Hutt City Council
Three Waters Growth Study 2022

Executive Summary

The Hutt City Three-Waters Growth Study has been undertaken to assess the anticipated forecast growth in the Hutt City territorial area, and identify three-water infrastructure improvements to accommodate predicted population growth over the next 30-years.

This study covers the geographical area of the Hutt City Council (HCC) including Wainuiomata, and Stokes Valley. The population used for assessment of drinking water and wastewater is based on forecasts provided and agreed with HCC in 2020, of 105,247 (2020) to 130,323 (2050), a growth of 25,075 (or 23.8%). Since population forecasts were confirmed for modelling, Sense Partners (2021) forecasts raised potential growth for HCC to 48,906 (42.9%) over 30-years (from 2021-2051).

The study is comprised of the following sub-components:

1. Three waters network constraints and opportunities assessment to enable growth;
2. Three-waters infrastructure options development to service HCC Plan Change 43 enabled development over the next 30 years (2020-2050).
3. Level 1 costs estimates for each identified concept option in accordance with the Wellington Water Cost Estimation Manual.
4. A strategic environmental assessment that identifies contributing factors for where growth impacts the environment via the three waters networks.

Due to the relatively flat nature of the Hutt valley floor, servicing for water supply is relatively straightforward, however, the topography brings significant challenges for wastewater and stormwater. Servicing Wainuiomata and Stokes Valley are the most challenging and expensive due to existing topographical constraints (e.g. Wainuiomata Hill requires pumping of wastewater over it; and in Stokes Valley steep hillsides and flat areas of land create challenges for managing stormwater).

This study has found that there is a significant programme of investigative, design, and physical works needed to meet the demands of future growth and bring existing networks to target levels of service. The proposed improvements that have been identified in this study have an associated cost estimate of approximately $1.27BIL.

The costs estimated to undertake water supply improvements are $191.26M, wastewater improvements are $271.13M and stormwater improvements are $810.2M. These were estimated using the Level 1 Cost Estimate method and using 2020 (revision 11) rates.

The significant cost estimates for stormwater are attributed to existing stormwater flooding issues and meeting targeted levels of service assumed for this study (habitable floor levels protected for 1 in 100yr + climate change). The prioritisation of investment needed in new stormwater infrastructure will need further early project development that factor in affordability criteria, emerging environmental standards, and community expectations for level of service.

The proposed capacity upgrades for city-level network infrastructure are:

a) Drinking water reservoir storage in Delaney (new), Holborn/Shaftesbury (new), Naenae (new), Wainuiomata (new) and Eastbourne (new).

b) Wastewater pump station and rising mains in Hutt CBD (new); Boulcott (new), North Wainuiomata (new); Wellington St & Wise Park, Wainuiomata (upgrades).

c) Wastewater storage at Engineered Overflow Points (EOPs) at Fraser and Main Road in Wainuiomata (new).

d) Wastewater improvements including regrading/upgrading pipes, increasing pump station capacity, and providing storage to address existing network constraints including in Stokes Valley, Alicetown, Maungaraki, Seaview, Waterloo and Waiwhetu.

e) Stormwater network capacity improvements and/or flood management in Stokes Valley, Alicetown, Taita, Naenae, Melling, Woburn and Wainuiomata.

f) Stormwater management improvements for Black Creek channel and Parkway Drive; and a proposed wetland in Upper Fitzherbert in Wainuiomata.

Exclusions from this study include:

- Bulk water source, treatment and distribution
- Wastewater Joint Venture Trunk Network and Seaview WWTP
- Water quality improvements (covered by SMS/SMPs consent)
- Local upgrades to facilitate development

A Strategic Environmental Assessment of growth, identified effects of growth varied depending on water type and receiving environment. In some situations, strategic interventions such as policies, may not be enough, resulting in need for communities to decide on allocation of investment to protect ecosystem services and also provide for growth. Strategic Interventions (or mitigation measures) are actions taken to avoid or minimise adverse environmental impacts. Examples may include caps on water use, increase in requirement for green infrastructure into new urban design, application of new technologies to reduce or improve water systems and sustained, deliberate and coordinated investment to support growth.

Key recommendations resulting from this study for HCC to consider include:

1. Review and prioritise investment to support growth for 2024 investment plan/strategy.
2. Develop adaptive and responsive strategies to manage uncertainty of growth, including improved data sharing and funding upgrades as growth progresses.
3. Identify opportunities to streamline projects with external infrastructure providers (e.g. Waka Kotahi, Kainga Ora)
4. Progress further policy/guidance work (as per Table 7)
5. Support option development, community engagement and investment cases for stormwater flood management.
6. Support WWL to undertake an integrated wastewater plan for Seaview WWTP and joint-venture network to support growth.

Lower Hutt Growth Study – Proposed 3-W Servicing Improvements

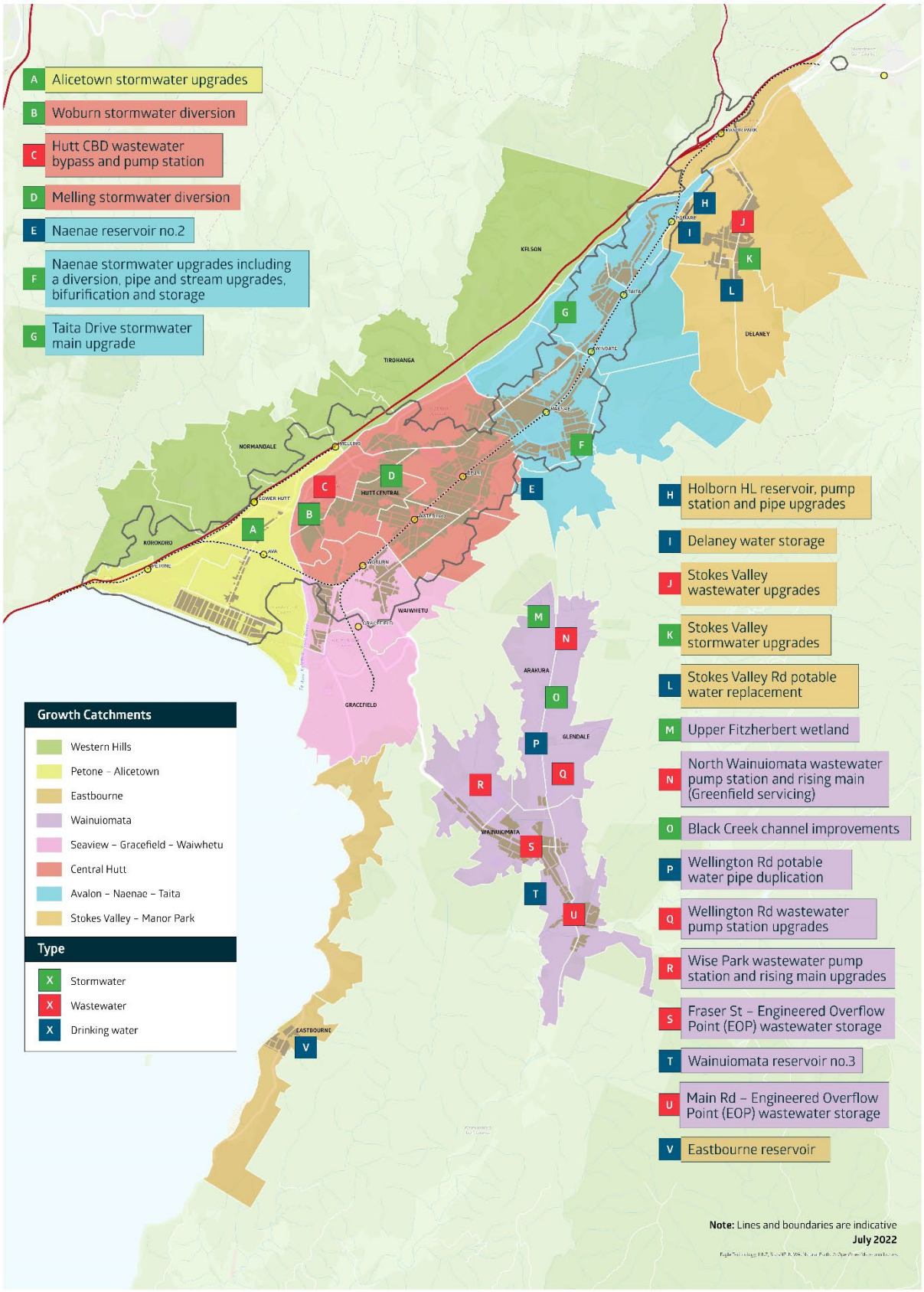

Figure 1: Hutt City Growth Study – Proposed key 3-W servicing improvements

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1. Introduction

1.1 Purpose of this study

The purpose of the Hutt City Growth Study is to assess the anticipated forecast growth in the Hutt City territorial area, and identify three-water infrastructure improvements to accommodate predicted population growth over the next 30-years (2020-2050).

The baseline information in this report provides a strategic overview of current knowledge, and recommendations for subsequent programming of further detailed investigations, business cases, early project development, and where possible, detailed design and delivery.

The information in this study can be used to develop long term planning and investment programmes for the City, such as, and not limited to, Long-Term Plans (LTP), Infrastructure Strategies, Asset Management Plans, and Development Contributions, and Wellington Regional Growth Framework (WRGF), Future Development Plans, Spatial and District Plans.

1.2 Scope of this study

The scope of the study includes:

- Assessing the three-waters upgrades required to support growth within Hutt City Council boundaries (including Wainuiomata).
- Support growth associated with Hutt City Council's Plan Change 43.
- Propose infrastructure servicing for city-level network infrastructure for drinking water, wastewater and stormwater. Refer to box below for categorisation of three waters infrastructure.
- Proposed improvements to address both Level of Service (LOS) and Growth.

There are a number of assumptions and limitations that have been applied to the study which can be found in 5.4.

Categorisation of three waters infrastructure

Three waters infrastructure can be categorised as:

- Regional (Trunk/Bulk) infrastructure – includes the wastewater (joint-venture) trunk pipe that runs the length of the Hutt Valley and connects to the Seaview Wastewater Treatment Plant (WWTP), and the WWTP itself. For water supply this includes water sources, bulk water pipelines and water treatment plants. This level of infrastructure is not included in this study and will be the subject of separate studies.
- City-level network infrastructure – includes upgrades to service growth at a city level, including addressing existing constraints and level of service deficits. For instance a new reservoirs in Stokes Valley, stormwater upgrades in Naenae, or wastewater upgrades across the city to support growth. The requirements for this level of infrastructure are included in this study.
- Local infrastructure – includes infrastructure to service localised areas such as pipes of 150mm diameter or less and other associated local (street or neighbourhood) infrastructure. For instance a small pipe that will need to be upgraded when a multi-unit development is undertaken in Epuni. The requirements for this level of infrastructure are not included in this study. Work on this will be required when pipes are being renewed, or local level developments are planned or being undertaken when more detailed information is available.

1.3 Study Components

The study scope encompasses, the following sub-components:

1. Three waters network constraints and opportunities assessment to enable growth;

2. Three-waters infrastructure options development to service HCC Plan Change 43 enabled development over the next 30 years (2020-2050).

3. Level 1 costs estimates for each identified concept option in accordance with the Wellington Water Cost Estimation Manual.

4. A strategic environmental assessment that identifies contributing factors for where growth impacts the environment via the 3-W networks.

1.4 Growth Study Areas

The study area for this Hutt City Growth Study is all the areas within the Hutt City Council boundaries. To support focuses on eight areas as identified in Figure 2**.** The eight study areas have been developed as a mechanism to provide for ease of reading and presentation of information in manageable sizes. The study areas are consistent with the areas as defined in the Hutt City Development Contributions Policy 2021, with some of the larger areas in the Development Contributions Policy then broken down into smaller areas using suburbs and Statistical Area 2 Units as defined by Statistics New Zealand (see Appendix C.3 for more information on this). Being identified as a study area does not mean the area will necessarily be experience growth or that the projected level of growth for each study area is expected to be the same.

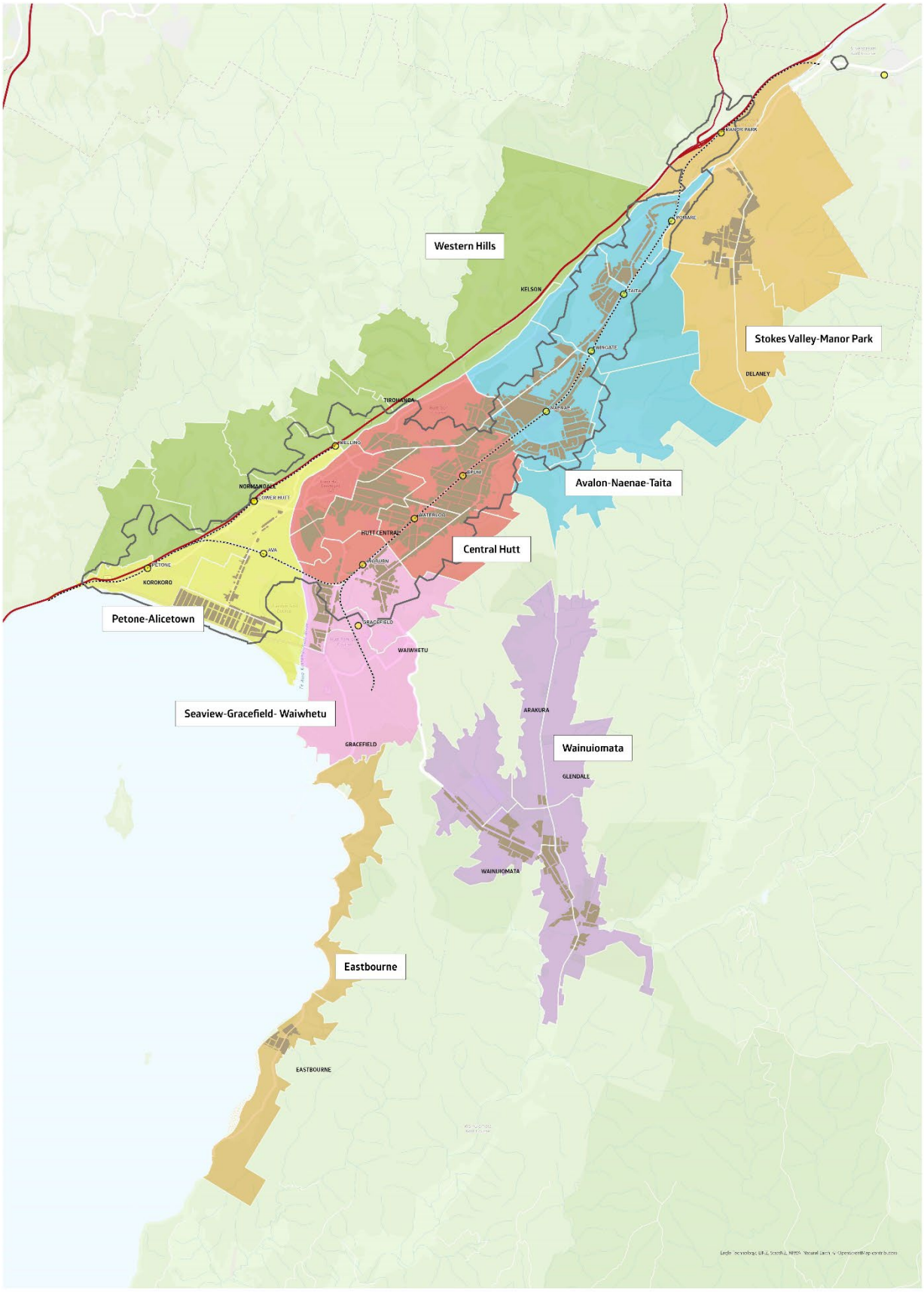


Figure 2: Growth Study Areas

1.5 Growth Assumptions

Understanding the level of housing and business growth expected in Lower Hutt over the next 30 years, or more is an important component of determining the three waters infrastructure requirements and the timing for these. However, population is only one consideration when planning three-waters infrastructure, and other factors such as hydraulic assumptions, network configuration/age, available material sizes, physical constraints, community/iwi views and consenting requirements may alter plans and designs. As designs develop the latest population forecasts and development intentions are used to assess requirements.

The level of growth for modelling purposes were provided by HCC and agreed in March 2020[1] to be used as a key input into all the technical reports undertaken to inform this study, a summary of the population is provided in Table 1.

Table 1: Hutt City Population Forecast (PC43, Forecast ID + Riverlink Dwellings) (HCC, March 2020)

Study Areas	2020	2050	2020-2050
Western Hills	13,310	15,208	1,898
Petone-Alicetown	12,109	13,565	1,456
Eastbourne	4,830	4,733	-97
Wainuiomata	18,510	24,494	5,983
Gracefield - Seaview – Waiwhetu	4,404	4,624	220
Central Hutt	21,945	34,038	12,093
Avalon-Naenae-Taita	19,988	21,694	1,706
Stokes Valley-Manor Park	10,151	11,966	1,815
Total	**105,247**	**130,323**	**25,075**

Since population numbers were confirmed for modelling in 2020 a number of things have occurred:

- COVID-19 and changing migration settings.
- The Wellington Regional Growth Framework has been completed which includes a "Lower Hutt Structure Plan" as an area of growth focus in the region covering the area from Woburn-Naenae-CBD/Riverlink and back across to Woburn.
- The Sense Partner forecasts (2021) developed as part of updating the Hutt City Council Housing and Business Development Capacity Assessment (HBA) shows a projected increase of nearly 49,000 people in Lower Hutt from 2021-2051.

Table 2 provides a comparison between modelled figures agreed in 2020, Sense Partners (2021) and (2022) forecasts.

Table 2: Population forecast comparisons

Population forecast source Lower Hutt Territorial Area	Current population (year)	Projected population (year)	Difference	% increase
Final HCC population numbers – March 2020 – based on PC43 using ForecastID	105,247 (2020)	130,323 (2050)	25,076	23.8
Sense Partners (developed for the HBA 2022) – 50th percentile – as at July 2021	113,905 (2021)	162,811 (2051)	48,906	42.9
Sense Partners – 50th percentile – as at March 2022	112,013 (2021)	153,192 (2051)	41,179	36.8

Note that:

- The Sense Partners (2021) projected growth in Wainuiomata (being a distinct catchment in itself) is lower than the entire urban area of Lower Hutt (projected to be a 33.6% increase in populations from 2021 to 2051).

[1] Note that whilst population forecasts have changed since the growth study was commissioned the modelling undertaken for this work has not been updated. Updating models is a time consuming and costly process, and only one factor in network design.

For further details on the growth assumptions used including comparison between sources, and breakdown of greenfield and infill assumptions, refer to Appendix C.

A faster increase in housing and population growth than first projected and modelled does not have the same implications for each of the three waters infrastructure requirements.

What are the implications from higher levels of population forecasts for the Lower Hutt Growth Study?

The implications for this Study from a higher/faster level of growth than initially projected are:

- Overall – housing development and therefore required three waters infrastructure to support this will occur faster than originally expected when ForecastID numbers were confirmed in March 2020. This has implications for the timing of funding for infrastructure.
- Drinking water – the level of water supply required is impacted by both the increase in population and the amount of water used per day per person. The increase in population forecast figures from the HCC population numbers provided in March 2020 to the Sense Partner forecast provided in July 2021 have been considered and are explored further the Appendix C.3 to this report. In summary, the new Naenae Reservoir No.2 capacity is driven by existing level of service deficit and future population growth.
- Stormwater – the main impact from a higher level of population and therefore dwellings is the increase in impervious surfaces and potential for proposed development on land that is less suitable (e.g. subject to ponding or overland flow paths). Significant impacts on flooding are expected if flood plains are filled in with housing resulting in reduction of storage and further constraining existing overland flow paths. Measures to reduce impermeable areas should be encouraged through water sensitive urban design and hydraulic neutrality measures.
- Wastewater – whilst more people will signal a higher level of wastewater being produced, assumptions on rainfall derived inflow & infiltration (RDII) and the ability to remove I&I from the network through for example pipe renewals and reduced cross-connections is shown to have a significant impact on the theoretical capacity of the network. A continued increase in population in both Lower Hutt and Upper Hutt may result in an impact on the trunk network (i.e., the pipe running through the Hutt Valley to the Seaview Wastewater Treatment Plant and the plant itself). As noted in the introduction section of this report, trunk infrastructure is not considered in this Study and will be evaluated in separate studies. The new strategic trunk model has been prepared using the Sense Partners 2021 forecasts, and will be used to test sensitivity to forecast growth projections.

2. Strategic Context

The strategic context for this study is twofold:

1. There are existing issues with meeting level of service within parts of Hutt City that need to be resolved to meet the needs of the existing population. A summary of the existing issues, are summarised in Section 6, with further details provided in supporting technical reports listed in Section 9.1
2. A need to provide a holistic view of the potential constraints and solutions for three-waters networks to service projected growth enabled under PC43.

HCC with support from wider actors have identified a number of areas for potential growth[2], these include:

- Hutt CBD - Riverlink redevelopment area in association with stopbank upgrades and new Melling bridge
- Greenfield areas including Northern Wainuiomata, Kelson and Stokes Valley
- Naenae town centre
- Waterloo station

2.1 Environmental Context

The environmental context is an important backdrop to growth, as the environment itself, as well as the consenting, legislative and policy framework and proposed (RMA and water) reforms have a significant impact on the standards and expectations placed on three-waters infrastructure into the future. Further details of the environmental context can be found in Appendix A. Climate change will also have an impact on future planning and development controls, particularly in Petone, Seaview and Moera. Appendix B provides details of climate change considerations in supporting technical studies.

Of region wide significance is the Waiwhetu Aquifer which Wellington draws a significant portion of its drinking water from and which sits underneath the Lower Hutt valley floor. The aquifer has environmental protection limits as a drinking water source, and remains at risk of contamination from future development intensification.

2.1.1 Aquifer Source Protection

The Waiwhetu Aquifer is a vital water source for the region (refer to Figure 3). Typically, about 40 percent of Wellington Waters' customer's drinking water is sourced from the aquifer, but this can be up to 70 percent during the summer. The Waiwhetu Aquifer is a natural underground water system located beneath the Hutt Valley and Wellington Harbour. It is generally located between 20 m and 70 m below ground level and is 'fed' by a combination of river and rainwater seeping into the ground and becoming confined beneath its aquitard. Layers of gravel trapped below the aquitard allow for water to flow underground as an aquifer.

Water sourced from the Waiwhetu Aquifer is drawn from eight bores located along the "Knights Road spine" (collectively known as the Waterloo Wellfield) and transferred to the Waterloo WTP via the Waterloo collector main. The bores are approximately 40 m deep with the bore head and chambers located underground. Six of the bores were installed in 1980 and two further were added in 1989.

[2] Note, as certainty over plans and timing for areas tagged for growth develop, associated infrastructure should be reviewed in more detail.

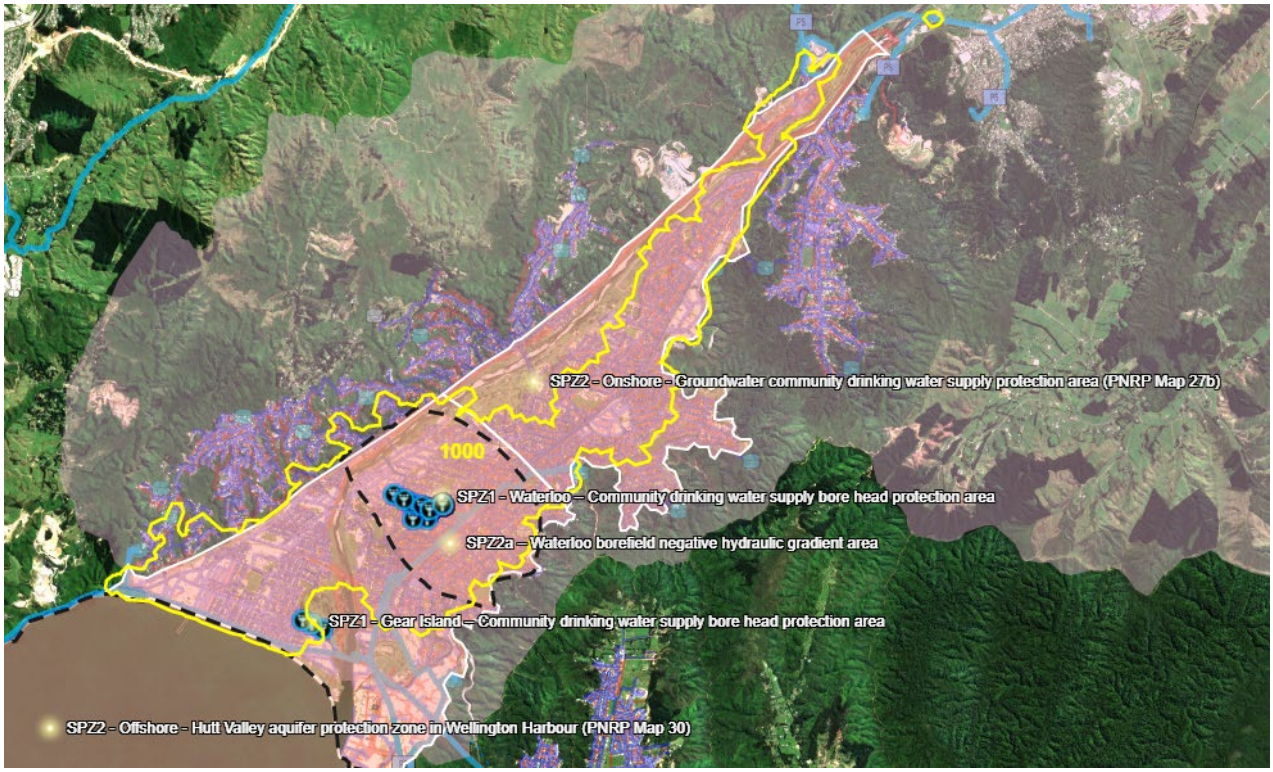


Figure 3: Aquifer Source Protection Zones and Walkable Catchments

What are the implications from this for the Lower Hutt Growth Study?
• Intensification within Source Protection Zone 1 needs to be appropriately managed so that development, in particular activity type and foundation design (e.g. piling) does not result in any negative effects on the aquifer. • Wellington Water has completed a technical assessment on the impact of building height on foundation design within the SPZ1 area to support future development assessments.

2.2 Strategic Environmental Assessment

To understand and recommend options to manage growth on the environment, a Strategic Environmental Assessment (SEA) was undertaken, and the findings of a case study focused on Lower Hutt are presented in Appendix F. The SEA utilised an ecosystems services approach focused on the benefits people obtain from ecosystems using four services of Provisional, Regulative, Supporting and Cultural.

Two scenarios are used in the assessment:

- **Maintain Status Quo Scenario** – Under this scenario environmental impacts have been assessed based on population growth without any specific Wellington Water intervention response other than continuing to meet regulatory requirements (i.e., policy implementation, meeting current consent conditions, implementing new consents and consent renewals) through maintenance of current three waters infrastructure
- **Strategic Intervention Scenario** – Under this scenario impacts of the three waters network on the receiving environment have been assessed assuming a level of intervention has been implemented to reduce significance of impacts.

A summary of the catchments and impacts is provided in Table 3, showing the impact of growth in Lower Hutt on the effects of the three water network operations on specified receiving environment ecosystem services for catchments:

- Wainuiomata & Orongorongo / Headwater / Wainuiomata Estuary
- Hutt River (Middle to Lower)/Hutt Estuary/Petone foreshore through to Eastbourne

Table 3: SEA Catchment and Impacts Summary

Catchment	Impacts
Wainuiomata & Orongongo / Headwater / Wainuiomata Estuary	• It is anticipated that strategic interventions will reduce the significance of adverse impacts in this catchment but the impacts while reduced could still be considered significant (i.e., moderate, or above). • The effect of growth on the wastewater network impacts and stormwater impacts is most significant in the surface freshwater and estuary/CMA receiving environments in this catchment. Generally, impacts on groundwater are not considered to be significant. • The effect of growth on the water supply network impacts is most significant in the surface freshwater receiving environments for Lower Hutt in this catchment.
Hutt River (Middle to Lower)/Hutt Estuary/Petone foreshore through to Eastbourne	• It is anticipated that strategic interventions will reduce the significance of adverse impacts but the impacts while reduced could still be considered significant (i.e., moderate, or above). • The effect of growth on the wastewater network impacts and stormwater impacts is most significant in the surface freshwater and estuary/CMA receiving environments in this catchment. In general impacts on groundwater are not considered to be significant. • The effect of growth on the water supply network impacts is most significant in the surface freshwater receiving environments for Lower Hutt in this catchment. The groundwater receiving environments is also impacted in the Hutt River catchment.

This assessment, can be used to inform an adaptive pathways approach to managing the impacts of growth, using various policies, mitigation measures, and infrastructure solutions depending on the scale of impact. Strategic interventions can range in terms of policy, behaviour-change or infrastructure solutions, but refer to taking action to address issues within a proactive and beyond meeting minimum regulatory requirements.

2.3 Growth Planning Framework

The *Wellington Water Growth Planning Framework* (Figure 4) shows the progression from planning to design & delivery as growth areas develop. Realistically this is a continuous cycle as system assumptions change both spatially and temporally.

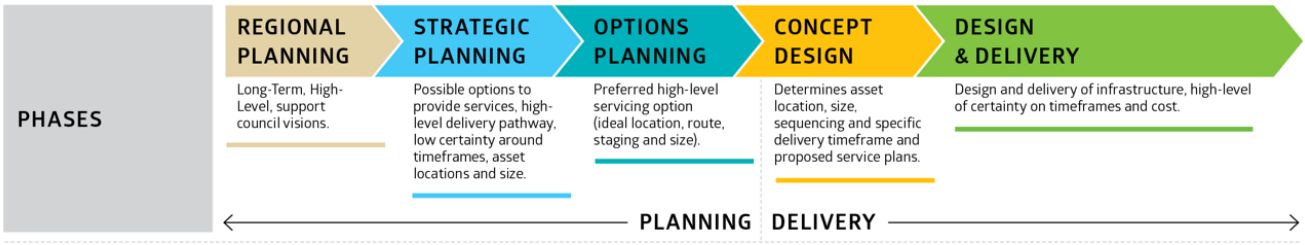


Figure 4: Growth Planning Framework Stages

The focus of the Hutt City Growth study is between the Strategic Planning and Options Planning stages of growth planning. Although options are used for the purposes of costing, these are only considered indicative at this stage as changes are expected when more detail and further information becomes available, which is addressed at the Concept Design stage.

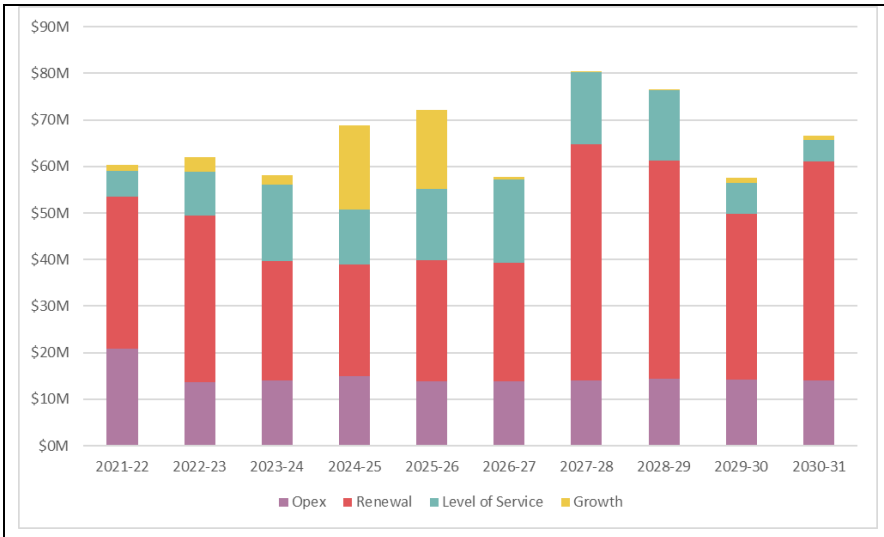
Growth planning in this Study takes the best information available today, knowing that there are uncertainties that cannot be predicted. It looks to understand the dynamic nature of growth and looks at ways to close any existing level of service gaps and to future-proof infrastructure investment interventions.

3. Service Planning and Investment Advice

Wellington Water developed the Regional Service Plan (RSP) to show the connection between the Wellington Water three waters strategy and implementing the operational and capital investment programmes overall and for each council. To support consistent investment advice, a set of priorities was developed as follows:

Wellington Water Strategic Priorities
Priority 1: Looking after existing infrastructure
Priority 2: Supporting growth
Priority 3: Sustainable water supply and demand
Priority 4: Improving environmental water quality
Priority 5: Climate resilience
Localised issues: reducing flood risk, seismic resilience, firefighting water supply

Taking the current regional challenges into account alongside the funding options available, Wellington Water developed an investment plan that outlines HCC key activities and projects to begin bringing levels of service up to performance expectations. Figure 5 shows the 2021 LTP focus of spending consistent with the medium investment plan option provided to Hutt City Council.



- Total capex spend on three waters infrastructure under the medium investment plan over the next 10 years is $512.2 M. $54.7 M or nearly 11% of this is for supporting growth.
- Total capex spend on three waters infrastructure under the medium investment plan over the next 30 years is $1,689.6 M. $141.7 M of this or just over 8% is for supporting growth.

Figure 5: HCC spend on three waters infrastructure over the next 30 years.

What are the implications from Hutt City Growth Study on service planning and investment?

- Decisions on what growth-related infrastructure to invest in from this Study are guided by the Wellington Water Service Goals (which are approved by Hutt City Council as a partner), Hutt City Council key priorities and the Regional Service Plan Strategic Priorities.
- Limits to growth funding and delays in infrastructure provision, comes with residual risks including:
    - Growth cannot occur due to no funding for growth related three waters infrastructure
    - Growth continues to occur, and the current levels of service are impacted i.e., current, and new customers get a lower level of service with Hutt City Council being unable to meet community and environmental requirements; or developers are required to put in place mitigations which result in longer term maintenance liabilities.
- At the time of 2021 LTP, work was not completed to support a full understanding of growth projects. Therefore, outputs from this study, can be used by Hutt City Council and new Entity, to consider in future LTP or Annual Plan changes to provide for new growth infrastructure.

