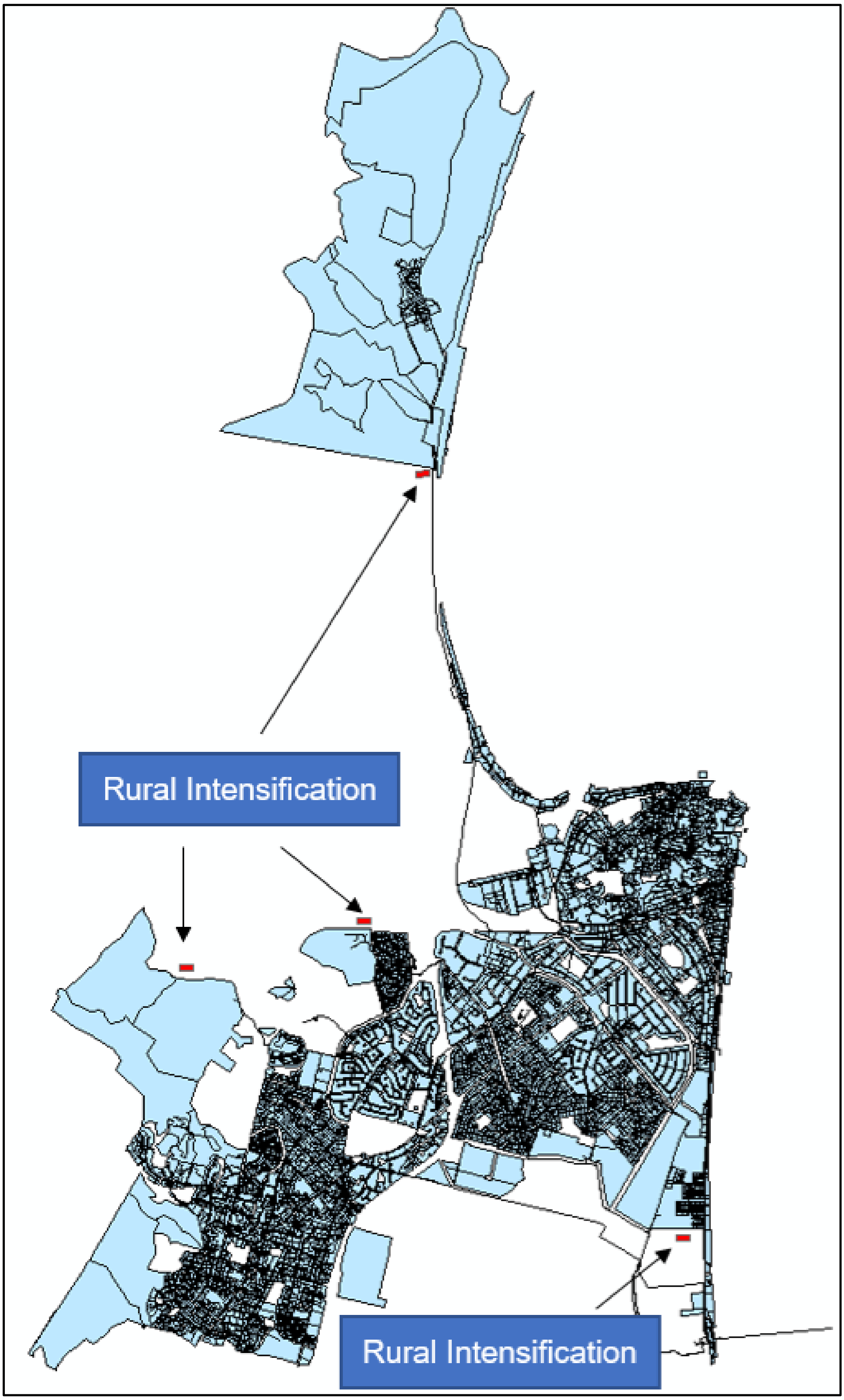


Figure 30 Location of created Rural Intensification sub-catchments / customer points

Spatial Picture Greenfield Growth

Growth data for the greenfield sites have generally been provided by B&A, and consist of yield assessments based on dwelling density. Multi-story developments are not specifically identified as being considered for the greenfield areas.

