GHD
Advisory

Hamilton - Waikato - Waipa Metropolitan Area - Southern Metro Wastewater Detailed Business case - Conveyance Options Report

Metro Wastewater Project Partners
June 2022

GHD

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1. Introduction

1.1 Purpose

The purpose of this Shortlist Options Report is to document the options development process of the shortlisted wastewater conveyance options for the Southern Hamilton, Waipa and Waikato Metro Area (known as the Southern Metro Area, refer Figure 1). This report is part of the Economic Case of the Waikato Metro Wastewater Treatment Detailed Business Case (DBC).

The conveyance options described in this report support the options assessment documented in the Metro Wastewater DBC Shortlist Options Report and the Preferred Options Report.

The purpose of the DBC is to explore potential wastewater strategic options for the wider metro area and determine a preferred wastewater treatment solution for the Southern Metro Area. This project will aim to align with the overarching Waikato Sub-regional Three Waters vision:

Tōku awa koiora me ōna pikonga he kura tangihia o te mātāmuri

"The river of life, each curve more beautiful than the last"

The investment arising from this DBC and subsequent work seeks to contribute to a future where a healthy Waikato River sustains abundant life and prosperous communities who, in turn, are all responsible for restoring and protecting the health and wellbeing of the Waikato River, and all it embraces, for generations to come.

1.2 Geographical Context

The Southern Metro Area includes areas in south Hamilton and continues south to Te Awamutu. Specifically this includes the following communities:

- Hamilton (South)
- Matangi
- Tamahere
- Hamilton Airport
- Ohaupo
- Rukuhia
- Tauwhare Pa
- Cambridge
- Te Awamutu

Figure 1 provides a detailed map of the areas and existing treatment plants currently servicing the metro area.

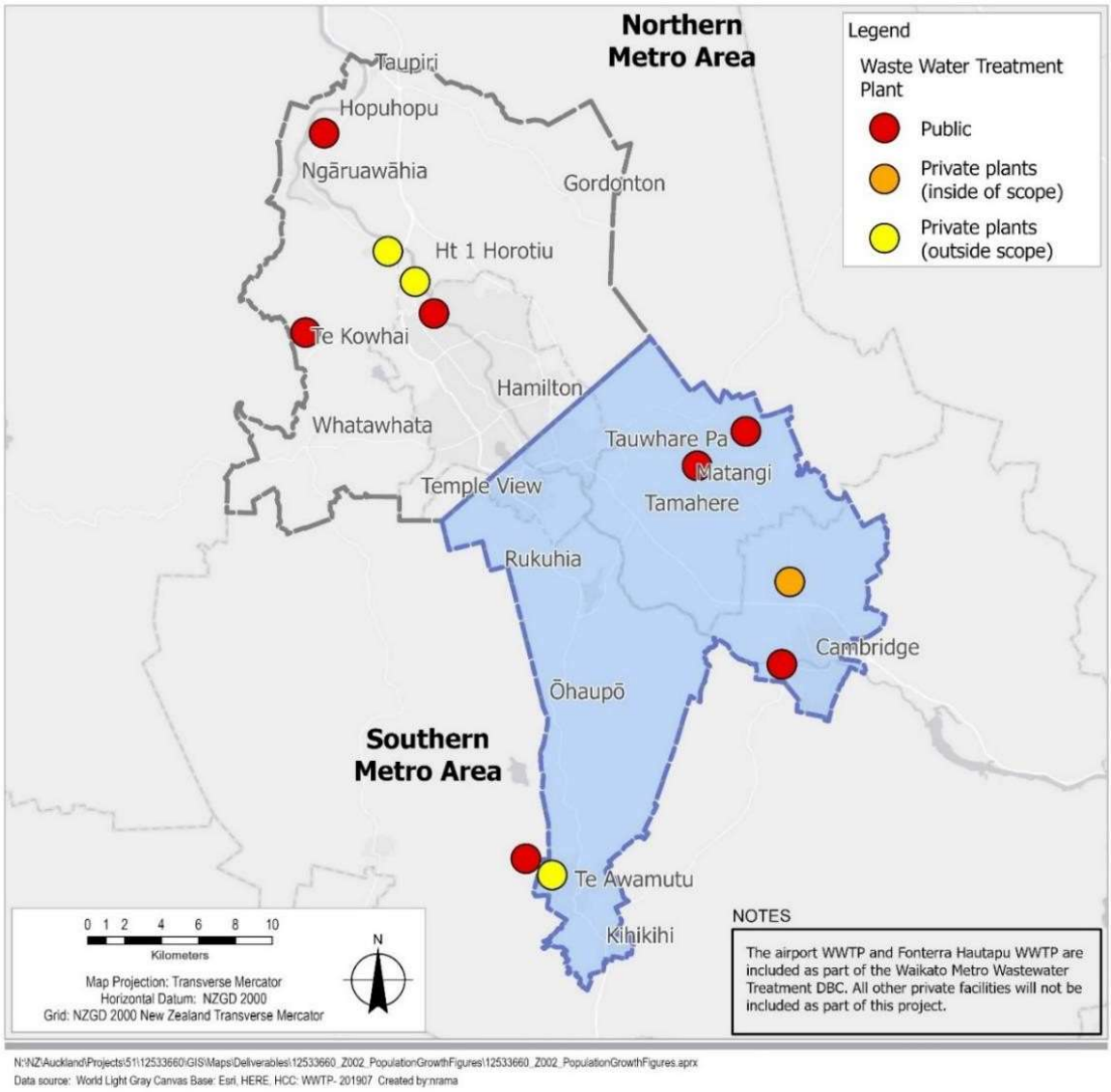

Figure 1 Overview Plan – Northern and Southern Metro Areas

Note: The Private plant was considered at the long list stage but was not considered viable and not included in the short list option development stage.

1.3 Short-list Options

Two options were shortlisted during the longlist assessment – Option 2A (centralised treatment at a new WWTP near the airport) and Option 4A (enhanced business as usual), these are shown in Figure 2 below. The shortlisted options do not include wastewater from Fonterra facilities, which were discounted at the long-list stage.

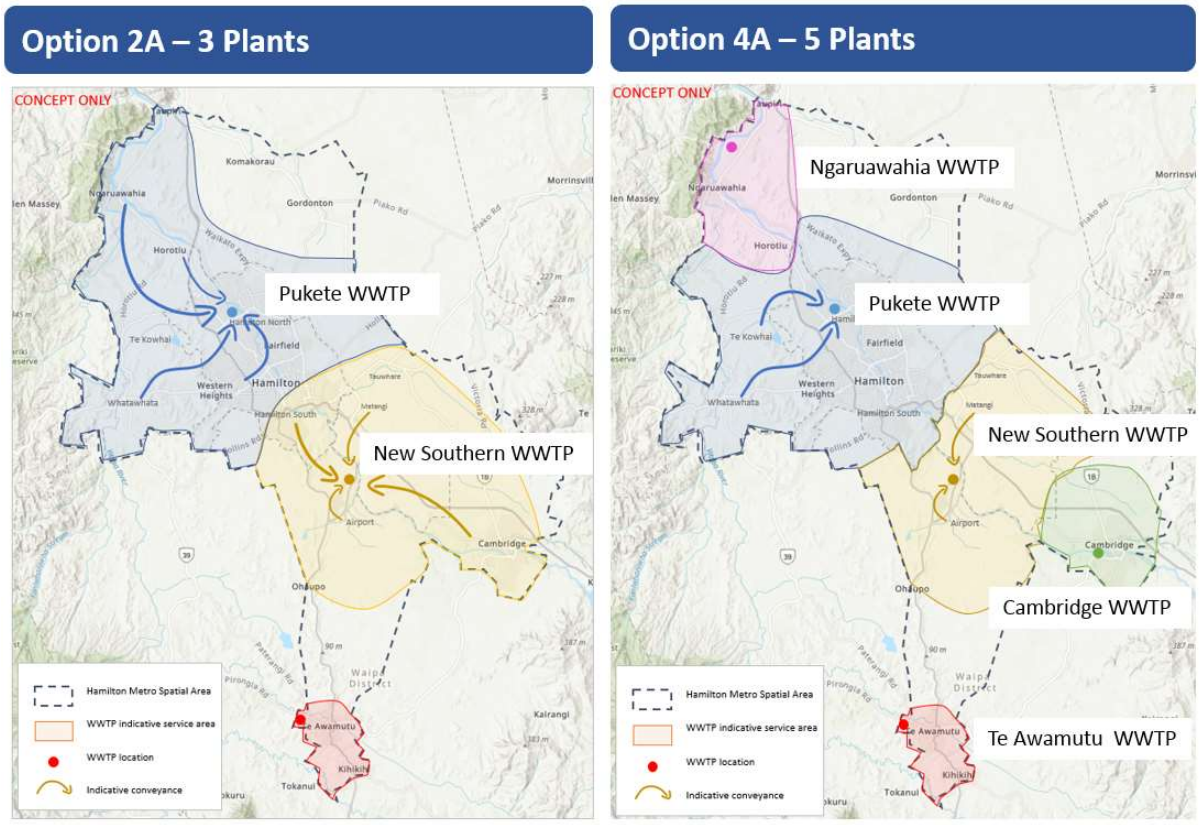

Figure 2 Short-list option overview

2. Basis of Design

2.1 Scope

For the short-list assessment, one conveyance is provided to service each community for each option. The servicing requirements (timing, flows, etc) were defined by the wastewater treatment optioneering undertaken or this project.

We have developed preferred pipeline routes between communities and WWTPs – generally on the most direct route possible using public road corridors to minimise pipe length and diameter (due to headloss). Given that the concept design of conveyance options is relatively high-level, there is little benefit in assessing sub-options for the conveyance routes at this stage. The pipelines have been sized for the 2061 horizon and checked for the 2041 horizon.

The concept design of conveyance inputs has been developed for option comparison purposes. While still relatively high-level, a consistent approach has been applied to the basis of design, inputs and assumptions to enable robust comparison and option section during the multi- criteria-assessment (MCA) process.

2.2 Design Standards

Typically, the Regional Infrastructure Technical Specification (RITS) was used as the basis for infrastructure sizing. This includes minimum velocities and emergency storage requirements. Flows are discussed in the following section.

2.3 Key Design Criteria

Option developed is based on the following criteria and assumptions listed below.

General

- Design for the 2061 horizon and check hydraulics for the 2041 horizon (to align with treatment plant option development)
- Staging of pipelines has not been considered in detail at this stage. Where multiple pipes are required for the ultimate design horizon, secondary pipe sizes have been stated, however costing is based on the assets required to convey the 2061 flows. Based on the hydraulic calculations, pipes sizes do not increase significantly over time
- Pump stations will be located within existing treatment plant land (except the Southern Hamilton redirection)
- Pump stations will be provided with nine hours ADF emergency storage (RITS).
- Storage is provided for the gravity catchment only (not pumped inflows, which is assumed to be provided at the upstream pump stations)
- Pump stations will include the facility to plug-in a back-up generator, rather than having a dedicated on-site facility

Assumptions relating to the Southern Hamilton redirection are described in Section 4.

Route development

The following general assumptions have been made in regard to the conveyance routes:

- The sub-regional WWTP will be located at the preferred site – north of Hamilton airport
- It is assumed that the wastewater assets servicing the Airport area are local reticulation and have not been included in the conveyance design
- Conveyance routes will follow public road corridors wherever practical
- The most direct route practical has been used
- It is expected that the pipeline alignment could be optimised by crossing through private properties, however this was considered higher risk than road corridors and as such was not explored at this stage
- Pipelines with retention times greater than eight hours will require chemical dosing to mitigate septicity and odour. Requirements can be confirmed through septicity analysis during design development.

Route specific assumptions are noted under the alignment sections below, where applicable.

2.4 Design flows

2.4.1 Average flow

The Regional Infrastructure Technical Specification (RITS) provides the following

- Domestic Average Daily Flow (ADF) is 200 litres per person per day
- Non-domestic ADF = development area catchment * population equivalent factor * 200 litres per day

2.4.2 Peak flow calculations

The Peak Daily Flow (PDF) and Peak Wet Weather Flow (PWWF) were initially calculated for each catchment using the method provided in RITS. The RITS method includes infiltration and surface water ingress allowances on a catchment area basis. While there is a peaking factor applied to the population component of the ADF to determine the PDF, for the PWWF the majority of the additional flow comes from the infiltration and surface water components, which are both based on the reticulated area, resulting in PDF and PWWF values that are approximately 5-10xADF and 10-20xADF respectively.