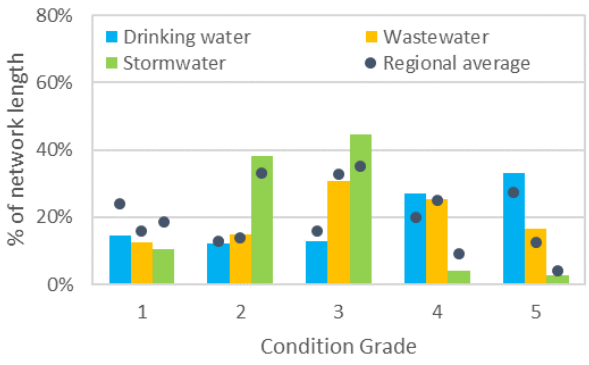
4. Existing three waters network

4.1 Overview of the three waters network

Hutt City Council has significant three-water network infrastructure across its city as shown in Figure 6.[3]

Figure 6: HCC three water assets (fair value)

In Hutt City, there is a sizeable amount of existing, aging infrastructure to look after, as can be seen in Figure 7.



Provisional condition grade	Remaining useful life range[4]	Condition description
1	>/= 75%	Very Good
2	50 – 74%	Good
3	25 – 49%	Moderate / Adequate
4	3 – 24%	Poor
5	</= 2%	Very Poor

Figure 7: Condition of Hutt City Councils pipe network

[3] As identified in Hutt City Council supplement to the Regional Service Plan for Water Services in the Wellington Region – August 2021

[4] Remaining Useful Life percentage range follows similar principals described in IPWEA Condition Assessment and Asset Performance Guidelines Practice Note 7 Water Supply and Sewerage, Table 9 - 2 (Water Mains).

4.2 Water Supply network

The water supply in Hutt City comprises:

- Bulk water supply - Greater Wellington owns the assets involved in the supply of bulk water in the region. In Lower Hutt that includes two water treatment plants, 13 pumping stations and just over 711 km of large-diameter pipeline.
- Water distribution system – this is the part of the water supply with components that carry potable water from a centralised place (e.g., a reservoir) to water consumers in order to adequately deliver water to satisfy residential, commercial, industrial, and firefighting requirements.

Three different water sources are used to supply Hutt City Council area, these are:

- The Te Marua water treatment plant (WTP) which can be fed from either the Hutt River intake or the Macaskill storage lakes. Water is pumped through the bulk network and distributed in Upper Hutt, the northern part of Hutt City, Porirua, and Wellington.
- The Waterloo WTP which is fed from the Waiwhetu aquifer and then boosted though one of two sets of pumps. The "Wellington" pumps convey water towards Wellington/Rahui/Wainuiomata. The "Naenae and Gracefield" pumps convey water towards the Naenae and Gracefield reservoirs.
- The Wainuiomata WTP which is fed from the Wainuiomata and Orongorongo rivers as well as three smaller creeks. Water gravitates to the Wainuiomata reservoirs. Any excess flow is conveyed towards the "Wellington" part of the Lower Hutt bulk network via the Tunnel Grove valve chamber.

The water network is required to meet certain performance criteria such as pressure, firefighting, pipe head losses, storage volume and storage replenishment.

The network to distribute this water through Lower Hutt can be broken down in seven different parts – Stokes Valley, Valley Floor, Western Hills, Eastbourne, Petone and Manor Park. The distribution network relies on a series of pump stations and booster pump stations across Lower Hutt. Figure 8 shows water storage areas (WSA)'s across Lower Hutt against Statistical Area 2 designations.

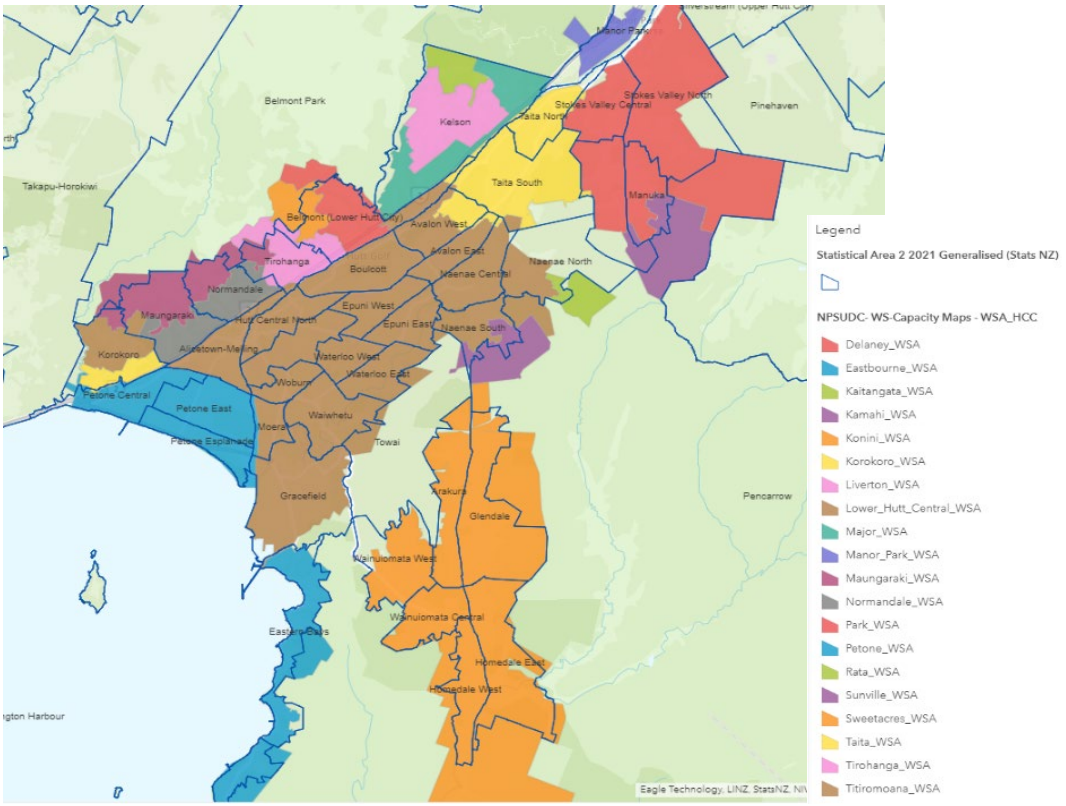


Figure 8: Hutt Water Storage Areas (WSA) v.s. Statistical Area 2

4.3 Wastewater network

The Lower Hutt wastewater catchment combines with inflows from the Upper Hutt catchment in the north and Wainuiomata catchment in the east, to discharge to the Seaview Wastewater Treatment Plant (WWTP).

The Lower Hutt wastewater catchment is approximately 3,200 ha in size and the wastewater network serves an estimated population of 80,865. When Upper Hutt and Wainuiomata are also included the totals are 5,800 ha and 134,000 people. The network consists of approximately 500 km of foul gravity sewers and 36 pump stations (HAL, 2021).

The Silverstream Storage Tank is located at the boundary between Lower and Upper Hutt and provides 10,000 m^3 storage immediately upstream of the river crossing providing some relief during large wet weather flow conditions. When activated, flows across the river are reduced and pumped into the storage tank and released once inflows have reduced.

The existing Wainuiomata wastewater catchment covers approximately 600 ha of predominantly residential land use. The network consists of six pump stations (with associated constructed overflow points), ten network Engineered Overflow Points (EOPs), and four bifurcations.

Two northern areas drain directly to the Wise Park and Wellington Rd pump stations, however, these both have wet weather flows diversions to the south and the remainder of the catchment drains directly to the Wainuiomata Pump Station. The Wise Park PS is the terminal point, from which the entire Wainuiomata catchment is pumped to the Seaview WWTP.

4.4 Stormwater network

Lower Hutt encompasses the following hydrological stormwater catchments as shown in Figure 9 Petone-Alicetown catchment, is located west of the Hutt River. The majority of the stormwater network operates under gravity, either to Wellington Harbour, the Hutt River, or the dead arm of the Hutt River. Five pump stations have been constructed in the Petone-Alicetown Catchment, the last of which was built in 1982. The catchment is also dissected with pressurised stormwater mains that drain areas in the western hills. The most significant of these is the Udy Street culvert, which drains a catchment of approximately 165 ha in the western hills.

- Waiwhetu catchment is defined by Waiwhetu Stream which flows southward from its headwaters in the Eastern Hutt hills to enter the Hutt River downstream of Estuary Bridge. The catchment is approximately 18 km^2, with a main stream length of about 9 km. The headwaters of the stream, in the Eastern Hutt hills, are relatively steep but as the stream emerges onto the valley floor in Naenae the gradient reduces. An estuarine zone of 2 km extends upstream from the Waiwhetu Stream mouth (GWRC, 2004).
- Wainuiomata catchment is primarily drained by Black Creek, which is a highly modified channel running from north to south through the catchment. The western areas of Wainuiomata drain to Parkway Drain before connecting to Black Creek downstream of the Nelson Crescent bridge. Black Creek ultimately drains to the Wainuiomata River to the south.
- Stokes Valley catchment is situated in the north-eastern part of Hutt City. It comprises flat areas of land in the valley surrounded by steep hillsides. The catchment size considered part of this investigation is approximately 1,145 hectares, with an approximate population of 10,151.
- Western Hills catchment is largely undeveloped and consists of vast areas of forest park, and rural properties. Flows from the Western Hills impact the Petone catchment.
- Eastbourne catchment is long and narrow and consists of short catchments, which drain to the sea, and will likely be impacted by sea level rise.

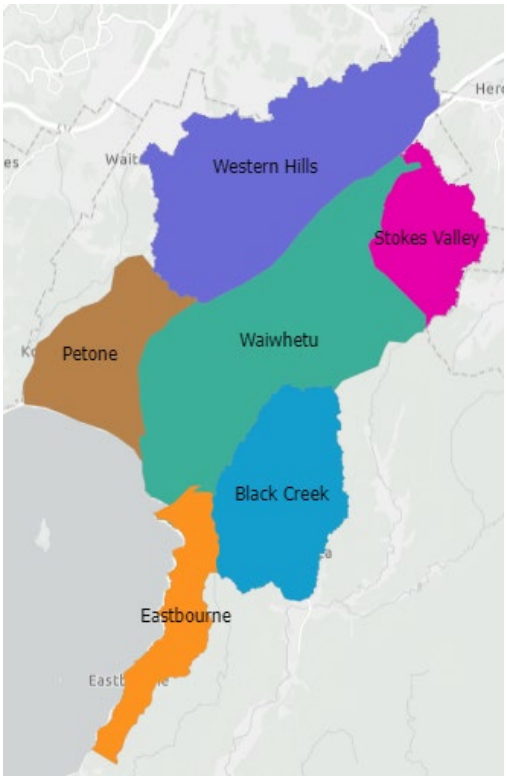


Figure 9: Hutt City Stormwater Catchments

4.5 Level of Service

LOS relates to a set of measures used to standardise customer and regulatory expectations. In this study LOS measures are used to verify that current and future populations will receive the same service. There remain uncertainties over future LOS in some areas especially those relating to environmental standards, such as water quality. Simplistically the gap in the targeted level of service required versus being provided, needs to be filled with water infrastructure and/or services and this comes at a cost.

In assessing existing level of service against a target level of service, several types of gaps need to be considered, as depicted in Figure 10.

- The existing capacity may not meet the current service target.
- The existing capacity may not meet the future service target.
- Apparent decline in capacity to match future service targets due to growth (increased demand) using up existing capacity.
- Changes to environmental requirements or community expectations are not met through existing infrastructure.

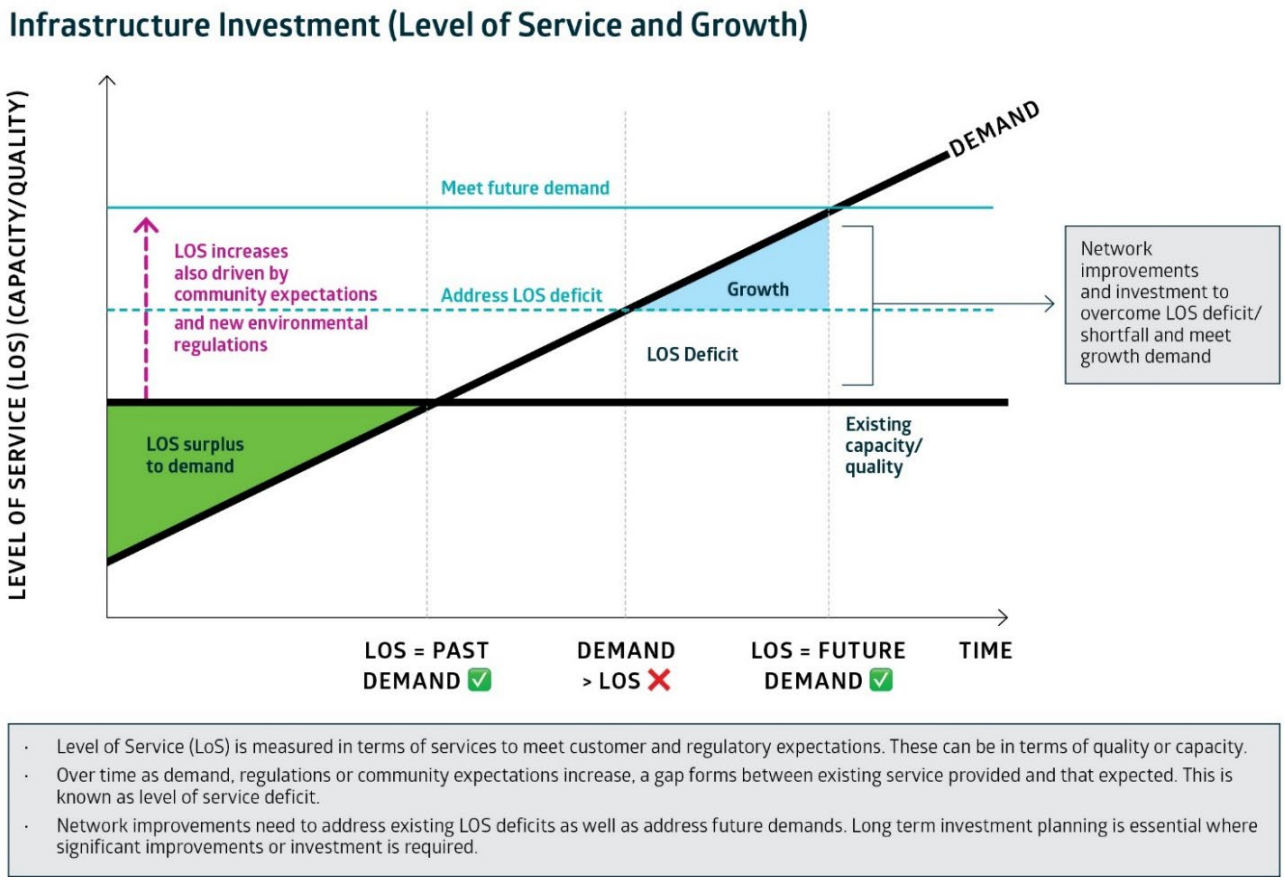


Figure 10: Level of Service and Growth

The following describes the level of service used in the Hutt City Growth Study.

4.5.1 Water Supply Level of Service

Water Supply levels of service are applied based on the Regional Standard for Water Services for:

- Minimum and maximum pressure
- Reservoir storage
- Reservoir replenishment (i.e. time to fill)

4.5.2 Wastewater Level of Service

The target levels of service for this study are:

- Uncontrolled overflows to not exceed a one spill per year wet weather overflow frequency
- Overflows at constructed locations to not exceed an average of two spills per year wet weather overflow frequency.

These levels of service may change in future as further work is completed to understand the community-environmental objectives, and cost-benefit of various scenarios through the consent process.

4.5.3 Stormwater Level of Service

The stormwater level of service used for growth planning are as follows:

- Safe access to and protection from flooding of habitable floors in the 100-year flood event that includes the predicted impact of climate change (20% increase in rainfall intensity).
- Safe access to and protection from flooding for Commercial/Businesses in the 10-year flood event.

In addition to flood protection, water quality considerations need to include the effects of existing and future stormwater networks discharging into the receiving environment. These must be managed in accordance with the Wellington Water Stormwater Management Strategy for the catchments as well as Greater Wellington Regional Council guidelines.

5. Overview of approach

The development and presentation of the findings of the Hutt City Growth Study involved the following key elements.

5.1 Baseline Performance and Constraint Analysis

Given the vast and complex Hutt City three-water networks it was important to start by undertaking a stock-take of existing network performance, including known issues and geographical challenges.

This stage involved:

- Development of constraints maps for each water, for example preliminary flood maps, known water storage constraints, and wastewater overflows shown within models.
- Review and compilation of existing study and options development information so as to make use of previous planning and investigations.
- Review of existing issues with network engineering and operational input to assess confidence and ground-truth modelled issues.

5.2 Option Development

Upon completing baseline performance and constraint analysis the next step was to close gaps in performance knowledge, assess potential causes, identify existing level of service deficiencies and assess the impacts of growth scenarios on the three-waters networks. The process followed was slightly different for each water, and catchment. Option development involves issues/problem identification and confidence assessment; followed by development of long-list of options before short-listing and modelling the outcomes of making changes to the networks to service future growth.

For water supply option development is further advanced due to clear level of service requirements, model calibration and relatively straight-forward nature of the network.

For wastewater, options were developed to achieve an assumed reasonable level of service criteria based on industry practices, however there is potential that performance criteria may change following development of future network overflow consents and regulatory requirements.

For stormwater, we have provided high-level options to address existing issues and support stormwater flooding levels of service driven by habitable floor flooding. The costs of reducing and mitigating flooding can be significant, therefore it is likely that further stakeholder consultation, option development and business case preparation be undertaken to support preferred ways forward.

5.3 Aggregation and Presentation of Findings

The last step in the preparing the growth study findings, was to aggregate and present the findings on the basis of constraints, options and recommendations. This involved compilation of findings of relevant technical options studies into a list and maps.

The findings represent a point in time, and a series of options available to meet the current and future target performance levels to service 30-year growth. It is likely that these options will evolve over time with growth demands, development activity, major infrastructure projects, community expectations and new standards. Therefore, identified projects and programmes should be considered as a set of possible options that will likely change as designs progress, costs are refined and community priorities change. They are our current best understanding to support a pipeline of future projects and investment profile.

5.4 Assumptions and Limitations

There remain a number of assumptions and limitations that have been used to support the development of this study, as follows.

Stormwater flooding areas
The following areas are excluded from the study for stormwater flooding, as these models are still under development, and areas were identified as low growth:

- Eastbourne
- Western Hills

Stormwater quality
Due to remaining uncertainty over the stormwater management strategy and management plans framework; stormwater quality has not been addressed in this growth study. Further detailed catchment level analysis will be needed to support the identification of catchment and localised water quality devices. What we do know is that future standards will likely be much more stringent and require investment in improving water quality outcomes and growth offers an opportunity to advance these objectives.

Population
Population information used to support the development of the growth study is based on the best available information at the time of modelling and option development. It is acknowledged that growth estimates remain uncertain and that there are likely further changes in these estimates based on a range of demographic, economic and regulatory factors. Where possible efforts have been made to assess the impacts of changes in population growth, and to comment on potential sensitivity of options to this growth. It is also important to remember, that as options develop into projects and progress through design and delivery the latest growth information is used.

6. Key Findings – Constraints and Solutions

This section of the report identifies the constraints on the current three waters networks and possible solutions available and costs to resolve these constraints, and provide for growth. For an understanding of solutions by study area refer to Appendix E. Figure 11 summarises the proposed options required to address existing constraints and provide for growth.

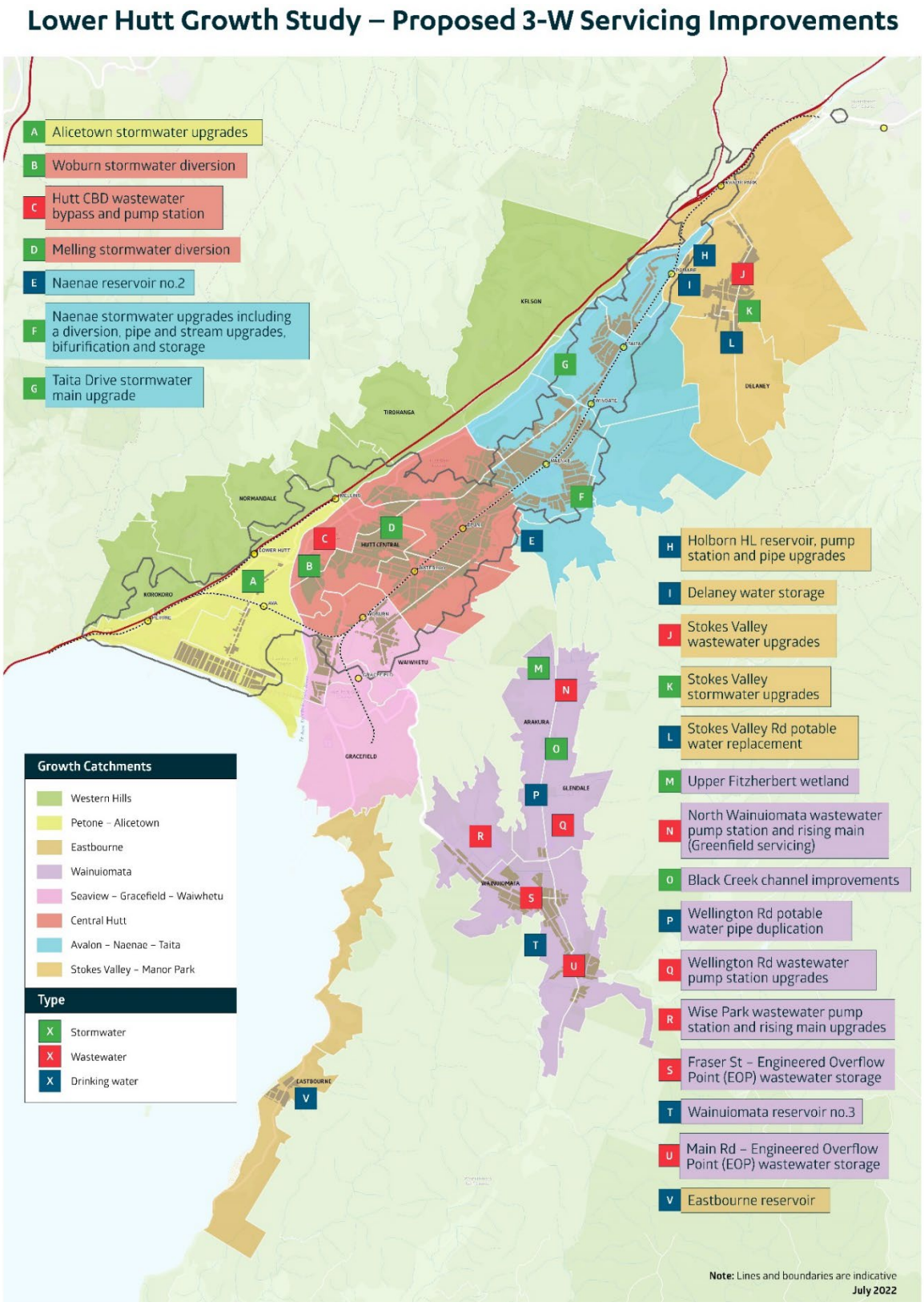


Figure 11: Hutt City Growth Study – Proposed key 3-W servicing improvements

6.1 Scale of infrastructure investment

6.1.1 Three waters costs by category

This study has sought to compile as far as possible a comprehensive list of drinking water, wastewater and stormwater options to support capacity upgrades needed to provide a defined level of service to existing communities and for growth in Lower Hutt over 30-years. At a strategic level, the solutions offered provide a basis to support long-term infrastructure investment planning, and funding discussions with council, agencies, communities and developers.

The overall cost of the three waters solutions presented in this study are summarised Table 4 and Figure 12 and detailed in Appendix D. These cost estimates, represent three-waters infrastructure to address existing level of service deficits, and provide for growth. Noting there may be some renewal components in upgrade infrastructure, but this is expected to be limited given the age of most parts of the network. These estimates exclude condition/age based renewals, compliance drivers (e.g. water quality), Joint-Venture wastewater assets and regional council owned bulk water network.

It is likely further costs will be incurred for local level infrastructure upgrades, e.g. smaller local pipes that may need upgrading or relocating as development progresses.

Table 4: Three waters costs by category

Category	Total cost $M (note 1)	Currently funded in 2021 LTP $M[5]	Shortfall $M
Water Supply (exc. bulk)	191.26	149.1	42.16
Wastewater (excl. JV)	271.13	24.5	246.63
Stormwater (excl. WQ)	810.2	60.0	750.2
TOTAL[6]	**1272.59**	**233.60**	**1038.99**

Note 1: There are a number of exclusions from the total cost, these include:

- 3-waters renewals
- Water supply – seismic strengthening of reservoirs, Manor Park reservoir, and fire upgrades as well as GWRC assets including new source and bulk water system upgrades.
- Stormwater – water quality requirements which will be covered in stormwater network discharges consent requiring the development of Stormwater Management Strategy and Management Plans.
- Wastewater – upgrades required for local networks caused by discrete developments; joint-venture assets; as well as any infrastructure required to meet more stringent containment standards. Containment standards are being developed as part of the wastewater overflows consents collaborative committee.

[5] 2021 LTP advice used findings of technical reports at the time (e.g. Wainuiomata growth study and HCC valley floor ZMP) and used 2019 base rates.

[6] Cost estimates are Level 1 (95th percentile excluding 8% management fee), and use 2020 (revision 11) rates.

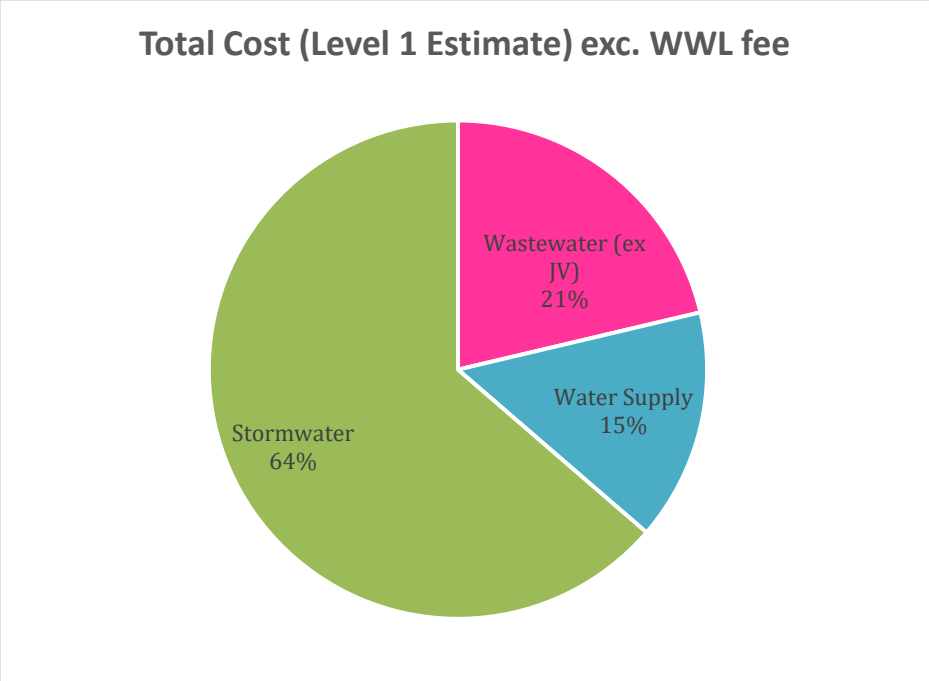


Figure 12: Proportion of costs by category

6.1.2 Cost-Allocation

Understanding renewal, level of service and growth components of projects is best completed at a project by project level and at the time of finalising investment plans, growth models and development contributions policies. Wellington Water have developed a Cost-Allocation process to be completed during investment planning to supporting funding categories (e.g. Renewal, LOS, Growth). This process uses two methods, average cost of capacity and beneficiary split. Average cost of capacity is useful where capacity information (such as volume of storage can be directly correlated to dwellings), otherwise a beneficiary split approach is recommended (in simple terms this splits cost based on growth over the capacity life provided). At a general level the portion of growth expected, e.g. 23.8% by HCC Plan Change 43 (March 2020) or 42.9% Sense Partners (June, 2021) (refer to Table 5) can give a sense of the level of cost recovery that can be expected across the network over time using a beneficiary approach. Where upgrades involve replacement of assets, depending on asset age, a portion may also be attributed to renewals.

6.1.3 Three-Waters Costs by Study Area

Table 5 shows a comparison of the growth study areas, with total cost (excluding WWL fees), and forecast population in 2050. This comparison shows that Stokes Valley-Manor Park and Wainuiomata result in the highest total cost/total population 2050.

This measure should be used for comparison purposes only, due the number of assumptions that have been used to distribute costs for each study area, as these may not fully reflect the contribution each project has towards renewals, levels of service, and growth which should be assessed individually.

Table 5: Three-Waters Upgrades Costs by Study Area and Population Forecast

Study area	Total Cost (Level 1 exc. WWL fee) ($M)	Total Population 2050 (HCC, 2020)	Total Cost/Total Population 2050
Avalon - Naenae - Taita	$181.2	21,694	$8,354
Central Hutt	$274.4	34,038	$8,062
Petone-Alicetown	$91.1	13,565	$6,714
Seaview-Gracefield - Waiwhetu	$24.6	4,624	$5,320
Hutt Valley Floor Sub-Total	$571.3	73,922	$7,729
Western Hills**	$11.6	15,208	$766
Eastbourne	$21.7	4,733	$4,590
Wainuiomata	$311.2	24,494	$12,704
Stokes Valley - Manor Park	$356.7	11,966	$29,812
TOTAL	$1,272.6	130,323	$9,765

Notes:
**These costs include for all existing and new dwellings, and serve as a comparison only for scale of investment based on the projects and growth assumed in this study.*
***note Belmont Park has been excluded from Western Hills due to uncertainty over greenfield servicing.*
****These results are only based on the assumptions used in this report, a range of factors may result in new infrastructure being required, and therefore changing the servicing costs.*

6.2 Water supply constraints and solutions

Summary

The water infrastructure requirements are most affected by the higher than projected population growth figures. Table 6 shows the comparison of total system demand on a peak day between the two population forecasts for Lower Hutt.

Table 6: Comparison of total system demand on a peak day under two population forecasts

Source	2018	2033	2048
HCC Zone Management Plan (2020)	43,436	47,183	49,961
Sense Partners 50th Percentile (2021)	47,271	56,026	63,190

Water Supply Constraint No 1 - Water storage

The water storage capacity for the whole city currently consists of 72.25 ML of storage with the main storage facilities being:

- Naenae, Gracefield and Taita reservoirs which have a combined capacity of 22.6 ML.
- Wainuiomata which has a storage capacity of 9.0 ML.

There is already a shortfall in the water storage in Hutt City that is impacting on existing levels of service, and this will be further impacted by growth. In particular and of most significance, there is not enough water storage volume in the Naenae and Gracefield reservoirs to meet Wellington Water's guidelines and meet modelled growth levels and there is a shortfall in Wainuiomata and Stokes Valley required to meet growth forecasts.

The amount of water storage required both for current storage and going forward is determined by the increase in the population of the city – the faster the population increases, the more demand on current storage and the sooner new storage capacity might be needed.

This projected shortfall as identified by Stantec (2021) is 25.7 ML or approximately 36% of the current water shortage in water storage. Unless a number of water storage solutions are implemented this will be a constraint to growth and continue to impact levels of service.

Figure 13 shows storage shortfall for the city as a whole in three ways - the current shortfall, the shortfall with expected growth levels and no solutions implemented and the shortfall with expected growth with solutions added. It is broken down into Water Storage Areas (WSA).

Points with regards to key[7] water storage constraints in the city are:

- Lower Hutt Central - the shortfall related to modelled levels of growth if calculated by strictly following the guidelines and the WSA extent is very large - around 30 ML. Given the proximity of the reservoir to the water treatment plant and source the required volume to service Lower Hutt Central has been reduced, with a new proposed 15ML reservoir.
- Wainuiomata - there is a predicted shortfall of 8.0 ML of storage volume with growth, to meet the seismic and operational (peak daily demand) levels of service. This will mean almost doubling the current storage volume in this area. Approximately half of this storage volume is needed just to meet current population and demand levels and the other half relates to predicted growth in existing areas and new greenfield.
- Stokes Valley – there is a forecast a shortfall of in Stokes Valley, as a result two new reservoirs are required in Stokes Valley – a 1.5 ML reservoir in Holborn to service greenfield growth in the short term and a 1.2 ML in Delaney in the long term. Both reservoirs address storage issues in Stokes Valley due to growth. Further analysis using Sense Partners (2021) increased population forecasts for the area may increase the longer term shortfall from 1.2ML to 4.2 ML. The size and storage configuration requirement needs to be investigated further.
- Eastbourne - the supply to Eastbourne can easily be interrupted through an operational outage or in a seismic event as the bulk supply crosses liquefaction-prone ground through Seaview. Whilst not a storage size issue, it could impact on supply. The size of this reservoir may need to be increased from the initial estimate of 1.3 ML to 2.2 ML due to increased populations forecasts (Sense Partners 2021) for this study area. A suitable location to place a new reservoir has proven challenging due to the terrain.
- Western Hills - The ZMP (2020) recommended no major investment was required as the shortfall in this study area was small and options available for construction of a new reservoir are limited. The ZMP recommended greenfield developments of in total of 370 lots, be fed by the existing Liverton Reservoir.