Bay View

Yield data for the Bay View area, which is situated north of Napier City, is shown below in Table 39 and visually represented in Figure 31. This data is 'total outturn' dwellings, rather than growth to be added to the existing number of dwellings.

Table 39 Bay View Development Areas and Potential Yields

Proposed Development Area	Approximate Site Area (m^2)	Dwelling Area (m^2)	Yield (dwellings) with no constraints	Yield (dwellings) with 55% developable land
Rural settlement with mixed use	350,000	400	875	481
Rural living	1,930,000	1,500	1,287	708
Large lot rural residential	2,720,000	3,000	907	499
Rural production	5,850,000	150,000	39	21
Coastal settlement	760,000	800	950	523
Park	200,000	-	-	-
Rural conservation	-	-	-	-
Land significant to mana whenua*	333,808	1,500	223	122
Total			**4,281**	**2,354**

* Whilst dwellings can be developed on land that is significant to mana whenua, the dwelling size/density is site specific and dependent on decisions by mana whenua. An indicative yield, in line with the other areas, has been included as a placeholder for growth in that area but has not been modelled at this stage.

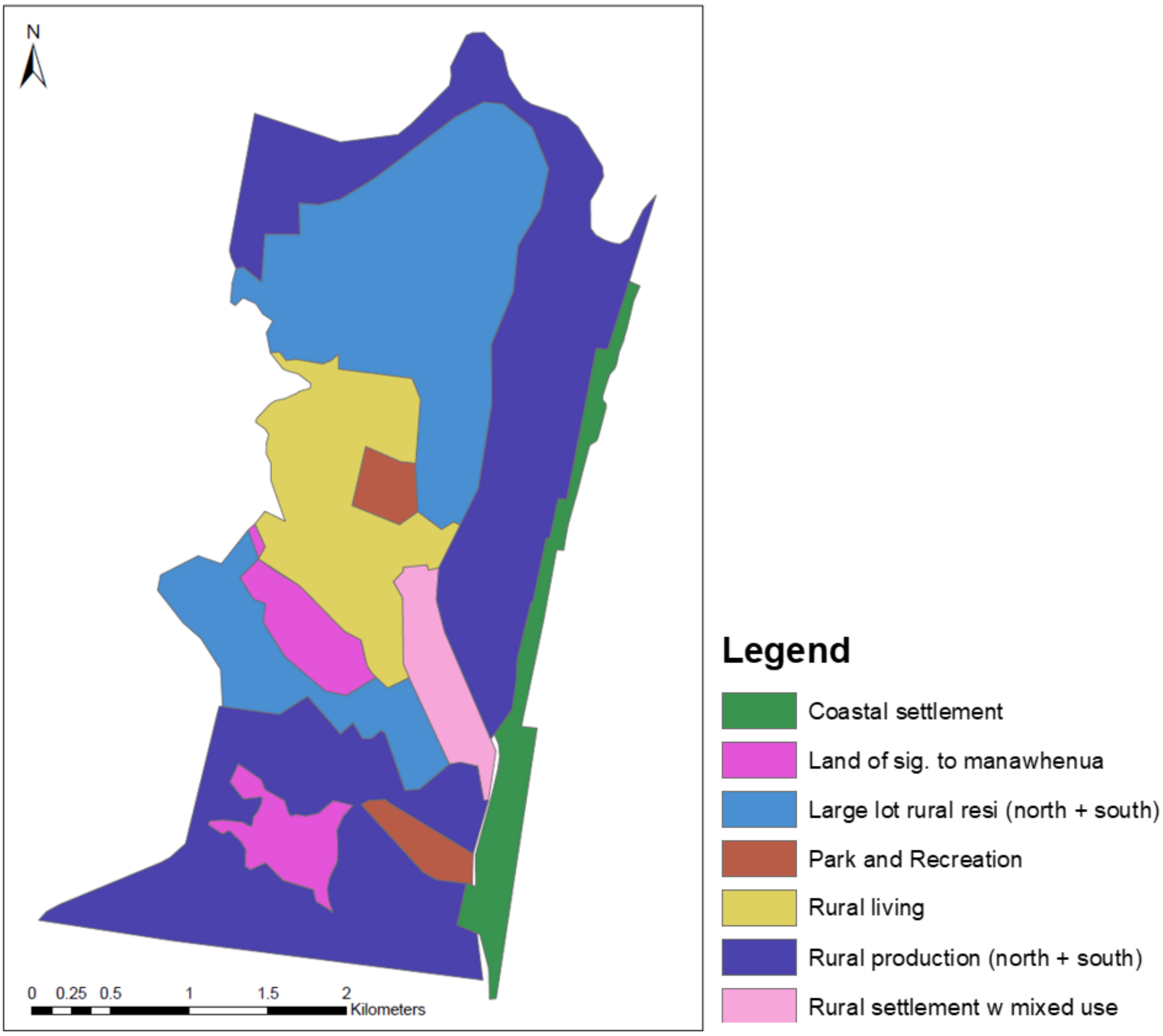


Figure 31 Bay View Indicative Yield Allocations

Wharerangi Road

As further engagement with Mana Ahuriri is planned for this site, the provided yields are indicative only. Scenario 1 will be used for the purposes of this assessment, as it represents the most conservative approach.

Table 40 Indicative Yields for the Development at Wharerangi Road

Land Use	Gross Floor Area / Household Yield (dwellings)
Supermarket	3,500 sqm – 5,000 sqm