For comparison, peak flows for current scenarios were calculated using recent catchment data provided by the Councils. The peak flows calculated using RITS were found to be significantly higher than those calculated using actual flow data. This was particularly true for the larger population centres such as Cambridge and Hamilton.

To prevent oversizing the infrastructure, the RITS methodology was modified to more accurately correlate with flow data for the current scenarios and then scaled to future design horizons using predicted growth numbers. This led to peaking factors that were significantly smaller than those calculated under RITS, averaging 5xADF for PDF and 10xADF for PWWF.

For all towns with a Population<10,000, the RITS calculations (section 5.2.4.2) were used unmodified to calculate the PDF and PWWF.

In terms of the sizing of pipes to accommodate forecast flows, pipe sizes were calculated based upon 2061 flows but performance was checked for 2041 flows.

The flow calculations are based on population projections developed at the long-list options stage (refer to the Long-list Options Report).

It is recommended that flow rates are further refined at the preferred option development stage.

3. Option 2A

3.1 Option overview

Option 2A consists of the components listed in Table 1 and is illustrated in Figure 4.

Table 1 Option 2A - Components

Treatment	Conveyance
One centralised southern plant to service southern communities (plant located on a new site near Hamilton airport): • Hamilton (South) • Matangi • Hamilton Airport • Ohaupo • Cambridge	New conveyance to the new WWTP from: • Matangi • Ohaupo • Cambridge Flows from South Hamilton (such as Peacocke) redirected towards the new Southern WWTP site. Some existing and planned assets may be able to be reconfigured – this is described further in Section 4.2.
Tauwhare Pa (standalone plant) to be upgraded	Not included in option
Te Awamutu/Kihikihi (standalone plant) to be upgraded	Not included in option

This option provides the flexibility to masterplan an efficient WWTP facility on a new site, which can minimise impacts. This option benefits from a centralised location between southern Hamilton and Cambridge.

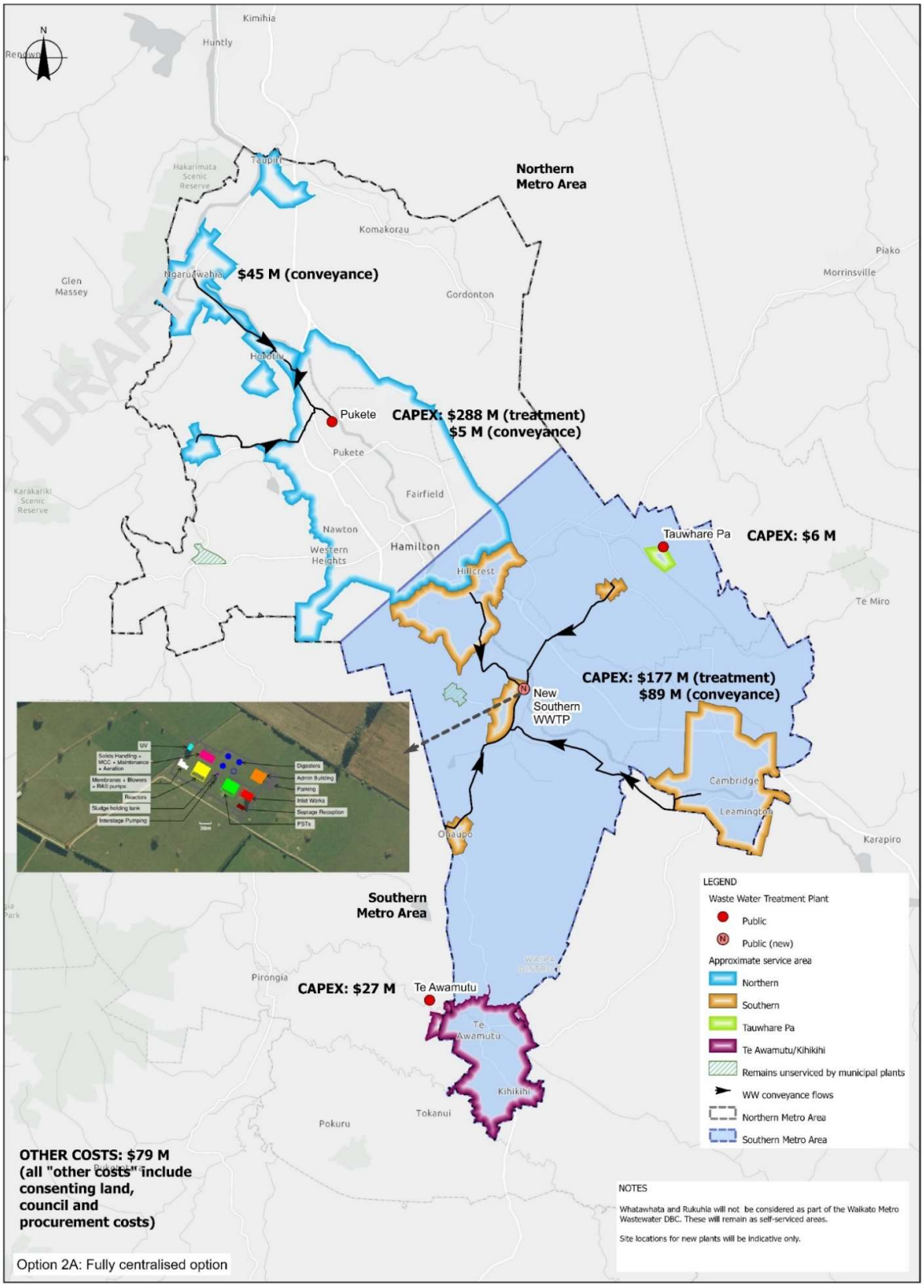

Figure 3 Overview Plan - Option 2A: Centralised Treatment

3.2 Pipeline alignments

3.2.1 Overview of routes

Figure 4 provides an overview of the pipeline alignments included in Option 2A. The conveyance route sketches are included in the section 3.2.2 to 3.2.4 below.

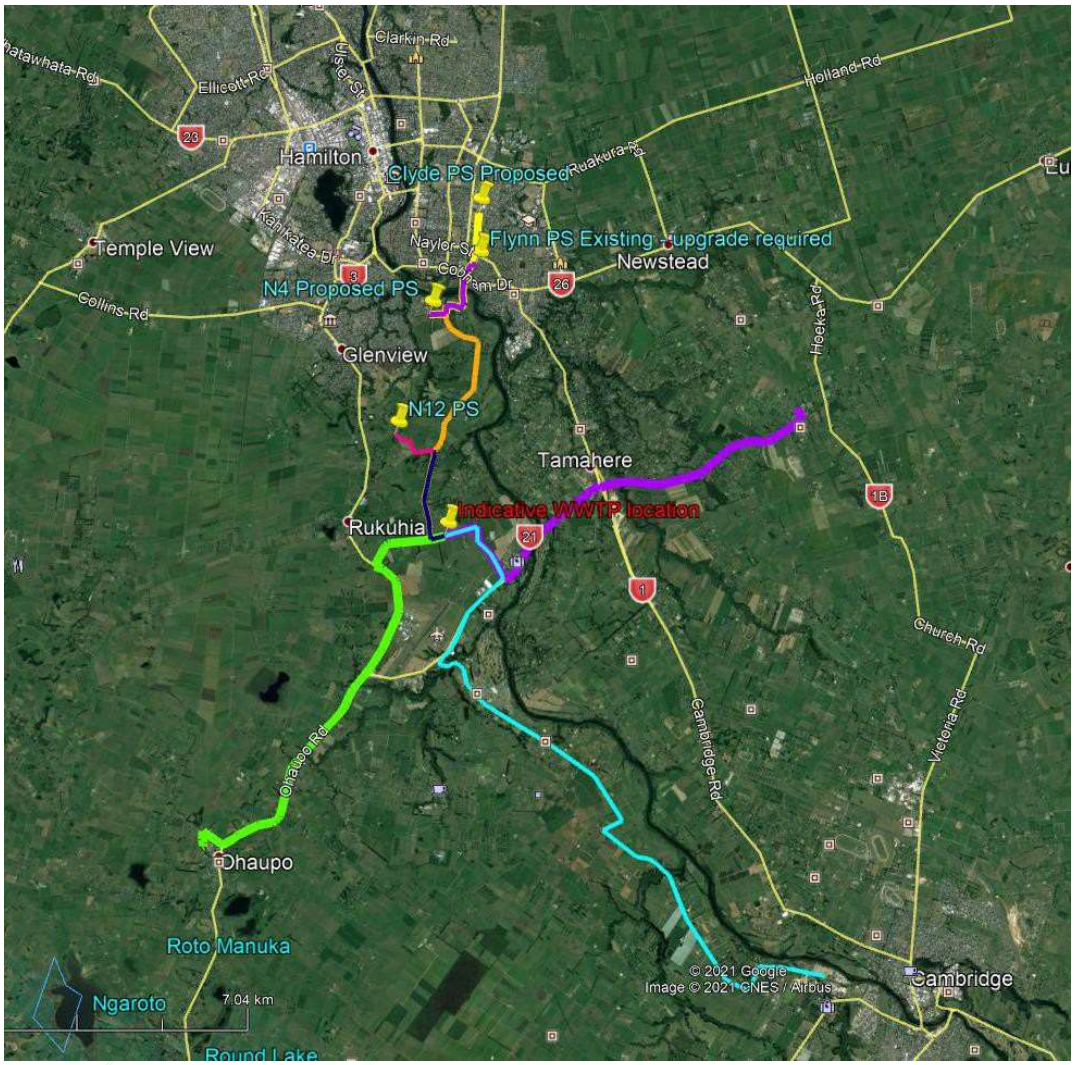

Figure 4 Overview Map - Option 2A

3.2.2 Matangi to Southern WWTP

The route alignment selected for the rising main pipeline between Matangi and the proposed Southern WWTP is illustrated in Figure 5. The elevation profile starts at Matangi. The alignment requires crossing of the Waikato River at 'The Narrows' and also will need to pass underneath the interchange of SH1 and SH21.

Where the route crosses SH1 at Tamahere, it is assumed that the pipeline will be constructed in the road through the existing underpass. Should this be deemed to be too disruptive to traffic movements, the pipeline could be installed under the stream, as well as the highway, in a single trenchless construction, likely drilling.

The highway is elevated in this location so there is not expected to be any issues with clearances. Detailed ground conditions not known at this stage.

The HDD alignment could change (likely to the south) when considered in more detail as working space at exit pit is quite limited.

Where the route crosses the Waikato River near Narrows Bridge, we have assumed that the pipeline will be installed on a dedicated pipe bridge due to the risk posed by the ground conditions (hard rock) expected in this area. It is GHD's experience that Waka Kotahi is becoming less receptive to pipelines being attached to road bridges, therefore we have allowed for a stand-alone structure. There is an opportunity to work with local authorities to provide a multi-functional bridge, e.g. footbridge / cycling in addition to supporting the pipe, however, this has not been included at this stage.

Further investigation of the ground conditions may determine that trenchless installation of the pipe under the river is an achievable alternative.