[7] Note there are other minor works recommended but these are of a smaller scale and therefore not included in this report. The full information can be found in the Stantec report "Hutt City Water Supply Zone Management Plan (Hutt Valley excluding Wainuiomata) – November 2020".

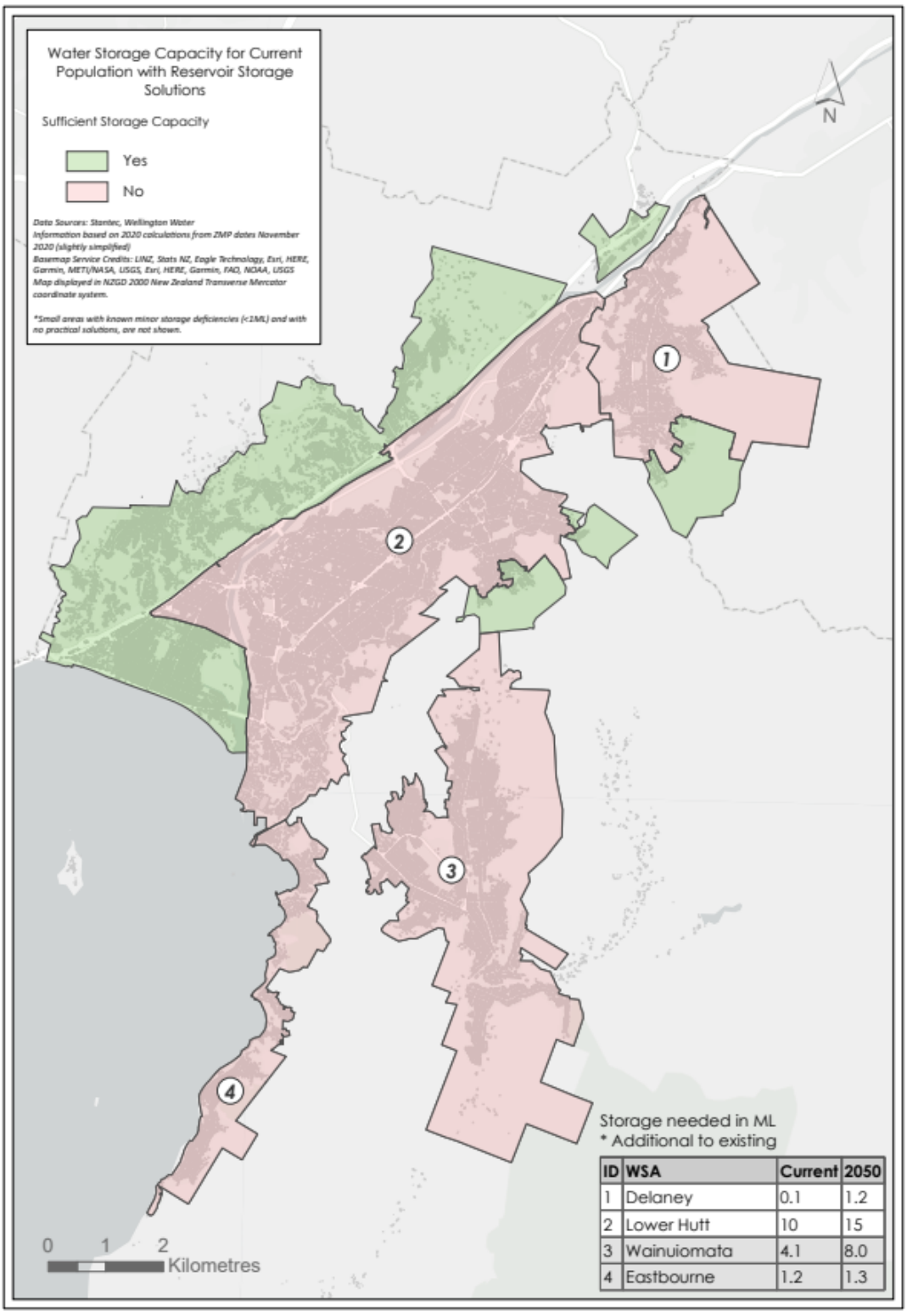


Figure 13: Water storage capacity for current population with reservoir storage solutions based on ZMPs.

Preferred water storage solutions

The preferred solutions to address the calculated storage shortfall in Lower Hutt are:

1. Central Hutt - a new 15 ML Naenae reservoir No.2[8] be constructed beside the existing Naenae Reservoir No.1. This is assumed to be online within the next 5 years. As discussed, 15 ML is less than the shortfall calculated strictly following Wellington Water's storage guidelines due to unique factors associated with the proximity of the reservoir to the WTP resulting in a reduction in the criteria relating to seismic storage. The new reservoir is also contingent on the installation of control valves to enable Operations to manage the transfer of water from the hills in an emergency.
2. Wainuiomata - a new 8.0 ML storage reservoir with the preferred location being adjacent to Fraser Street. This includes creating a new low-level pressure zone. The timing of the reservoir should be reviewed alongside changes in population growth.
3. Stokes Valley – There are two solutions here:
    a. To meet the current storage shortfall a number of options were examined and for the purpose of this study, the assumption is that land would be secured for additional future storage adjacent to the proposed Holborn High Level reservoir needed for greenfield growth.
    b. To meet the total number of new dwellings in the Holborn and Shaftesbury development sites the construction of Holborn High Level reservoir (approximately 1.5 ML) will be required.
4. Western Hills - with the 2021 Sense Partners forecasts, showing increased growth for the entire Western Hills study area, it is now noted that there may potentially be a need for a new reservoir for Normandale and Tirohanga. Both Normandale and Tirohanga are unlikely to contain a site suitable for a new reservoir, but it is recommended that this is confirmed.

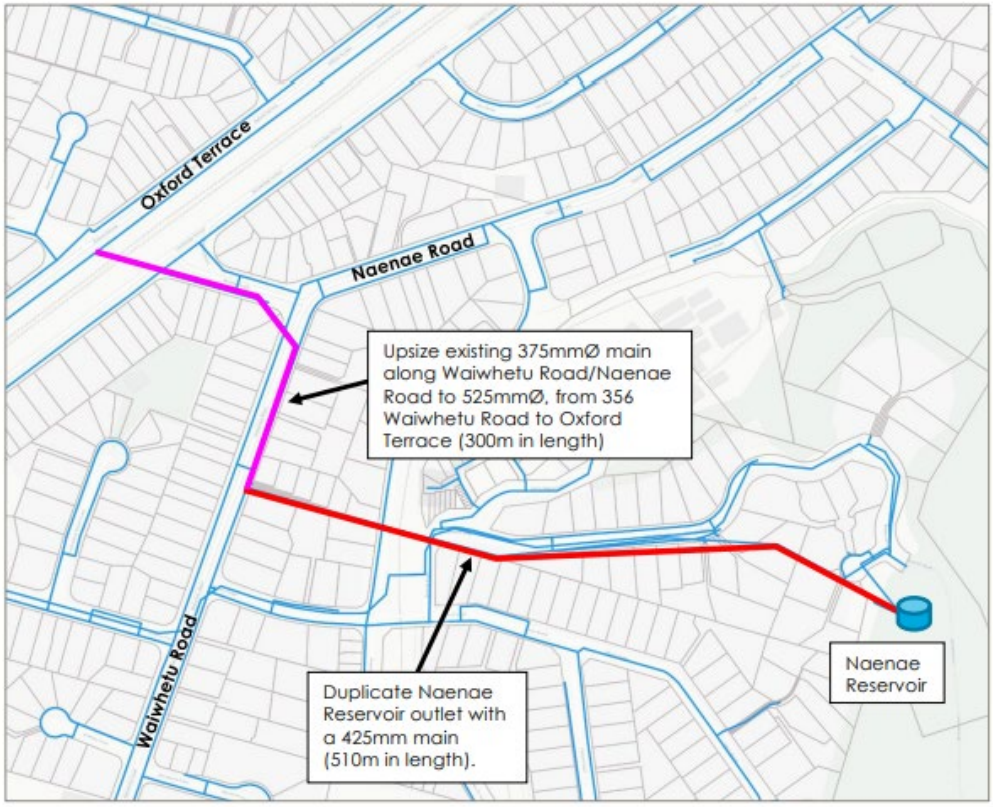


Figure 14: Upgrades to accommodate increased flow through Naenae reservoir outlet main

[8] The size of a reservoir is determined by a number of factors including population growth, seismic resilience, fireflow and water usage levels per person per day

Water Supply Constraint No 2 - Bulk water network connection to the distribution network

A key current feature of the Valley Floor network that needs attention is that the bulk network is connected to the distribution network via three un-metered cross-connections located near the Waterloo WTP.

The key drivers for keeping these cross-connections open, historically, was to maintain sufficient pressure upstream of the Pharazyn Pump Station (this has now been upgraded) and the cross connections also remain open to maintain sufficient pressure to some high-elevation properties.

Maintaining the cross connections open is problematic as it:

- Leads to pressure increase during peak demand.
- Causes undesirable effects on the water quality and safety with lime additive used in the Waterloo WTP tending to precipitate and deposit in the network.
- Causes a reduction in effective pipe diameter and water quality issues.
- Means that the Naenae and Gracefield reservoirs which would normally provide buffers against a possible source water contamination are essentially by-passed – meaning a contamination event not eliminated by the WTP can reach customers directly.

It is essential to close the bulk network cross-connections for water quality and safety reasons. However, closing the cross-connections causes substandard pressures in the Eastern Hills, specifically on the higher elevation properties adjacent to the Rata and Sunville DMAs. Solutions for improving the pressure in these areas are therefore required hand in hand with closing the cross connections and these are covered below in to address water pressure.

Water Supply Constraint No 3 - Water pressure

The current network does not have capacity to maintain sufficient pressure if the water demand increases following the projected population growth. In particular:

1. Stokes Valley - there are two greenfield development sites in Stokes Valley – Holborn (186 lots) and Shaftesbury Grove (120 lots). Both development sites are located at the end of Shaftesbury Grove, a high elevation area within the Kingsley Reservoir pressure zone (~165 m HGL) which is currently experiencing pressure and firefighting deficiencies.
2. Wainuiomata – the pressure across the Wainuiomata network is generally high (up to 100 m), particularly along the valley floor. According to the hydraulic model, the pressure in the network remains above 45m under current demand conditions. In some areas, the pressure is above 90 m, which is outside the target level of service. The proposed developments at the northern end of Wainuiomata will generate a significant water demand. The existing water distribution network has insufficient capacity for proposed developments and upgrades will be required to meet the target level of service for pressure.

Preferred water pressure and bulk water cross connection solutions
1. To enable bulk water cross connections to be closed - numerous network upgrades are required, including 3 km of old AC pipe renewal, 350 m of new pipe, two new PRVs. In the long term (before 2033), it will also be necessary to increase the capacity of the Naenae Reservoir outlet main.
2. Stokes Valley - to address pressure and firefighting deficiencies as well as enable the network to supply to the development sites, it is proposed to construct and install the new Holburn High Level reservoir, install a new pump station adjacent to the Delaney Reservoir, construct a number of dedicated outlet mains (over 2 km in length in total), rezone the existing Holborn DMA into the new Holborn HL DMA and renew the existing AC pipes in the new Holborn PMA (approximately 1.4 km in total length). This upgrade also addresses firefighting deficiencies in Whitechapel Grove and Shaftesbury Grove.

Water Supply Constraint No 4 - Fire flow deficiencies

The current network does not have sufficient capacity to meet the Fire Code requirements in certain areas. This is an existing issue and not directly associated with growth.

Preferred fire flow solutions
1. No upgrade is recommended in some instances e.g., where fire flow is not achieved due to high elevation of properties and most properties not connected to reticulation and have private tanks.
2. A number of fire flow upgrades are suggested, and these can be seen in Table 13.1 on pages 82-86 of the Hutt Valley Water Supply Zone Management Plan (Hutt Valley excluding Wainuiomata) – November 2020.
3. These fire flow upgrades will need to be reviewed and prioritised for funding.

6.3 Wastewater constraints and solutions

Summary

Problem areas were identified throughout the Lower Hutt network, these problem or issue areas range in scale and complexity. In some instances they represent local network constraints and in other cases represented significant constraints or problems. Figure 15 and Figure 16 provide a view of all identified problem areas and Figure 17 and Figure 18 provide a view of the network solutions.

The timing of wastewater upgrades will need to be integrated with the resource consent process for wastewater network overflows.

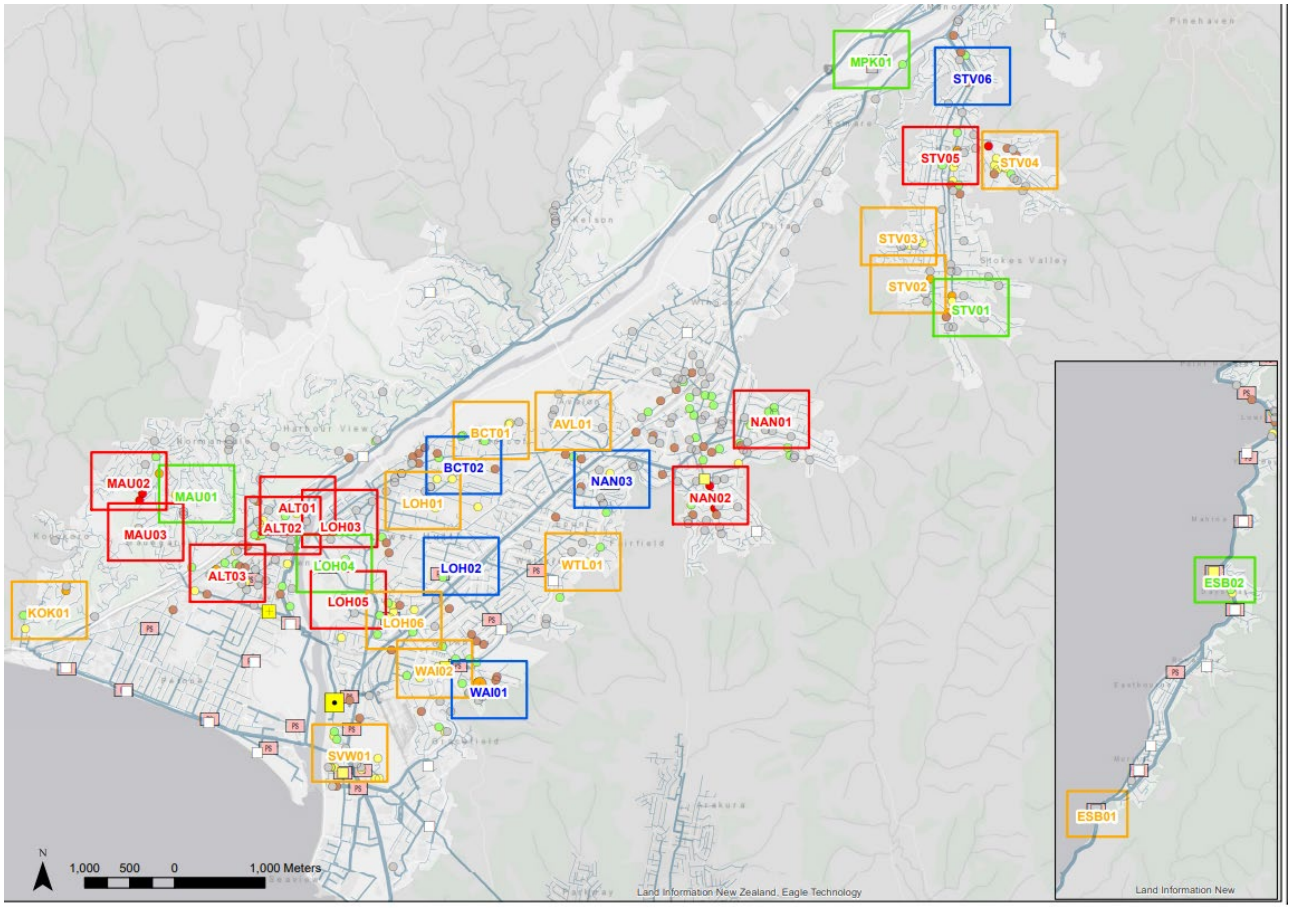


Figure 15: Identified wastewater problem areas (Hutt City Valley Floor excluding Wainuiomata)

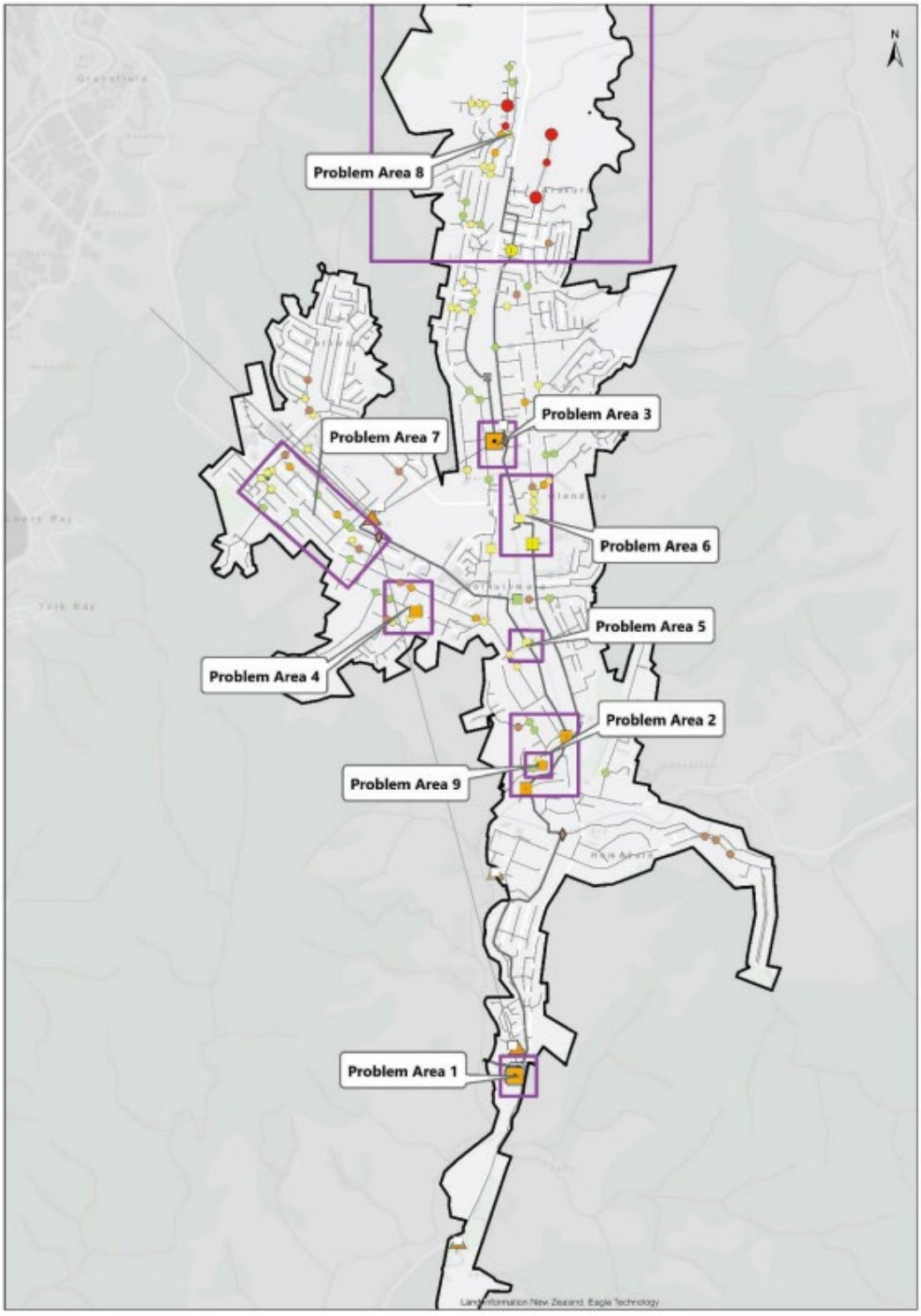


Figure 16: Identified wastewater problem areas Wainuiomata (HAL, 2020)

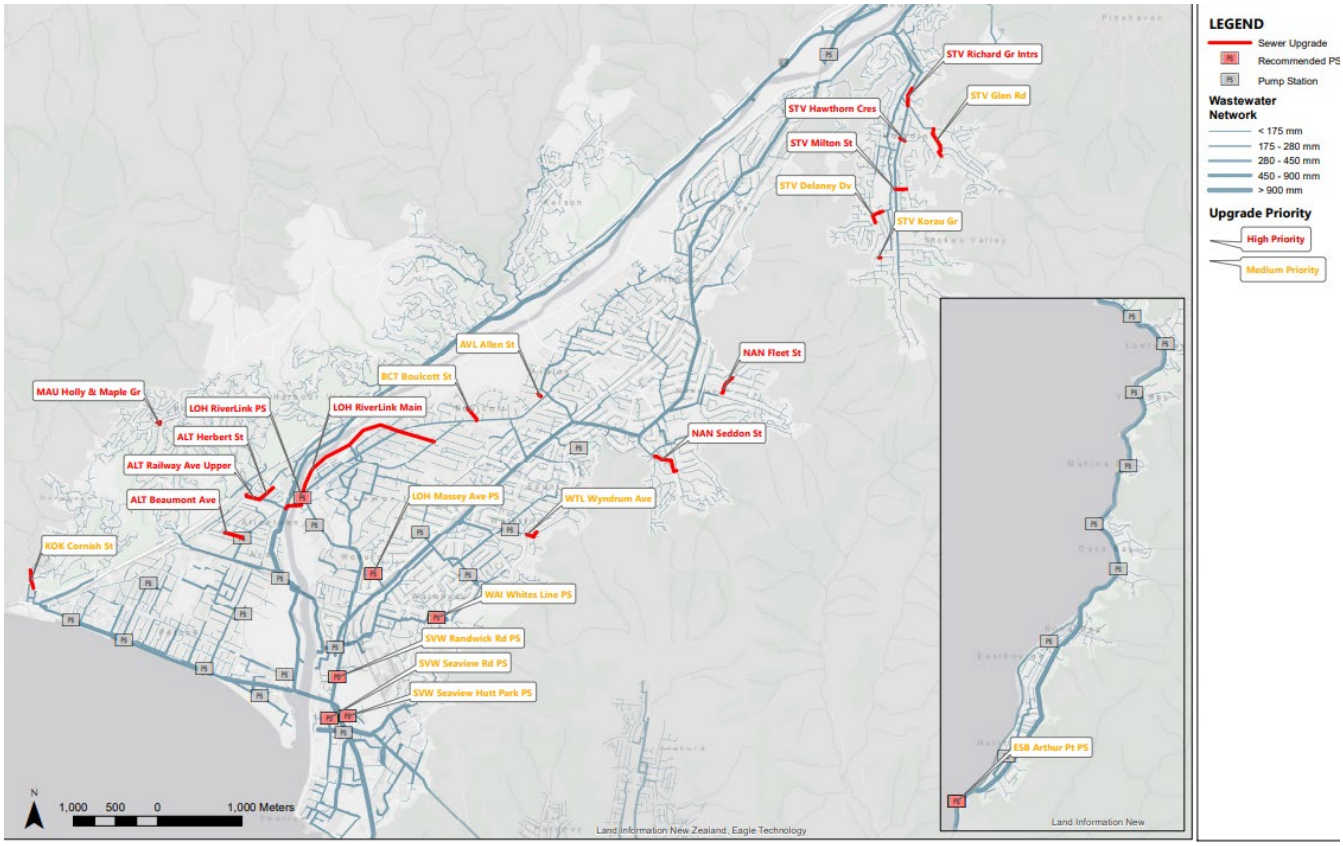


Figure 17: Identified wastewater network upgrades (excluding Wainuiomata) (HAL, 2021)

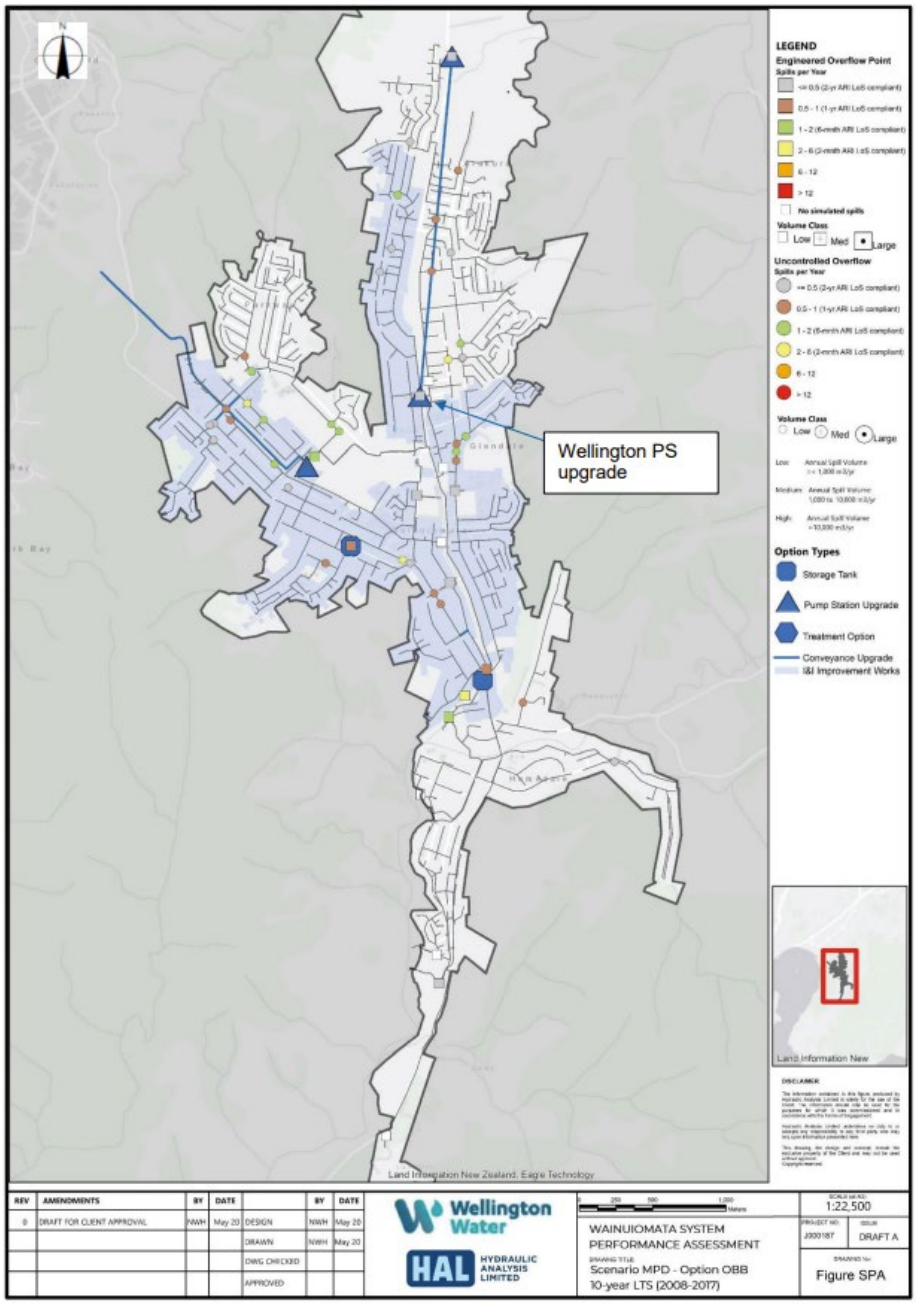


Figure 18: System Performance including Proposed Upgrades (HAL, 2020)

<u>Wastewater constraint No 1 – Alicetown</u>

The wastewater network in Alicetown is aged and in many places in a poor condition. Flooding issues are confirmed by Wellington Water and renewal projects are currently being planned for. A number of pipe sections have inadequate capacity causing relatively steep hydraulic grade lines and large energy losses.

There are the following constraints/issues:

- Williams Grove - manhole is simulated to spill frequently (4.5 spills/yr on average under existing conditions) due to downstream pipe capacity constraints at Herbert Street. Some sections of the network in this area are due for renewal and could be combined with provision of additional capacity. GIS data shows pipe condition grade 5 (i.e., Fail) for half of Herbert St.
- Railway Ave - manhole surcharges frequently (simulated 7 spills/yr on average under existing conditions) due to pipe capacity constraints. Also, other fairly frequent overflows simulated in this area, and static

capacity calculations also indicate potential limitations, as does the existence of a bifurcation. GIS data shows pipe condition grade 5 (i.e., Fail) for all of Railway Ave.

- Beaumont Ave - frequent flooding (simulated 8 spills/yr on average under existing conditions) of multiple manholes in Beaumont Ave, Victoria St and Wakefield St. Wakefield St is affected by elevated levels further downstream and close to Ava PS. Further, there are several bifurcations within the vicinity which makes assessment of the performance of the network complex, but which are indicative of capacity constraints. GIS data shows pipe condition grade 5 (i.e., Fail) or 0 (i.e., not assessed) for most of this network.

Preferred Alicetown solutions
Providing pipe upgrades in Alicetown at Railway Avenue and Herbert Street including a storage tank / large diameter pipe at Beaumont Avenue to mitigate the flooding issues in this area. The proposed upgrades at Herbert Street, Railway Avenue and Beaumont Avenue are expected to be adequate to reduce spiling risk to acceptable spill frequencies. It is recommended that those upgrades are further optimised.

Wastewater constraint No 2 – Central Lower Hutt including RiverLink

The central Lower Hutt area is low lying and very flat and consists of fairly large trunk sewer pipes (up to 600mm diameter). There are a number of trunk wastewater mains close to or below their capacity and result in frequent uncontrolled flooding which are locations at risk of frequent overflowing, especially around Kings Crescent, Woburn Road and Massey Avenue pump station.

The RiverLink urban redevelopment will significantly increase the population in the Hutt CBD and will subsequently put additional pressure on the network capacity.

Preferred Central Lower Hutt including RiverLink solutions
Significant upgrades are required to accommodate the increased flows associated with population growth in the RiverLink re-development area. Due to the flatness of the terrain, upgrading or extending the existing gravity network is not considered effective. A new pump station is proposed near Woburn Road roundabout near Ewen Bridge. This pump station can be installed with a low invert level to provide the opportunity of installing a new trunk main at a fairly efficient gradient (i.e., 0.3%) servicing the RiverLink development. The rising main for this new pump station is proposed to run across the Hutt River to join the main trunk gravity line to Ava pump station. Planned upgrade of the Barber Grove and Ava pump station rising mains are required to allow for the additional discharge from the new pump station. The new pump station (including associated trunk main and rising main) in combination with the proposed upgrade of the Massey Avenue pump station is expected to provide the required future drainage capacity for the majority of the Lower Hutt area (as shown in Figure 19). An alternative option is a new rising main to Barber Grove PS (this would have benefits of being more resilient, but would be 2 km longer). During concept design development these options should be evaluated and a preferred alignment confirmed.

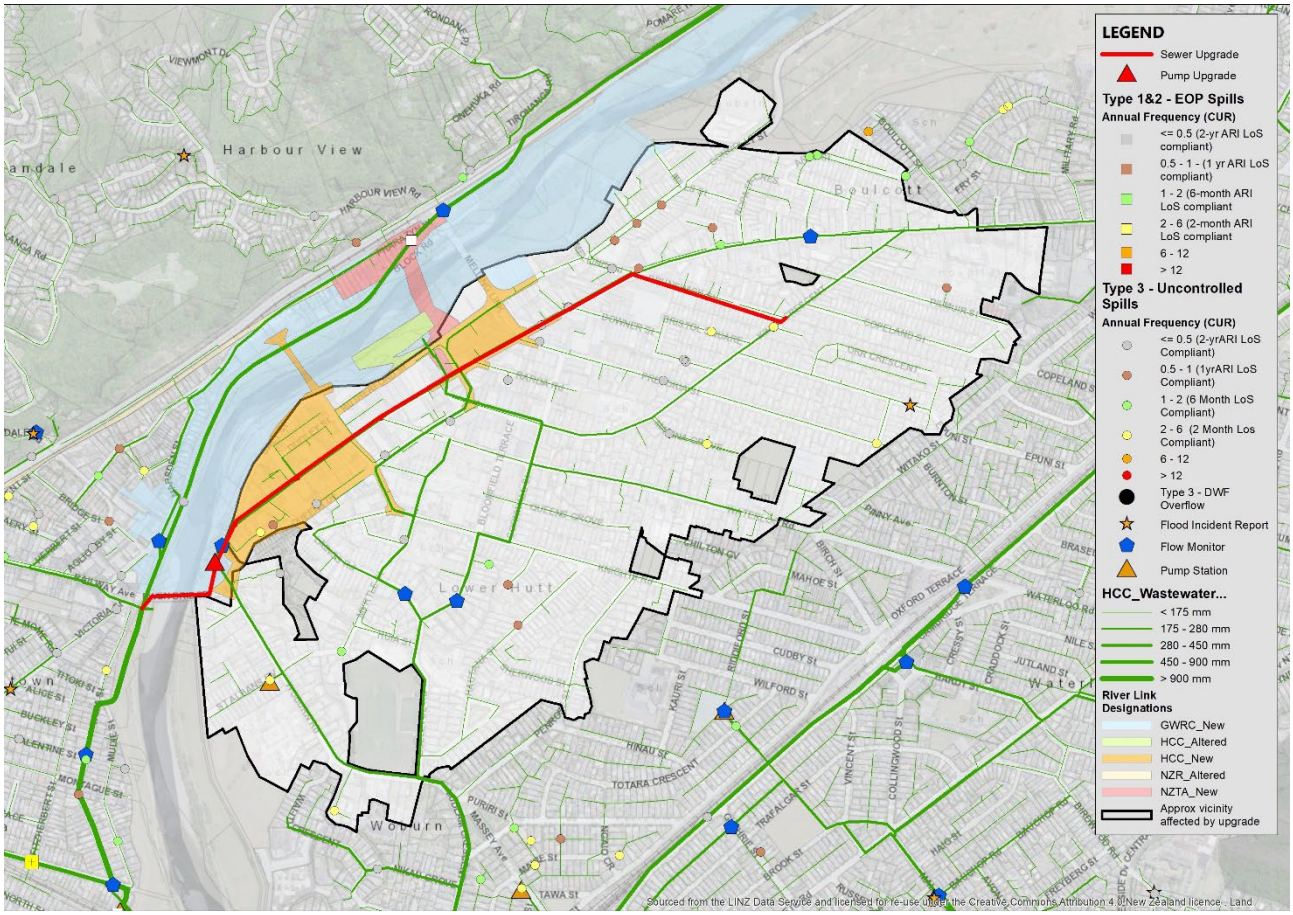


Figure 19: Preliminary extent of capacity improved by modelled Riverlink option

Wastewater constraint No 3 – Maungaraki

The main network constraints are located on a wastewater line installed in a steep valley west of Dowse Drive. Upsizing this line is expected to be complicated and relatively expensive due to access. Providing storage in the catchment is also not considered very effective.