Other commercial	4,700 sqm
Scenario 1 – Residential Yield – Medium Density Scenario (Average 1:200 sqm)*	520
Scenario 2 – Residential Yield – General Residential Density Scenario (Average 1:350 sqm)*	297

*Assuming 80% developable land

Heretaunga Plains Urban Development Strategy

The Heretaunga Plains Urban Development Strategy (HPUDS) South consists of greenfield development areas situated south of Napier City. Two scenarios have been developed by B&A:

- Scenario 1 – South Pirimai and The Loop areas would be purely general residential development at an average density of 350 square metres per dwelling
- Scenario 2 –The Loop area would be purely general residential development, at an average density of 350 square metres per dwelling. Whilst the South Pirimai area would be a mix of large and smaller lots at a density of 3,000 square metres and 350 square metres per dwelling respectively

Scenario 1 has been selected by NCC for GHD to use within this study, as it represents the highest yield numbers, with details shown in Table 41 and Figure 32.

Table 41 Indicative Yields for HPUDS South – Scenario 1 (generated from data provided by B&A, June 2022)

Location Reference	Approximate Site Area (m^2)	Classification	Dwelling Area (m^2)	Yield (dwellings) with 80% developable land
1	14,371	General Residential	350	33
2	144,296	General Residential	350	330
3	126,290	General Residential	350	289
4	67,219	General Residential	350	154
5	12,434	General Residential	350	28
6	147,168	General Residential	350	336
7	42,836	General Residential	350	98
8	233,016	General Residential	350	533
Total				**1,800***