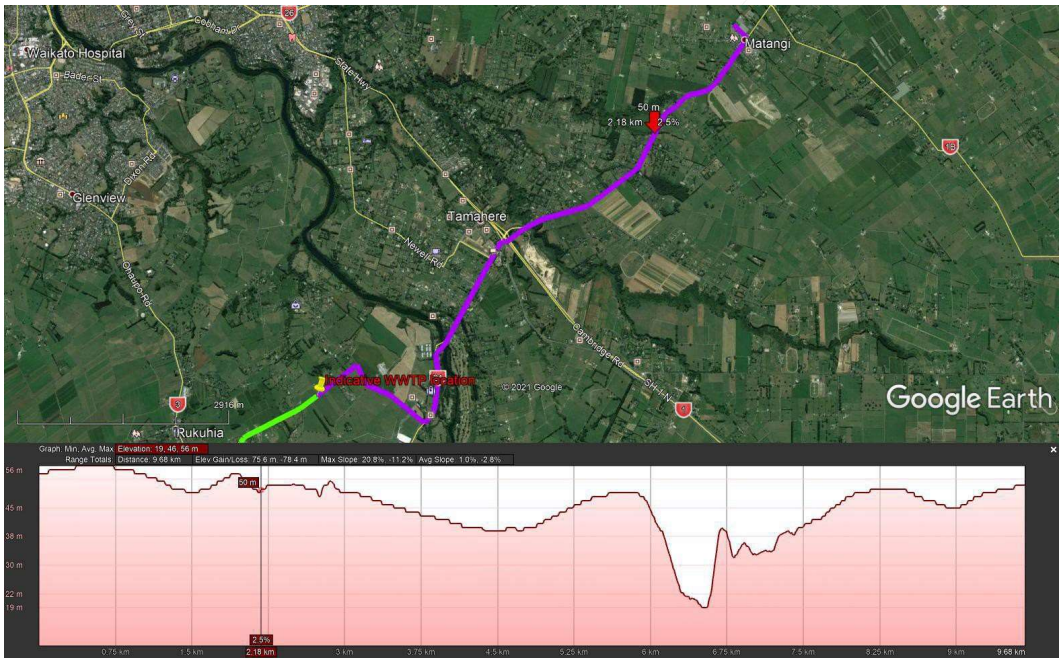

Figure 5 Route Sketch - Matangi to Southern WWTP (purple line)

3.2.3 Ohaupo to Southern WWTP

The route alignment selected for the rising main pipeline between Ohaupo and the proposed Southern WWTP is illustrated in Figure 6. The elevation profile starts at Ohaupo. There is a high point at the start of the alignment which impacts the pumping required – subsequent design could consider variations in the routes to reduce the static head to some extent.

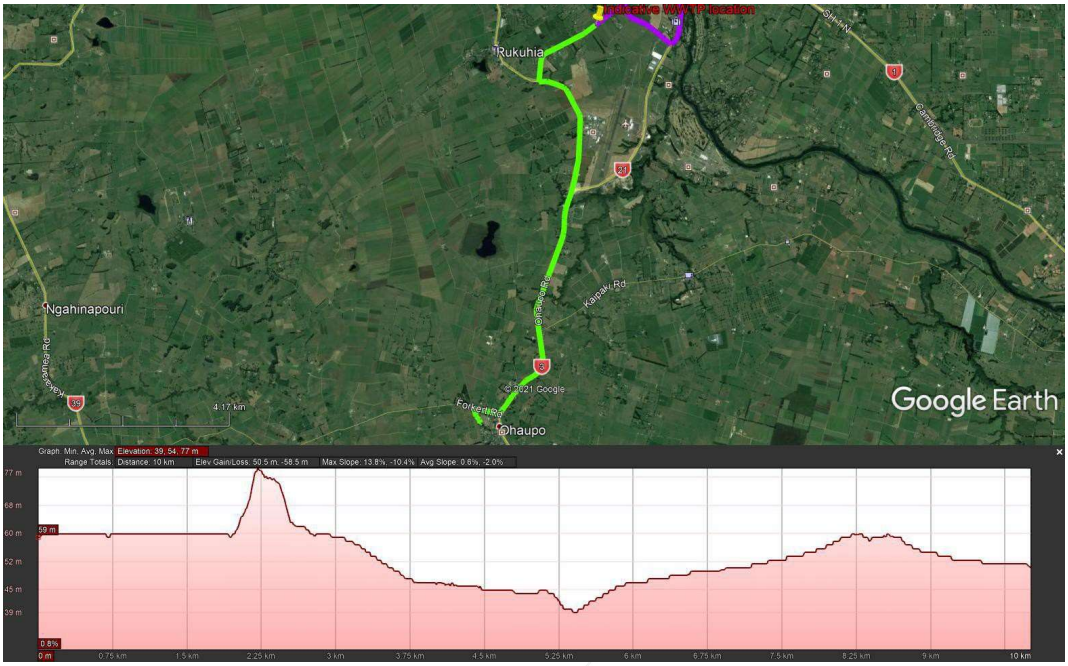

Figure 6 Route Sketch - Ohaupo to Southern WWTP (green line)

3.2.4 Cambridge to Southern WWTP

The route alignment selected for the rising main pipeline between Cambridge and the proposed Southern WWTP is illustrated in Figure 7. The elevation profile starts at Cambridge.

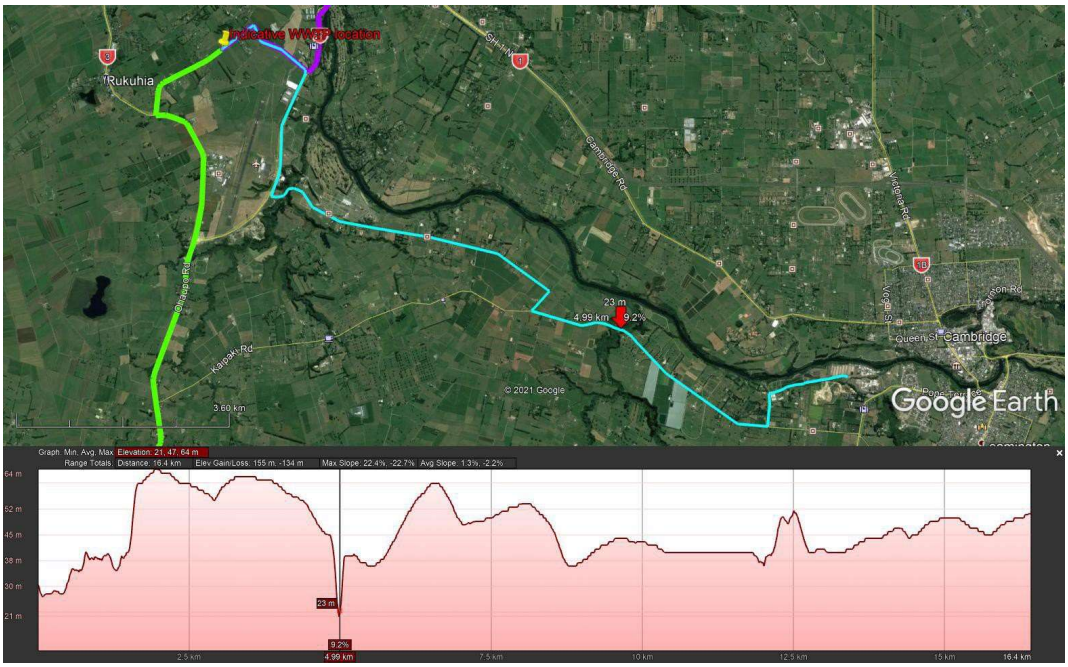

Figure 7 Route Sketch - Cambridge to Southern WWTP (turquoise line)

3.2.5 Southern Hamilton to Southern WWTP

The re-direction of Southern Hamilton catchments to the Southern WWTP is described in Section 4, below.

3.3 Concept design

Concept design of the pump stations and pipelines associated with the 2061 design horizon is documented in Table 2.

Pricing schedules, including item descriptions and quantities, have been provided as inputs for cost estimating. Estimated annual power consumption figures have also been provided to inform OPEX and operation carbon estimates.

Table 2 Option 2A Concept Design Summary

Pipe Length (m)	Pipe Diameter (mm) + Pressure Class	Duty Flow (L/s)	Total Pump Power (kW)	Pump Station (indicative)	Emergency Storage Volume (indicative) (m3)	Comments
Matangi to Southern						
9680	DN200 PN16	24	32	Package PS assumed with integrated wet well 32KW - 58m TH and 20L/s	35 (100% of total catchment)	Three minor stream crossings along Tauwhare Road - looks like space could be available without separate crossing (could be managed in road reserve). 2 stream crossings at SH1 intersection, assumed to be a single underbore of that stream. SH1 underpass should be available. Pipe also crosses Waikato River, assumed to be separate pipe bridge crossing at The Narrows (drilling unlikely to be suitable). Note: Matangi cannot feasibly be pumped in 2021. DN200 pipe can be made from 2xDN160 (additional DN160 in 2051).
Ohaupo to Southern						
10000	DN250 PN16	40	56	Package PS assumed with integrated wet well 56KW - 85m TH and 40L/s	80 (100% of total catchment)	"Built up area" is Ohaupo, construction not expected to be difficult. There is another ~500m of "built up" near Kaipaki Rd, however the built up is only one side of road so it wasn't included. Crosses two minor (should be able to be accommodated within road reserve) and 1 relatively major stream just

Pipe Length (m)	Pipe Diameter (mm) + Pressure Class	Duty Flow (L/s)	Total Pump Power (kW)	Pump Station (indicative)	Emergency Storage Volume (indicative) (m3)	Comments
						before SH21 intersection (may be able to be managed within current road reserve). Note - DN250 pipe can be made from DN225 and an additional DN160 in 2051.
Cambridge To Southern						
16400	DN710 PN16	402	538	Supply and installation of 2m diameter, 3-4m deep concrete wet well, including slab, McBerns type cover. Assumes some local gravity network to be intercepted	1690 (50% of total catchment)	Two relatively major stream/gully crossings – Kaipaki Road and Mystery Creek Road. Both large culvert/small bridge structures, incised channels, may require a separate crossing. First 1.4km of pipeline through Cambridge WWTP

Pipe Length (m)	Pipe Diameter (mm) + Pressure Class	Duty Flow (L/s)	Total Pump Power (kW)	Pump Station (indicative)	Emergency Storage Volume (indicative) (m3)	Comments
Southern Hamilton Redirection						
Clyde utilising existing pipework to N4 (2920m)	Existing	350	75	Supply and installation of 3.5m diameter, 6-7m deep concrete wet well, including slab, McBerns type cover. Local gravity network to be intercepted (current diameter doesn't allow for space for the pumps so will be undersized)	2060 (100% of total catchment)	Utilises 'existing' DN630mm dia pipe
Flynn utilising existing pipework to N4 (1900m)	Existing	72	12	Upgrade existing	85 (20% of total catchment)	Assumes modification of existing PS is possible - note constrained site at current location
N4 to Faiping Discharge chamber (3870m)	DN 630 and 450	400 (in 2041) + 178 in 2061	309 Kw for initial stage; additional 145 kW for	Peacocke Pump Station may need to be upgraded to suit	210 (20% of total catchment)	Twin rising mains to the Faiping gravity section

Pipe Length (m)	Pipe Diameter (mm) + Pressure Class	Duty Flow (L/s)	Total Pump Power (kW)	Pump Station (indicative)	Emergency Storage Volume (indicative) (m3)	Comments
			second stage - complex PS			
N12 to Faiping Discharge chamber (1030m)	DN 400	155	133	Supply and installation of 3.5m diameter, 5-6m deep concrete wet well, including slab, McBerns type cover. Assumes some local gravity network to be intercepted	185 (20% of total catchment)	
Faiping Gravity section - 2150m	750mm nom. RCRRJ / HDPE / GRP	733	n/a	n/a	n/a	New discharge structure (to receive flows from N4 and N12); allow 4m by 5m plan, 3m deep, 3 No. incoming pipes with penstocks. Divided into 2 chambers with half height baffle wall; single outlet pipe

4. Southern Hamilton Redirection

4.1 Overview

Several sub-catchments in the southern portion of Hamilton are redirected to the new Sothern WWTP under Option 4A. The redirection will require interception of wastewater from existing catchments by repurposing pump stations and pipelines or providing new assets.

The main components are (refer to Figure 8):

- Clyde to N4 pump station – the DN630mm rising main that is currently being constructed is repurposed to convey wastewater south. A new pump station is required
- Flynn to N4 pump station - the DN355mm rising main that is currently being constructed is repurposed to convey wastewater south. The existing pump station is upgraded
- N4 pump station to discharge chamber at Faiping/Peacocke Road intersection
- N12 pump station to discharge chamber at Faiping/Peacocke Road intersection
- Faiping to Southern WWTP (gravity sewer).