Preferred Maungaraki solutions
I&I investigations are recommended to analyse to firstly quantified existing I&I (as this catchment was not directly monitored during the model calibration) and to assess if I&I reduction could be of some benefit for this catchment.

Wastewater constraint No 4 – Naenae

The suburb of Naenae experiences wastewater capacity constraints resulting in overflows, with some high confidence problem areas.

Preferred Naenae solution
To resolve the problems at Naenae it is required to provide storage options to prevent increasing overflows and flooding further downstream in the catchment. Pipe upgrades and storage is proposed at Fleet Street and Seddon Street in Naenae, which includes a diversion of flows through a new line at Waddington Drive.

Wastewater constraint No 5 – Stokes Valley

The suburb Stokes Valley experiences wastewater capacity constraints resulting in overflows, with some high confidence problem areas. A key constraint in Stokes Valley is the relatively small diameter pipe section at

Stokes Valley Road directly north of the intersection with Rischard Grove and Glen Road. Modelling results show this potential constraint causes backwater issues further up in the catchment. It is acknowledged that the current pipe diameter needs to be confirmed prior to further analysis.

Preferred Stokes Valley solution
Upgrades of the main sewer line at Stokes Valley Road (near Richard Grove / Glen Road intersection) as enabling work for other upgrades at Hawthorn Crescent and Milton Street. Additional asset investigation is recommended prior to further concept development.

Wastewater constraint No 6 – Wise Park pass forward capacity

Wise Park previously had a pass forward capacity of 210 l/s, and was a significant constraint upon the network. Whilst it was not predicted to spill, this is because as water levels at the pump station rise, the Wainuiomata and Wellington Road pump stations progressively shut down through the Remote Telemetry Control (RTC) operation to minimise the risk of wet weather overflows at this location. Modelling completed in 2020 recommended the pump station be upgraded to 300 l/s which has now taken place, a future upgrade will be needed (referred to as Stage 2).

The two main types of issues are:

- Engineered overflow point not meeting the level of service.
- Frequent, uncontrolled wet weather overflows

The Seaview Wastewater Treatment Plant (WWTP) receives flow from Upper and Lower Hutt as well as Wainuiomata. Passing forward additional flows from Wainuiomata will increase the frequency and volume of wet weather overflows at the WWTP, as there are limitations on the capacity of the outfall. Therefore, although passing forward is an option, optimisation of the whole network is required to adequately manage hydraulic capacity of the existing trunk network, WWTP and outfall.

Preferred solutions
Two refined solution sets were chosen from a longlist, an interim upgrade, and a future state upgrade. The assessment of required wastewater infrastructure improvement options which initially was projected to be required within **2033 planning horizon, and with increased growth rates may be required by earlier.** The options include a number of pump stations, inflow and infiltration programme, greenfield servicing, storage tanks and assessment and replacement of laterals. Within the **2050** growth horizon additional wastewater infrastructure improvements include the duplication of the gravity line - from Wainuiomata to Gracefield, further inflow and infiltration work and Wellington Road Pump Station upgrade.

6.4 Stormwater constraints and solutions

Stormwater constraint No 1 – Wainuiomata channels, pipe network and backwater effects

Flooding has been an issue in Wainuiomata for many years. Black Creek is a highly modified channel which was originally designed to convey a 1 in 50-year average recurrence interval (ARI) storm event. However, a hydraulic study undertaken in 2004/2005 found that much of the channel had less than a 1 in 30-year ARI capacity.

It has been identified that flooding in the network is a result of three key issues:

- Undersized channels - the major channels in the network, Black Creek and Parkway Drain, have insufficient capacity for large sections of the channels. The previous channel upgrades did not go far enough to resolve all of the problems associated with insufficient channel capacity.
- Undersized pipe network - the upstream piped network is undersized in numerous locations such as the area around Parkway Drain and upstream of Mary Crowther Park. A number of open channels in the network which drain to Black Creek and Parkway Drain have road crossings with undersized culverts.
- Backwater effects - flow from the network and from overland is unable to enter the channel network at key locations due to backwater effects. For example, this occurs at multiple locations along the western side of Black Creek and around Mohaka St and Parkway Drain.

Preferred solutions
The preferred options through to 2033 are a new Detention / Wetland in Northern Greenfield, Black Creek and Parkway widening and Lees/Fraser and Upper Fitzherbert Pipe upgrade. In addition to the above options, there is a proposed Waiu Stormwater Upgrade for growth through to 2050 (now 2045). The calculated increase in channel capacity as a result of the proposed channel improvements is between 52% and 84%.

Stormwater constraint No 2 – Alicetown-Petone catchment flooding

The Petone-Alicetown catchment is a low-lying area at the southern end of the Hutt Valley and covers an area of 500 ha. It is approximately triangular in shape and is bounded to the northwest by Belmont Hills and State Highway 2 (SH2), the east by the Hutt River and the south by Wellington Harbour.

The catchment is very flat and low lying, with approximately 60% of the catchment area below the predicted future high tide level of 2.1 m RL. The catchment has a history of flooding, with significant events occurring in 2004, 2015 and 2016. Flooding affected both residential and commercial properties.

The five sources of flooding within the Petone-Alicetown catchment are shown in Figure 20 and are:

- Rainfall inside the catchment
- Runoff from the western hill's catchment
- Flooding of the Korokoro Stream
- Flooding due to the high-water level in the Hutt River
- Flooding due to high tide level

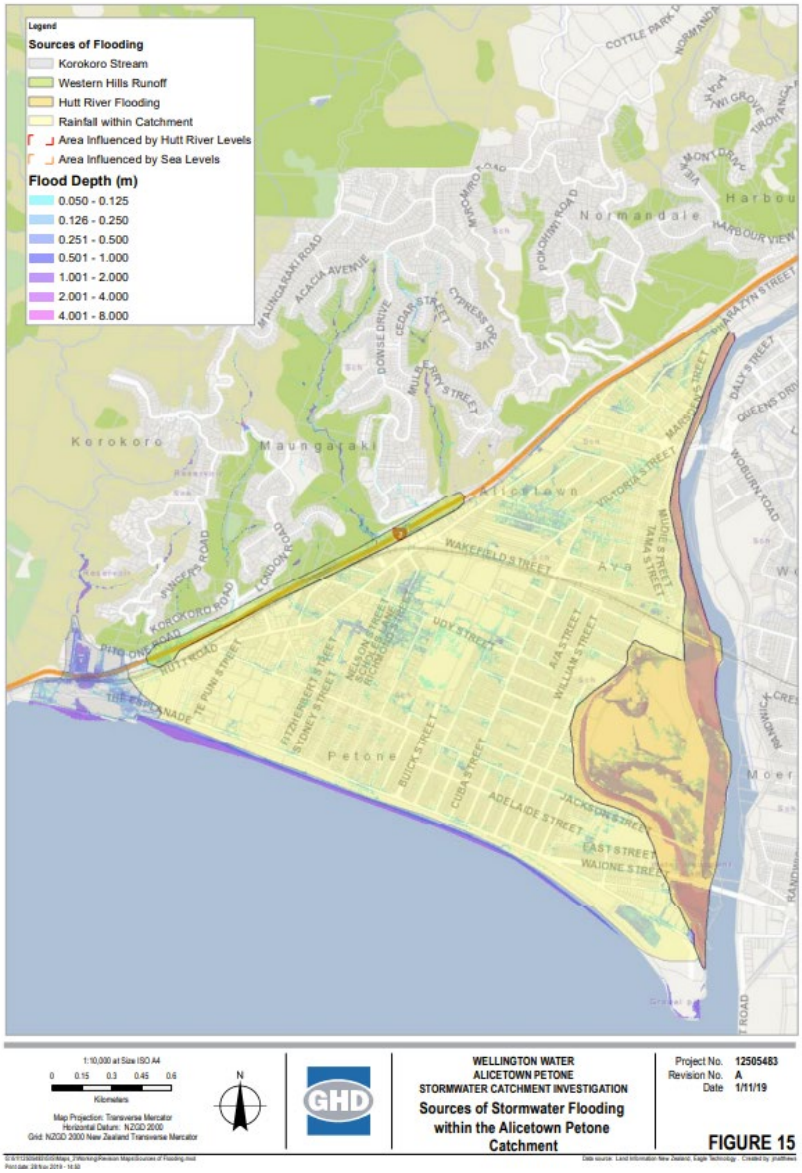


Figure 20: Source of flooding within the Alicetown-Petone catchment

Preferred solutions
The preferred solution is a mix of projects, aspects for further consideration and investigations as below: Projects - Ensure all outlets to the Hutt River have operating flapgates and proceed with the Hume to Victoria culvert project. Considerations including installing non-return valve on all outlets to the harbour, storage or options to reduce and elongate peak runoff upstream of the Udy Street culvert and construction of a pump station at the end of Nelson Street. Investigations including capacity constraints in the network upstream of the Marsden Street pump station, pumpstation upgrade options for Te Mome pump station, upsizing the Nelson Street culvert, Regent Street stormwater main and John Street pump station and the existing Korokoro Stream culvert constraints. Planning controls including building floor level and overland flow path controls are also important to manage risks to new dwellings.

Stormwater constraint No 3 – Waiwhetu catchment flooding

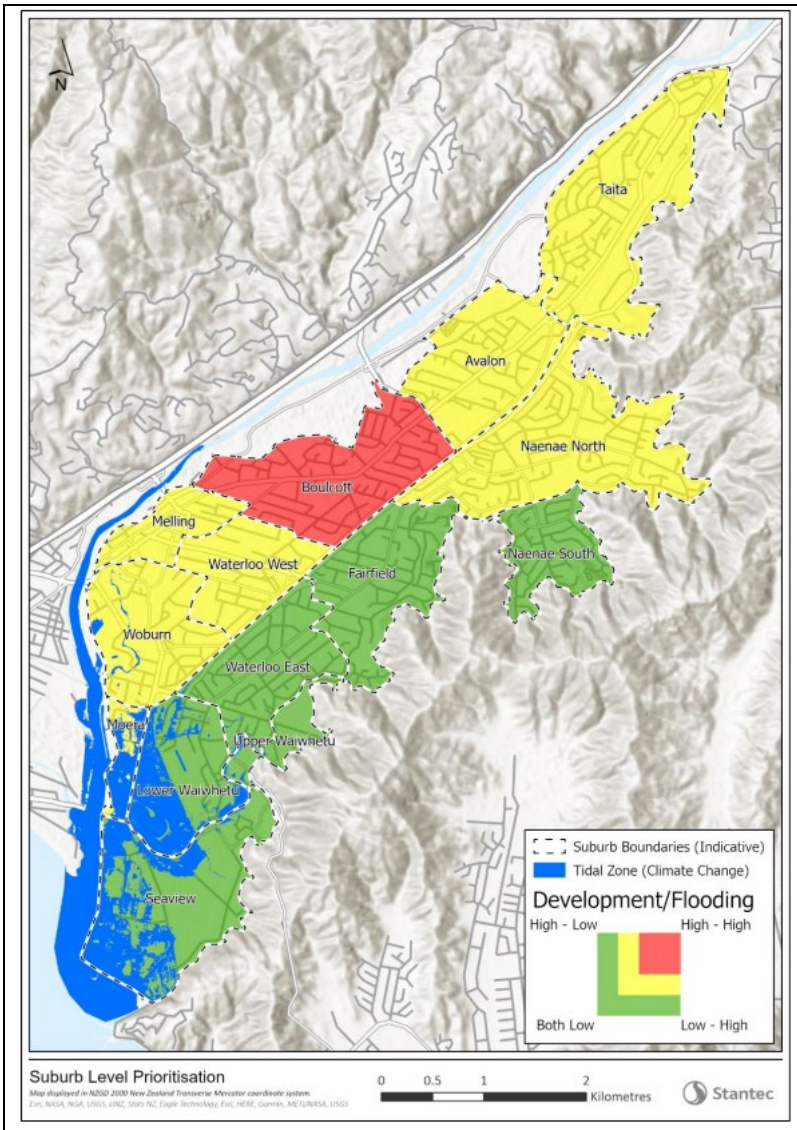


Figure 21: Suburb Prioritisation within Waiwhetu Catchment

The Waiwhetu (sometimes referred to as Eastern Lower Hutt) catchment includes the following suburbs

- Taita
- Avalon
- Naenae North and Naenae South
- Boulcott
- Fairfield
- Melling
- Waterloo West and Waterloo East
- Woburn
- Upper Waiwhetu and Lower Waiwhetu
- Moera
- Seaview

These areas are shown on Figure 21, which also indicates the resulting prioritisation following the assessment of flood risk and growth.

It includes areas that are low-lying which causes them to be prone to flooding.

An assessment was undertaken to understand flooding in the Waiwhetu catchment and identify the key causes of flooding in the area (as shown in Figure 22). This was done by examining reported flooding incidences, examining modelled areas of flooding, and undertaking some catchment-wide conceptual modelling. These are shown in

The main causes of flooding in the Waiwhetu catchment are:

- High inflows (particularly from steep rural catchments in Naenae and Taita)
- Pipe network undersized
- Channels undersized
- Depressions and overland flow obstructions
- High tailwater (Hutt River, Waiwhetū Stream, tide)
- Intake capacity issues (sumps, inlets)

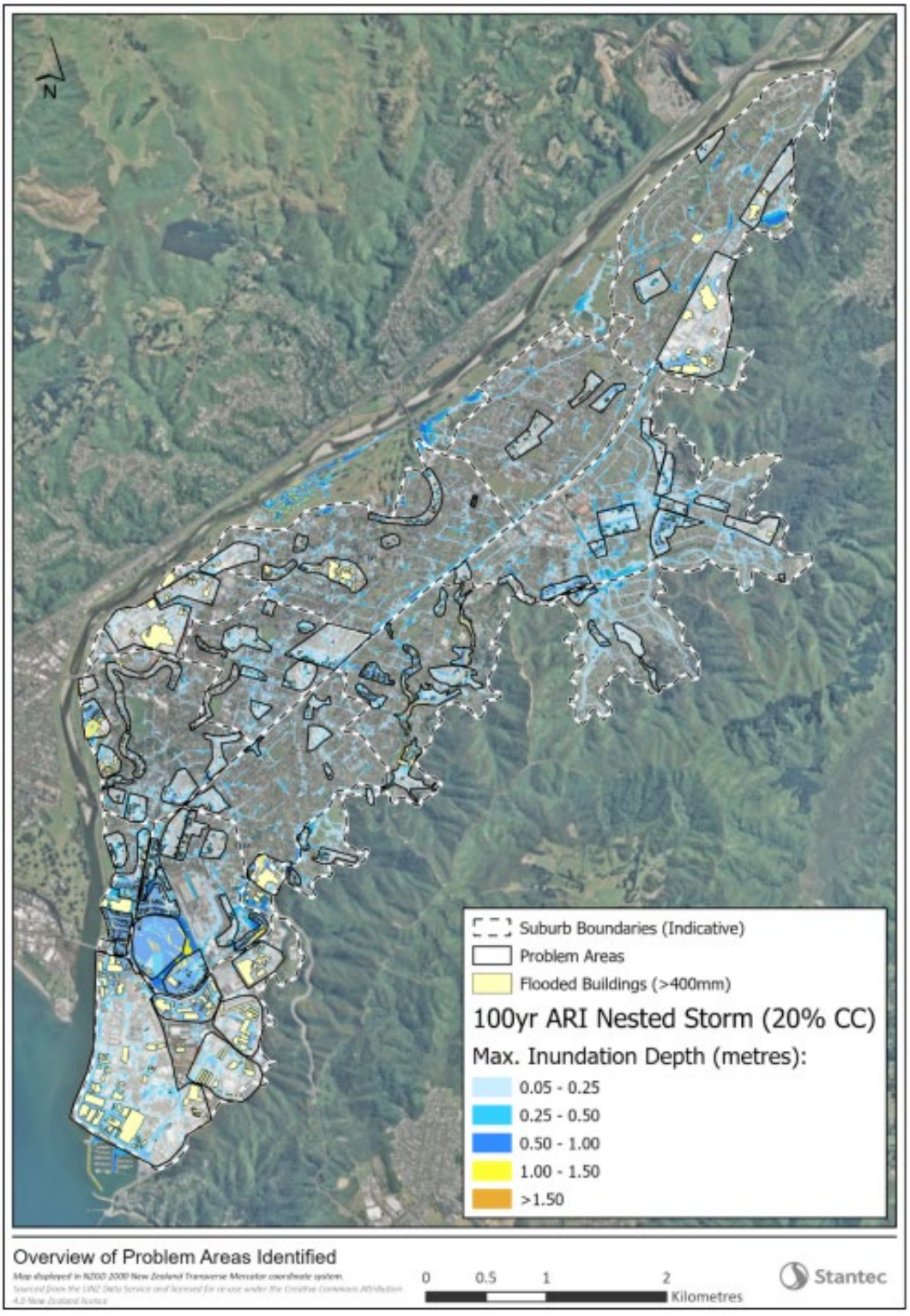


Figure 22: Waiwhetu Problem areas identified as flood prone in 1%AEP + CC event (Stantec 2021)

Work was undertaken to identify flood prone areas and understand the cause, extent and impact of flooding in the Waiwhetu catchment. The Opahu Stream was identified as key constraint to the network with much of the Boulcott, Melling, Woburn and Waterloo West networks discharging to it. The Opahu Stream is relatively small and meanders through residential properties; therefore, it is considered un-feasible to increase the capacity of the stream. Flow diversion from the Opahu Stream directly to the Hutt River has instead been considered.

Preferred solutions
The preferred solutions for the Waiwhetu (otherwise referred to as Eastern Lower Hutt) catchment are listed below and all solutions are shown in Figure 23: • Woburn-Melling - a combination of the Kings Crescent Diversion and the Woburn Diversion + Riddiford St Diversion noting that the Kings Crescent Diversion would likely provide the greatest benefit to the Melling catchment including the 'Golden Triangle' area. • Naenae solutions are independent of each other, and it is recommended all upgrades are undertaken. These are a range of projects including diversions, pipe upgrades, bifurcation, stream updates and detention storage. • Avalon solutions – three options are provided - Taita Drive Main Upgrade (Preferred solution), High Street Soakage Tanks and High Street building Floor Level Raise. • Boulcott solutions – two preferred options are provided - Kingston St Rising Main and High Street upgrade + Pump station. The other options are soakage tanks, floor level raises, pump stations and a stream diversion. • Waterloo West solutions – the preferred option is the Waterloo Rd Rising Main. Other options are floor level raises and soakage/storage.

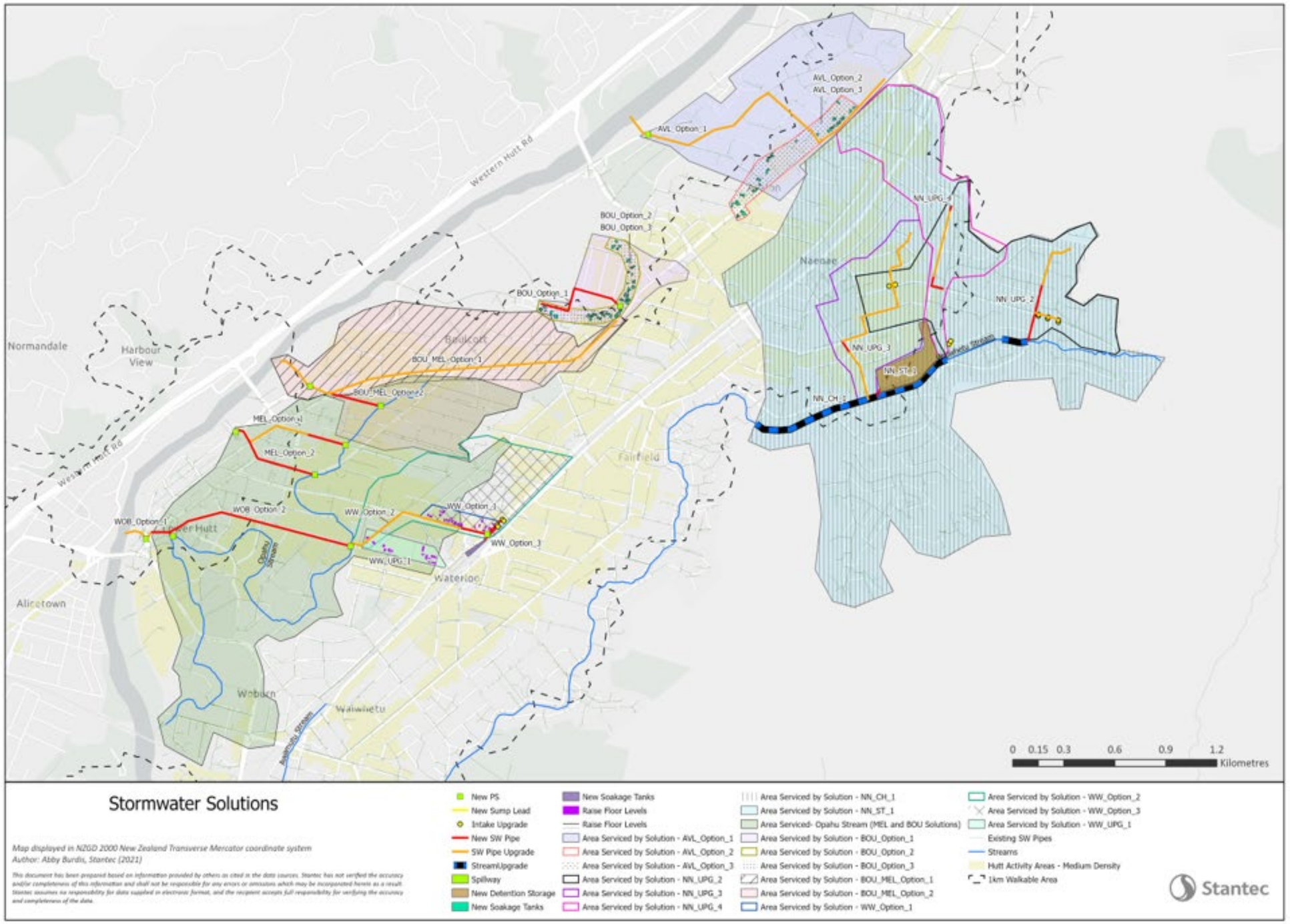


Figure 23: Waiwhetu Stormwater Solutions

7. Observations

Geographical constraints

For Hutt City, geographical features (i.e. flat valley floor, with steep hills, and separate valleys) play an important role in the options and issues to overcome in the provision of three-waters services. For example, with hill catchments draining to a flat valley floor making it more difficult to manage stormwater flooding however easier to provide water storage at scale. The Wainuiomata catchment, being separated from Seaview WWTP by a large hill, results in the need for expensive rising mains and pump stations to remove wastewater.

Common themes continue to emerge from growth planning studies, that brownfield development is less expensive and more incremental than greenfield development. Greenfield developments are typically at the extent of networks and require the installation new and upgrade of existing infrastructure.

To service growth in Hutt City (Lower Hutt), the costs to service Wainuiomata are in the order of $311.2 million in comparison to $274.4 million in Central Hutt, and $356.7 million in Stokes Valley.

Addressing stormwater flooding challenges for Hutt City Council are significant, with estimated costs in the order of $1072 million to meet targets levels of service used in this study for current and new residents. This challenge raises a number of opportunities for more integrated land-use in water sensitive urban design, land-use planning options and guidance to reduce the demands on hard infrastructure solutions.

Dispersed nature of growth

With new residential capacity enabled under PC43, and further enablement required by NPS-UD and medium density residential standards, the opportunities for intensification are significantly increased. This also brings with it challenges, in terms of forecasting and planning three-waters upgrades to support growth which is likely to be more dispersed and difficult to predict.

This more dispersed growth, lends itself to more adaptive and flexible approaches, involving:

- Improving visibility of developer intentions (including scale and timing) to better understand impacts.
- Preparing catchment/neighbourhood plans that developers contribute to implementing, this will be particularly important in large-scale and high-intensification areas.
- Allowing budgets and resources for responsive upgrades to address network constraints and impacts of growth as these arise.
- Using renewals driven programmes as an opportunity to provide for future needs.
- Undertaking programme approaches to remove existing network constraints

Managing bulk and trunk network infrastructure

This study focused on network infrastructure to support Hutt City Council growth, and excludes regional/cross-council assets in bulk water infrastructure; and wastewater joint-venture trunk infrastructure. There is more work to do in this space to manage the regions water and wastewater infrastructure; including managing the timing of future upgrades to manage changes in growth patterns.

Uncertainty and Sensitivity to Change

When planning into the future there will remain a degree of uncertainty. The work completed for this study is based on a set of assumptions, and the best available knowledge at the time. As there are many dynamic factors that influence the provision of future three water services, including future regulatory and community expectations, population growth, funding options and designs progress these are expected to evolve. In the future we are expecting higher community and environmental expectations, and more

severe events (e.g. sea level rise, storm events, droughts) – these will increase the demands and risks to our three-waters networks and may result in higher levels of investment needed.

The recommendations and outputs from this study are intended to provide a consolidated set of options, investigations and recommendations for how to service growth to achieve a defined levels of service.

How has our understanding changed?
This study is the culmination of years of model development, analysis and options development. It is the first time that all of this knowledge has been compiled into a single place to support a holistic view of the network and how it will be impacted by growth. We have been able to use new tools (such as the Waiwhetu stormwater model). New tools and data will continue to become available, and these will support future in-depth understanding of the networks refinement of options and designs.

This study has significantly increased our understanding of the costs involved in managing existing and future three-waters networks.

8. Findings, Recommendations and Next Steps

8.1 Key findings

The key findings from the Hutt City Growth Study, include:

- There is a significant programme of investigative, design, and physical works needed to meet the demands of future growth and bring existing networks to target levels of service. The proposed improvements that have been identified in this study have an associated cost estimate of approximately $1.27BIL.
- The costs estimated to undertake water supply improvements are $191.26M, wastewater improvements are $271.13M and stormwater improvements are $810.2M. These were estimated using the Level 1 Cost Estimate method and using 2020 (revision 11) rates.
- The significant cost estimates for stormwater are attributed to stormwater flooding issues and meeting targeted levels of service assumed for this study (habitable floor levels protected for 1 in 100yr + climate change). The prioritisation of investment for new stormwater infrastructure will need further development factoring in climate retreat/mitigation policies, emerging environmental standards, and community expectations for level of service and affordability.
- The proposed capacity upgrades for city-level network infrastructure are:
    a) Drinking water reservoir storage in Delaney (new), Holborn/Shaftesbury (new), Naenae (new), Wainuiomata (new) and Eastbourne (new).
    b) Wastewater pump station and rising mains in Hutt CBD (new); Boulcott (new), North Wainuiomata (new); Wellington St & Wise Park, Wainuiomata (upgrades).
    c) Wastewater storage at Engineered Overflow Points (EOPs) at Fraser and Main Road in Wainuiomata (new).
    d) Wastewater improvements including regrading/upgrading pipes, increasing pump station capacity, and providing storage to address existing network constraints including in Stokes Valley, Alicetown, Maungaraki, Seaview, Waterloo and Waiwhetu.
    e) Stormwater network capacity improvements and/or flood management in Stokes Valley, Alicetown, Taita, Naenae, Melling, Woburn and Wainuiomata.
    f) Stormwater management improvements for Black Creek channel and Parkway Drive; and a proposed wetland in Upper Fitzherbert in Wainuiomata.

Exclusions from this study include:

- Bulk water source, treatment and distribution
- Wastewater Joint Venture Trunk Network and Seaview WWTP
- Water quality improvements (covered by SMS/SMPs consent)
- Local upgrades to facilitate development

- Due to the relatively flat nature of the Hutt valley floor, servicing this system for water supply is relatively straight-forward, however brings significant challenges for wastewater and stormwater.
- Servicing Wainuiomata and Stokes Valley (although each with their own unique setting) are the most challenging and expensive due to their existing topographical constraints.
- Growth will continue to place pressure on existing networks, and require the need for new investment in each level of infrastructure, from bulk/trunk; to city-level network, and local upgrades. This study has largely focused on city-level network infrastructure, further upgrades may be needed at the time of land development in the local network; and will be required in bulk/trunk infrastructure.
- Changes to urban planning rules and policies will make it more difficult to predict when and where development will take place. This will require more adaptive responses, including policies/standards for new land developments when connecting to the three-waters network, neighbourhood/catchment infrastructure plans and progressive upgrades as areas develop.
- A Strategic Environmental Assessment of growth, identified effects of growth varied depending on water type and receiving environment. In some situations, strategic interventions such as policies, may not be enough, resulting in need for communities to decide on allocation of investment to protect ecosystem services and also provide for growth. Strategic Interventions (or mitigation measures) are actions taken to avoid or minimise adverse environmental impacts. Examples may include caps on water use, increase in requirement for green infrastructure into new urban design, application of new technologies to reduce or improve water systems and sustained, deliberate and coordinated investment to support growth.

8.2 Recommendations

Key recommendations resulting from this study for HCC to consider include:

7. Review and prioritise investment to support growth for 2024 investment plan/strategy.
8. Develop adaptive and responsive strategies to manage uncertainty of growth, including improved data sharing and funding upgrades as growth progresses.
9. Identify opportunities to streamline projects with external infrastructure providers (e.g. Waka Kotahi, Kainga Ora)
10. Progress further policy/guidance work (as per Table 7)
11. Support option development, community engagement and investment cases for stormwater flood management.
12. Support WWL to undertake an integrated wastewater plan for Seaview WWTP and joint-venture network to support growth.

8.3 Further work

Table 7: Lower Hutt Growth Study – Further Work

No.	Further Work	Responsibility
1.0	**Policy**	
1.1	Identify preferred areas and staging of growth within Lower Hutt to better enable prioritisation of spend on three waters infrastructure. At present there is minimal identification of where growth would be preferred and timing which makes it harder to prioritise which three waters infrastructure should be invested in first.	Hutt City Council
1.2	Support Finance & Policy position on local-stormwater flood controls, and target level of service with stakeholders to inform investment. The proposed upgrades are based on the regional water services standard, which have identified significant investment required. Without clear positions on criteria to make an investment decision it is difficult to prioritise these projects.	Hutt City Council
1.3	Policy position required on the use of alternative sewer options, including pressure sewers in Wainuiomata.	Hutt City Council
1.4	Prepare foundation design guide for building near Waiwhetu aquifer.	Wellington Water
1.5	Prepare building on flood plains policy/guidelines. For example, when to have piled foundations and when no filling of flood plains can occur and any minimum width requirements especially along main streams/ flowpaths.	Hutt City Council / Wellington Water
2.0	**Business Case/Investment Planning**	
2.1	Undertake a programme level business case process for the Seaview wastewater system including trunk and Seaview WWTP and outfall given the increase in population forecasts for both Lower Hutt and Upper Hutt; and potential vulnerability to sea level rise and increasing environmental standards.	Wellington Water
2.2	Fund and undertake a business case process for stormwater flooding upgrades required in Lower Hutt, including cost-benefit analysis, willingness to pay for level of service upgrades, and insurance obligations etc.	Wellington Water

9. Information sources and references

9.1 Information sources

This Lower Hutt Growth Study, draws on a range of information sources as presented in Table 8.

Table 8: Information Sources

Name of report	Undertaken by	Version, Date	Purpose/Objectives
Strategic Environmental Assessment (SEA)	Jacobs	Ver 0, July 2021	To assist the assessment of the environmental impacts arising from population growth across Lower Hutt over the next 30 years, specifically as it relates to Wellington Waters response in ensuring continued 3 waters services in the future.
Hutt City Three Waters Catchment Growth Study Including Plan Change 43 - Wainuiomata Catchment	GHD	Ver 3, Dec 2020	To assess the performance of the existing three waters network in Wainuiomata, the impacts the projected population growth will have on the networks and consider catchment scale options needed to meet the required levels of service and population growth to 2050.
Lower Hutt Wastewater Network Options Assessment	Hydraulic Analysis Limited (HAL)	Ver 1, Sept 2021	To summarise the understanding of existing and future predicted system performance capacity issues within the Lower Hutt wastewater network, identify potential upgrade options, and select preferred options to enable growth and mitigate existing network constraints.
Alicetown - Petone Stormwater Catchment Investigation Options Report	GHD	Ver 0, Jan 2020	To undertake a catchment wide investigation into flooding, and options for mitigation, of the Petone-Alicetown catchment. This will provide a greater knowledge of potential flooding in the catchment and provide evidence to inform future spending
Waiwhetu Stormwater Solutions	Stantec	Ver 2, Oct 2021	To assess and identify the stormwater issues and constraints in Waiwhetu (Eastern Lower Hutt), with a focus on areas identified for future growth.
Hutt City Water Supply Zone Management Plan (excluding Wainuiomata)	Stantec	Ver 4, Nov 2020	Zone Management Plan (ZMP), which identifies investigations and capital upgrades required for the water supply network to meet the Level of Service now and in the future. This report focuses on the Hutt Valley, including the Western Hills, Eastbourne, and Stokes Valley, but excluding Wainuiomata.
HCC Water Supply Zone Management Plan (Wainuiomata)	Stantec	Ver 1, May 2020	Hutt Zone Management Plan (ZMP), which identifies investigations and capital upgrades required for the water supply network to meet the Level of Service now and in the future. This report focuses on the Hutt Valley, including the Western Hills, Eastbourne, and Stokes Valley.