*Includes existing residential units

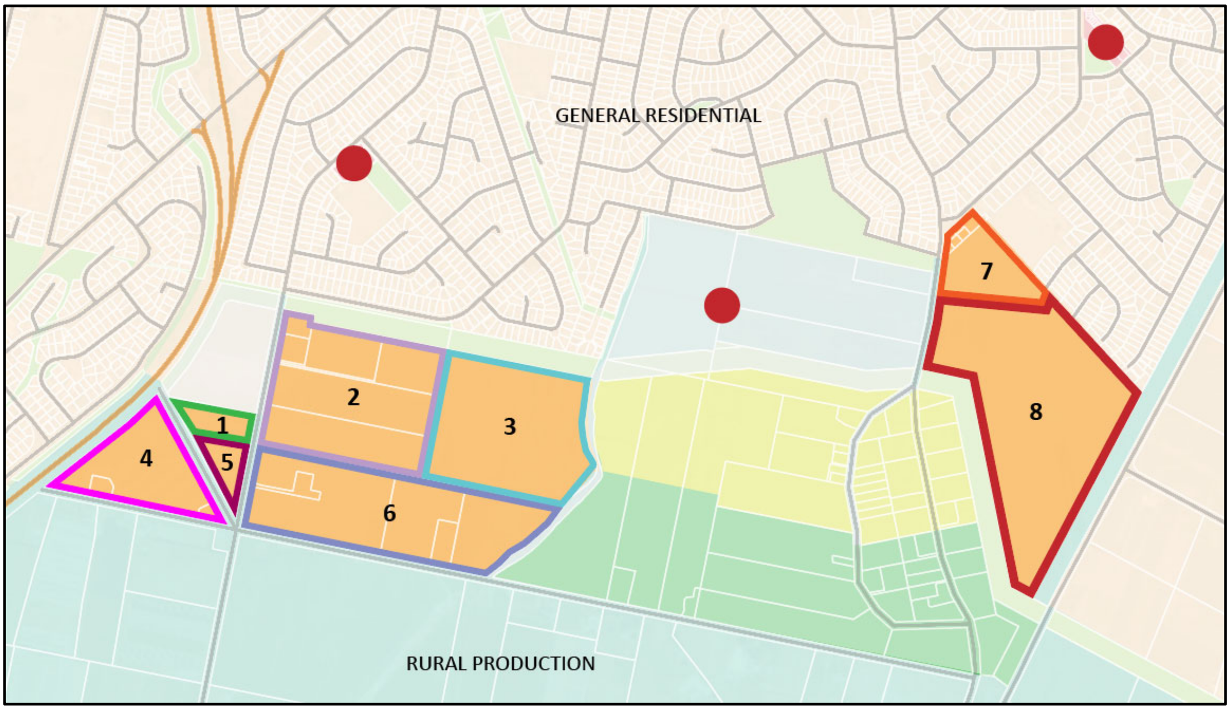


Figure 32 HPUDs South Development (extract from B&A data) – Scenario 1

It should be noted that neither scenario includes the Riverbend Development (currently estimated to contain an Equivalent Population of 2,384 and 0.5 Ha of commercial area), nor the two areas to the south of it (represented by the yellow and green areas in the figures).

NCC have confirmed that growth at Riverbend is to be included in this assessment and the two areas south of this are to be excluded.

Additional Greenfield Areas

The Mission Hills and Parklands developments are both included in HPUDS 2017 but are not included within the HPUDS scenarios developed by B&A. It was agreed with NCC the population equivalents from these areas should be included as growth within the scope of this assessment, as follows:

- Mission Hills - 1,200
- Parklands – 310 (this is in addition to the existing population in this area)

Appendix C

Existing Model Growth

Water Supply Model

The Future Day Scenario contains the following projected growth for the year 2047, as per the "Napier Water Supply Network Model Development" Report by Stantec (October 2017). The 2047 water supply model contains 31,365 properties, an increase of 2,333 properties from the 2017 model. It is noted that the additional properties were all greenfield growth. Based on model build, it was identified and confirmed that infill intensification was represented in the 2047 model by factoring up the residential consumption by 10%. This shows why the additional properties were purely greenfield.

The model build report states that the only substantial increase in commercial/industrial water demand other than greenfield developments is the expansion of an aquatic centre, with other non-residential demand remaining the same. It is estimated that the pool volume would increase by 65%, although this expansion is not identified in the growth data that GHD have been provided with for this study.

Table 42 Comparison of Current and Future Day Consumption – Water Supply

Area	Demand Category	Current Day Specific Consumption (l/p/day)	Future Day Specific Consumption (l/p/day)	Multiplier
Bay View	Dom_BayView	296.7	326.37	1.1
Enfield	Dom_Enfield	296.7	326.37	1.1
Taradale	Dom_Taradale	460.4	506.44	1.1
Thompson Boosted	Dom_ThompBoosted	438.9	482.79	1.1
Thompson Gravity	Dom_ThompGravity	431.6	474.76	1.1
Bay View – Non-Residential	Nonres_BayView	296.7	296.7	1.0
Enfield – Non-Residential	Nonres_Enfield	296.7	296.7	1.0
Taradale – Non-Residential	Nonres_Taradale	460.4	460.4	1.0
Thompson Boosted – Non-Residential	Nonres_ThompBoosted	439.9	439.9	1.0
Thompson Gravity – Non-Residential	Nonres_ThompGravity	431.6	431.6	1.0
Commercial Greenfield	Comm_Greenfield	-	0.00	-
Residential Greenfield	Residential_Greenfield	-	468.75	-

Greenfield growth was represented within the future day model by adding new customer points and assigning properties to it.