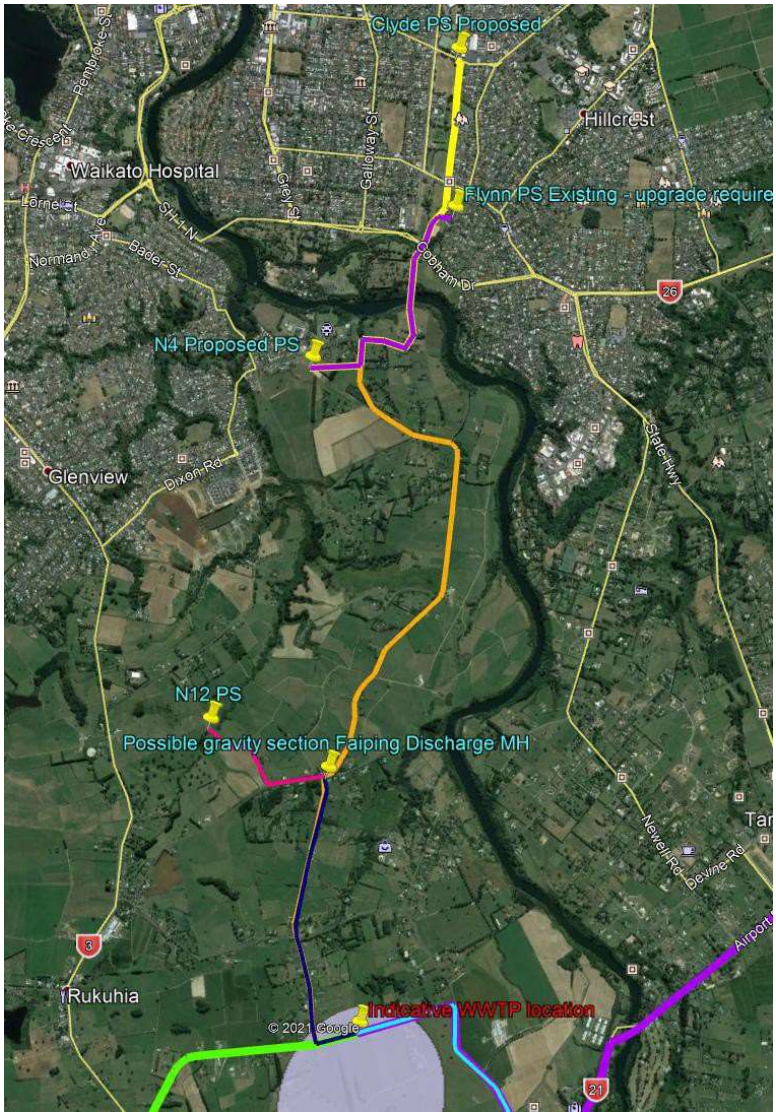

Figure 8 Overview Map - Southern Hamilton Redirection

4.2 Network configuration

Hamilton City Council staff provided insight into which parts of the existing Hamilton South area could potentially be redirected towards the southern WWTP. Wastewater flows from existing catchments of Flynn, Clyde, and Fitzroy/Te Anau/Splitt could be intercepted and, with new (or modified) pump stations, redirected south. This can be achieved in part through the infrastructure currently being designed/installed to support the Peacocke development. Refer to the catchment plan in Figure 9.

Existing catchments not included in the southern redirection are Snell, Lorne, and Normandy – these continue to the Pukete WWTP via the existing wastewater network.

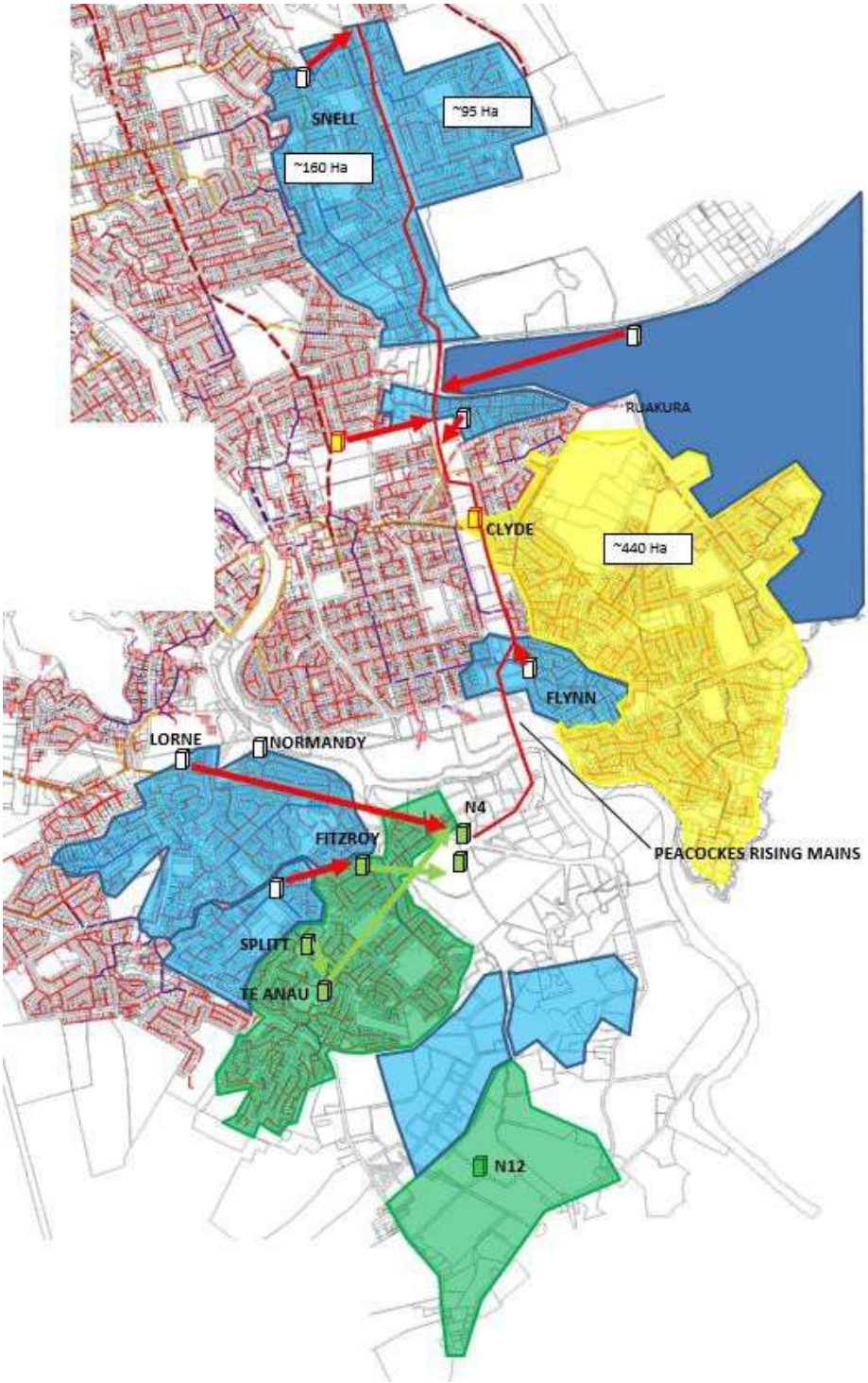

Figure 9 Southern Hamilton Re-direction - Catchment Plan

4.3 Assumptions

The Clyde and Flynn pump stations will pump downhill for the majority of the way to the N4 pump station. We have assumed that controls will be in place at the end of the rising mains to stop them emptying. This will minimise air movements and associated odour issues but will require further discussion with HCC staff. The hydraulic analysis has been competed on the basis that the mains run full and allow for friction losses along the full length of the pipelines (this is considered to be a conservative approach, suitable for this concept level of design.

The Flynn PS will likely need to be pumped at a higher rate than its incoming PWWF to achieve self-cleansing velocity in the pipe. We have assumed a pump rate of 100 L/s vs the PWWF of 72.5 L/s for concept design.

A 50/50 split for contributing catchment area / flow between the N4 and N12 pump stations. This is a rough estimate however HCC have confirmed it is a reasonable high-level assumption.

N4 will pump directly towards the WWTP, rather than to N12 to be re-lifted. This will significantly reduce the size of the N12 pump station and rising main and reduce operational cost and carbon.

There is a high point approximately 2km before the WWTP. It is proposed that the rising mains from N4 and N12 discharge to a gravity sewer at Faiping/Peacocke Road intersection to:

a) avoid the need for duplicate pressure pipelines along this final stretch where gravity is viable

b) simplify operation (not pump downhill)

c) save operational cost and carbon.

We have assumed that a discharge structure will be required to accommodate incoming flows from N4 and N12.

Dual rising mains have been assumed between N4 and the discharge structure into the gravity section. The following flow split has been considered between the N4 rising mains: 400L/s at the 2041 horizon and an additional 178L/s into the second rising main at the 2061 horizon, as the majority of the contributing catchment is already developed.

The network configuration assumed for concept design is illustrated Figure 10.

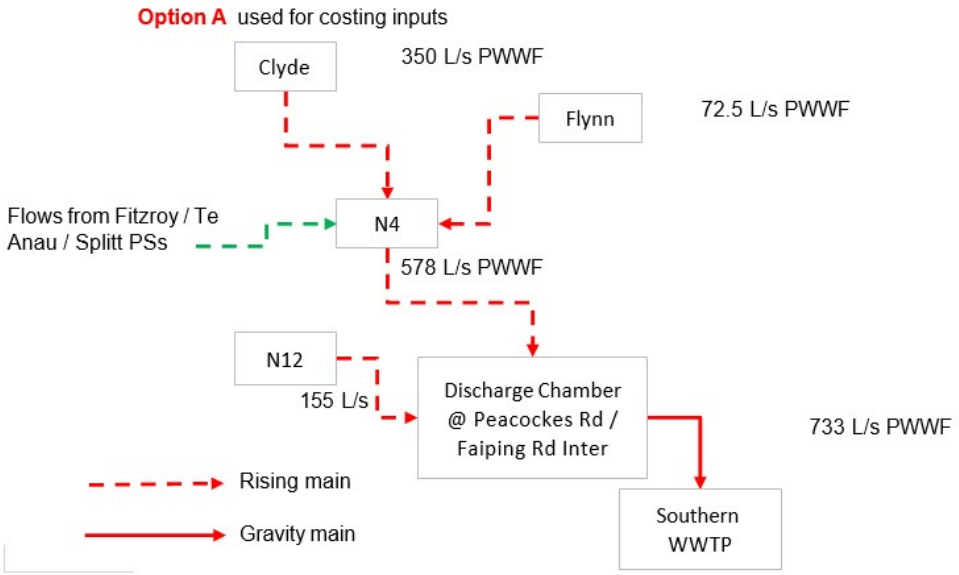

Figure 10 Southern Hamilton Redirection Schematic

4.4 Pipeline alignments

The route alignment selected for the rising main pipeline between a new Clyde pump station and the N4 pump station (currently under construction) is illustrated in Figure 11. The elevation profile starts at Clyde pump station.

Figure 11 Route Sketch - Clyde to N4

The route alignment selected for the rising main pipeline between an upgraded Flynn pump station and the N4 pump station (currently under construction) is illustrated in Figure 12. The elevation profile starts at Flynn pump station.

Figure 12 Route Sketch - Flynn to N4

The route alignment selected for the rising main pipeline between a reconfigured N4 pump station and the Faiping Road discharge chamber is illustrated in Figure 13. The elevation profile starts at N4 pump station.