Name of report	Undertaken by	Version, Date	Purpose/Objectives
Wainuiomata Stormwater Model Options Assessment Report	GHD	Dec 2020	To assess and identify the stormwater issues and constraints in Wainuiomata, with a focus on areas identified for future growth.
Wainuiomata Wastewater Growth Options Report	HAL	June 2020	To summarise the understanding of existing and future predicted system performance capacity issues within the Wainuiomata wastewater local network, identity potential upgrade options, and select preferred options to enable growth and mitigate existing network constraints.
Stokes Valley Catchment Stormwater Flood Mitigation Investigation Report	Calibre	May 2022	Investigation and hydraulic modelling for the Stokes Valley stormwater catchment to provide concept design solutions to mitigate identified flooded areas.

9.2 Abbreviations

Table 9: Abbreviations

Abbreviation	Description
ARI	Average recurrence interval
CAA	Climate Adaptation Act
CC	Climate Change
DMA	District Metered Area
ELH	Eastern Lower Hutt
EOPs	Engineered Overflow Points
HBA	Housing and Business Development Capacity Assessments
HCC	Hutt City Council
LOS	Level of Service
LTP	Long Term Plan
ML	Mega Litre (a million litres)
MLD	Mega litres per day
MPD	Maximum Probable Development
NBA	Natural and Built Environments Act
NPSUD	National Policy Statement on Urban Development
PC43	Plan Change 43
RiverLink	Project encompassing Melling Interchange & River Stopbank Upgrades
RPS	Regional Policy Statement
SEA	Strategic Environmental Assessment
SPA	Set Pair Analysis (model)
WRGF	Wellington Regional Growth Framework
WSA	Water Storage Area
WTP	Water Treatment Plant

WWTP	Wastewater Treatment Plan
ZMP	Zone Management Plan

9.3 References

Table 10: References

Title	Author (year)	Link
Wellington Regional Standard for Water Services	Wellington Water (2021)	https://www.wellingtonwater.co.nz/contractors/technical-information/regional-standard-for-water-services/
Flood hydrology of the Waiwhetu Stream	Greater Wellington Regional Council (2004)	http://www.gw.govt.nz/assets/council-publications/Flood%20Hydrology%20of%20the%20Waiwhetu%20Stream%20Screen%20Version%20.pdf
HCC Provided Population Forecasts for PC43 (2019/2020)	Hutt City Council with Forecast ID Inputs	

9.4 Definitions

Table 11: Definitions

Level of service expenditure	Capital expenditure that is required to bring the infrastructure service provided to the existing community up to the adopted level of service. This is also called backlog expenditure.
Renewals expenditure	Capital expenditure that renews existing infrastructure assets or replaces them with modern assets of the same capacity.
Growth expenditure	Capital expenditure that provides for growth such as upgrading to, extending networks, or providing new services and/or capacity at the adopted level of service.

APPENDICES

APPENDIX A: CONTEXTUAL INFORMATION

A.1 Environmental context

Environmental Consenting Framework

On behalf of its client councils, Wellington Water is responsible for obtaining and implementing resource consent applications under the Resource Management Act 1991 (RMA). In addition, Wellington Water also inputs to resource management policy and plan development processes to ensure that provisions relating to three waters management are appropriate and enable the delivery of these services in accordance with the organisation's Statement of Intent.

Table A-1 outlines a number of environmental aspects and key resource management challenges that need to be considered and taken into account when responding to and planning for growth. Some of these are still underway or the outcome of them is unknown.

Table A-1: Environmental and resource management challenges

What	Explanation
Whaitua te Whanganui-a-Tara Implementation Plan (WIP)	This is a catchment based set of recommendations for achieving Te Mana o to Wai developed by community members, local authorities and mana whenua. It will form the basis of upcoming Regional Plan changes and has a number of detailed recommendations relating to three waters infrastructure.
RC-1 Seaview WWTP intermittent discharges and associated infrastructure	The consents for the discharges to the Waiwhetū Stream expired in 2018 and replacement consents are currently being processed. These consents are required because, during heavy rainfall events, when stormwater enters the wastewater network, the ocean outfall from the treatment plant has insufficient capacity for the additional flows. The excess flows (diluted by stormwater) are discharged to the lower Waiwhetū Stream. That overflow pipe has also been used from time to time to divert treated wastewater to enable maintenance work on the main outfall pipe (MOP).
RC-4 Wastewater network consents	Wellington Water is preparing resource consent applications to address our existing overflows of untreated wastewater from the network. These consents will be on catchment wide scales, with one covering all of Hutt Valley.
RC-9 Global stormwater consent, stage 2 – metropolitan area	The existing consent for discharges from the stormwater networks in Wellington, Lower Hutt, Upper Hutt and Porirua expires in November 2023. A Phase 2 replacement consent needs to be lodged in May 2023. This application needs to be accompanied by stormwater management strategies for each council's network.

What are the implications from this for the Lower Hutt Growth Study?
• The Wellington Regional Natural Resources Plan will consider recommendations from the Whaitua. This may result in new targets or environmental limits which the network and those connecting to it are required to comply with. This may result in more stringent requirements for growth. • The wastewater network consents will define the regulatory framework for how network overflows will be managed. This will have an impact on the target levels of service that new infrastructure will be required to meet. • The stormwater management strategies and subsequent more detailed catchment management plans will detail the water quality interventions required to achieve agreed outcomes in each catchment. This may require future network infrastructure or require developers to incorporate mitigations or design elements (e.g. Water Sensitive Urban Design) in order to connect to the public stormwater network.

A.2 Legislative and Policy Context

An increasing amount of legislative and policy direction either has been developed, is underway or is proposed. This section considers the requirements of these directions where known and identifies any implications for the Lower Hutt Growth Study.

Table A-2 provides an overview on direction that either does or has the potential to impact on growth related to three waters infrastructure requirements.

Table A-2: Summary of relevant legislative and policy context

National or regional statutory document	What is this?	Timing
National Policy Statement on Urban Development (NPSUD)	The NPSUD is designed to improve the responsiveness and competitiveness of land and development markets. In particular, it requires local authorities to open up more development capacity, so more homes can be built in response to demand. The NPSUD provides direction to make sure capacity is provided in accessible places.	The NPSUD is active. 20 August 2022 is the deadline for Tier 1 and 2 councils (which includes Hutt City) to notify intensification plan changes.
Natural and Built Environments Act (NBA)	This is the core piece of legislation to replace the RMA. The purpose of this Act is to enhance the quality of the environment to support the wellbeing of present and future generations. This would be achieved by: • Promoting positive outcomes for both the natural and built environments. • Ensuring that use, development, and protection of resources only occur within prescribed environmental limits ensuring adverse effects of activities on the environment are avoided, remedied, or mitigated.	An Exposure Draft (an early look at key parts of the new NBA) was released for comment in mid-2021. The NBA bill is to be introduced to Parliament, along with the Strategic Planning Act bill, in early 2022. It is intended these bills will be enacted this parliamentary term.
National Planning Framework (NPF)	Under the NBA this Framework will provide a set of mandatory national policies and standards on specified aspects of the new system. These will include environmental natural limits, outcomes, and targets.	The NBA Bill will contain transitional provisions to address how this requirement applies to the preparation of the first NPF.
Strategic Planning Act (SPA)	This Act will provide a strategic and long-term approach to how we plan for using land and the coastal marine area. Long-term spatial strategies in each region will be developed to identify areas that: • Will be suitable for development • Need to be protected or improved	The SPA bill is to be introduced to Parliament in early 2022. It is intended these bills will be enacted this parliamentary term.

National or regional statutory document	What is this?	Timing
	• Will need new infrastructure and other social needs such as hospitals and schools • Are vulnerable to climate change effects and natural hazards such as earthquakes.	
Climate Adaptation Act (CAA)	This Act will support New Zealand's response to the effects of climate change. It will address the complex legal and technical issues associated with managed retreat and funding and financing adaptation.	The aim is to have the CAA being passed into law in by the end of 2023.
Essential Freshwater Package including the National Policy Statement Freshwater (NPSFM)	The Essential Freshwater package introduces new rules and regulations to: • Stop further degradation of New Zealand's freshwater resources and improve water quality within five years • Reverse past damage and bring New Zealand's freshwater resources, waterways, and ecosystems to a healthy state within a generation. New National Environmental Standards for Freshwater and a new National Policy Statement for Freshwater Management will prevent further loss and degradation of freshwater habitats and introduce controls on some high-risk activities.	These came into force on 3 September 2020.
Regional Policy Statement (RPS)	The Regional Policy Statement (RPS) sets out the framework and priorities for resource management in the Wellington region. The Resource Management Act 1991 (the Act) requires all regional councils to produce an RPS for their region and review it every 10 years.	The RPS for the Wellington region was made operative in April 2013. There are two upcoming dates for changes to the RPS with different requirements at each timeframe being mid-2022 and mid/end 2024.

What are the implications from this national and regional direction for the Lower Hutt Growth Study?

- NPSUD - HCC will be required to enable more housing density around rapid transit networks. This will impact on the amount of growth that we will need to account for in this study.
- National and Built Environment Act – at this stage there are no known implications for this Study (mainly due to the stage the NBA changes are at). In the future the entity responsible for regional and local planning is likely to change.
- National Planning Framework - at this stage there are no known implications for this Study (mainly due to the stage the work is at). It is noted that the set of national directions in the NPF will be integrated, with conflicts between instruments resolved e.g., NPSUD and Freshwater Management.
- Strategic Planning Act – there will be minimal impact as the region including Hutt City has already developed the Wellington Regional Growth Framework which includes most of the aspects (as known) required under the Strategic Planning Act.
- Climate Adaptation Act – at this stage there are no known implications for this Study (mainly due to the stage the work is at). It may impact areas of growth into the future.
- Essential Freshwater Package – as this is already in force this will need to be considered as part of future district plan and resource consent considerations.
- Regional Policy Statement – requirements from the current RPS will already be taken into account in the Hutt City District Plan changes. The RPS will be updated by mid-2022 and then mid 2024 as required. This may result in implications for growth in Lower Hutt.

A.3 Three waters reform context and assumptions

In July 2020, the Government launched the Three Waters Reform Programme – a three-year programme to reform local government three waters service delivery arrangements. The Government's starting intention is to reform local government's three waters services into a small number of multi-regional entities with a bottom line of public ownership. Wellington Water client councils are identified as being part of Entity C, being one of four entities across the country.

The current three waters reform programme timetable and activity is as follows:

- 2021 – consultation and decisions on reforms
- 2022 – preparation for the formation of water service entities
- 2023 – preparation for operation of new water services entities.
- 2024 – operation of new entity

What are the implications from the three waters reform for the Lower Hutt Growth Study?

- Wellington Water is currently undertaking this study for Hutt City Council. The reforms signal that the current structure of three waters will be changed by mid-2023.
- The proposed form of the reforms has ownership of the assets and/or management of the service provision and three waters infrastructure work changing.
- Hutt City Council has current issues with LOS and resilience of three waters networks and needs to understand, plan for and invest in three waters infrastructure to meet current and growth requirements, regardless of what occurs with the three waters reform.
- Regardless of the ownership structure of three-water assets, investment will continue to be required to close level of service gaps and provide for growth.

APPENDIX B: CLIMATE CHANGE CONSIDERATIONS

Table provides an overview of climate change considerations in supporting technical reports.

Table B-1: Climate Change Considerations in study

Report	Comment
Strategic Environmental Assessment (SEA)	Climate change impacts are not part of scope and so are not assessed in this report. Climate change has broadly been considered using the GWRC/NIWA online climate tool. Over the lifetime of the assessment described in this report (30 years), at a high-level impacts of climate change were regarded as a consistent impact across the region and were could not meaningfully be broken down into domain specific or catchment specific impacts that could be brought into this assessment methodology.
Three Waters Catchment Growth Study Including Plan Change 43 - Wainuiomata Catchment December 2020	The stormwater Levels of Service for the HCC Catchment Plan in Wainuiomata are in accordance the following - Safe access to and protection from flooding of habitable floors in the 100-year flood event that includes the predicted impact of climate change.
Lower Hutt Wastewater Network Options Assessment – July 2021	The current SPA model does not include an allowance for future climate change conditions. Ideally, the performance of a future scenario for the network would be tested with a 10-year rainfall time-series adjusted for climate change. Developing such a time-series is complex. An alternative is to use the projections of extreme rainfall events. An initial methodology has been developed as is proposed to be formalised; once this has been completed, the hydraulic sizing of the options should be reviewed.
Alicetown - Petone Stormwater Catchment Investigation Options Report January 2020	To evaluate and understand the effectiveness of each stormwater option, a base scenario was initially modelled. This involved modelling three design floods. The design floods are as follows: • 10% MAF: Represents a design storm with a 10% AEP, coinciding with a mean average flow in the Hutt River • 10% 10%: Represents a design storm with a 10% AEP, coinciding 10% AEP high in the Hutt River • 1%+CC 10%+CC: Represents a design with a 1% AEP, coinciding with a 10% AEP high in the Hutt River. The study also considered the effects of climate change on the tide level. For future, climate change conditions, 1 m was added to represent sea level rise. The peak of the tide was set to correspond to the peak rainfall event.
Hutt Valley Growth Stormwater Solutions September 2021	Each suburb was rated according to percentage of area within the identified growth areas. Following this, suburbs were then further rated on potential flood risk, which was assessed using the maximum modelled flood depths (m) for the 1% AEP event + 20% rainfall increase for climate change and pipe surcharge state for the 10% AEP event.
Hutt City Water Supply Zone Management Plan (excluding Wainuiomata) November 2020	Climate change is not applicable to storage, and network performance as these are based on pre-defined levels of service. Climate change of course is related to source water availability (supply-side) and demand-side management.

APPENDIX C: GROWTH IN LOWER HUTT

C.1 Growth in Lower Hutt

Understanding the level of housing and business growth expected in Lower Hutt over the next 30 years, or more is an important component of determining the three waters infrastructure requirements and the timing for these.

The level of growth for modelling purposes was agreed in 2020[9] based on Forecast ID forecasts and used as a key input into all the studies undertaken to inform this report. These forecasts and the percentage of change associated with these can be seen in Figure .

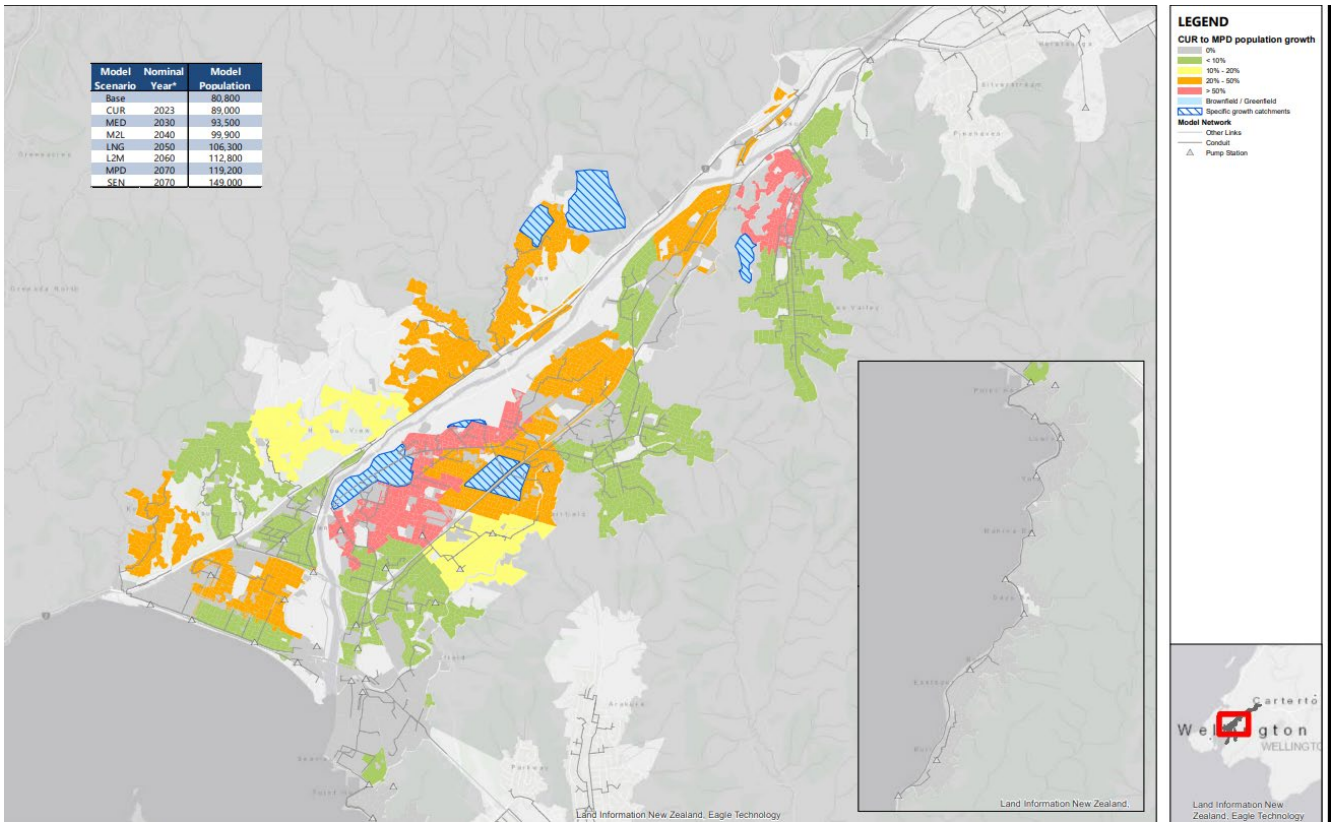


Figure C-1: Modelled populations forecasts (HCC provided based on Forecast ID 2019)

Since those population numbers were first confirmed for modelling in 2020 a number of things have occurred. These are explained below and comparison of populations shown Table

1. The National Policy Statement – Urban Development (NPS-UD) has been finalised and requires that Hutt City Council provides for a higher level of density than has already been accounted for in PC43. Analysis on what potential housing growth is likely to be required to align with the NPSUD requirements is currently underway and is expected to be completed by mid-2022. Once complete the implications for three waters infrastructure will become clearer.

2. The Wellington Regional Growth Framework has been completed which includes a "Lower Hutt Structure Plan" as an area of growth focus in the region covering the area from Woburn-Naenae-CBD/Riverlink and back across to Woburn. Growth figures in this area have not been developed in detail, however, at this stage the level of growth is expected to be in line with PC43 and RiverLink expectations.

[9] Note that whilst population forecasts have changed the modelling undertaken for this work has not been updated. Updating models is a time consuming and costly process.

3. Housing and population numbers in Lower Hutt have recently been growing at a much faster rate than expected when modelling figures were confirmed in 2020. This change is consistent with what is being seen across the region.
4. The latest Sense Partner forecasts developed as part of updating the Hutt City Council Housing and Business Development Capacity Assessment (HBA) shows a projected increase of nearly 49,000 people in Lower Hutt from 2021-2051.

Table provides a comparison between the modelled figures agreed in 2020/21 and the Sense Partners (2021) forecasts.

Table C-1: Population forecast comparisons

Population forecast source Lower Hutt Territorial Area	Current population (year)	Projected population (year)	Difference	% increase
Final HCC population numbers – March 2020 – based on PC43 using ForecastID	105,247 (2020)	130,323 (2050)	25,076	23.8
Sense Partners (developed for the HBA update) – 50th percentile – as at July 2021	113,905 (2021)	162,811 (2051)	48,906	42.9

Note that:

- With most of the expected growth in housing in Lower Hutt coming from infill and intensification development (i.e., within the current urban boundary) this will result in a focus on upgrading current three waters network infrastructure (rather than building new infrastructure) which will also include level of service components.
- The Sense Partners projected growth in Wainuiomata (being a distinct catchment in itself) is lower than the whole of Lower Hutt (projected to be a 33.6% increase in populations from 2021 to 2051).

The difference in these population forecast numbers in Table can be explained by two main things:

1. Firstly, the population forecasts for Lower Hutt and the country as a whole have increased significantly in the sixteen months between March 2020 and July 2021, relative to previous periods.
2. Secondly, the methodology used by ForecastID, and Sense Partners are different with the migration outlook being the key difference between the two as noted below:
    a. Sense Partner forecasts include 0.7% increase in population per year, on average, due to net migration
    b. By comparison Statistics New Zealand's forecasts include 0.1% growth per year due to net migration
    c. Historically, net migration (nationally) caused a 0.7% increase in the population each year on average between 1991 and 2018, based on cumulative net migration since 1991 as a proportion of the 1991 population averaged over 27 years.

C.2 Greenfield growth in Lower Hutt

Most of the projected growth in Lower Hutt is expected to be within the current urban boundary – areas of the city where housing already exists. However, a number of potential greenfield development sites were identified by HCC for this Study as shown in Table C-2.. These are the projected greenfield sites identified and used for modelling and infrastructure solutions purposes. Some of these have since been completed. It is noted the development yields were estimated before the announcement of the new intensification rules in October 2021. These rules allow buildings of up to three storeys on most sites without the need for resource consent from August 2022.

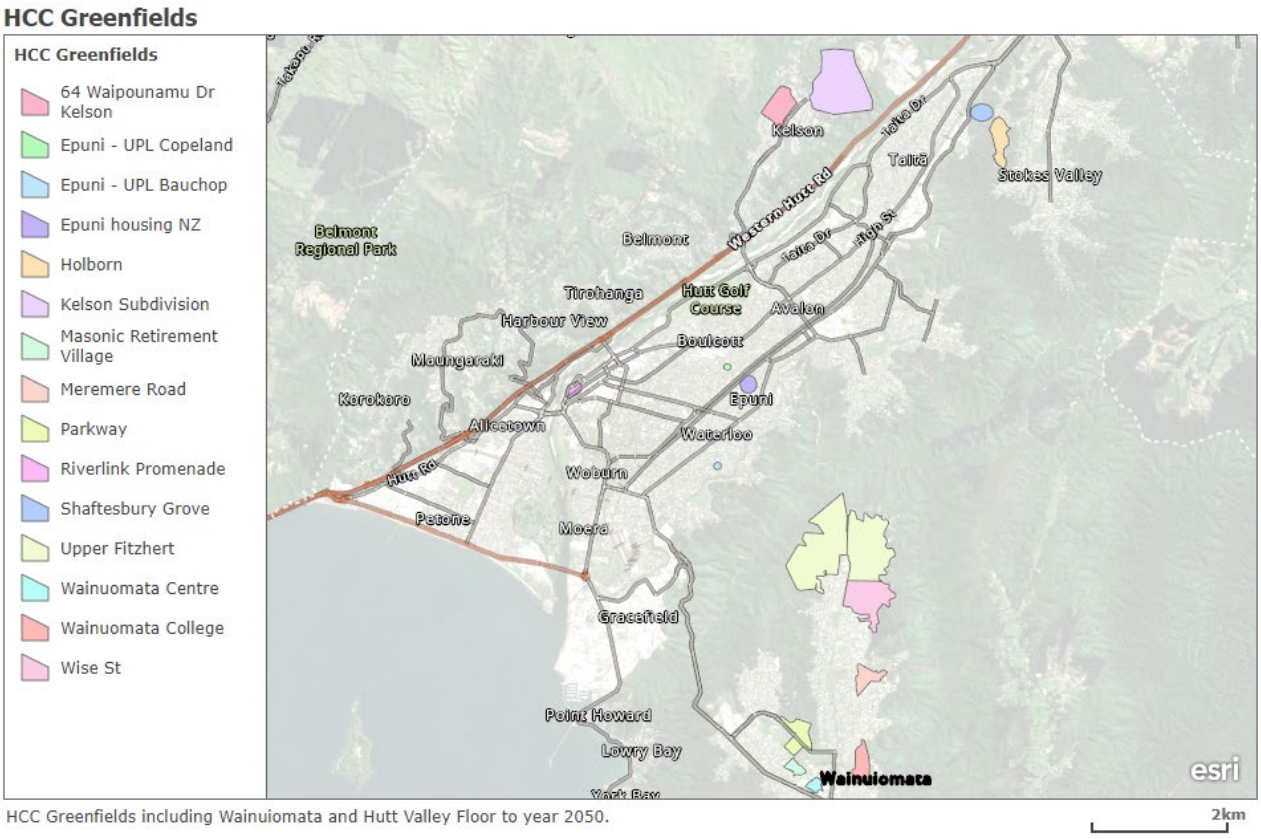


Figure C-2: Greenfield Development Areas (HCC, 2019)

Table C-2: Greenfield development site expected number of new dwellings (HCC, 2019)

Development site	Expected number of dwellings 2050
Waipounamu Drive Kelson	250
Epuni – UPL Copeland Street	32
Epuni – UPL Bauchop	32
Epuni – Kainga Ora	153
Holborn	186
Kelson Subdivision	120
Riverlink *(redevelopment site)*	1750
Shaftesbury Grove, Stokes Valley	120
Wainuiomata North	1841
Wainuiomata – Parkway (2 sites)	176
Wainuiomata – Glendale (Moohan St and Moores Rd)	208
Wainuiomata – Wise Street Stage 1	120
Wainuiomata – Wise Street Stage 2	1100

C.3 Dwelling Data by Study Areas

Table C-3: Growth Study Areas Dwellings (HCC, 2020) – Data used for water supply and wastewater modelling

Study Areas	Suburbs	2020		2050		2020-2050
Western Hills	Belmont	2,770	13,310	3103	15,208	**1,898**
	Haywards-Manor Park – Kelson	3,283		4384		
	Maungaraki	3,940		4097		
	Normandale - Tirohanga	3,317		3624		
Petone-Alicetown	Alicetown – Melling	2,645	12,109	2634	13,565	**1,456**
	Esplanade	2,661		2737		
	Korokoro - Petone Central - Wilford	6,803		8194		
Eastbourne	Eastbourne	4,830	4,830	4733	4,733	**-97**
Wainuiomata	Arakura	2,576	18,510	3627	24,494	**5,983**
	Fernlea	2016		2077		
	Glendale	4116		7380		
	Homedale – Pencarrow	6282		6923		
	Parkway	3520		4486		
Gracefield - Seaview – Waiwhetu	Gracefield	4,404	4,404	4624	4,624	**220**
	Seaview					
	Waiwhetu					
Central Hutt	Boulcott	2,610	21,945	3846	34,038	**12,093**
	Epuni West	3,128		3529		
	Epuni East	3,128		4183		
	Hutt Central - Waterloo West	5,409		14369		
	Moera – Woburn	3,285		3402		
	Waterloo East	4385		4709		
Avalon-Naenae-Taita	Avalon	5,188	19,988	5987	21,694	**1,706**
	Naenae North	4,825		5046		
	Naenae South	3,784		3868		
	Taita North	3122		3594		
	Taita South	3069		3200		
Stokes Valley-Manor Park	Stokes Valley East	5244	10151	5409	11966	**1815**
	Stokes Valley Northwest – Holborn	2287		3635		
	Stokes West	2620		2922		
Total			**105,247**		**130,323**	**25,075**

Table C-4: Growth Study Areas Dwellings (Sense Partners 2021)

Study Areas	Suburbs	SA2	2018	2048	2018-2048 Change
Western Hills	Belmont Haywards-Manor Park – Kelson Maungaraki Normandale - Tirohanga	Maungaraki Korokoro Tirohanga Kelson Normandale Belmont (Lower Hutt)	5959	9809	3850
Petone-Alicetown	Alicetown – Melling Esplanade Korokoro - Petone Central - Wilford	Petone East Petone Central Alicetown-Melling Petone Esplanade	4782	6931	2149
Eastbourne	Eastbourne	Eastern Bays Eastbourne	2308	2739	431
Wainuiomata	Arakura Fernlea Glendale Homedale – Pencarrow Parkway	Wainuiomata West Glendale Wainuiomata Central Arakura Glendale Homedale West Homedale East	7227	10432	3205
Gracefield - Seaview – Waiwhetu	Gracefield Seaview Waiwhetu	Gracefield Moera Waiwhetu	2718	4003	1285
Central Hutt	Boulcott Epuni West Epuni East Hutt Central - Waterloo West Moera – Woburn Waterloo East	Boulcott Epuni East Epuni West Hutt Central – North Hutt Central – South Woburn Waterloo East Waterloo West	8835	12699	3864
Avalon-Naenae-Taita	Avalon Naenae North Naenae South Taita North Taita South	Avalon East Taita North Avalon West Taita South Naenae Central Naenae North Naenae South	8092	12091	3999
Stokes Valley-Manor Park	Stokes Valley East Stokes Valley Northwest – Holborn Stokes West	Manor Park Stokes Valley Central Stokes Valley North Delaney Manuka	4193	7008	2825

APPENDIX D: LOWER HUTT THREE-WATER GROWTH STUDY PROJECT SCHEDULES AND COSTS

D.1 Cost estimation process

Level One cost estimates for capital upgrades were prepared according to the WWL Cost Estimation Manual (rev 0). Level One estimates are based on:

- Risk Register outputs
- No site investigations
- Estimate land requirements.
- Estimated consent conditions.
- Possibility of scope change
- A range of options that may be developed and delivered

This is further explained below and is illustrated by Figure D-1, with Level One cost estimates including a 40% contingency and a 60% funding risk.

The cost estimates provided in this assessment, use 2020 base rates (version 11). Funding and investment plans using these estimates should consider additional costs associated with inflation, financing, land costs and management fees.

WWL Cost Estimation Manual – Estimate Process

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

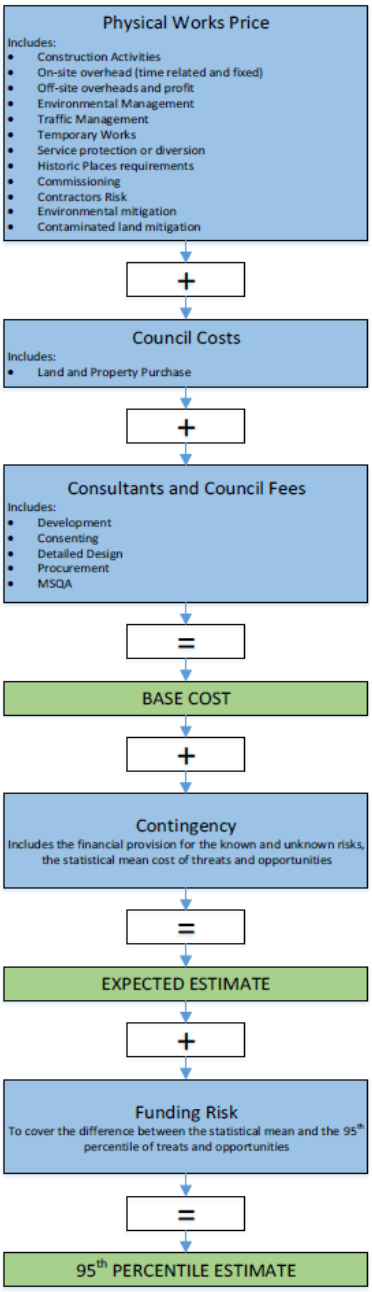


Figure D-1: WWL Cost Estimation Manual Process

D.2 Cost Estimation Schedules

The following schedules provide project summary information for each water type and geographically grouped. These schedules can provide a useful compilation of options available to provide for growth and meet levels of service. Although there are a number of limitations in the geographic extent of areas covered and assumptions on level of service which should be taken into account when reviewing this data. As per details outlined on the cost estimation process, estimates exclude inflation, financing and land costs.