It should be noted that there is variance between the calibration report and the future day model in the following areas:

- The current day model has 141 additional properties than the calibration report
- The calibration report has 2,706 additional properties than the future day model
- The future day model has different property totals for Bay View, Thompson Boosted, Thompson Gravity, Western Hills/The Terraces and Otatara compared to the calibration report.
- Variances occur within Enfield and Taradale due to differences in property distributions

Greenfield growth is 2,635 properties in the calibration report compared to 2,475 in the future day model

Wastewater Model

The "WW_2050+Upgrades" Scenario contains growth data similar to the "Napier Wastewater Masterplan 2020-50" by GHD (July 2020), with growth separated into intensification and greenfield areas as shown in Table 43 and

Table 44. The discrepancies shown in the tables are due to more recent updates being made to the model, following completion of the Wastewater Masterplan.

Table 43 Comparison of Infill Intensification - Wastewater

Area	Wastewater Documents		Model
	Anticipated Dwellings – Total by 2035	Anticipated Dwellings – Total by 2050	2050 Model – Ultimate Scenario
Jervoistown*	150	226	-
Ahuriri	208	400	390
Taradale	1,435	1,725	1708
Greenmeadows	733	881	881
Tamatea / Poraiti	108	130	130
Central Suburbs	483	580	577
Te Awa and South	261	314	314
Napier Hill and North	500	650	675
City Centre and Surrounds	400	800	800
Total	4,278	5,706	5,475

*The growth at Jervoistown was noted as 226 dwellings. However, the wastewater masterplan stated that these dwellings would be infill growth whereas the wastewater future day model classified them as greenfield growth. It is suspected that this is a reporting error rather than doubling up growth at Jervoistown.

Table 44 Comparison of Greenfield Growth – Wastewater

Area	Wastewater Documents		Model
	Anticipated Dwellings – Total by 2035	Anticipated Dwellings – Total by 2050	2050 Model – Ultimate Scenario
Parklands	440	440	440
Te Awa	800	970	970
Mission Residential	400	650	1,200
Wharerangi Road	170	170	170
Bay View	190	190	254
Taradale Hills South	-	600	600
Taradale Hills North	-	150	150
Tironui Drive Extension	-	900	900
Mission Surrounds	-	550	550
Jervoistown*	-	-	226
Total	2,000	4,620	5,480

*The growth at Jervoistown is 226 dwellings. However, the wastewater masterplan states that these dwellings are infill growth whereas the wastewater future day model classifies them as greenfield growth. It is suspected that this is a reporting error rather than doubling up growth at Jervoistown.

Stormwater Model

Growth numbers are not directly represented within the HBRC 2050 stormwater model, rather an impervious area is assigned to represent the level of development within an area, with more densely developed areas represented by higher imperviousness percentages.

Every sub-catchment within the stormwater model, has an assigned impervious component. This denotes the percentage of that catchment with the highest stormwater runoff. For some specific areas such as roads and industrial areas, this percentage can be up to 100%, however when a full sub-catchment area is considered, these percentages are lower as they incorporate pervious areas as well.

For the growth areas, Stantec have advised that the following approach has been applied to the model:

- If the existing sub-catchment imperviousness value was below those shown in Table 45, then it was not increased beyond this threshold
- If the existing sub-catchment imperviousness value was above those shown in Table 45, and the sub-catchment was identified as a growth area, then the values were assessed and revised

Whilst individual sub-catchments, within the growth areas, may have an imperviousness greater than shown in Table 45, the areas as a whole, are generally reflective of the table. This balances out across existing land uses, such as roads, and those sub-catchments that straddle growth area boundaries.