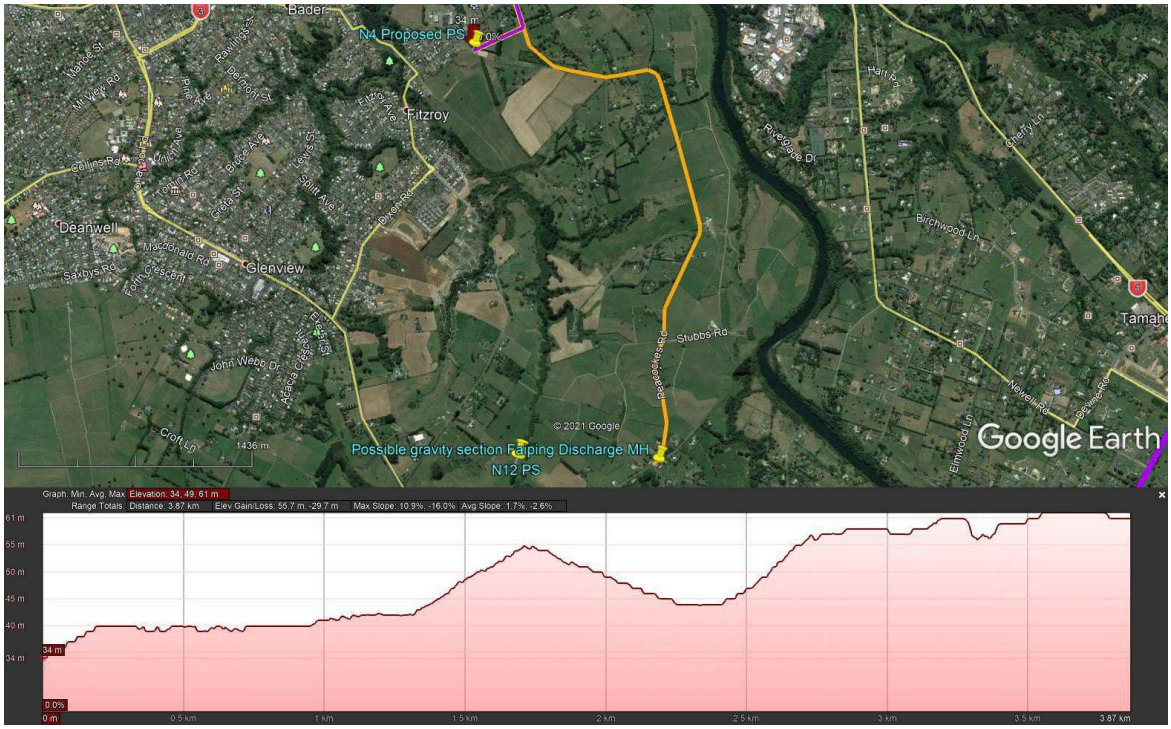

Figure 13 Route Sketch - N4 to Discharge Chamber

The route alignment selected for the rising main pipeline between a new N12 pump station and the Faiping Road discharge chamber is illustrated in Figure 14. The elevation profile starts at N4 pump station.

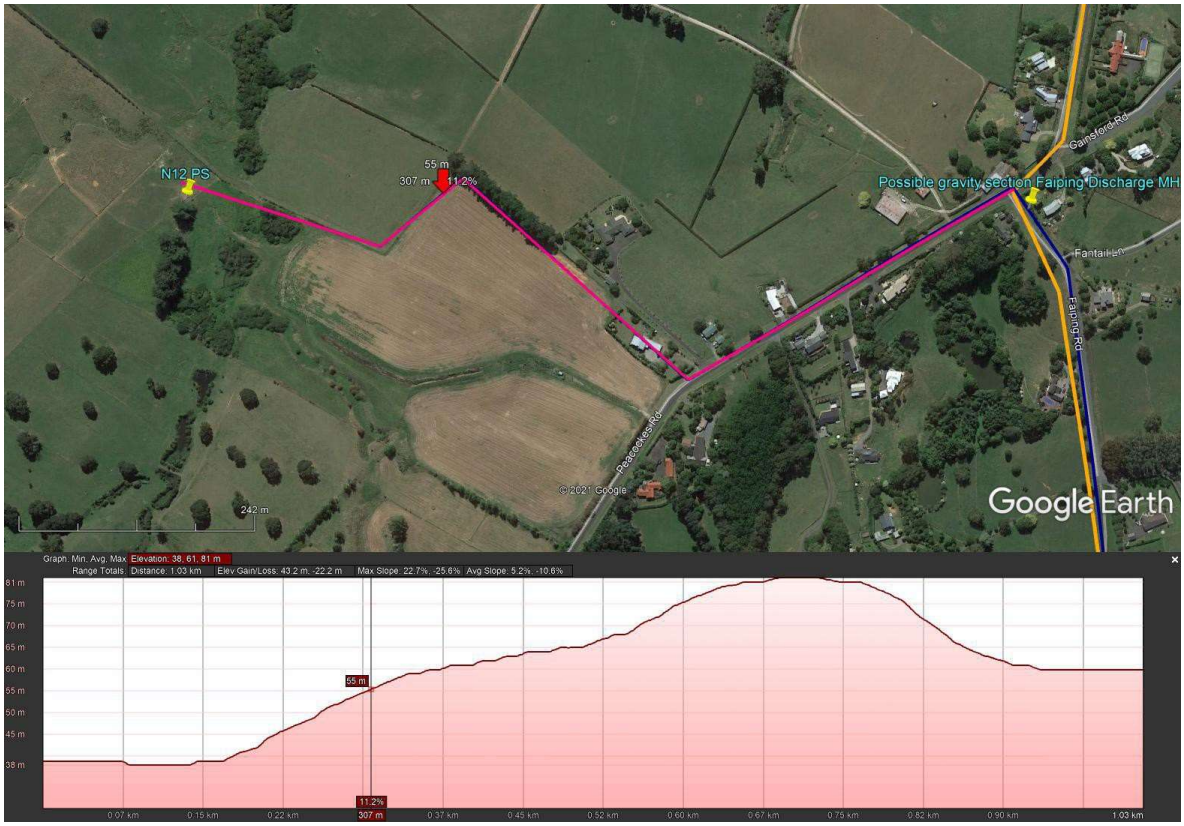

Figure 14 Route Sketch - N12 to Discharge Chamber

The route alignment selected for the gravity sewer between the Faiping Road discharge chamber and the Southern WWTP is illustrated in Figure 15.

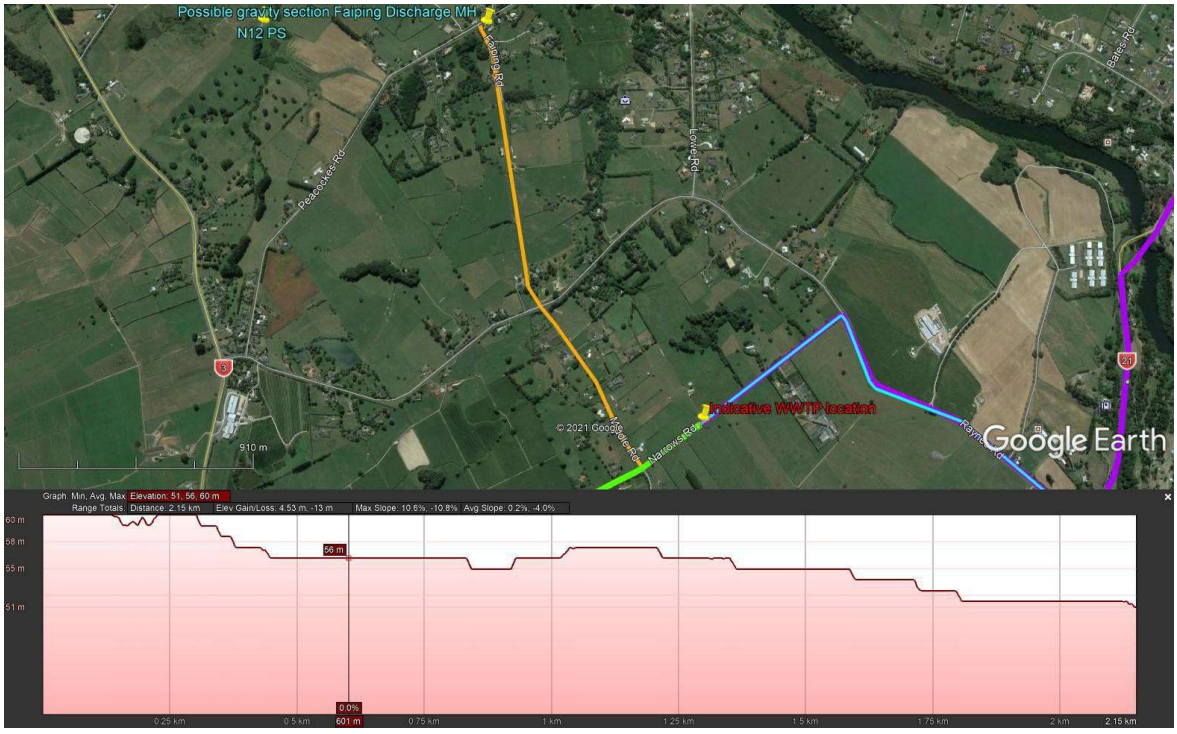

Figure 15 Route Sketch - Discharge Chamber to Southern WWTP

5. Option 4A

5.1 Option overview

Option 4A consists of the components listed in Table 3 and is illustrated in Figure 16.

Table 3 Option 4A – Components

Treatment overview	Conveyance overview
Southern plant to service small southern communities (plant located south of Hamilton): • Matangi • Hamilton Airport • Ohaupo	New conveyance to the new WWTP from: • Matangi • Ohaupo
New plant at Cambridge (standalone plant)	Not included in option
Tauwhare Pa (standalone plant) to be upgraded	Not included in option
Te Awamutu/Kihikihi (standalone plant) to be upgraded	Not included in option

A new southern plant to service the airport will be master planned to cater for Matangi and Ohaupo. However, both communities will only be connected once flows are large enough to minimise retention risks and the servicing option is needed. In the interim, the Matangi plant is likely to require short to medium term upgrades. This option also maintains council boundaries.

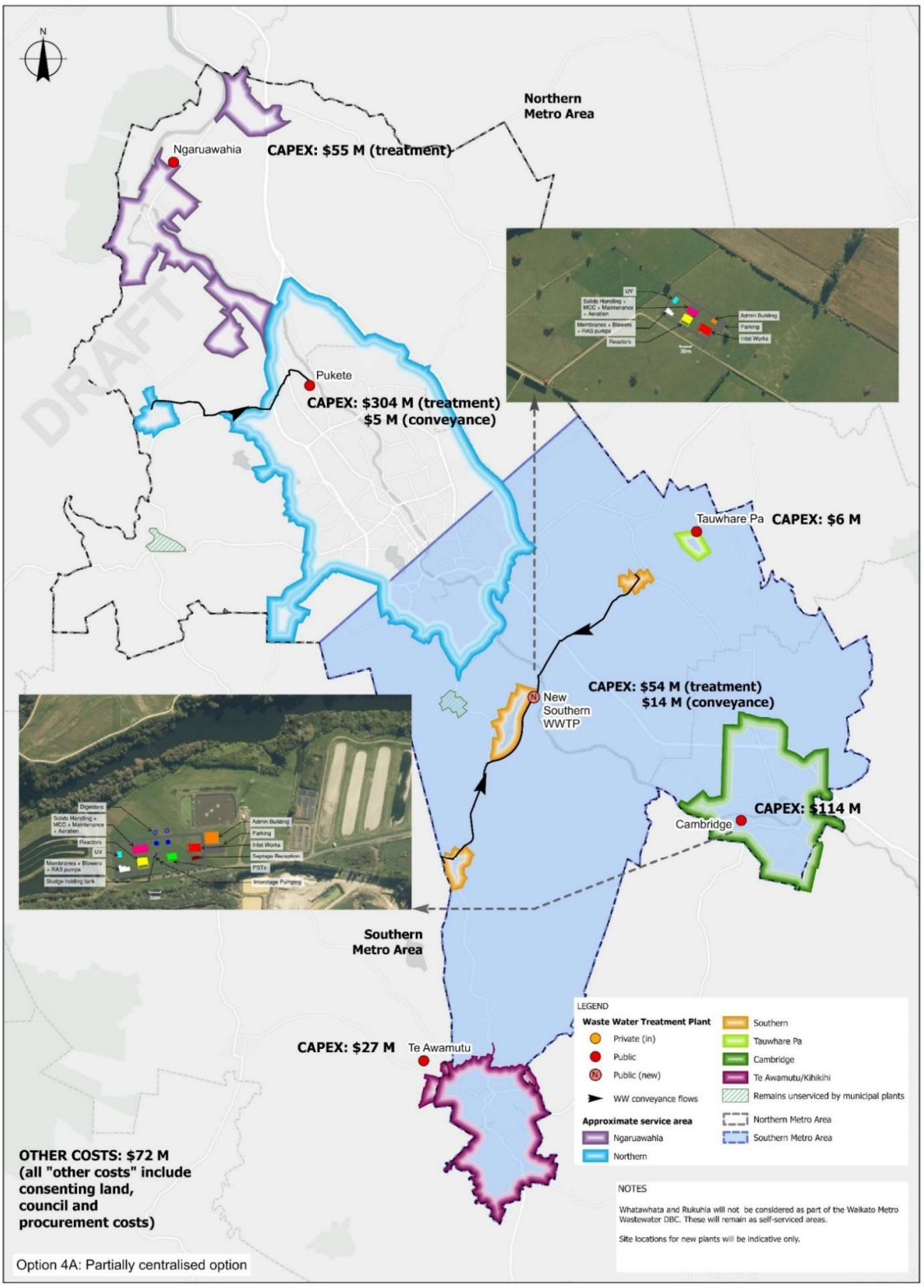

Figure 16 Overview Plan - Option 4A: Enhanced BAU

5.2 Pipeline alignments

5.2.1 Overview of routes

Figure 17 provides an overview of the pipeline alignments included in Option 4A. This option shares components with Option 2A.