D.2.1 Water Supply – Central (excluding Wainuiomata)
D.2.2 Water Supply – Wainuiomata

D.2.3 Wastewater – Central (excluding Wainuiomata)
D.2.4 Wastewater – Wainuiomata

D.2.5 Stormwater – Petone Alicetown
D.2.6 Stormwater – Central, Eastern, Stokes Valley
D.2.7 Stormwater – Wainuiomata

HUTT CITY GROWTH STUDY - WATER SUPPLY (Ex. Wainuiomata)										
Reference	**Growth Areas**	**Infrastructure type**	**Option**	**Reason / Benefit**	**New/Existing Asset**	**Recommended Priority**	**Include / Discounted**	**Level 1 (95 percentile) w/out WWL Fee**	**Expected opex**	**Trigger for upgrade**
H_UPG-S1_Rezone Rata (pipe upgrades + new PRV)	Avalon - Naenae - Taita	Pipes and Pressure relief valve	- Replace AC pipes to be included in the new Rata pressure zone (1.5km of 100mmØ ID mains) - New PRV set at 95m head at the intersection of Hay St and Rata St	To address pressure issues	Existing / New	High	YES	$ 6,615,031	Low	To address zone changes
H_UPG-S2_Rezone Sunville (rising main, PRV and pipe relocation/replacement)	Avalon - Naenae - Taita	Pipes and PRV	- 350m of new 150mmØ suction main along Wilkie Crescent to the pump station - 100m of new 150mmØ rising main along Wilkie Crescent from the pump station to Swainson Drive. - Relocate existing Sunville PRV to the top of Swainson Drive and set to 95m head. - Replace 1.5km of 150mmØ AC pipes in the new Sunville pressure-reduced zone. - New PRV on Seddon Street and set to 95m head.	To address low pressures	Existing / New	High	YES	$ 9,213,646	Low	To address zone changes
H_UPG-S3_New Holborn HL reservoir, pump, rising main and outlet main, and pipe renewal	Stokes Valley - Manor Park	Reservoir, pump station, & pipes	- New 1.5 ML reservoir at ~184m TWL. - New 17kW pump station adjacent to Delaney Reservoir - 600m of new dedicated 150mmØ rising main from the new pump station to the new Holborn HL Reservoir. - Renew 1.4km of existing 100mmØ/150mmØ AC pipes in the new Holborn HL PMA - 1.5km of new 200mmØ outlet main	To increase capacity to cater for the development sites.	New / Existing	Medium	YES	$ 25,155,183	High (Pumpstation) / Low (pipes and reservoir)	To address growth from greenfield sites
H_UPG-S4_Naenae Reservoir Outlet Duplication and Upgrade of Waiwhetu Rd Main	Central Hutt, Avalon-Naenae-Taita	Main and reservoir outlet	- Duplicate Naenae Reservoir outlet with 510m of 425mm mains. - Upsize 300m of existing 375mmØ main along Waiwhetu Road/Naenae Road to 525mmØ, from Waiwhetu Road to Oxford Terrace	To address decreasing pressure as population increases	Existing / New	Medium	YES	$ 4,952,746	Low	To address anticipated growth
H_UPG-S5_Naenae Reservoir No.2	Central Hutt, Avalon-Naenae-Taita, Gracefield	Water storage	- Construct additional Naenae storage (15ML)	To address calculated storage shortfall	New	High	YES	$ 37,078,929	Low	To address existing LOS issues
H_UPG-S6_Delaney Reservoir No.2	Stokes Valley - Manor Park	Water storage	- Construct additional Delaney storage (4.2ML)	To increase capacity to cater for the development sites (future stages)	New	Medium	YES	$ 18,409,974	Low	To address future storage storage shortfall
H_UPG-S7_Lower Hutt Central Alternative Source - Emergency PRVs and Flow Control Valves	Lower Hutt Central & Western Hills	PRV and flow control valves	- Use emergency PRVs and flow control valves to transfer supply from the Western Hills to the Hutt Valley Floor	For resilience during operational or seismic outage	New	Medium	YES	$ 1,633,498	Low	To address network resilience
H_UPG-S8_Lower Hutt Central Alternative Source - PRV controls	Lower Hutt Central & Western Hills	Controls for the PRV and flow control valves	- Set up of controls for PRVs and flow control valves to transfer supply from the Western Hills to the Hutt Valley Floor	For resilience during operational or seismic outage	New	Medium	YES	$ 136,125	Low	To address network resilience
H_UPG-S9_New Eastbourne Reservoir	Eastbourne	Water storage	- Construct additional Eastbourne storage (2.2ML reservoir)	For resilience and to meet existing seismic and operational requirements	New	Medium	YES	$ 12,900,584	Low	To address existing shortfall (decision required based on growth and network resilience factors)
H_INV_P1_Gracefield Reservoir Refill Investigation	Gracefield, Avalon-Naenae-taita, and Central Hutt	Investigation	- Undertake investigation to enable Gracefield Reservoir to refill to at least 70% full.	To meet WWL storage requirements to be 70% full under current peak day	N/A	High	YES	$ 272,250	N/A	To address existing LOS issues
H_INV-P2_Petone - High Pressure Investigations	Petone - Alicetown	Investigation	- Undertake further investigation on pressure reduction	Assess opportunities to reduce very high leakage	N/A	Medium	YES	$ 272,250	N/A	To address existing LOS issues
							SUM	**$ 116,640,214**		

HUTT CITY GROWTH STUDY - WATER SUPPLY - WAINUIOMATA											
Reference	**Growth Areas**	**Infrastructure Type**	**Option**	**Reason/Benefit**	**New / Existing Asset**	**Included / Discounted**	**Recommended Priority**	**Level 1 (95 percentile) w/out WWL Fee**	**Expected Opex**	**Trigger for Update**	**Comments**
WMTA_PW1_Local Upgrade Fire	Wainuiomata	Pipes	- Upsize 170m of 200mm dia main to 250mm dia - Upsize 430m of 150/200mm dia main to 225mm dia along Meremere St - Upsize 520m of 100mm dia to 150mm dia along Lees Gr, Reading St, and Holland St - Upsize 500m of 100mm dia to 150mm dia along Hair St - Open boundary valves along Fitzherbert Rd and install two flowmeters	- Address existing LOS issues for firefighting flows.	Existing	Included	High	$ 8,165,897	Low	- Address existing LOS issues	2019/2020 planning horizon
WMTA_PW2_Local Upgrade Fire	Wainuiomata	Pipes	- Upsize 450m of 200mm dia to 225mm along Parkway Rd - Upsize 600m of 150mm dia to 200mm dia along Main Rd and Homedale Rd	- Address growth LOS issues for firefighting flows.	Existing	Included	High	$ 6,235,236	Low	- Address future growth LOS	2033 planning horizon
WMTA_PW3_Strategic Upgrade Option 1 (Fitzerbert Rd + Meremere St PRVs, Wainuiomata 3 Reservoir)	Wainuiomata	Reservoir, Pumpstation and pipes	- Install two emergency PRVs at Fitzherbert Rd and Meremere St - New Wainui 3 Reservoir	- Reduce existing high pressures, leakages, demand and bursts.	New	Included	Medium	$ 40,218,479	Low	- Address future growth LOS	2033 planning horizon
WMTA_PW4_Local Pressure Upgrade Wise St, Wellington Rd	Wainuiomata	Pipes	- Construct new parallel 150mm dia main along Wise St - Extend existing 150mm dia main along Wise St with a 20mm dia main up to the development site - Upsize 1400m of 150mm dia to 300mm dia along Wellington	- Address growth LOS issues	New / Existing	Included	High	$ 20,002,080	Low	- Address future growth LOS	2050 planning horizon
WMTA_PW5_Section 1 Bulk Watermain Reservoir Rd	Wainuiomata	Pipes	- Offline replacement of 750mm dia pipeline in Section 1 along Reservoir Rd	- Improve resilience of the bulk water main	Existing	Included	Medium	$ 39,727,802	Low	- Address resilience	Not a direct cost to HCC as it is owned by GWRC
WMTA_PW6_Section 2 Bulk Watermain Moores Valley Rd	Wainuiomata	Pipes	- Offline/online replacement of 750mm dia pipeline in Section 2, (Moores Valley Rd / hair St). - New alignment at Moores Valley Rd / Hair St intersection to remove the pipe from private land and facilitate relocation of the motorised line valve. - Abandon section of Orongorongo to Karori main	- Improve resilience of the bulk water main	Existing	Included	Medium	$ 10,149,364	Low	- Address resilience	Not a direct cost to HCC as it is owned by GWRC
WMTA_PW7_Section 3 Bulk Watermain Wainuiomata Rd	Wainuiomata	Pipes	- Online replacement of Section 3a (Main Rd / Wainuiomata Rd) - Existing steel connection pipework to Wainuiomata PS No.1 to be retained - Online / offline replacement of Section 3b (Wainuiomata Rd)	- Improve resilience of the bulk water main	Existing	Included	High	$ 72,146,270	Low	- Address resilience	Not a direct cost to HCC as it is owned by GWRC
							SUM	$ 196,645,127			
					Sub-Total (HCC)			$ 74,621,692			
					Sub-Total (GWRC)			$ 122,023,436			

HUTT CITY GROWTH STUDY - WASTEWATER (Ex. Wainuiomata)										
Reference	**Growth Areas**	**Infrastructure type**	**Option**	**Reason / Benefit**	**New / Existing Asset**	**Recommended Priority**	**Level 1 (95 percentile) w/out WWL Fee**	**Expected opex**	**Trigger for upgrade**	**Information gaps**
ALT03_Beaumont Ave WW pump station connection / storage tank	Petone-Alicetown	Storage	- Replace 150mm sewer with 100m long 1500mm dia storage tank. - Upgrade 150m to 225mm dia and connection to PS to 300mm dia.	- Improve existing frequent flooding of multiple Manholes	Existing	High	$ 3,481,064	Low	Address existing LOS issues	- Network Optimisation (around bifurcation operation) as storage could provided in away to allow the existing poor condition assessed to be abandoned.
ALT01_Herbert St gravity main upgrade	Petone-Alicetown	Conveyance	- Upgrade 225mm dia gravity main to 300mm dia	- Address potentially frequent spills of the MH shown in the model. - This option also allows for the replacement of the poor condition asset	Existing	High	$ 2,393,242	Low	Address existing LOS issues and part of current renewal programme	
ALT02_Railway Ave - sewer replacement	Petone-Alicetown	Conveyance	- Replacement of the 225mm with 180m of 300mm ID sewer	- Improve manhole surcharges	Existing	High	$ 1,225,810	Low	Address existing LOS issues and part of current renewal programme	
LOH03_Lower Hutt CBD Wastewater Bypass	Central Hutt	Pump Station & Network	- New 80-100 l/s pump station with 600m3 of emergency storage - New 350m of 300mm dia rising main across Ewen Bridge to trunk line on true right river bank. - New 2,050m of 375mm dia gravity sewer	- Improve frequent surcharges in existing manhole - Address flooding which is expected to increase due to expected growth Riverlink project	New	High	$ 33,109,444	High (pump station) / Low (pipes)	Riverlink housing regeneration (growth)	- Whether a pumped overflow should be installed with the station to provide resilience to surrounding network. - Extent and size of the required gravity sewer - Ability for the downstream network to receive flows during extended wet weather flow periods and operation of the Silverstream Tank. - Investigations into staging of works including pump station capacity requirements at differing horizons, as upgrade is likely to be influenced by the riverlink redevelopment
MAU02_Holly & Maple Gr WW storage	Western Hills	Investigations	- Install 300m3 of storage at the intersection of Acacia Avenue & Dowse Drive.	- Improve existing flooding issues	New	High	$ 10,137,649	Low	Address existing LOS issues	- Flow monitoring required to assess feasibility of I&I reduction
NAN01_Fleet St WW storage	Avalon - Naenae - Taita	Storage	- 230m of 150mm large diameter sewer tank (providing ~400m3 of storage)	- Improve existing spill issues	New	High	$ 5,272,621	Low	Address existing LOS issues and provide for growth	- Investigations are required to identify whether this storage tank can be installed on grade or requires a pumped return to the existing network
NAN02_Seddon St WW Storage	Avalon - Naenae - Taita	Storage & Conveyance	- Provision of 200m3 of storage, consisting of: - 100m long 1500mm dia storage tank - 150m of 225mm dia gravity sewer - 100m of 150mm dia gravity sewer	- Improve frequent surcharges	New	High	$ 3,964,836	Low	Address existing LOS issues and provide for growth	
STV05a_Hawthorn Cres Sewer Connection	Stokes Valley - Manor Park	Conveyance	- Install a new 225mm dia sewer connection and raise IL of existing lines to complete catchment diversions and provide wet weather capacity	- Improve surcharge of manholes and constraints in the downstream trunk network	New/existing	High	$ 1,157,898	Low	Needed to address existing issues	
STV05b_Richard Gr Intrsctn Sewer	Stokes Valley - Manor Park	Conveyance	- Upgrade of 310m of existing 375mm dia sewer to 450mm dia.	- Improve surcharge of manholes and constraints in the downstream trunk network	Existing	High	$ 5,671,071	Low	Needed to address existing issues	- Additional investigation into the asset data as there are anomalies with low confidence
AVL01_Allen St Storage	Avalon - Naenae - Taita	Storage	- Installation of 100m3 storage tank	- Improve existing spilling of manhole	New	Medium	$ 8,824,208	Low	Address existing LOS issues and provide for growth	- Whether this storage tank can be installed on grade or requires a pumped return to the existing network.
BCT01_Boulcott St WW Main Upgrade	Avalon - Naenae - Taita	Pump Station	- Upgrade 190m main from 150mm to 225mm dia	- Improve existing frequent surcharges in manhole	Existing	Medium	$ 1,573,956	Low	Address existing LOS issues	- Sensitivity of downstream sewer to this option and tailwater levels
ESB01_Pt Arthur PS Storage Tank	Eastbourne	Storage	- Install a 100m3 storage tank	- Improve existing spills	New	Medium	$ 8,824,208	Low	Address existing LOS issues	- Difference between model and existing situation
KOK01_Cornish St Sewer Main Upgrade	Western Hills	Conveyance	- Upgrade the existing sewer main from 150mm da to 225mm dia.	- Address modelled spills and improve existing issues	Existing	Medium	$ 1,157,898	Low	Address existing LOS issues	- Linkage with the trunk performance and the currently proposed upgrade to pass additional flow forward requires additional investigation
LOH06_Massey Ave WW Pump Station	Central Hutt	Pump Station	- Increase pump station capacity (from 11L/s to 25L/s)	- Address modelled spills	Existing	Medium	$ 3,752,955	High	Growth	- Downstream network capacity - The pump station and rising main capacity and condition
STV03_Delaney Dv Sewer Main Upgrade	Stokes Valley - Manor Park	Conveyance	- Upgrade 230m of existing 150mm dia sewer main with a 230m long gravity main (i.e. 225mm dia).	- Improve existing spills at manholes - Address modelled spills at manholes	Existing	Medium	$ 1,905,315	Low	Address existing LOS issues and provide for growth	- Linkage with the trunk performance and the currently proposed upgrade to pass forward additional flow requires additional investigation.
STV04_Glen Rd Sewer Main Upgrade	Stokes Valley - Manor Park	Investigations	- Upgrade 380m of existing 150mm dia sewer main to 225mm dia	- Address the modelled overflows in the upper network	Existing	Medium	$ 1,905,315	Low	Address existing LOS issues and provide for growth	- Further investigation needs to be undertaken to confirm modelled asset data prior to progressing this option. - Linkage with the trunk performance and the currently proposed upgrade requires additional investigation.
STV02_Korau Gr WW Storage Tank	Stokes Valley - Manor Park	Storage	- Install storage tank (provisionally 100m3) including back flow prevention	- Improve the existing spills and address the modelled flooding	New	Medium	$ 8,824,208	Low	Address existing LOS issues and provide for growth	- Investigations required to identify whether this storage tank can be installed on grade or requires a pumped return to the existing network
SVW01_Seaview Rd WW Pump Station Upgrade	Seaview-Gracefield - Waiwhetu	Conveyance	- Increase Seaview Rd pump station capacity to 18L/s from 12L/s - Replace existing rising main with 100mm dia pressure pipe	- Address modelled spilling (caused by inadequate pump capacity)	Existing	Medium	$ 3,933,064	High	Address existing LOS issues	- Capacity of downstream network - Linkage with the trunk performance and the currently proposed upgrade to pass forward additional flow
SVW01_Seaview Hutt Park WW Pump Station Upgrade	Seaview-Gracefield - Waiwhetu	Conveyance	- Increase Seaview Hutt Park pump station from 7 L/s to 12L/s	'- Address modelled spilling (caused by inadequate pump capacity)	Existing	Medium	$ 3,433,263	High	Address existing LOS issues	- Capacity of downstream network - Linkage with the trunk performance and the currently proposed upgrade to pass forward additional flow
SVW01_Randwick Rd WW Pump Station Upgrade	Seaview-Gracefield - Waiwhetu	Conveyance	- Increase Randwick Rd Pumpstation capacity from 19L/s to 28L/s	'- Address modelled spilling (caused by inadequate pump capacity)	Existing	Medium	$ 3,826,404	High	Address existing LOS issues	- Capacity of downstream network - Linkage with the trunk performance and the currently proposed upgrade to pass forward additional flow
WAI01_Whites Line WW Storage	Seaview-Gracefield - Waiwhetu	Conveyance	- Provide 200m3 storage volume (either tank or pipe storage)	- Improve the existing uncontrolled overflow and other smaller flooding locations in the catchment upstream of Whites Line PS.	New	Medium	$ 9,480,929	Low	Address existing LOS issues	
WTL01_Wyndrum Ave Sewer Main Upgrade	Central Hutt	Conveyance	- Upgrade 150m long existing 150mm dia sewer main to 225mm dia	- Address modelled spilling at manhole and improve existing issues.	Existing	Medium	$ 868,423	Low	Address existing LOS issues	- Linkage with the trunk performance and the currently proposed upgrade requires additional investigation
						SUM	**$ 124,723,781**			

HUTT CITY GROWTH STUDY - WASTEWATER - WAINUIOMATA											
Reference	**Growth Areas**	**Infrastructure Type**	**Option**	**Reason/Benefit**	**New / Existing Asset**	**Included / Discounted**	**Recommended Priority**	**Level 1 (95 percentile) w/out WWL Fee**	**Expected Opex**	**Trigger for Update**	**Comments**
WMTA_WW1_Wise St PS 1	Wainuiomata	Pump Station	- 300L/s upgrade to existing PS on Wise St	- Reduce frequency and volume of wet weather overflows	Existing	Included	High	$ 1,240,234	High	Address existing issues and also to meet future LoS for growth	Interim upgrade 2020 planning horizon
WMTA_WW2_Wise St PS 2	Wainuiomata	Pump Station	- 400L/s upgrade to existing PS - Upgrade to 1.56km of 560mm Rising Main	- Reduce frequency and volume of wet weather overflows	Existing	Included	Low	$ 16,216,021	High	Address existing issues and also to meet future LoS for growth	Future state 2050 planning horizon
WMTA_WW3_Prioritised I&I	Wainuiomata	Pipes	- Prioritised inflow and infiltration reduction though CCTV investigation and relining of pipes with faults	- To reduce inflow and infiltration	Existing	Included	High	$ 41,591,235	Low	To meet existing LOS	Interim upgrade 2020 planning horizon
WMTA_WW4_Targeted I&I	Wainuiomata	Pipes	- Targeted inflow and infiltration reduction though CCTV investigation and relining of pipes with faults	- To reduce inflow and infiltration	Existing	Included	Low	$ 28,268,572	Low	To meet existing LOS	Future state 2050 planning horizon
WMTA_WW6_Greenfield Servicing	Wainuiomata	Pump Station, pipes	- New 40L/s PS - New 2.4km DN180mm rising main	- To service northern greenfield development	New	Included	Medium	$ 10,058,133	High	Address future growth	Interim upgrade 2033 planning horizon
WMTA_WW7_Fraser St EOP Storage	Wainuiomata	Storage tank	- 120m, 2.1m dia RCRRJ storage pipe in berm	- To reduce spills	New	Included	High	$ 5,302,221	Low	To meet existing LOS	Interim upgrade 2020 planning horizon
WMTA_WW8_Main Road EOP Storage	Wainuiomata	Pipes	- 144m length, 2x2.1m dia pipes	- To address existing capacity issues and spills	New	Included	High	$ 6,256,619	Low	To meet existing LOS	Interim upgrade 2020 planning horizon
WMTA_WW9_Private Lateral I&I CCTV Investigation	Wainuiomata	Investigation	- CCTV investigation of private WW laterals and relining of pipes with faults	- To reduce inflow and infiltration	N/A	Included	Medium	$ 28,715,135	Low	To meet existing LOS	Interim upgrade 2020 planning horizon
WMTA_WW10_Wellington Rd PS Upgrade	Wainuiomata	Pump Station	- Upgrade to 225L/s for existing Wellington Rd Pump Station	- To reduce spills	Existing	Included	Low	$ 1,087,040	High	Address future LoS for growth	Future state 2050 planning horizon
WMTA_WW11_Duplicate Gravity Main in Tunnel	Wainuiomata	Pipes	- Duplicate 355mm OD PE gravity main in existing tunnel	- To address potential future development which may push for a replacement of the on-site WW disposal.	New	Included	Low	$ 7,671,203	Low	Address future LoS for growth	Future state 2050 planning horizon
							SUM	$ 146,406,414			

HUTT CITY GROWTH STUDY - STORMWATER (Petone-Alicetown)											
Reference	**Growth Areas**	**Infrastructure type**	**Option**	**Reason / Benefit**	**New / Existing Asset**	**Included / Discounted**	**Recommended Priority**	**Level 1 (95 percentile) w/out WWL Fee**	**Expected opex**	**Trigger for upgrade**	**Information gaps**
PNATN_ Option_1b_Te Mome Pump Station, Wakefield St, Fitzherbert St, & Kiwi St Upgrade	Petone-Alicetown	Pump station, New pipes	- Construction of new pump station, stormwater pipes and manholes	- Improve the pumping capacity of current undersized pump stations. - Address existing flooding issues	New	Included	Medium	$ 31,935,907	High	Needed to address existing issues and also to meet future LoS for growth	
PNATN_ Option_2_William St Pump Station and South St Upgrade	Petone-Alicetown	Pump station, New pipes	- Construction of new pump station, stormwater pipes and manholes	- To address flooding issues	New	Discounted	Low	~~$ 13,263,556~~	High	Needed to address existing issues and also to meet future LoS for growth	
PNATN_ Option_3a_John St Pump Station & Nelson St Upgrade	Petone-Alicetown	Pump station, New pipes	- Construction of new pump station, stormwater pipes and manholes	- Reduce flooding in the John Street pump station catchment	New	Included	High	$ 21,060,889	High	Needed to address existing issues and also to meet future LoS for growth	Further investigations into a PS at the end of Nelson Street
PNATN_ Option_4_Marsden St Pump Station, Marsden St & Bridge St Upgrade	Petone-Alicetown	Pump station, New pipes	- Construction of new pump station, stormwater pipes and manholes	- Reduce flooding around Pharazyn Street. Existing pump station undersized.	New	Included	Low	$ 6,121,248	High	Needed to address existing issues and also to meet future LoS for growth	Further investigation into the capacity constraints between the flooding in Pharazyn Street and Marsden Street pump station are needed
PNATN_ Option_6_Nelson St, Regent St, & Hutt Road Upgrade	Petone-Alicetown	New pipes and nodes	- Construction of stormwater pipes and manholes	- Reduce existing flooding issues	New	Included	Medium	$ 18,738,640	Med	Needed to address existing issues and also to meet future LoS for growth	
PNATN_ Option_7_Kiwi St, Beaumont St, Laery St, & Railway Ave Upgrade	Petone-Alicetown	New pipes and nodes	- Construction of stormwater pipes and manholes	- Reduce flooding. Existing stormwater pipes are undersized.	New	Included	Medium	$ 5,843,668	Med	Needed to address existing issues and also to meet future LoS for growth	
					SUM		**SUM**	**$ 83,700,352**			

HUTT CITY GROWTH STUDY - STORMWATER (CENTRAL, EASTERN AND STOKES VALLEY)											
Reference	**Growth Areas**	**Infrastructure type**	**Option**	**Reason / Benefit**	**New / Existing Asset**	**Included / Discounted**	**Recommended Priority**	**Level 1 (95 percentile) w/out WWL Fee**	**Expected opex**	**Trigger for upgrade**	**Information gaps**
AVL_Option 1_Taita Drive SW Pump Station and Realignment	Avalon - Naenae - Taita	Alignment	- New Pump station (4m3/s capacity) - Realignment from High St, along Mabey Rd, and down Taita Dr	- Improve conveyance & backwater effects/ponding - Pumping will assist discharge to the Hutt River when flows are high.	New	Included	Medium	$ 63,050,415	High	Needed to address existing issues and also to meet future LoS for growth	
BOU_MEL_Option_1_High Street SW upgrade + Pump station	Central Hutt	Pump Station & main upgrade	- New pump station - Main upgraded in diameter to convey more flow	- Improve conveyance & backwater effects/ponding - Pumping will assist discharge to the Hutt River when flows are high.	New / existing	Included	Medium	$ 61,918,204	High	Needed to address existing issues and also to meet future LoS for growth	The impact of upsizing the High Street main.
BOU_Option 1_Kingston St SW Rising Main	Central Hutt	Rising Main	- A new rising main	- Pump flows from properties affected by ponding	New	Included	Medium	$ 7,898,312	Med	Needed to address existing issues and also to meet future LoS for growth	
MEL_Option_2_Kings Crescent SW Diversion	**Central Hutt**	**Flow diversion**	**- Flow diversion and pumping at diversion - Riverlink proposed sump and storm alignment upgrades undertaken alongside Pretoria Street Opahu Diversion - The Melling diversion is undertaken with one of the Woburn diversions to maximise flooding improvements**	**- Reduce backwater effects by diverting stream flows to the Hutt River. - Pumping will assist discharge to the Hutt River when flows are high.**	New	**Included**	**High**	$ 36,573,860	**High (pump) / Low (pipe)**	**Needed to address existing issues and also to meet future LoS for growth**	**The most feasible route for diversion of the Opahu Stream.**
NN_CH_1_Naenae Waiwhetū Stream Upgrade	Avalon - Naenae - Taita	Stream upgrade	- Waiwhetū Stream upgrade (between Waddington Dr and Balgownie St)	- Increase capacity of stream to reduce backwater effects on network.	Existing	Included	Medium	$ 989,878	High	Needed to address existing issues and also to meet future LoS for growth	
NN_ST_1_Naenae Park Detention Storage	Avalon - Naenae - Taita	Spillway/Weir	- Detention storage in Naenae Park during Waiwhetū Stream high flows. - A spillway/weir and the park regraded to allow detention. - Flow to re-enter the channel slowly at the southern end of the park	- Detain flows to slowly re-enter the network. Storage should help to offset downstream effects of the increase in channel conveyance	New	Included	Medium	$ 1,869,060	Med	Needed to address existing issues and also to meet future LoS for growth	
NN_UPG_2_Rimu Street SW Diversion	Avalon - Naenae - Taita	Flow diversion	- A new alignment from Prebble Street, along Rimu Street to the Waiwhetū Stream.	- Divert large flows to channel with more capacity to reduce overland flow from pooling - Improve ponding	Existing	Included	Medium	$ 21,012,455	Low	Needed to address existing issues and also to meet future LoS for growth	
NN_UPG_3_Dempsey Rd to Waiwhetū Stream Pipe Upgrade	Avalon - Naenae - Taita	Pipe upgrade, new alignment and new connection	- Pipe upgrade along Chapman Cres, Dempsey St, Bush St, and Naenae Rd. - A new alignment to bifurcate some flows to the Waiwhetū Stream where the channel upgrade is proposed - A new connection, and upgrade of the Seddon St main	- Improve conveyance to reduce ponding	New / Existing	Included	Medium	$ 23,036,258	Low	Needed to address existing issues and also to meet future LoS for growth	
NN_UPG_4_Naenae Rd Bifurcation	Avalon - Naenae - Taita	New pipe connection Pipe upgrade New pipe	- A new connection is installed - the main along Naenae Rd is upgraded and new pipe is installed to continue to Rata St to discharge to the Waiwhetū Stream.	- Provide conveyance storage to reduce overland flow and ponding in properties	New / Existing	Included	Medium	$ 12,300,382	Low	Needed to address existing issues and also to meet future LoS for growth	
WOB_Option_2_Woburn + Riddiford St SW Diversion	**Central Hutt**	**Stream diversion**	**- Incorporates Option 1 – Woburn but includes an additional diversion location for the Opahu Stream at Riddiford St.**	**- Reduce backwater effects on the network from the Opahu Stream by diverting stream flows to the Hutt River. - Pumping will assist discharge to the Hutt River when flows are high.**	New	**Included**	**High**	$ 77,005,400	**High**	**Needed to address existing issues and also to meet future LoS for growth**	**Further investigation is recommended to determine the most feasible route for diversion of the Opahu Stream**
Waterloo_West_Option 2_Waterloo Rd SW Rising Main	Central Hutt	Pump overland flows	- Pump overland flows from Oxford Terrace. This solution would only be feasible in conjunction with one of the Opahu Stream diversions (Melling and Woburn solutions)	- Collect overland flows from Oxford Terrace that cause ponding in properties along Waterloo Rd. - Reduce impact of flooding in Waterloo Station	New	Included	Medium	$ 32,107,847	High	Needed to address existing issues and also to meet future LoS for growth	
Waterloo_West_Upgrade_1_Knights Rd/Birch St Floor Level Raise	Central Hutt	Floor level survey	- An assessment on floor levels along Mahoe St, Birch St, and Knights Rd to determine whether floor levels are above predicted flood levels. Followed by raising floor levels for properties at risk of flooding.	- Reduce inundation for properties in flood prone depression.	N/A	Included	Medium	$ 4,900,493	N/A	Needed to address existing issues and also to meet future LoS for growth	
SV_Stokes Valley Catchment-Stormwater Flood Mitigation	Stokes Valley	New pipes and nodes	A range of solutions have been developed to meet a 1% AEP, in order to provide a high-level cost estimate. Further work is required to refine these solutions, and prioritise them given the high-cost to achieve this level of protection in the catchment.	- Stormwater flood mitigation for 1% AEP	New	Included	Medium	$ 293,706,543	Med	Needed to address existing issues and also to meet future LoS for growth	
							SUM	**$ 636,369,108**			

HUTT CITY GROWTH STUDY - STORMWATER - STOKES VALLEY								
Reference	**Growth Areas**	**Infrastructure Type**	**Option**	**Reason/Benefit**	**New / Existing Asset**	**Level 1 (95 percentile) w/out WWL Fee**	**Trigger for Update**	**Comments**
Upgrade stormwater network at Stokes Valley Road	Stokes Valley	Pipes and Sumps	• Upsize the existing 750mm diameter pipeline between 493 and 435 Stokes Valley Road to 1350mm diameter culvert, and the 900mm diameter culvert between 435 Stokes Valley and the Korau Culvert to 1500mm diameter culvert with some adjustment to the vertical alignment for 1% AEP • Barricade around the inlet at 493 Stokes Valley Road to isolate people and minimise the risk of drowning • Divert the upstream part of sub-catchment O (discharging to the stream) to drain to the pipe system at Stokes Valley, starting outside property No. 570 Stokes Valley Road. Diversion reduces the flooding problems downstream, where the options to upgrade the downstream networks are limited • Add pipe network starting from outside No. 570 Stokes Valley and upgrade the existing 225 diameter pipeline between 560 and 525 Stokes Valley Road to 1350mm diameter • Install High-Capacity sump upstream of property No. 568 Stokes Valley Road. To control the surface runoff before it entre this private property • Upgrade the existing 1050 mm diameter pipeline between 435 and 371 Stokes Valley to 1500mm diameter culvert, including adjustment of the vertical alignment for the culvert • Install a new 1500 dia culvert from 371 Stokes Valley to the intersection of Tanekaha Street and upgrade existing pipes along Stokes Valley Road from Tanekaha Street and Rawhiti Street stream	- Address existing flooding with consideration of forecast growth	New/Existing	N/A	Needed to address existing issues and also to meet future LoS for growth	LOS + Sequencing to be deteremined.
Upgrade of Raukawa Street Culvert	Stokes Valley	Culvert Upgrade Stream Capacity and Sumps	• Upgrade existing 1050 diameter culvert between property number 15 and 10 Raukawa Street to 1350 diameter, • Increase the capacity of the downstream section of the existing stream by installing 450mm high bunds along the stream. The bunds installation would achieve a 300mm freeboard, • Replace existing sumps outside number 15 and 10 Raukawa Street to higher capacity sumps.	- Address existing flooding with consideration of forecast growth	New/Existing	N/A	Needed to address existing issues and also to meet future LoS for growth	LOS + Sequencing to be deteremined.
Upgrade Stormwater network in Kairimu Street and Akepiro Grove	Stokes Valley	Kerb and Channel, Pipe/Culvert and Sumps	• Establish a new Kerb and Channel along Akepiro Grove to divert surface water running down this road away from Koraunui school grounds, • Install new sumps at the intersection of Kairimu Street and Akepiro Grove to control surface runoff from upstream section of the roads, • Upgrade the existing 300 and 375 dia pipe between 17 Kairimu Street and Stokes Valley Road to a new 900 dia culvert and connect to the proposed culvert at Stokes Valley Road, • Install High-capacity sump (Superpit) outside 17 Kairimu Road.	- Address existing flooding with consideration of forecast growth	New/Existing	N/A	Needed to address existing issues and also to meet future LoS for growth	LOS + Sequencing to be deteremined.
New pipework in George Street	Stokes Valley	Sumps, Culvert, Outlet Upgrade	• Install new Megapits outside 375 and 400 George Street and connect to the proposed culverts along George Street, • New 1800mm diameter culverts along George Street between property numbers 400 and 113 George Street. Installation of 1800mm diameter culverts along George Street is to drain to the existing stream, • Upgrade existing 225mm diameter outlet discharging to the stream at the rear of 109 George Street.	- Address existing flooding with consideration of forecast growth	New/Existing	N/A	Needed to address existing issues and also to meet future LoS for growth	LOS + Sequencing to be deteremined.
New pipework in Chittick Street	Stokes Valley	Sumps	Replace existing single sumps outside property numbers 11 and 20 Chittick Street with new Megapits and connect to the proposed culverts at George Street.	- Address existing flooding with consideration of forecast growth	New/Existing	N/A	Needed to address existing issues and also to meet future LoS for growth	LOS + Sequencing to be deteremined.
Upgrade of the piped network in Delany Drive, August Street, Hanson, and Rintoul Grove	Stokes Valley	Culverts, Sumps	• Install 2x1200mm diameter culverts along Delaney Drive starting from Shackleton Grove intersection and connecting to the proposed pipe network at George Street, • Divert pipe network between 80 and 74 Delaney Drive; connects to the proposed drainage system along Delany Drive, • Divert pipe flow starting from outside property number 3 August Street; connects to the proposed culverts at Delaney Drive, • Retain the existing pipeline at the rear of property numbers 49 and 29 to drain the already connected properties to this line, • Upgrade existing sumps to high-capacity sumps in Delaney and connect to the new proposed culverts, • Upgrade existing 600mm diameter pipe from the intersection of Wainhouse Street and number 18 Hanson Grove to 900 dia.	- Address existing flooding with consideration of forecast growth	New/Existing	N/A	Needed to address existing issues and also to meet future LoS for growth	LOS + Sequencing to be deteremined.
Upgrade and re-route Lowry Crescent and Lowry Heights Stormwater network	Stokes Valley	Pipes	• Install a new 450 dia pipe from outside 24 Lowry Crescent and connect to the manhole at Lowry Cres and Horoeka Street intersection. Upgrade existing 300mm diameter pipeline to 600mm diameter pipeline between 41 and 43 Horoeka Street, • 9B Lowry Crescent: The inlet and outlet pipes connected to the manhole in the driveway are 150mm diameter. Upgrade the SW system and connect to the proposed 450mm diameter pipe at Lowry Crescent to deviate the flow instead of discharging the pipelines crossing property numbers 10 and 8 Lowry Crescent, • 37 Lowry Crescent: Pipes conveying flow from the creek are 300mm diameter before decreasing to 225mm diameter and becoming under capacity. Install a new 450mm diameter pipeline and intake and connect to the proposed within the Lowry Cres rather than discharging to pipelines along the back of properties, • Consider connecting the creek and associated SW system at 1 Lowry heights to the new suggested pipe within Lowry Crescent, instead of the 225mm diameter discharging to the 600mm diameter at the back of 16-24 Lowry Crescent.	- Address existing flooding with consideration of forecast growth	New/Existing	N/A	Needed to address existing issues and also to meet future LoS for growth	LOS + Sequencing to be deteremined.
Upgrade in Poppy Watts Grove	Stokes Valley	Culvert	• Upgrade the existing 1050mm diameter culvert, crossing Poppy Watts Gr between 404 Stokes Valley (on Poppy Watts side) and 14 Poppy Watts, to a new 1500mm diameter culvert for 1% AEP. • Upgrade the depth of the existing streams by 450mm. Upgraded stream depth would allow a 300mm freeboard.	- Address existing flooding with consideration of forecast growth	New/Existing	N/A	Needed to address existing issues and also to meet future LoS for growth	LOS + Sequencing to be deteremined.
Upgrade Stormwater network in Tawhai Glen and Glen Road	Stokes Valley	Pipe/Culvert, Diversion	• Upgrade the pipe network along Tawhai Street to 1500mm diameter culvert, • Upgrade piped network along Glen Road to 2000mm diameter culvert, • Increase capacity of the stream by diverting some of the catchments to drain to the proposed culvert within Tawhai Street.	- Address existing flooding with consideration of forecast growth	New/Existing	N/A	Needed to address existing issues and also to meet future LoS for growth	LOS + Sequencing to be deteremined.
					SUM	**$ 293,706,543**		