Table 45 Stormwater Masterplan Imperviousness – Table 3.2 within Section 3.4.2 of the Stormwater Masterplan

Scenario	Growth Type	Area	Masterplan Imperviousness (%)
2035 Future Scenario	Growth	Parklands	80
		Te Awa	80
		Park Island	80
		Mission	40
	Intensification	Portion of Jervoistown	80
		Ahuriri	80
		CBD	80
		Maraenui	80
		Marewa	80
		Onekawa	80
		Industrial growth – dry industries only	90
2050 Ultimate Scenario	Growth	Western Hills	40

Appendix D

Model Growth Updates

Water Supply Growth Assignment

As the 2047 design horizon included the masterplan modifications and upgrades, the 2047 peak day model was used to assess achieved levels of service. To facilitate the impact assessment of the new growth numbers, several modifications were made to the model:

- For non-greenfield areas, the number of properties within the model were matched to the 2017 design horizon, with Stantec's 110% factoring of the current day consumption reversed
- For greenfield sites the existing growth in the model was either removed, by assigning zero properties to them, or altered

Brownfield Intensification

The brownfield intensification was applied only to residential areas, existing residential customer points within the NSP were identified and grouped based on their statistical area. Groups of residential customer points within each statistical area were identified based on location, with representative customer points selected. The brownfield intensification was added into the water supply model by distributing the medium/mixed and high-density growth amongst the representative points.

Greenfield Growth

Greenfield growth was mostly added into the model by adding new customer points that used Stantec's demand profiles and consumptions. Exceptions to this include residential greenfield growth at the Riverbend Development, Mission Hills, and Parklands. Greenfield growth at Riverbend and Mission Hills was already represented in the water supply model and were modified by updating the number of properties at Stantec's existing customer points to 655 and 1200 respectively. Greenfield growth at Parklands was also implemented using an existing customer point. However, the number of properties assigned was 489, an additional 347 properties, rather than 310. This was because the water supply model had 142 properties at Parklands whereas the wastewater model had 179 properties. As both values were representing the same area, the 310 additional properties were added to the wastewater model's 179 to provide a conservative total. The 489 total properties were thus assigned to both models.

Commercial greenfield developments are outlined in Table 46.

Table 46 Greenfield commercial development assumptions – Water Supply

Location	Area (ha)	Assumption	Demand (l/s)
Riverbend Development	0.5	Commercial and Light Industrial Flow	0.350
Wharerangi Road Supermarket	0.5	Retail and Suburban Commercial Area	0.200
Wharerangi Road 2 Other Commercial	0.47	Retail and Suburban Commercial Area	0.118

The greenfield growth for the Bay View area differs from the other areas, as the data provided was for the ultimate level of development, not just growth, i.e. it included the total number of properties and not just the additional properties. This was represented in the model by totalling the residential properties in each of the Bay View GIS polygons. The number of properties in each of the Bay View GIS polygons were then adjusted to reflect the ultimate growth scenario.

Note that the rural brownfield intensification has been added as four new customer points with 20 properties each.

Wastewater Growth Assignment

As the 2050 design horizon included the masterplan modifications and upgrades, the 2050 wet weather flow model was used to assess achieved levels of service. Except for greenfield catchments, the population of each catchment within the model were matched to the 2020 design horizon to ensure that infill growth was removed from the model. All greenfield growth within the model was removed by assigning zero population to them with the exception of Mission Hills, Parklands, and Riverbend.

Growth was implemented into the model by assuming 2.5 persons/household as per NCC's Code of Practice for Land Development and Subdivision Infrastructure (NCC CoP).

Brownfield Intensification

As the brownfield intensification was to only be applied to residential areas, the centroids of residential wastewater catchments within the NSP were identified and grouped based on their statistical area. The brownfield intensification was distributed evenly across all identified residential centroids based on whether they were considered as medium/mixed or high-density growth.

Greenfield Growth

Greenfield growth was added into the model by adding new catchments based on the provided GIS polygons and using similar catchment parameters. Exceptions to this, included developments at Mission Hills, Parklands, and Riverbend. Greenfield growth at Parklands and Mission Hills was represented in the wastewater model by using the existing catchments and assigning 1,222.5 people (489 properties) and 3,000 people (1,200 properties), respectively. The population at the Riverbend residential catchment has been set as 2,384 people (655 properties) and is based on the latest information provided by the developer rather than the NCC CoP.