The conveyance route sketches are included in section 5.2.2 and 5.2.3 below.

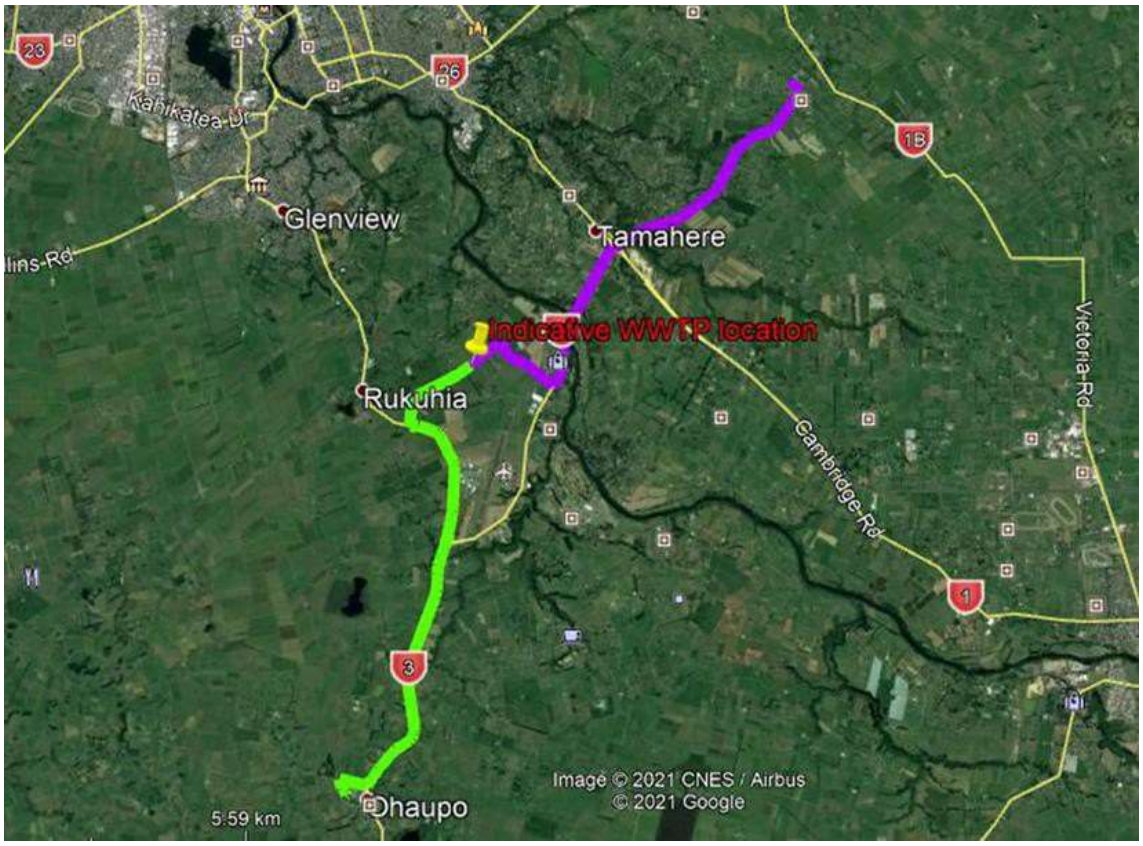

Figure 17 Overview Map - Option 4A

5.2.2 Matangi to Southern WWTP

The route alignment selected for the rising main pipeline between Matangi and the proposed Southern WWTP is illustrated in Figure 18. The elevation profile starts at Matangi.

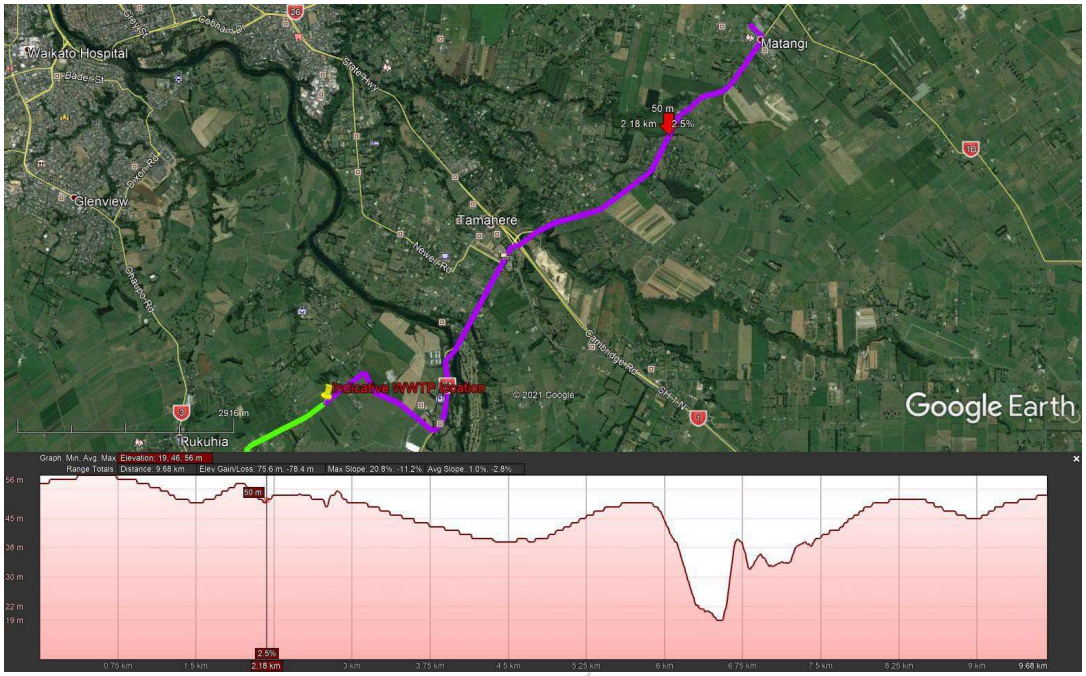

Figure 18 Route Sketch - Matangi to Southern WWTP (purple line)

5.2.3 Ohaupo to Southern WWTP

The route alignment selected for the rising main pipeline between Ohaupo and the proposed Southern WWTP is illustrated in Figure 19. The elevation profile starts at Ohaupo.

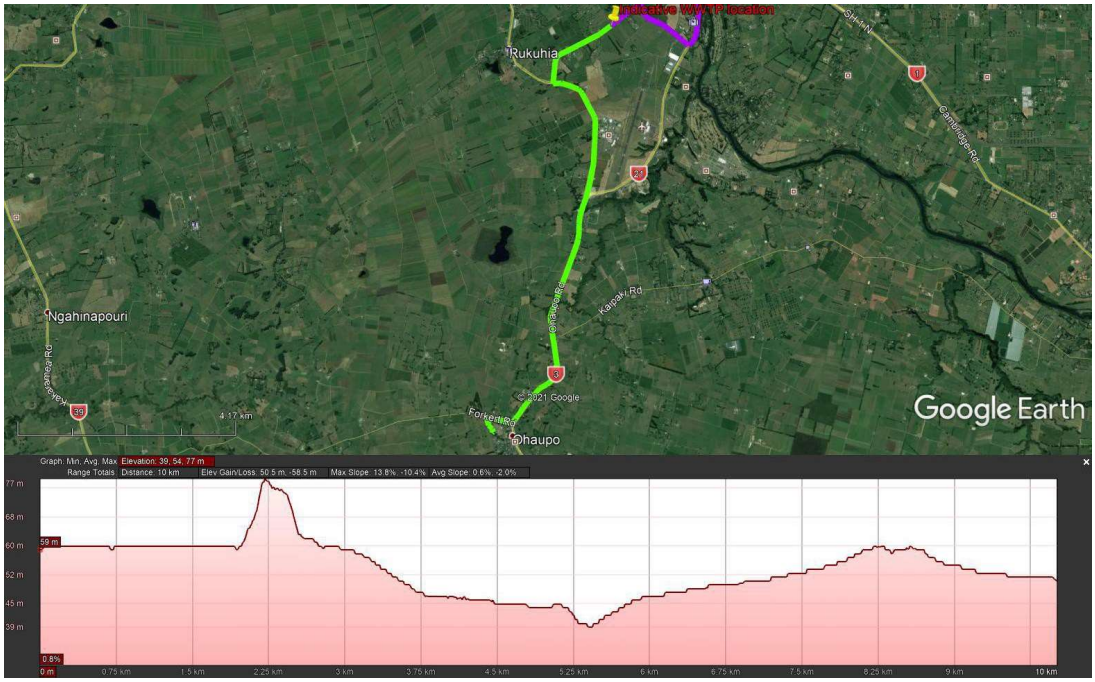

Figure 19 Route Sketch - Ohaupo to Southern WWTP (green line)

5.3 Concept design

Concept design of the pump stations and pipelines associated with the 2061 design horizon is documented in Table 4.

Pricing schedules, including item descriptions and quantities, have been provided as inputs for cost estimating. Estimated annual power consumption figures have also been provided to inform OPEX and operation carbon estimates.

Table 4 Option 4A Concept Design Summary

Pipe Length (m)	Pipe Diameter (mm) + Pressure Class	Duty Flow (L/s)	Total Pump ower (kW)	Pump Station (indicative)	Emergency Storage Volume (indicative) (m3)	Comments
Matangi to Southern						
9680	DN200 PN16	24	32	Package PS assumed with integrated wet well 32KW - 58m TH and 20L/s	35 (100% of total catchment)	Note: Matangi cannot feasibly be pumped in 2021. DN200 pipe can be made from 2xDN160 (additional DN160 in 2051)
Ohaupo to Southern						
10000	DN250 PN16	40	55	Package PS assumed with integrated wet well 56KW - 85m TH and 40L/s	80 (100% of total catchment)	DN250 pipe can be made from DN225 and an additional DN160 in 2051

6. Preferred option

6.1 Preferred Option Refinement

The preferred option refinement stage included additional specification and conceptual design of the Southern WWTP. Specifically, the refinement investigated a staged approach for the Southern WWTP to provide more flexibility to respond to demand and to allow for parts of south Hamilton and southern links to be serviced by this plant in the future. The preferred option was confirmed by the Governance Group on the 16th of April 2021.

Through the development of this DBC It was confirmed that the Cambridge WWTP was to be upgraded by Waipa District Council and planning for this upgrade and related consent is currently being progressed. Te Awamutu WWTP does not require an upgrade for a considerable time period, and it was confirmed that Tauwhare Pa WWTP is to be expanded and continue to be a discharge to land approach. For these reasons this DBC focuses on a staged development of the Southern WWTP.

6.2 Overview of the preferred option

The preferred option for the Southern Metro area is a refinement of Option 4A and was selected through assessments of the two short-listed options (Option 2A and 4A), risk and opportunity considerations and additional investigations. The two short-listed options for the Northern Metro area (i.e. conveying all flows to an upgraded Pukete WWTP or upgrading both Ngaruawahia and Pukete WWTPs) will be evaluated and a preferred option identified as part of the Northern Metro DBC.

The Preferred Option does address the problem identified in the Strategic Case and the investment objectives as outlined in the report above. Key to addressing these problems is providing a solution that results in high water treatment standards and water quality outcomes for the community which are the primary objectives of this investment and reflected in the Water Quality, Ecology and Cultural Connectivity investment objectives. The adoption of minimum treatment performance standards across all plants (refer to Section 5.3 below) over time along with other outcomes is critical and will be met through delivery of the Preferred Option.