HUTT CITY GROWTH STUDY - STORMWATER- WAINUIOMATA											
Reference	**Growth Areas**	**Infrastructure Type**	**Option**	**Reason/Benefit**	**New / Existing Asset**	**Included / Discounted**	**Recommended Priority**	**Level 1 (95 percentile) w/out WWL Fee**	**Expected Opex**	**Trigger for Update**	**Comments**
WMTA_SW3_ Storage C: Upper Fitzherbert Wetland	Wainuiomata	Wetland	- 1.05ha wetland (ave depth 1.5m)	- Address existing flooding with consideration of forecast growth	New	Included	Medium	$ 20,402,518	Low	Needed to address existing issues and also to meet future LoS for growth	2033 planning horizon
WMTA_SW4_Black Creek A: Wellington Rd to Upper Fitzherbert	Wainuiomata	Channel	- 332m of channel deepend by 3m and ave width 3m	- Increase capacity of channel by 6m3/s with catchment growth taking up 1.4m3/s of the increased capacity	Existing	Included	High	$ 2,098,689	Low	Needed to address existing issues and also to meet future LoS for growth	2020 planning horizon
WMTA_SW5_Black Creek B: Norfolk St to Wellington Rd	Wainuiomata	Channel	- 1190m existing channel widened	- Increased capacity of channel by 25.8m3/s with catchment growth taking up 10.3m3/s of this increased capacity	Existing	Included	High	$ 5,754,307	Low	Needed to address existing issues and also to meet future LoS for growth	2020 planning horizon
WMTA_SW6_Black Creek C: Nelson Cr to Norfolk St and Nelson Cr Bridge	Wainuiomata	Channel	- 1500m existing channel widened - Bridge redesign	- Increased capacity of channel by 29.1m3/s with catchment growth taking up 11.3m3/s of increased capacity	Existing	Included	High	$ 6,998,648	Low	Needed to address existing issues and also to meet future LoS for growth	2020 planning horizon
WMTA_SW7_Parkway Drain Improvements	Wainuiomata	Channel, weir	- 595m existing channel widened - Weir removed	- Increased capacity by 6.8m3/s, with catchment growth taking up 0.8m3/s of this increased capacity.	Existing	Included	High	$ 2,438,147	Low	Needed to address existing issues and also to meet future LoS for growth	2020 planning horizon
WMTA_SW8_Waiu St SW Upgrade	Wainuiomata	Pipes	- SW pipes upgrade along Waiu St - Support adjacent buildings within 3m of alignment	- Address capacity issues	Existing	Included	Medium	$ 13,426,145	Low	Needed to address existing issues and also to meet future LoS for growth	2033-2050 planning horizon
WMTA_SW9_Lees/Fraser St SW Upgrade	Wainuiomata	Pipes	- Upgrade SW pipes along Lees/Fraser St. - Support adjacent buildings within 3m of alignment	- Address capacity issues	Existing	Included	Medium	$ 28,339,947	Low	Needed to address existing issues and also to meet future LoS for growth	2020 planning horizon
WMTA_SW10_Upper Fitzherbert SW Network	Wainuiomata	Pipes	- New SW network in Upper Fitzherbert to drain to proposed wetland	Growth - For new development in Upper Fitzherbert	New	Included	Medium	$ 10,677,083	Low	Needed to address existing issues and also to meet future LoS for growth	2033 planning horizon
					SUM		**SUM**	**$ 90,135,484**			

APPENDIX E: THREE-WATER ANALYSIS BY STUDY AREA

E.1 Summary of Three-Water Infrastructure Investment

This section of the report provides key infrastructure required to facilitate growth (which includes significant level of service upgrades) by Study Area to provide a spatial view of requirements. Table E.1 shows the total cost for each of the three waters by Study Area.

Table E.1: Cost of City- level infrastructure by Study Area and three water type.

Study area*	(Level 1 exc WWL Mgmt Fee)			
	Water** $MIL	Stormwater $MIL	Wastewater $MIL	Total Cost $MIL
Avalon-Naenae-Taita	39.34	122.26	19.64	181.24
Central Hutt	16.28	220.40	37.73	274.42
Petone-Alicetown	0.27	83.70	7.10	91.1
Seaview-Gracefield-Waiwhetu	3.93	excluded	20.67	24.60
Western Hills	0.35	excluded	11.30	11.65
Eastbourne***	12.9	excluded	8.82	21.72
Wainuiomata	74.62[10]	90.14	146.41	311.17
Stokes Valley-Manor Park	43.57	293.71	19.46	356.74
Hutt Total	**191.26**	**810.21**	**271.13**	**1272.64**

Notes to the table:
* The costs in this table indicate the 95th percentile level 1 estimate excluding Wellington Water management fee; land, inflation and financing costs.
** Only city-level upgrades have been considered in this analysis. Therefore, there are an additional $44.1 M (Level 1 Cost Estimate excl. WWL Management Fee) of fire and pressure upgrades which have not been included. Furthermore, there are some water upgrade projects which cover multiple study areas. High level approximations to breakdown by study area have been made. More detailed analysis for each project will be prepared based on Cost Allocation Guide to support any proposed Development Contributions.
*** Eastbourne water reservoir excluded.
****GWRC bulk water main renewals/upgrades not included.

[10] Note this excludes the $122 M for the renewal of bulk water main as this is a GWRC cost

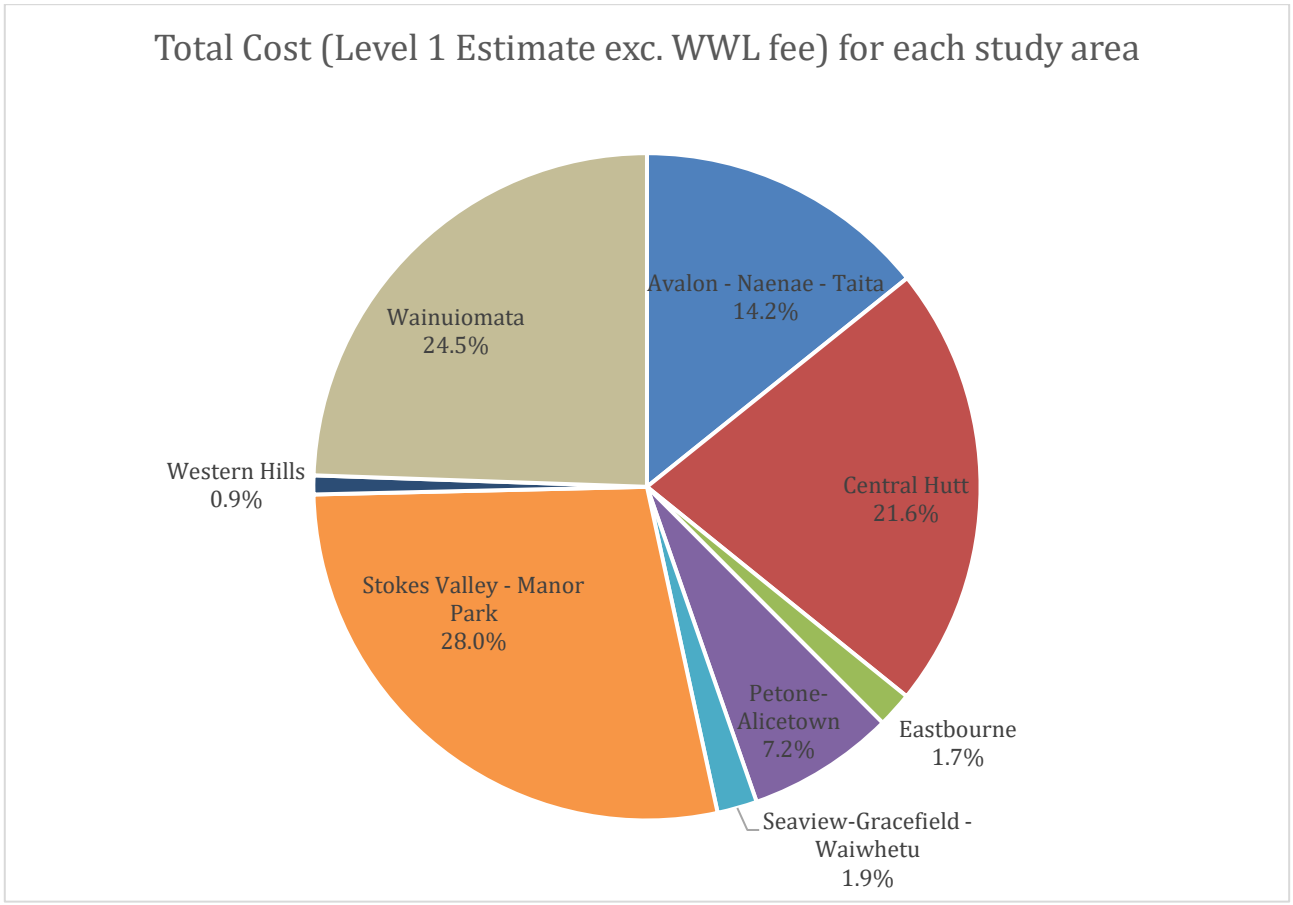


Figure E.1: Total HCC Cost (Level 1 Estimate excl. WWL fee) for each study area

E.2 Petone-Alicetown Study Area

Petone-Alicetown study area		
Summary	This study area as shown in the adjacent map. This area is expecting relatively high levels of population growth over the next 30 years compared to the rest of Lower Hutt and is more likely than other areas in Lower Hutt to be affected by climate change impacts.	
Population	Sense Partner (2021) forecasts to 2048 for this study area show an increase of 2149 dwellings – a 45% increase from 2018.	
Greenfield/ Brownfield	All of the considered growth in this study area is brownfield development. No greenfield has been considered.	

Figure E.2: Petone-Alicetown study area

Key three waters solutions required in the Petone-Alicetown study area to support growth are:

Water
No major growth investment required.

Wastewater
The wastewater network in Alicetown is aged and in many places in a poor condition. Flooding issues are confirmed by Wellington Water and renewal projects including the Barber Grove rising main are currently being planned for. Once the upgrades are completed it is expected that the capacity of Ava pump station would increase.

There are proposed upgrades at Herbert Street, Railway Avenue and Beaumont Avenue and these are expected to be adequate to reduce spiling risk to acceptable spill frequencies. It is recommended that those upgrades are further optimised.

Stormwater
The following are recommended:

- Projects - Ensure all outlets to the Hutt River have operating flap gates and proceed with the Hume to Victoria culvert project
- Installing non-return valve on all outlets to the harbour, storage or options to reduce and elongate peak runoff upstream of the Udy Street culvert and constructions of a pump station at the end of Nelson Street.

Investigations are required including capacity constraints in the network upstream of the Marsden Street pump station, pumpstation upgrade options for Te Mome pump station, upsizing the Nelson Street culvert, Regent Street stormwater main and John Street pump station and the existing Korokoro Stream culvert constraints.

E.3 Central Hutt Study Area

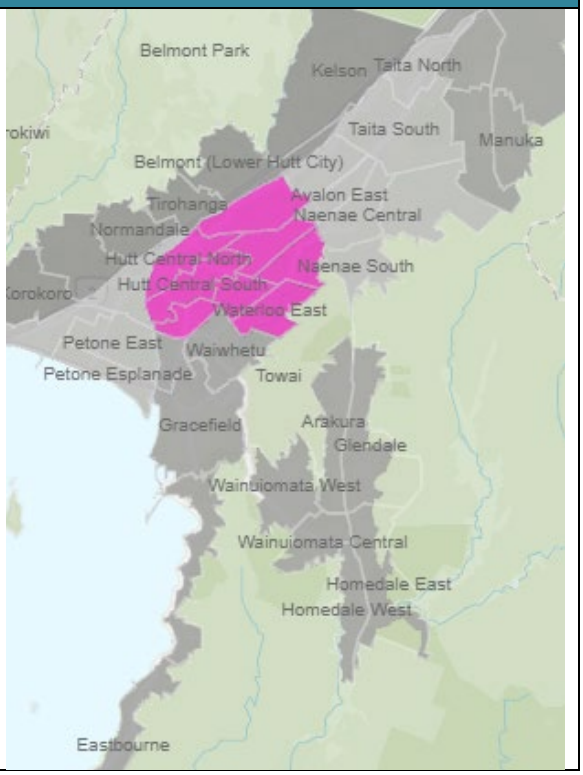
Central Hutt Study Area		
Summary	This study area as shown in the adjacent map. This area is expecting relatively higher levels of population growth over the next 30 years compared to the rest of Lower Hutt and is less likely than other areas in Lower Hutt to be affected by climate change impacts.	
Population	Sense Partner (2021) forecasts to 2048 for this study area show an increase of 3864 dwellings – a 44% increase from 2018.	
Greenfield/ Brownfield	All of the considered growth in this study area is brownfield development. No greenfield has been considered.	

Figure E.3: Central Hutt study area

Key three waters solutions required in the Valley Floor study area to support growth are:

Water

- The High Street water main is recommended to be renewed, due its age and network criticality.
- In addition, new water infrastructure outlined under the Naenae-Taita study area will provide improvement in this study area.
- The current network does not have sufficient capacity to meet the Fire Code requirements in certain areas and a number of upgrades are recommended.

Wastewater

- A new pump station is proposed near Woburn Road roundabout near Ewen Bridge. This pump station can be installed with a low invert level to provide the opportunity of installing a new trunk line (375mm) at a fairly efficient gradient (i.e., 0.3%) servicing the RiverLink development. The rising main for this new pump station is proposed to run across the Hutt River to join the main trunk gravity line to Ava pump station. The new pump station (including associated trunk line and rising main) in combination with the proposed upgrade of the Massey Avenue pump station is expected to provide the required future drainage capacity for the majority of the Lower Hutt central area.
- Upgrade of the planned Barber Grove and Ava pump station and rising mains are required to allow for the additional discharge from the proposed new pump station.
- The alternative is to have a new rising main to Barber Grove pump station. This would avoid having to construct a rising main along Ewen Bridge, which would add risk in case of a major seismic event. The disadvantage is that the length of the rising main would be approximately 2km longer, although it can be

constructed along the true left riverbank, which should not cause major conflicts with other services or infrastructure. During concept design both options are recommended to be investigated.

Stormwater

The key focus for solutions in **Boulcott** is to address ponding for properties that appear to be in an old stream bed. The following describes two preferred solutions and three options to mitigate the ponding in Boulcott. The Melling Rd pump station proposed by the Riverlink project is utilised in the proposed solutions.

There are two preferred options provided for Boulcott - Kingston St Rising Main and High Street upgrade + Pump station. The other options are soakage tanks, floor level raises, pump stations and a stream diversion.

The focus for stormwater solutions in **Woburn and Melling** is to relieve some of the flows in the Opahu Stream which much of the Melling, Woburn and Waterloo West network discharges to. A combination of the Kings Crescent Diversion and the Woburn Diversion + Riddiford St Diversion are preferred noting that the Kings Crescent Diversion would likely provide the greatest benefit to the Melling catchment including the 'Golden Triangle' area.

The focus for stormwater solutions in **Waterloo West** is to address localised ponding that results from depressions in the terrain. The solutions propose upgrades to mitigate flooding that is residual following the Opahu Stream upgrades. The preferred option is the Waterloo Rd Rising Main. Other options are floor level raises and soakage/storage.

E.4 Wainuiomata Study Area

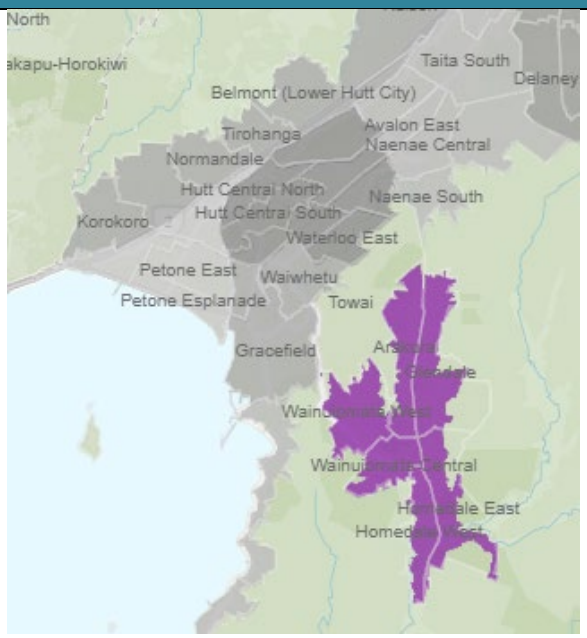
Wainuiomata		
Summary	The Wainuiomata study area is shown in the adjacent map. Wainuiomata is expecting relatively comparable levels of population growth over the next 30 years compared to the rest of Lower Hutt and is less likely than other areas in Lower Hutt to be affected by climate change impacts.	
Population	Sense Partner (2021) forecasts to 2048 for this study area show an increase of 3205 dwellings – a 44% increase from 2018.	
Greenfield/ Brownfield	The considered growth in this study area includes both brownfield and greenfield (Wainuiomata North greenfield area).	

Figure E.4: Wainuiomata study area

Key three waters solutions required in the Wainuiomata study area to support growth are:

Water

- An 8ML reservoir of which 50% (4 ML) is required to resolve current LOS issues and 50% is required for growth. Note that the location of the reservoir requires costly earthworks and so the cost of building a 4ML reservoir is more than half of the cost.
- A series of pipe network upgrades
- Renewal of 5.2 km of existing bulk water main (this is a GWRC not a HCC cost)

Wastewater

Wastewater solutions were originally for two-time frames to support a certain level of population in Wainuiomata at those times. Population growth is now expected faster than originally expected and this can be seen in Table If the rate of population increases or slows down from these current forecasts, this will affect the time at which these solutions are required. As a base, the population in Wainuiomata in 2013 was 17,787.

Table E.2: Wainuiomata population forecast changes (Forecast ID 2019 v.s. Sense Partners 2021)

Timeframe	Wainuiomata population level	Year originally projected to occur by	Year currently projected to occur by[11]
Medium Term	21,190	2033	2027 or 2028
Long-Term	24,294	2050	2045

[11] Using Sense Partners (2021) Population Forecasts

Wastewater – to support growth in Medium Term

- Wise Park pumpstation upgrades (Stage 1 and Stage 2)
- I& I programme primarily for level of service requirements
- Greenfield servicing
- Fraser storage tank and Main/Rowe storage tank
- Assessment and replace of laterals for LOS

Wastewater – to support growth in Long-Term

- Duplication of the gravity line (from Wainuiomata to Gracefield)
- Further I&I work
- Upgrade of Wellington Road Pump Station

Stormwater – – to support growth in Medium Term

- New detention/wetland to provide for northern greenfield growth
- Black Creek widening (top, middle, and lower sections)
- Parkway widening
- Lees/Fraser pipe upgrade
- Upper Fitzherbert pipe upgrade to provide for growth

Stormwater – to support growth in Long-Term

- Waiu stormwater upgrade to provide for growth

E. 5 Avalon-Naenae-Taita Study Area

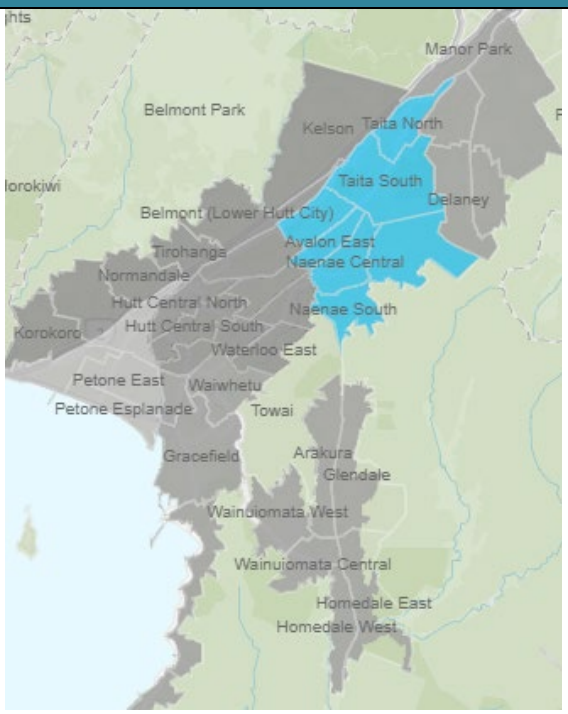
Avalon-Naenae-Taita Study Area		
Summary	The Avalon-Naenae-Taita study area is shown in the adjacent map. This area is expecting relatively comparable levels of population growth over the next 30 years compared to the rest of Lower Hutt and is less likely than other areas in Lower Hutt to be affected by climate change impacts.	
Population	Sense Partner (2021) forecasts to 2048 for this study area show an increase of 3999 dwellings – a 49% increase from 2018.	
Greenfield/ Brownfield	All of the considered growth in this study area is brownfield development. No greenfield has been considered.	

Figure E.5: Avalon-Naenae-Taita study area map

Key three waters solutions required in the Naenae-Taita study area to support growth (brownfield) are:

Water

- New Naenae Reservoir No.2 (15 ML) beside the existing Naenae Reservoir to service Hutt Central water storage area. This new reservoir is assumed to be online within the next 10 years.
- To enable bulk water cross connections to be closed - numerous network upgrades are required before the cross-connections can be closed, including 3 km of old AC pipe renewal, 350 m of new pipe, two new PRVs. In the long term (before 2033), it will also be necessary to increase the capacity of the Naenae Reservoir outlet main.

Wastewater

To resolve the problems at Naenae it is considered required to provide storage and conveyance options at Fleet Street and Seddon Street to prevent increasing overflows and flooding further downstream in the catchment

Stormwater

The key focus for solutions in **Naenae** is to improve conveyance to the Waiwhetū Stream, address channel capacity issues (which causes much of the flooding in Naenae) and mitigate the effects of increasing conveyance through network upgrades by providing detention.

Each proposed upgrade for Naenae addresses an independent flooding issue. It is proposed that all solutions are undertaken, and some solutions rely on others to be feasible. These are a range of projects including diversions, pipe upgrades, bifurcation, stream updates and detention storage.

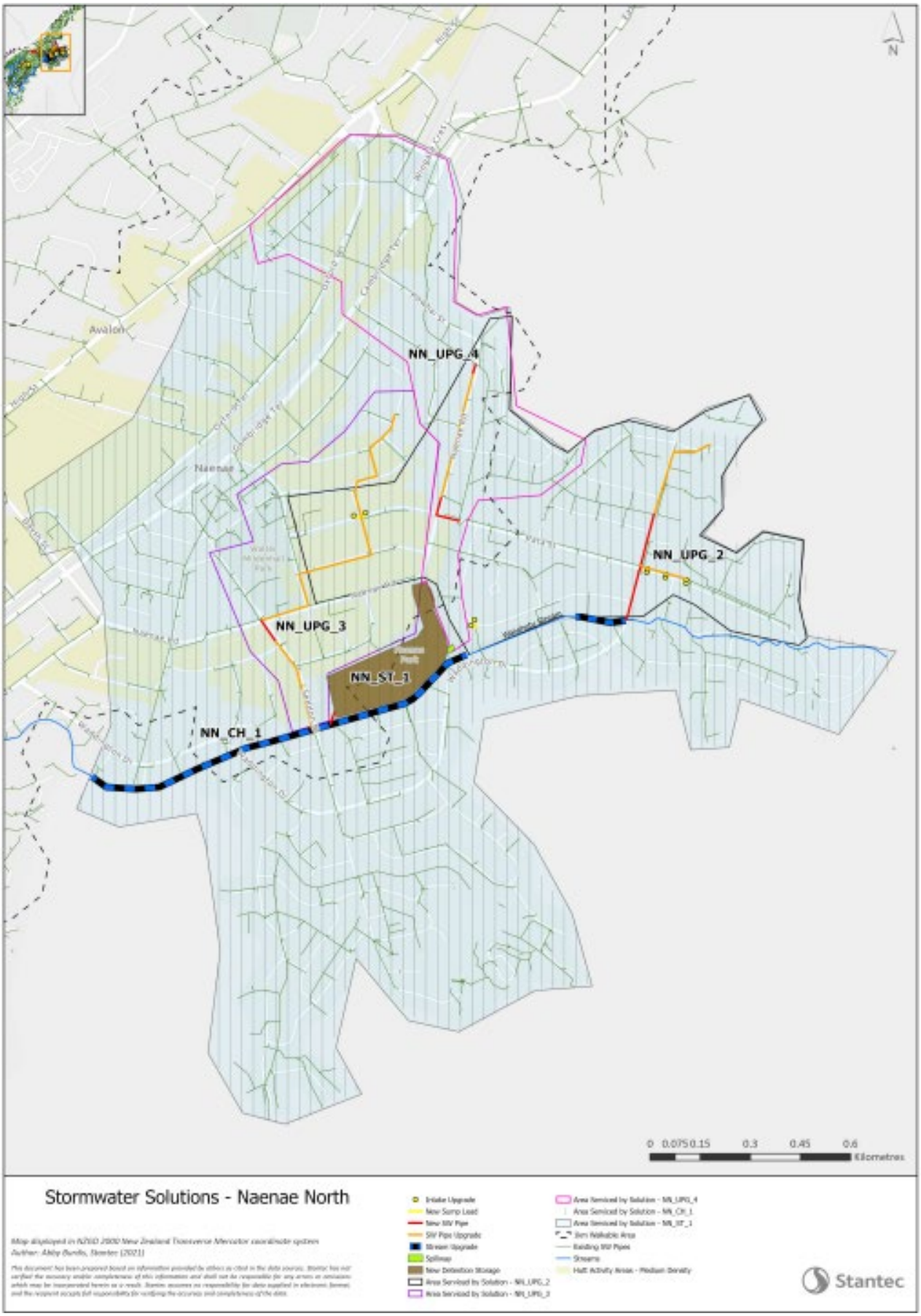


Figure E.6: Naenae North - Stormwater Solutions

The key focus for stormwater solutions in **Avalon** is to improve conveyance in the Taita Drive main which should in turn improve capacity issues where the network discharges to the Taita Drive main. It is also to

mitigate ponding in properties along High St that appear to be within an old overland flow path or depression.

Three options are provided for Avalon being Taita Drive Main Upgrade (Preferred solution), High Street Soakage Tanks and High Street Floor Level Raise.

E.6 Stokes Valley-Manor Park Study Area

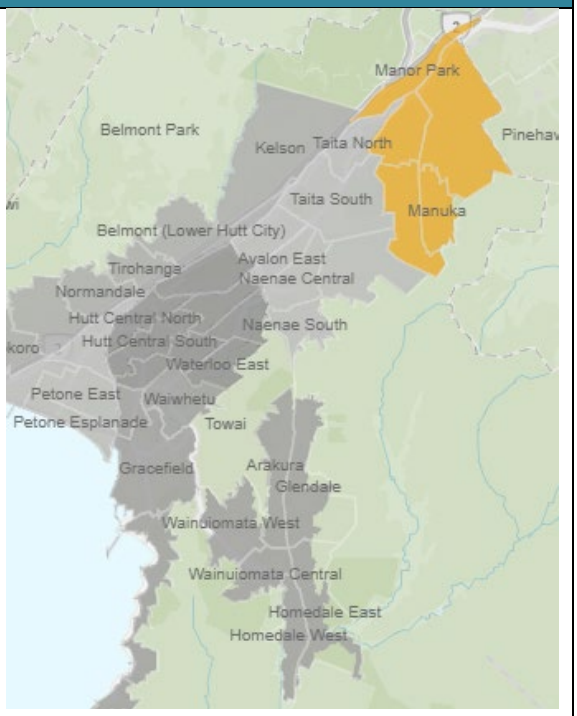
Stokes Valley-Manor Park Study Area		
Summary	The Stokes Valley-Manor Park study area is shown in the adjacent map. This area is expecting relatively higher levels of population growth over the next 30 years compared to the rest of Lower Hutt and is less likely than other areas in Lower Hutt to be affected by climate change impacts.	
Population	Sense Partner (2021) forecasts to 2048 for this study area show an increase of 2825 dwellings – a 65% increase from 2018.	
Greenfield/ Brownfield	The considered growth in this study area includes both brownfield and greenfield. The greenfield sites are Shaftesbury Grove (120 lots) and Holborn Drive (186 lots) greenfield areas).	

Figure E.7: Stokes Valley-Manor Park study area

Key three waters solutions required in the Stokes Valley-Manor Park study area to support growth are:

Water

- To meet the total number of new dwellings in the Holborn and Shaftesbury development sites a 1.5 ML reservoir will be required (referred to as Holburn High Level) (shown in Figure E.8).
- To service existing communities and provide for infill development, additional storage will be required (in the order of 1.2ML to 4.2ML depending on scale of growth and options for suitable sites). In the ZMP (2020) it was recommended that land be secured for a future reservoir and further investigations be undertaken into site selection, sizing and staging of water storage.

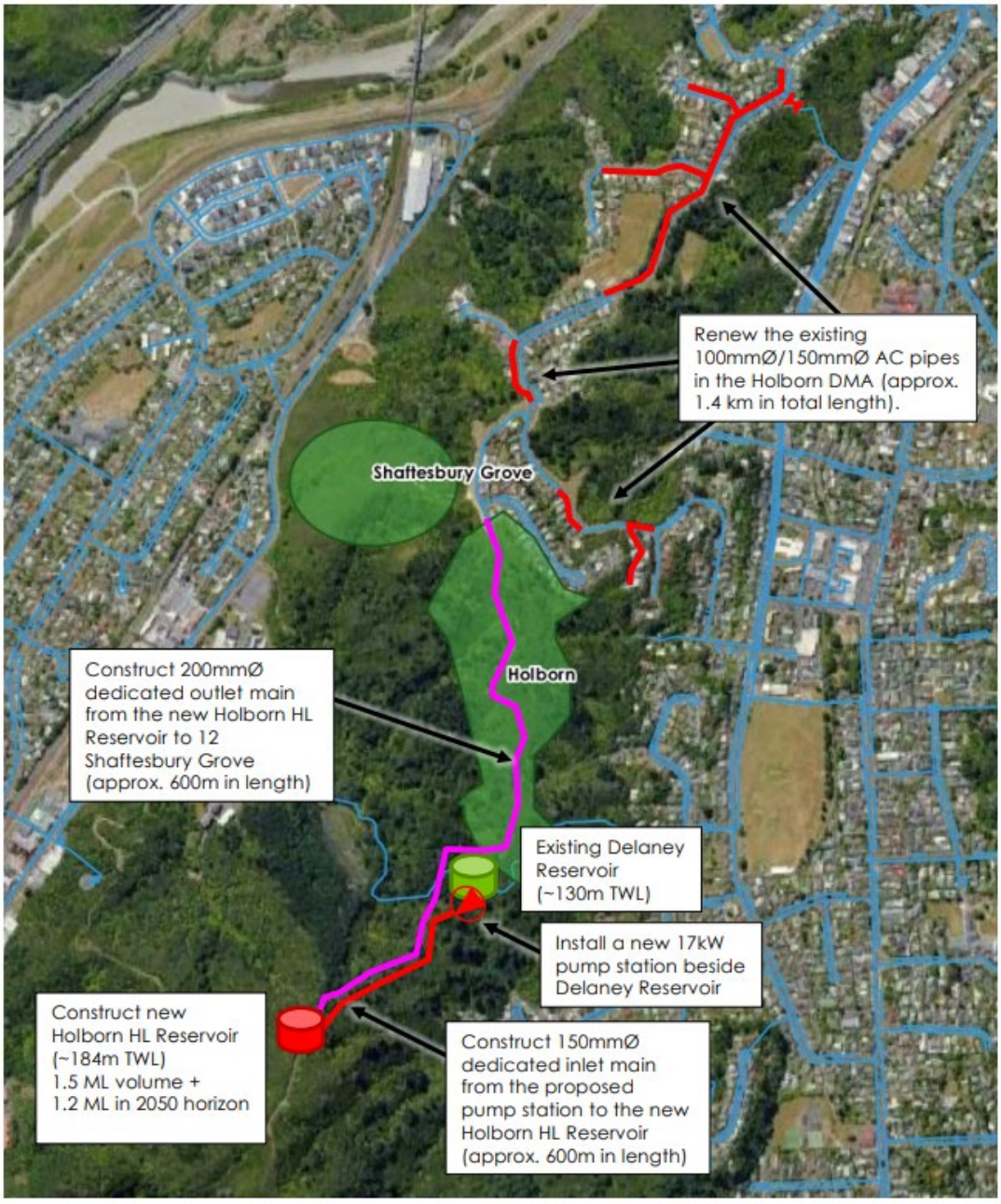


Figure E.8: Greenfield development sites in Stokes Valley and proposed upgrades

Wastewater

A key constraint is the relatively small diameter pipe section at Stokes Valley Road directly north of the intersection with Richard Grove and Glen Road. Modelling results show this potential constraint causes backwater issues further up in the catchment.