Commercial greenfield developments are outlined in Table 47.

Table 47 Greenfield commercial development assumptions – Wastewater

Location	Area (ha)	Assumption	PWWF (m^3/ha)
Riverbend Development	0.5	Commercial and Light Industrial Flow	0.0007
Wharerangi Road Supermarket	0.5	Retail and Suburban Commercial Area	0.0004
Wharerangi Road 2 Other Commercial	0.47	Retail and Suburban Commercial Area	0.0004

The greenfield growth for the Bay View area differs from the other areas, as the data provided was for the ultimate level of development, not just growth, i.e. it included the total number of properties and not just the additional properties. This was represented in the model by totalling the residential properties in each of the Bay View GIS polygons. The number of properties in each of the Bay View GIS polygons were then adjusted to reflect the ultimate growth scenario.

Note that the rural brownfield intensification has been added as four new catchments, assuming 20 properties each, equivalent to 50 people.

Appendix E

ROC Estimate Breakdowns

Wastewater Description	Unit	Quantity	Rate	Price	Preliminaries & Generals (20%)	Contingency (15%)	TOTAL
Willowbank Avenue				$ 879,000.00	$ 175,800.00	$ 131,850.00	$ 1,186,650.00
Supply and lay OD355 PE100 main (300 ID)	m	1465	$ 600.00	$ 879,000.00			
Chambers Street to Ellison Street				$ 730,000.00	$ 146,000.00	$ 109,500.00	$ 985,500.00
Supply and lay OD355 PE100 main (300 ID)	m	1075	$ 600.00	$ 645,000.00			
Removal of existing fire hydrants	each	10	$ 2,000.00	$ 20,000.00			
Supply and Install new fire hydrants	each	10	$ 6,500.00	$ 65,000.00			
Ellison Street/Georges Drive				$ 12,000.00	$ 2,400.00	$ 1,800.00	$ 16,200.00
Supply and lay OD355 PE100 main (300 ID)	m	20	$ 600.00	$ 12,000.00			
Ellison Street to Vigor Brown Street through Nelson Crescent				$ 674,500.00	$ 134,900.00	$ 101,175.00	$ 910,575.00
Supply and lay OD355 PE100 main (300 ID)	m	940	$ 600.00	$ 564,000.00			
Removal of existing fire hydrants	each	13	$ 2,000.00	$ 26,000.00			
Supply and Install new fire hydrants	each	13	$ 6,500.00	$ 84,500.00			
Sanders Avenue to Carnell Street				$ 526,000.00	$ 105,200.00	$ 78,900.00	$ 710,100.00
Supply and lay OD355 PE100 main (300 ID)	m	735	$ 600.00	$ 441,000.00			
Removal of existing fire hydrants	each	10	$ 2,000.00	$ 20,000.00			
Supply and Install new fire hydrants	each	10	$ 6,500.00	$ 65,000.00			
Hyderabad Road to Lever Street through Battery Road				$ 557,000.00	$ 111,400.00	$ 83,550.00	$ 751,950.00
Supply and lay OD355 PE100 main (300 ID)	m	815	$ 600.00	$ 489,000.00			
Removal of existing fire hydrants	each	8	$ 2,000.00	$ 16,000.00			
Supply and Install new fire hydrants	each	8	$ 6,500.00	$ 52,000.00			
Battery Road to Marina Parade through Breakwater Road				$ 1,549,000.00	$ 309,800.00	$ 232,350.00	$ 2,091,150.00
Supply and lay OD355 PE100 main (300 ID)	m	2065	$ 600.00	$ 1,239,000.00			
Removal of existing fire hydrants	each	20	$ 2,000.00	$ 40,000.00			
Supply and Install new fire hydrants	each	20	$ 6,500.00	$ 130,000.00			
DN300 PRV	each	2	$ 20,000.00	$ 40,000.00			
DN300 Meter	each	2	$ 50,000.00	$ 100,000.00			
TOTAL				$ 4,927,500.00	$ 985,500.00	$ 739,125.00	$ 6,652,125.00

Pipe Laying rate inclusive of abandoning existing watermain
Costs based on recent NCC rates and HDC rates