The preferred option for the Southern Metro area consists of:

- A new Southern WWTP to service the Airport Industrial precinct, Matangi/ Tamahere commercial area and southern Hamilton. Development of the plant will be staged to meet demand. Land discharge is proposed for Stage 1 with a move toward a discharge to water in Stage 2 and beyond as flows increase
- Retaining and upgrading the Tauwhare Pa WWTP and land discharge to service local growth with the potential to be reticulated to the new southern WWTP or HCC network in the future if appropriate
- A new WWTP at Cambridge with discharge to the Waikato River to meet the long term needs of Cambridge
- Retaining and upgrading the Te Awamutu WWTP to achieve improved treatment standards and cater for growth. Continued discharge via rock channel to the Mangapiko Stream is assumed
- Improvements to the existing Matangi WWTP until the wastewater is conveyed to the new southern WWTP in around 2040

- Tamahere commercial hub to continue to utilize on-site wastewater treatment and discharge systems until 2040 when Matangi is diverted to the Southern WWTP
- Ohaupo continuing with private on-site wastewater systems as there are no known environmental concerns with existing systems and development is expected to continue to be low density lifestyle type properties.

An overview of the key features of the preferred option (i.e. indicative treatment plant locations and areas served) is shown in Figure 20. Specific details of the areas and population equivalents served by each plant are included in Table 5.

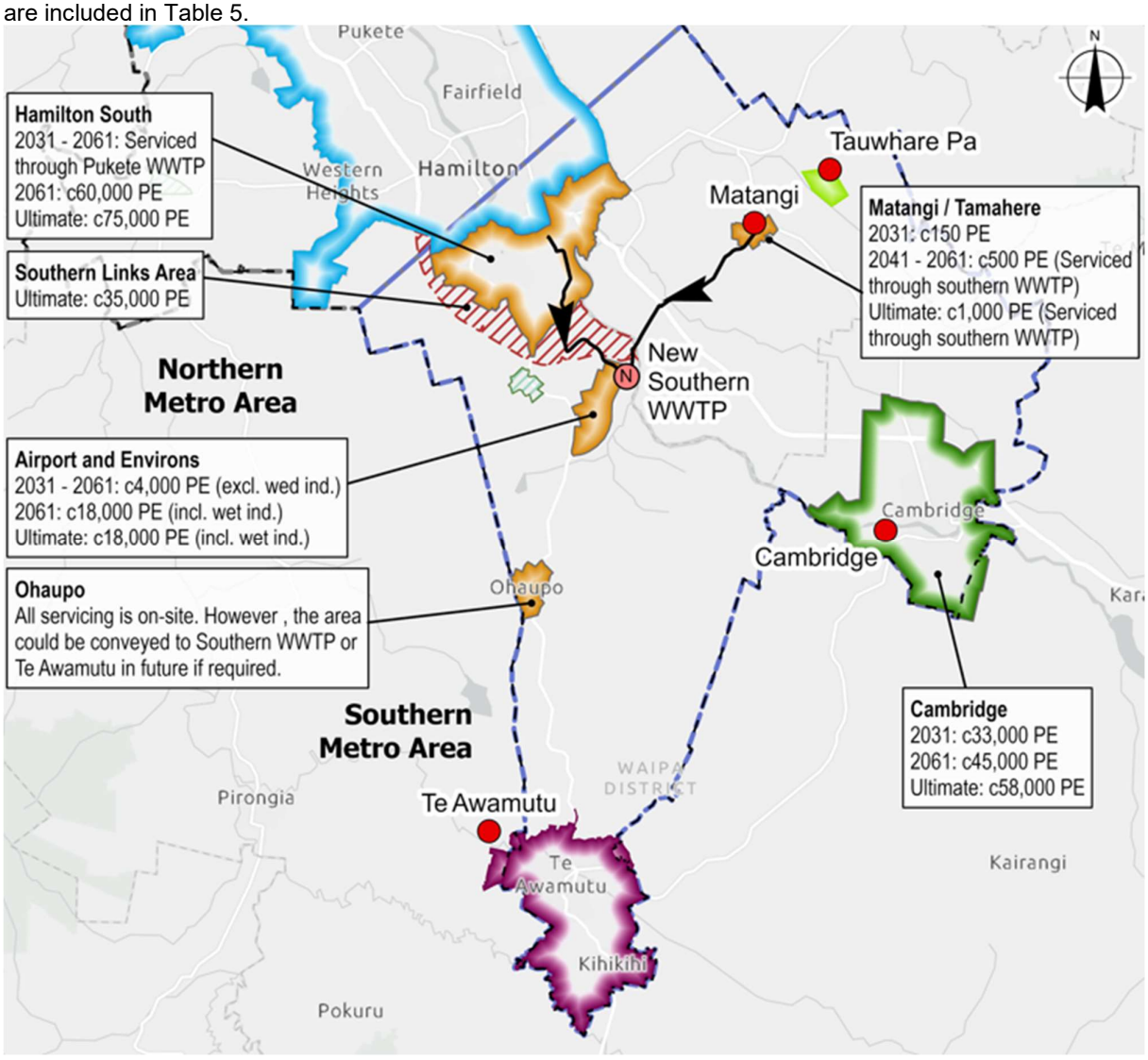

Figure 20 Preferred Option Overview – Servicing solutions for each community over time, and associated population equivalents Wastewater Treatment Plants locations, population equivalents and timing of serviced and timing.

Table 5 Summary of Preferred Option WWTPs, Service Areas and Population Equivalents Served over time

WWTP	Locations served	Population equivalent serviced by capacity available at the following dates					Notes
		2031	**2041**	**2051**	**2061**	**Ultimate**	
Matangi WWTP	Matangi Village	150			Transfer to Southern WWTP		
Tauwhare Pa WWTP	Tauwhare Pa	619	619	619	619	889	2031 projection includes for additional 500 PE at Tauwhare Pa from current estimates. Ultimate includes allowance for Tauwhare Village (270PE)
New Southern WWTP	Airport & environs	4,000	6,000	17,852	17,852	17,852	Assumptions are based on ~85ha of developed dry industrial land being serviced at 2031; ~140ha of dry industrial land being serviced at 2041; Assumptions includes for flows from wet industrial land use from 2051*
	Matangi/ Tamahere	Existing standalone facility	464	464	464	1,035	Includes servicing Tamahere commercial area (does not include Tamahere residential area)
	Hamilton South: Hillcrest, Riverlea, Glenview, Peacock.	Serviced through Pukete WWTP			59,626	75,366	DBC assumes diversion to new WWTP at 2061. Additional PE in "ultimate" horizon is based on infill in these areas from 2020 Metro Spatial Plan.
	Southern Links Area	Not Serviced			35,000		Ultimate forecast includes allowance for Southern Links
	Sub-Total	**4,000**	**6,464**	**18,316**	**77,942**	**129,253**	The Stage 3 WWTP can operate from 40,000 Population equivalent demand level
Cambridge WWTP	Cambridge	32,940	37,801	42,892	45,031	57,649	Assumptions includes for flows from wet industrial land use for small area
Te Awamutu WWTP	Te Awamutu	27,989	30,905	34,982	36,001	42,011	
No WWTP	Ohaupo	Not serviced					All servicing is on-site. However, the area could be conveyed to Southern WWTP or Te Awamutu in future if required.

* Wet industrial flow assumptions based on 50ha (~20% of airport industrial land) producing an addition 2 litres per second per hectare of wastewater flow.

6.3 Water Discharges

A range of discharge options have been identified as part of the options development and evaluation and is included in Section 3.2.3 of the Shortlist Options Report. For the purpose of this DBC, assumptions have been made regarding discharge methods to be employed at each plant. Appropriate discharge methods will need to be considered and evaluated in detail as part of each Project to support resource consenting of any discharge activities.

6.4 Conveyance

The Preferred Option conveyance consists of the new conveyance infrastructure to connect to current and future reticulation networks to the treatment facilities.

Stage 1

This involves the development of a small WWTP near Hamilton Airport. For this stage there no conveyance is assumed as shown in Figure 21.

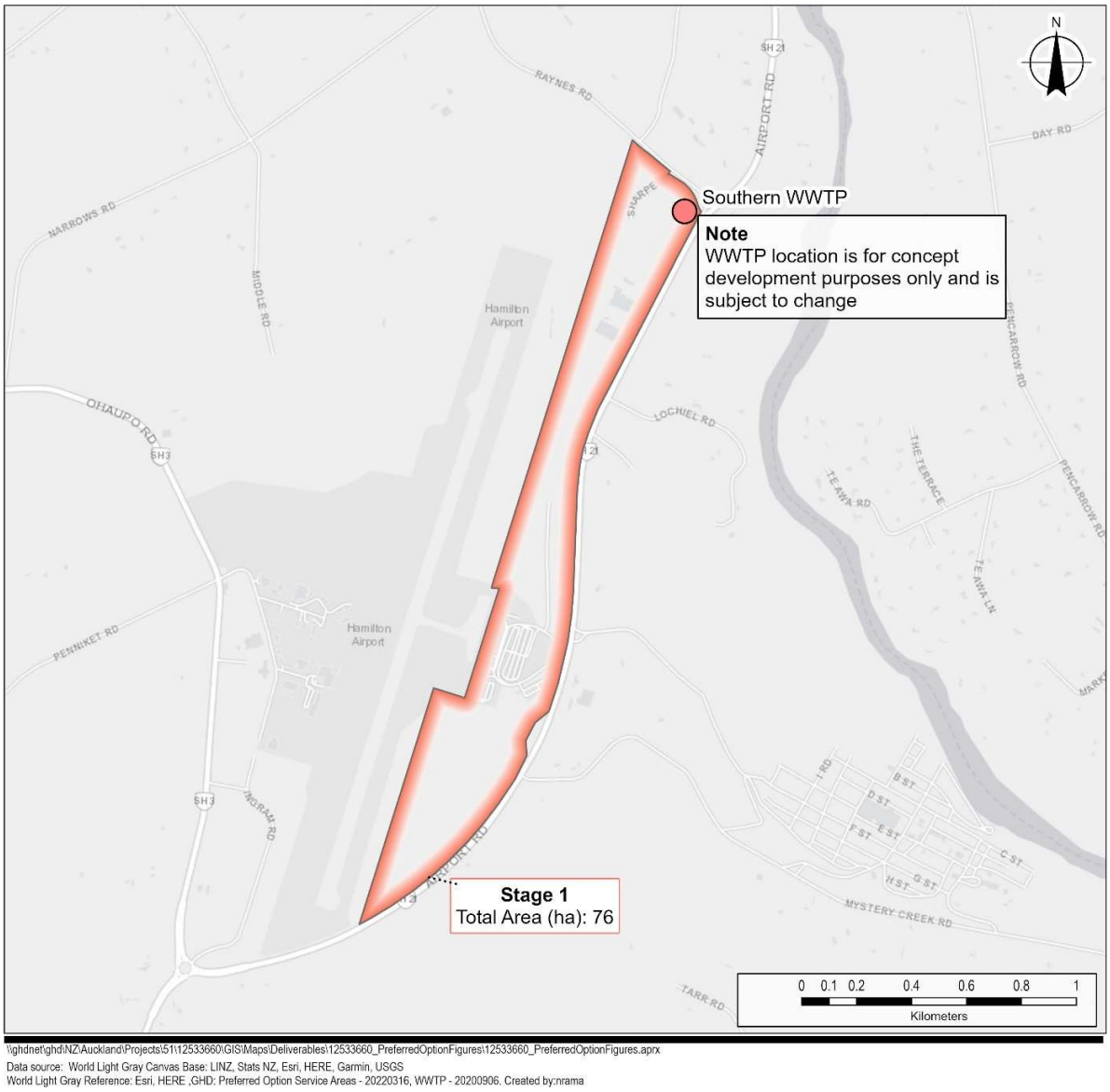

Figure 21 Stage 1 Servicing and Conveyance

Stage 2

Stage 2 involves an upgrade of the WWTP to include servicing of Matangi, Tamahere (commercial only) and industrial areas to the west of the airport as shown in Figure 22

A new pump station at Matangi discharging into a 9.7km 200OD PE pressure main to the new Southern Plant is shown in Figure 22 below. For the purpose of this DBC, conveyance from Matangi to the southern plant is assumed to occur in 2041, however actual connection timing will be triggered by demand. When flows at Matangi are 3-4 times existing flows there are less likely to be septicity issues in the pipeline. This could be through additional residential or commercial development in the village or connecting up more of the surrounding area. Tamahere hub could also connect into this pipeline.