Stormwater

Stormwater flooding investigations identified a number of issues with the existing network including:

- Inadequate or incorrect location of sumps to capture surface runoff
- Overgrown vegetation, sedimentation, and debris in the streams, stream inlets and sumps reducing network capacity.
- Under capacity conveyance systems.

Concept level upgrades have been developed across the catchment, which involve a range of pipe/culvert upsizing, diversions, and high-capacity sump upgrades, across 9 areas. The extensive upgrades identified are

likely to be unaffordable and require further refinement and community engagement on levels of service and costs involved to support prioritisation and options for funding.

- Upgrade stormwater network at Stokes Valley Road
- Upgrade of Raukawa Street Culvert
- Upgrade Stormwater network in Kairimu Street and Akepiro Grove
- New pipework in George Street
- New pipework in Chittick Street
- Upgrade of the piped network in Delany Drive, August Street, Hanson, and Rintoul Grove
- Upgrade and re-route Lowry Crescent and Lowry Heights Stormwater network
- Upgrade in Poppy Watts Grove
- Upgrade Stormwater network in Tawhai Glen and Glen Road

E.7 Eastbourne Study Area

Eastbourne Study Area		
Summary	The Eastbourne study area is shown in the adjacent map. This area is expecting low levels of population growth over the next 30 years compared to the rest of Lower Hutt and is more likely than other areas in Lower Hutt to be affected by climate change impacts.	
Population	Sense Partner (2021) forecasts to 2048 for this study area show an increase of 431 people – a 19% increase from 2018.	
Greenfield/ Brownfield	All of the considered growth in this study area is brownfield development. No greenfield has been considered.	

Figure E.9: Eastbourne Study Area

Key three waters solutions required in the Eastbourne Study area to support growth are provided below. There are minimal recommended solutions in this study area as there is minimal growth expected.

Water

The supply to Eastbourne can easily be interrupted through an operational outage or in a seismic event as the bulk supply crosses liquefaction-prone ground through Seaview. Whilst not a storage size issue, it could impact on supply.

A new storage reservoir of at least 1.3 ML, which may need to be increased up to 2.2 ML (applying Sense Partners 2021 population forecasts for this study area).

Wastewater

No major investment identified.

Stormwater

No major investment has been identified in this study to service growth. However, further investment in Eastbourne will be required to manage existing level of service and expected impacts of sea level rise. Further investigations will be required to address these as required.

E.8 Western Hills Study Area

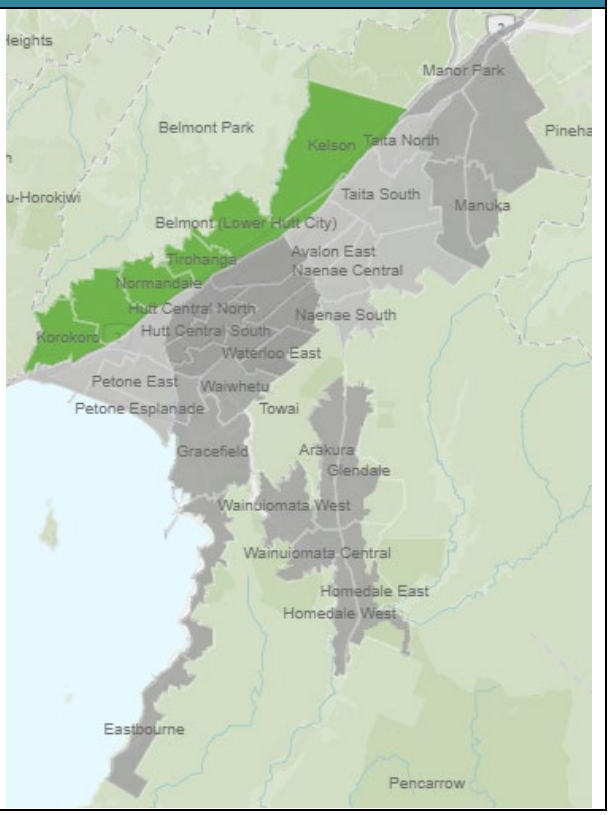
Western Hills Study Area		
Summary	The Western Hills study area is shown in the adjacent map. This area is expecting relatively comparable levels of population growth over the next 30 years compared to the rest of Lower Hutt and is less likely than other areas in Lower Hutt to be affected by climate change impacts.	
Population	Sense Partner (2021) forecasts to 2048 for this study area show an increase of 3850 people – a 42% increase from 2018[12].	
Greenfield/ Brownfield	The considered growth in this study area is both brownfield and greenfield development. There are two major development sites in Kelson – Kelson Subdivision (120 lots) and 64 Waipounamu Drive (250 lots).	

Figure E.10: Western Hills Study Area

Key three waters solutions required in the Western Hills study area to support growth are provided below. Overall, there are minimal recommended solutions in this study area as there is minimal growth expected. However, Sense Partners 2021 forecasts predicted significant growth in Western Hills, this growth hasn't been assessed in this study, and any indications of largescale future growth in this catchment will require further three-waters servicing assessments.

Water

The ZMP (2020) recommended that no major investment was required as the shortfall in this study area was too small and the construction of a new reservoir was considered too difficult. The ZMP recommended that the greenfield developments, in total of 370 lots, be fed by the existing Liverton Reservoir as seen in Figure .

However, with the 2021 Sense Partners forecasts, showing increased growth forecasts for the entire Western Hills study area, it is now noted that there may potentially be a need for a new reservoir for Normandale and Tirohanga. Both Normandale and Tirohanga are unlikely to contain a site suitable for a new reservoir, but it is recommended that this is confirmed.

[12] Note this does not include Belmont Park

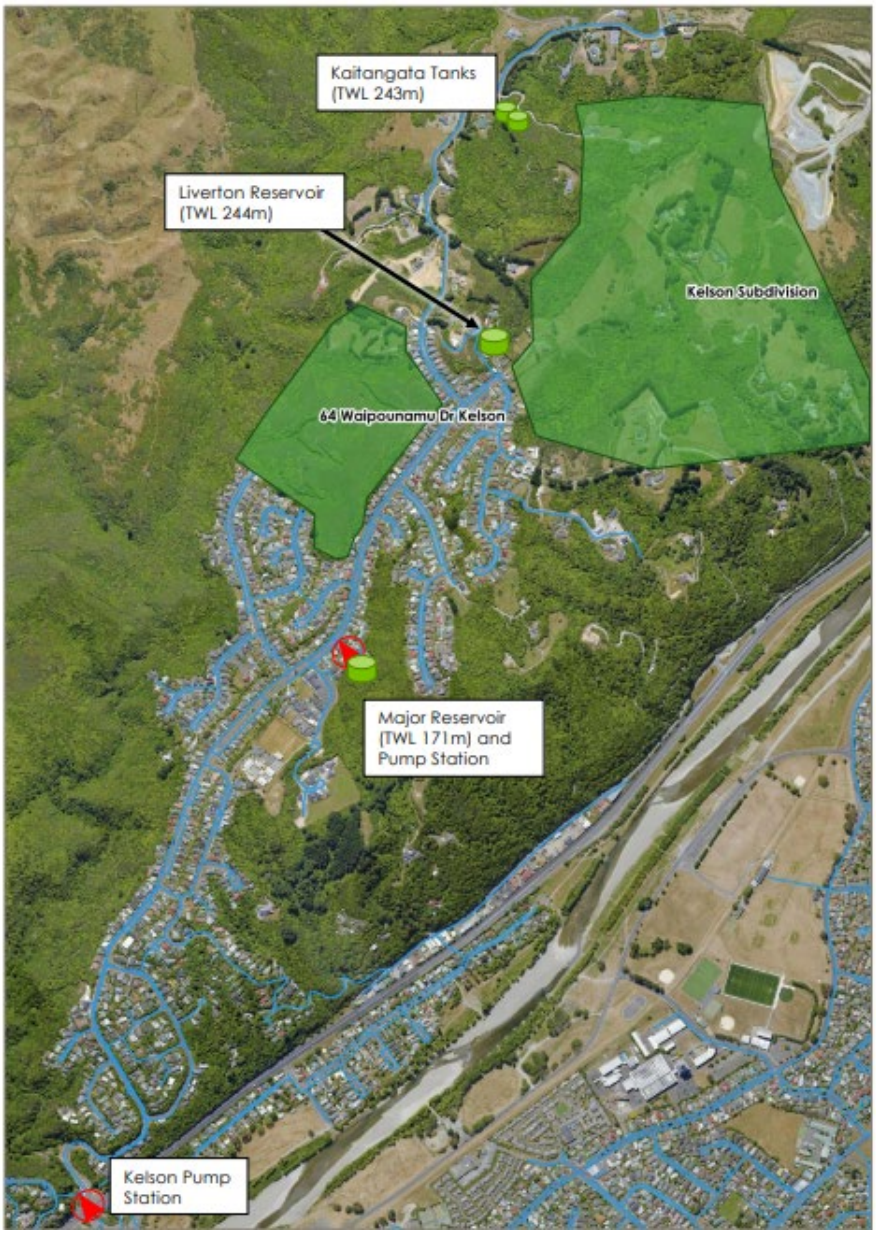


Figure E.11: Greenfield sites in the Western Hills study area

Wastewater

I&I investigations are recommended to firstly quantify existing I&I (as this catchment was not directly monitored during the model calibration) and to assess if I&I reduction could be of benefit for this catchment.

Stormwater

Greenfield developer/s will be required to demonstrate Water Sensitive Urban Design (WSUD) practices, provide stormwater neutrality, and demonstrate no downstream effects.

E. 9 Seaview-Gracefield-Waiwhetu Study Area

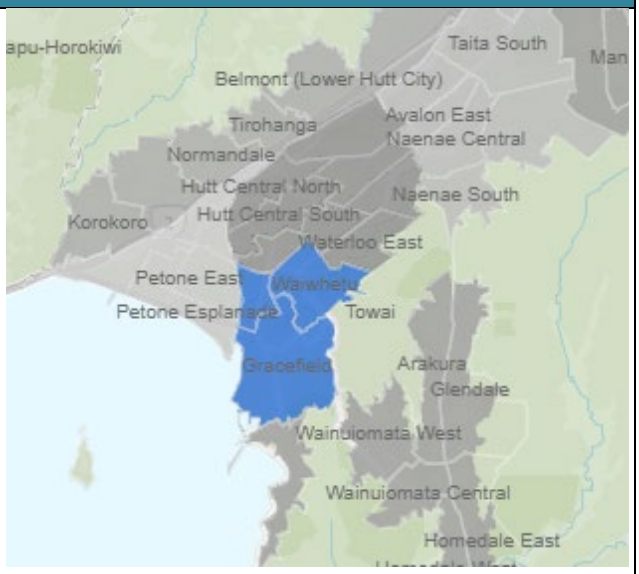
Seaview-Gracefield-Waiwhetu Study Area		
Summary	This study area as shown in map is expecting relatively comparable levels of population growth over the next 30 years compared to the rest of Lower Hutt and is more likely than other areas in Lower Hutt to be affected by climate change impacts.	
Population	Sense Partner (2021) forecasts to 2048 for this study area show an increase of 1285 dwellings – a 47% increase from 2018.	
Greenfield/ Brownfield	All of the considered growth in this study area is brownfield development. No greenfield has been considered.	

Figure E.12: Seaview-Gracefield-Waiwhetu study area

Key three waters solutions required in the Seaview-Gracefield-Waiwhetu study area to support growth are:

Water

The water infrastructure outlined under the Naenae-Taita study area will provide improvement in this study area.

Wastewater

To address modelled spilling, caused by inadequate pump capacity, pump capacity should be increased for Seaview Road PS, Seaview Hutt Park PS and Randwick Road PS. Furthermore, the existing uncontrolled overflow and smaller flooding locations in the catchment upstream of Whites Line Ps can be improved by providing 200m^3 storage volume.

Stormwater

This area is subject to stormwater flooding, and recognised to be further impacted by climate change and sea level rise. Residential growth in this area is expected to be minimal, therefore no specific upgrades have been recommended to support growth.

APPENDIX F: STRATEGIC ENVIRONMENT ASSESSMENT (SEA) CASE STUDY

F.1 SEA Background

Wellington Water commissioned a Strategic Environmental Assessment (SEA) to account for the effects of planned and future growth across the Wellington Region for which Wellington Water manages its client councils three waters assets.

Key catchments currently serviced by Wellington Waters three waters network were assessed in terms of the Ecosystem Services provided to people in those catchments, from groundwater, surface water, and coastal water receiving environments.

Within the SEA population growth was considered as the key driver for change in potential impacts and was assessed at the strategic level regarding how potential or actual impacts may change over the 30-year growth period. There are other potential drivers of changes in impacts, climate change is briefly commented on as it may exacerbate potential changes in impacts.

An ecosystems services approach was undertaken to this assessment which means that it focused on the benefits people obtain from ecosystems. Therefore, the conclusion on sensitivity is grouped into the following four services:

1. Provisional: Essential resources, food, freshwater.
2. Regulative: Climate regulation, water purification, disease control.
3. Supporting: nutrient cycling, primary production.
4. Cultural: Aesthetics, cultural heritage, and sense of place (mana whenua), educational, recreational, spiritual, and religious.

Two scenarios are used in the assessment:

- **Maintain Status Quo Scenario** – Under this scenario environmental impacts have been assessed based on population growth without any specific Wellington Water intervention response other than continuing to meet regulatory requirements (i.e., policy implementation, meeting current consent conditions, implementing new consents and consent renewals) through maintenance of current three waters infrastructure
- **Strategic Intervention Scenario** – Under this scenario impacts of the three waters network on the receiving environment have been assessed assuming a level of intervention has been implemented to reduce significance of impacts.

The objective of the impact assessment is to identify the likely significance of impacts on the environment resulting from Wellington Waters response to population growth over the next 30 years in order to maintain three waters services to the Wellington region.

Impacts determined to be ‘Moderate’, ‘High’ or ‘Very High’ are deemed significant. Where impacts are determined to be significant then mitigation measures are required to reduce these impacts to an acceptable level i.e., ‘Low’ or ‘Very Low’. Refer to Figure F-1 for further information.

		Magnitude				
		Very High	High	Moderate	Low	Negligible
Sensitivity	Very High	Very High	Very High	High	Moderate	Low
	High	Very High	High	Moderate	Low	Very Low
	Moderate	High	High	Moderate	Low	Very Low
	Low	Moderate	Low	Low	Low	Very Low
	Negligible	Low	Very Low	Very Low	Very Low	Very Low

Figure F-1: SEA Impact Matrix

F.2 Lower Hutt Case Study Summary

Table F-1, Figure F-1, Figure F-2 and Figure F-3 show the significance of the impact of growth in Lower Hutt on the effects of the three water network operations on specified receiving environment ecosystem services under the 'Maintain Status Quo' and 'Implement Strategic Interventions' scenarios. The catchments are:

- Wainuiomata & Orongorongo / Headwater / Wainuiomata Estuary
- Hutt River (Middle to Lower)/Hutt Estuary/Petone foreshore through to Eastbourne

Table F-1: Catchment and Impacts Summary

Catchment	Impacts
Wainuiomata & Orongorongo / Headwater / Wainuiomata Estuary	• It is anticipated that strategic interventions will reduce the significance of adverse impacts in this catchment but the impacts while reduced could still be considered significant (i.e., moderate, or above). • The effect of growth on the wastewater network impacts and stormwater impacts is most significant in the surface freshwater and estuary/CMA receiving environments in this catchment. Generally, impacts on groundwater are not considered to be significant. • The effect of growth on the water supply network impacts is most significant in the surface freshwater receiving environments for Lower Hutt in this catchment.
Hutt River (Middle to Lower)/Hutt Estuary/Petone foreshore through to Eastbourne	• It is anticipated that strategic interventions will reduce the significance of adverse impacts but the impacts while reduced could still be considered significant (i.e., moderate, or above). • The effect of growth on the wastewater network impacts and stormwater impacts is most significant in the surface freshwater and estuary/CMA receiving environments in this catchment. In general impacts on groundwater are not considered to be significant. • The effect of growth on the water supply network impacts is most significant in the surface freshwater receiving environments for Lower Hutt in this catchment. The groundwater receiving environments is also impacted in the Hutt River catchment.

F.3 Wastewater network impacts arising from growth under the two SEA scenarios

The Wainuiomata & Orongorongo catchment moderate or above impacts arising from growth are anticipated on surface/freshwater and estuary/CMA ecosystem values. This arises primarily from the anticipated increase in frequency and magnitude of wastewater overflows plus increased loads discharged from the treatment plant that can affect ecological, cultural, and recreational based ecosystem services values.

With the consideration of strategic interventions these impacts could be reduced to generally moderate ratings. It is not expected that interventions could be undertaken to address all the impacts of growth within suitable timelines to keep pace with growth hence the significance is not reducing down to low or very low.

Within the middle to lower Hutt River catchment there was generally a higher rating of potential impact significance across all receiving environments and ecosystem services compared to the Wainuiomata and Orongorongo. In general, the impact significance dropped to moderate under a strategic intervention scenario.

In both of these catchments the fact that the impact significance does not drop to low or very low under the implement strategic interventions scenario highlights the risk that in areas with existing effects from their operations and where networks are under pressure “new” strategic interventions are not likely to occur in time to address all potential future impacts or may not be affordable to minimise effects totally. Strategic interventions refer to targeted policy, infrastructure and non-infrastructure solutions that make a positive step towards managing the impacts of growth.

This leads to a consideration within the adaptive planning approach to managing growth of whether it is better to seek that growth in certain areas be avoided or minimised if it is too challenging or costly to adapt to and the risk of adverse effects is too high.

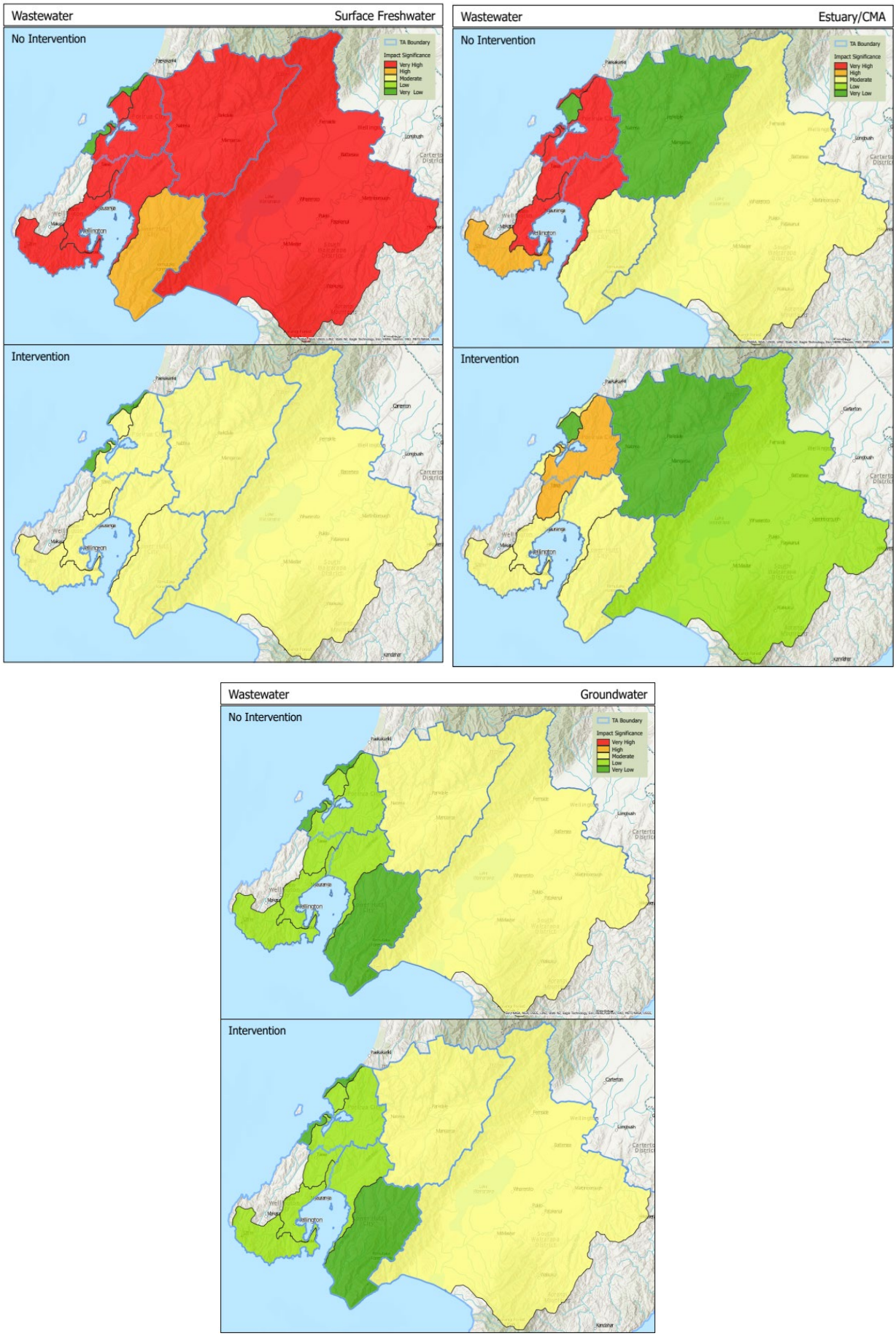


Figure F.2: SEA – Wastewater Growth Environmental Impact Assessment on Freshwater; Estuary/CMA; Groundwater

F.4 Stormwater network impacts arising from growth under the two SEA scenarios

The effect of growth on the impact of the stormwater network are anticipated to be significant in the surface freshwater and Estuary/CMA receiving environments for both the Hutt River and Wainuiomata & Orongorongo catchments with higher significance effects anticipated in the middle to lower Hutt River catchment than the Wainuiomata & Orongorongo catchment.

It is anticipated that with even with intervention (i.e., under the Strategic Intervention Scenario) some significant impacts would still occur – at best there could be reduced to "high" impacts in the Hutt River catchment and "moderate" impact in the Wainuiomata & Orongorongo catchment.

This is due to the values of the receiving environments but also the recognition that best practice stormwater interventions would not address all effects of growth. For example, new development may not fully implement water sensitive urban design especially where growth occurs as infill in existing areas and drains to existing networks that may not be modified. In addition, growth in population will likely grow vehicle numbers and with increased contaminant load through existing stormwater networks may increase.

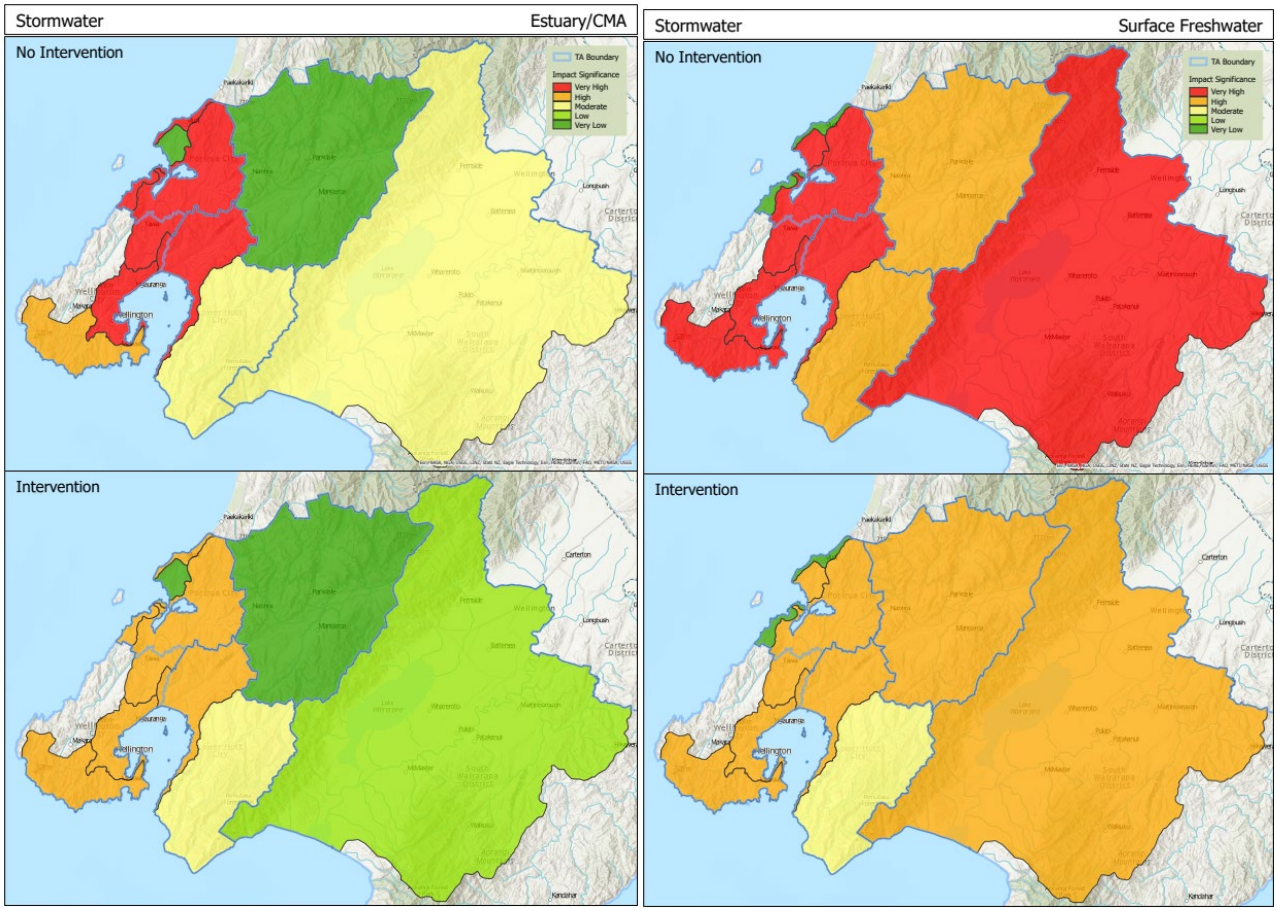


Figure F.3: Stormwater Growth Environmental Impact Assessment on Freshwater; Estuary/CMA

F.5 Water Supply impacts arising from growth under the two SEA scenarios

In Lower Hutt the impact of the water supply network operation is anticipated to be different for the two catchments. Within the Wainuiomata & Orongorongo catchment it is expected to be more significant on the surface freshwater receiving environment and, in the middle, to lower Hutt River more significant on groundwater. In both, it is anticipated that interventions will still result in some significant impacts.

Even with water demand control interventions and loss minimisation etc. there is likely to still be a requirement for more supply, therefore some impacts are still likely to occur as a result of taking more water.

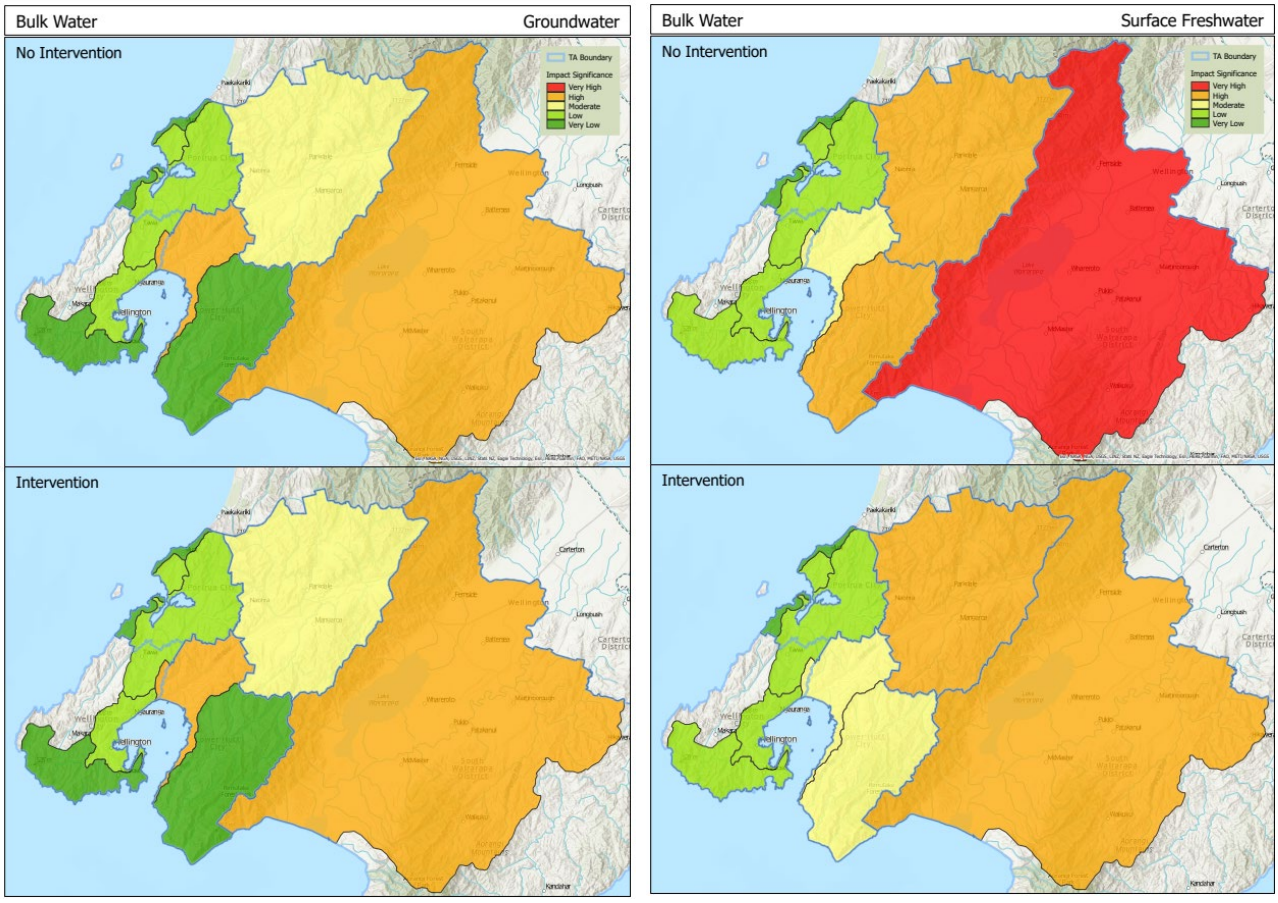


Figure F.4: Water Supply Growth Environmental Impact Assessment on Ground Water and Surface Water

APPENDIX G: FURTHER INVESTIGATIONS

Further investigations to be undertaken are included in the following table.

3.0	**Investigations**	
3.1	Undertake the following **water** investigations	
3.1.1	A preliminary investigation to confirm the location of the proposed Holborn Reservoir. The location of this reservoir impacts most other upgrades significantly. It is essential that is confirmed prior to starting any other capital works to service this area.	Wellington Water
3.1.2	A preliminary investigation to confirm the location of the proposed Delaney additional storage.	Wellington Water
3.1.3	Options to allow the Gracefield Reservoir to refill to at least 70% full without the Naenae Reservoir overfilling.	Wellington Water
3.1.4	Based on HCC growth plans and planning rules. Investigate the need for a new reservoir for Normandale and Tirohanga. Both Normandale and Tirohanga are unlikely to contain a site suitable for a new reservoir, but it is recommended that this is confirmed if growth is proposed in this area.	Wellington Water
3.1.5	Further investigation into the effects of reducing pressure on sprinkler systems, commercial water installations and internal multi-storey building water systems.	Wellington Water
3.2	Undertake the following high priority **wastewater** investigations/further analysis:	
3.2.1	Commence concept design of the new strategic wastewater upgrades required to service growth in Lower Hutt and expected general growth and in particular the RiverLink project. The proposed solution is a new gravity main draining to a pump station near the existing roundabout at Woburn Rd near Ewen Bridge to accommodate the expected general growth and in particular the RiverLink project. The rising main is proposed to cross the Hutt River at Ewen Bridge and connect to the existing trunk gravity line to Ava pump station, although an alternative route to Barber Grove should be considered as this would provide more resilience against earthquake risks. Confirmation on the impact of this additional flow on Ava pump station capacity and rising main is also to be confirmed.	Wellington Water
3.2.2	Develop designs for pipe upgrades in Alicetown at Railway Avenue and Herbert Street including a storage tank / large diameter pipe at Beaumont Avenue to mitigate the flooding issues in this area.	Wellington Water
3.2.3	Further investigations into I&I in Maungaraki catchment to reduce flooding risk at Holly and Maple Grove. Pipe upgrades and storage is proposed at Fleet Street and Seddon Street in Naenae, which includes a diversion of flows through a new line at Waddington Drive.	Wellington Water
3.2.4	Upgrades of the main sewer line at Stokes Valley Road (near Richard Grove / Glen Road intersection) as enabling work for other upgrades at Hawthorn Crescent and Milton Street. Additional asset investigation is recommended prior to further concept development.	Wellington Water
3.2.5	Complete the Seaview Wastewater Strategic Model to be able to support analysing upgrade options of the trunk system.	Wellington Water
3.3	Undertake the following **stormwater** investigations:	

3.3.1	Further investigation into capacity constraints in the network upstream of the Marsden Street pump station to determine the cause of flooding in Pharazyn Street.	Wellington Water
3.3.2	Investigate pump upgrade options for the Te Mome Pump Station	Wellington Water
3.3.3	Investigate upsizing the Nelson Street culvert, Regent Street stormwater main and John Street pump station.	Wellington Water
3.3.4	Consider storage or options to reduce and elongate peak runoff upstream of the Udy Street culvert.	Wellington Water