Wastewater Description	Unit	Quantity	Rate	Price	Preliminaries & Generals (20%)	Contingency (15%)	TOTAL	
Frickleton Street/Kauri Street, Murphy Road and Meeanee Road				$ 639,000.00	$ 127,800.00	$ 95,850.00	$ 862,650.00	
Upgrade DN225 pipes to DN300	m	1065	$ 600.00	$ 639,000.00				
Gloucester Street				$ 581,250.00	$ 116,250.00	$ 87,187.50	$ 784,687.50	
Upgrade DN450 pipes to DN525	m	775	$ 750.00	$ 581,250.00				
Neeve Road				$ 367,250.00	$ 73,450.00	$ 55,087.50	$ 495,787.50	
Upgrade DN300 pipes to DN375	m	565	$ 650.00	$ 367,250.00				
Kent Terrace				$ 162,250.00	$ 32,450.00	$ 24,337.50	$ 219,037.50	
Upgrade DN150 pipes to DN225	m	295	$ 550.00	$ 162,250.00				
Mission Hills related				$ 3,204,000.00	$ 640,800.00	$ 480,600.00	$ 4,325,400.00	Excluded
Supply and lay DN225 pipes	m	1025	$ 550.00	$ 563,750.00				
Supply and install DN1050 concrete manholes (assume 1/100m of gravity pipe)	ea	11	$ 6,000.00	$ 66,000.00				
Supply and lay OD180 PE100 main (150 ID)	m	665	$ 450.00	$ 299,250.00				
New Mission Hill PS (38 L/s)	LS	1	$ 1,000,000.00	$ 1,000,000.00				
New Pinotage Pumps 70 l/s max (duty, duty, standby all sized at 35 L/s each) - assume replacement of pump, pipework and wet well	LS	1	$ 1,000,000.00	$ 1,000,000.00				
Supply and lay OD250 PE100 main (200 ID)	m	550	$ 500.00	$ 275,000.00				
South Pirimai – Gravity Main connection and Trinity Crescent				$ 2,144,000.00	$ 428,800.00	$ 321,600.00	$ 2,894,400.00	
Upgrade DN375 pipes to DN450	m	350	$ 700.00	$ 245,000.00				
Upgrade DN375 pipes to DN450	m	570	$ 700.00	$ 399,000.00				
New Bill Hercock Pumps 130 l/s max (duty, duty, standby all sized at 65 L/s each) - assume replacement of pump, pipework and wet well	LS	1	$ 1,500,000.00	$ 1,500,000.00				
South Pirimai – Pressure Main connection				$ 2,000,000.00	$ 400,000.00	$ 400,000.00	$ 2,800,000.00	Excluded
Supply and lay OD250 PE100 main (200 ID) with connections to both existing pressure mains (Taradale and Greenmeadows) (assumed length)	m	1500	$ 500.00	$ 750,000.00				
New South Pirimai PS (Estimated at approx. 50 L/s)	LS	1	$ 1,250,000.00	$ 1,250,000.00				
Riverbend Development				$ 1,700,000.00	$ 340,000.00	$ 340,000.00	$ 2,380,000.00	
Supply and lay OD250 PE100 main (200 ID) with connection to existing Taradale pressure main (assumed length)	m	900	$ 500.00	$ 450,000.00				
New Riverbend PS (Estimated at approx. 50 L/s)	LS	1	$ 1,250,000.00	$ 1,250,000.00				
The Loop				$ 1,550,000.00	$ 310,000.00	$ 310,000.00	$ 2,170,000.00	
Supply and lay OD250 PE100 main (200 ID) with connection to existing Taradale pressure main (assumed length)	m	600	$ 500.00	$ 300,000.00				
New The Loop PS (Estimated at approx. 50 L/s)	LS	1	$ 1,250,000.00	$ 1,250,000.00				
TOTAL				$ 7,143,750.00	$ 1,428,750.00	$ 1,234,062.50	$ 9,806,562.50	

Gravity networks for servicing developments not included in the costs
It is assumed that all existing wastewater manholes can be re-used even with the increased pipe size
Costs based on recent NCC rates and HDC rates (limited PS data)