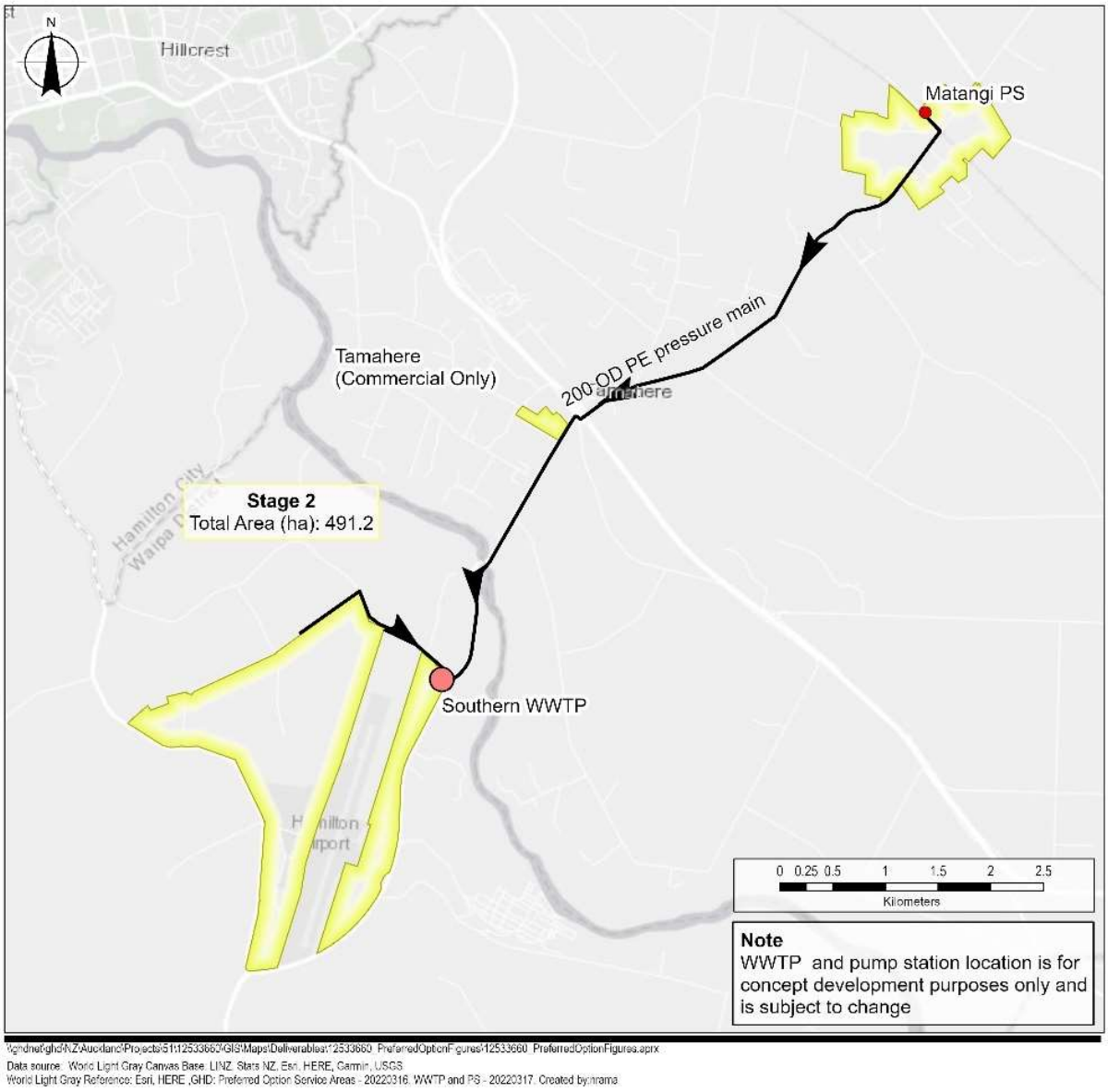

Figure 22 Stage 2 Servicing and Conveyance

Stage 3

Stage 3 involves the diversion of south Hamilton which is assumed to occur from 2061 and is shown in Figure 23 below. The areas of Hamilton that are most practical to divert to the south are Peacocke and Fitzroy/Te Anau and Splitt pump stations south via N4/N12 pump stations (in Peacocke growth cell). This requires additional pipelines to be installed. In the future it may be more practical to divert flows from other areas in Hamilton south rather than upgrade conveyance to Pukete WWTP. Concept designs and costings have included a new pump station at Clyde Street and an upgraded Flynn pump station both utilising the Peacocke rising mains in reverse.

Some initial conveyance concepts for the Southern Links area have also been developed which link in with the Peacocke area. This allows flows from parts of southern links that are difficult to service to be conveyed to the Southern WWTP but these have not been included in the cost estimates for conveyance.

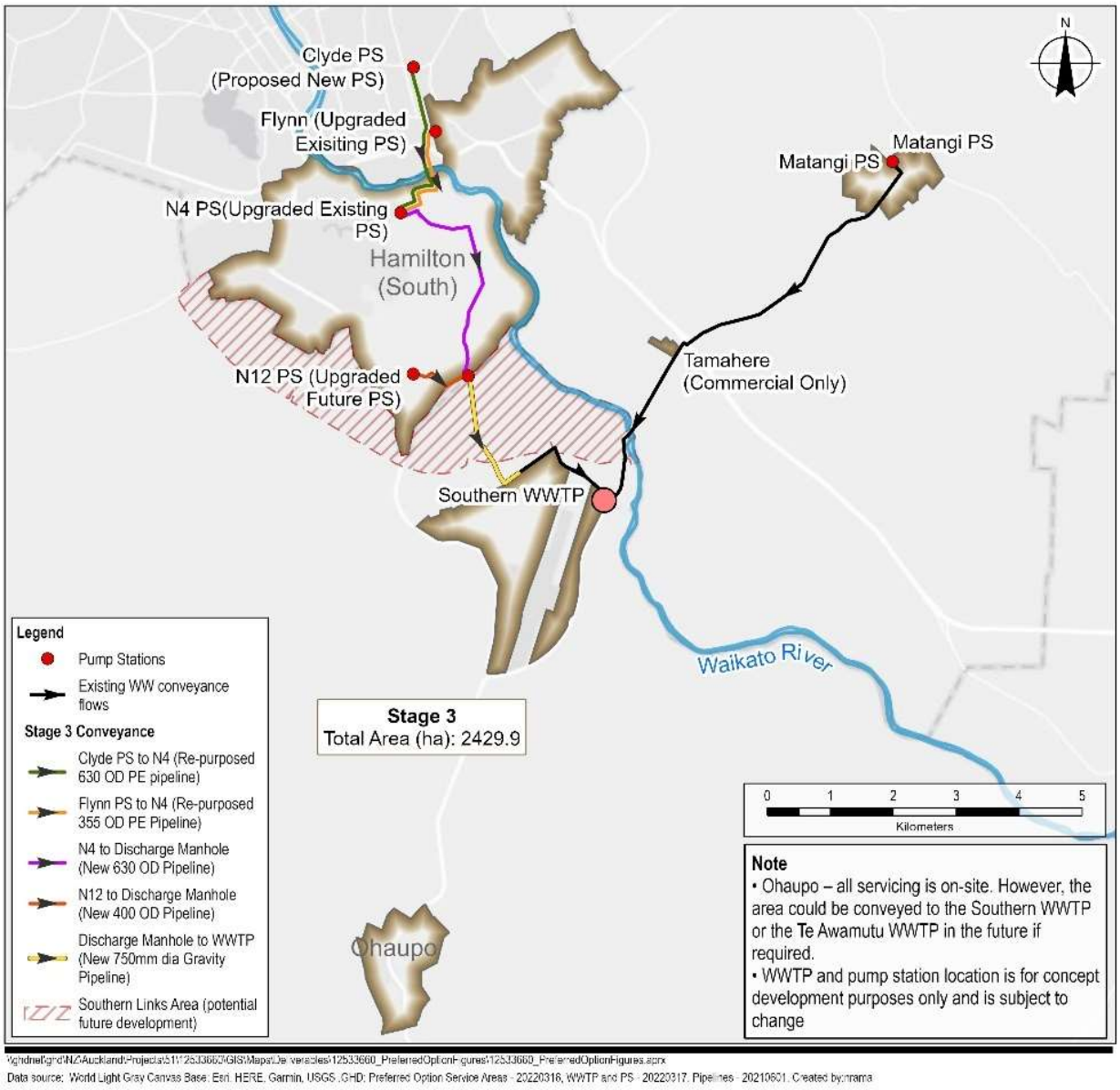

Figure 23 Stage 3 Servicing and Conveyance

Upgrades to existing pump stations in the Peacock growth cell and construction (or repurposing) of pipelines to the southern plant: For this purpose of this DBC diversion of south Hamilton is assumed to occur in 2061. As shown in Figure 23 above, and further outlined in the Preferred Option Report (Southern Links Summary Appendix C) the areas of south Hamilton considered most practical to divert initially are the Peacock growth cell and areas serviced by the Fitzroy/Te Anau and Splitt pump stations. The flow diversion will occur through strategic pump stations N4 and N12 located in the Peacock growth cell discharging into new (or repurposed) pressure mains to the southern plant. A number of factors will influence the actual timing south Hamilton

diversion, including the cost of upgrading the Hamilton strategic wastewater network and Pukete plant versus the cost of conveyance and upgrades to the southern plant, and the rate and scale of growth in the and around south Hamilton.

The cost of local reticulation and trunk conveyance infrastructure (such as that needed to service the Airport Industrial Precinct) have not been included in this DBC as these costs would sit with developers, rather than be funded by Councils.

Costs of network upgrades needed to service growth within each of city/community have not been included in this DBC as in most cases investment in upgrading the existing conveyance networks would be required regardless of the wastewater treatment solution.

The Southern WWTP has been developed to be able to be expanded to meet changing needs and growth across Hamilton and the sub-region. The recommended site footprint for the southern plant provides for sufficient space to expand the plant to service a larger part of Hamilton in the future if deemed more efficient in the future. Concept designs and costings have included a new pump station at Clyde Street and an upgraded Flynn pump station utilising the Peacocke rising mains in reverse.

Some initial conveyance concepts for the Southern Links area have also been developed which link in with the conveyance concept for the Peacocke area. The costs of conveyance and plant upgrades to service other parts of Hamilton not outlined above and/or Southern Links area through the southern plant are not included in the financial assessments of the preferred option.

7. Conveyance risks and opportunities

7.1 Risks

The following key risks have been identified during concept design of the conveyance options.

7.1.1 Flows

The sizing of infrastructure is reliant on an understanding of the average and peak flows from the network. The peak flow calculations described in Section 2.4.2 are based on the input data available at the time. There is opportunity to refine the flow estimates using hydraulic modelling software to reduce the risk of under or over-sizing new infrastructure.

The timing and scale of flow from new growth areas is also a risk that will need to be considered further as design progresses. If flows are lower than anticipated then additional efforts may be required to manage septicity risk and operational issues that can occur from low flows.

7.1.2 Investigations

Further investigations are required to confirm the alignments. These may include geotechnical assessments at critical areas (at the Narrows or example) to confirm what options are available for crossing the Waikato River, as well as at the proposed crossing at the interchange of SH1 and SH21. Further investigation is also required where new structures are proposed – pump stations, storage chambers and large discharge structures.

Services investigations will be required to confirm existing services and potential clashes to be resolved with the proposed infrastructure.

7.1.3 Timing/consenting risks

Sufficient time will need to be allowed within the programme for managing consultation and consenting for new infrastructure. This is particularly critical for new pump stations (such as Clyde), the new proposed discharge structure and the crossings of SH1 and the Waikato River. While these will be managed as part of the overall programme of consenting, they will require specific assessments that have not been undertaken at this time.

7.2 Opportunities

It is recommended that the following opportunities to refine the conveyance design are considered during development of the preferred option:

- Staging of infrastructure - this will allow for some infrastructure to be staged and sized to better match the expected flows over time. Staging could include staging of pipes (twin pipes, swapping between different size pipes within a similar corridor), as well as staging of pump station capacity and emergency storage
- Peak flow balancing - there are opportunities to provide additional operational storage to manage peak flows associated with wet weather flows in order to reduce pump station and rising main pipe sizes.

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