Hamilton - Waikato - Waipa Metropolitan Area - Southern Metro Wastewater Detailed Business Case - Preferred Option Report

Metro Wastewater Project Partners

April 2022

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Glossary of Terms

DBC	Detailed Business Case
Metro Area	The region surrounding Hamilton from Taupiri to Te Awamutu/Cambridge
Southern Metro	The area south of Hamilton, including Hamilton South
PE	Population Equivalent
TN	Total Nitrogen
TP	Total Phosphorous
PST	Primary Sedimentation Tank
Reactor	Wastewater Bioreactor
WAS	Waste Activated Sludge
HDD	Horizontal Directional Drilling
MCC	Main Control Centre
IDEA	Intermittent Decanted Extended Aeration
N_2O	Nitrous Oxide
GHG	Greenhouse Gas
WWTP	Wastewater Treatment Plant
UV	Ultra Violet
SBR	Sequencing Batch Reactor
MBR	Membrane Bio-Reactor
BNR	Biological Nutrient Removal
ADF	Average Daily Flow
CEC	Contaminants of Emerging Concern
PFAS	Per- and polyfluoroalkyl substances
RSC	Recirculating Sand Contactor
CIP	Clean in place
ASR	Activated Sludge Reactor

Executive summary

Purpose

The metro area covers from Taupiri through to Te Awamutu (North - South) and Te Kowhai/Whatawhata to Tauwhare (East - West) and forms part of the Sub-Regional Three Waters Study Area.

This report will only consider the southern metro area, which consists of the following small communities and areas:

- Southern Hamilton
- Southern Links area
- Peacockes
- Rukuhia
- Matangi (including Tamahere commercial area)
- Tauwhare Pa
- Airport industrial area
- Ohaupo
- Cambridge
- Te Awamutu.

The purpose of this report is to provide more detail on the preferred southern metro wastewater servicing solution (Southern WWTP) to service a population equivalent (PE) of 78,000 by 2061 and an ultimate PE of 130,000. This report outlines staging, risks and implementation considerations.

Growth

Growth assumptions have been developed with reference to the councils and relevant strategic planning documents to inform development of the preferred option. The growth assumptions relevant to the southern area include:

- Population projections from Waikato and Waipa District Councils.
- Population equivalent projections from Hamilton City Council created for Wastewater Master Plan V3.
- Planned industrial development and timing (e.g. , Airport, Cambridge / Hautapu).
- Additional infill development as noted in the Metro Spatial Plan.
- "Wet industry" allowances at, Airport and Cambridge. While these allowances have been included in the current DBC work from 2051, the most appropriate strategic locations for wet industrial activity in the Metro Area needs to be properly considered and determined by Future Proof.
- The ultimate design horizon also includes 35,000 Population Equivalent (PE) for the area between the Southern Links designation and the current Hamilton City Boundary, and an additional 30,000 PE in the vicinity of Ruakura.

Preferred Option

The Preferred Option consists of the following:

- Southern wastewater treatment plant (WWTP) to ultimately service Airport Industrial precinct, Matangi and southern Hamilton. For the purpose of the DBC the plant is assumed to have a discharge to land initially (Stage 1) and move toward a water discharge in the future for Stage 2 and beyond.

- Existing Tauwhare Pa WWTP to be upgraded to service local growth with discharge to land
- New WWTP at Cambridge with discharge to the Waikato River
- Te Awamutu/Kihikihi WWTP to be upgraded to achieve improved treatment and cater for growth and continue to discharge via rock channel to the Mangapiko Stream
- Improvements to the existing Matangi WWTP until the wastewater is conveyed to the new southern WWTP or HCC network around 2040
- Ohaupo to continue using private on-site wastewater systems
- Tamahere hub to continue to utilize on-site wastewater treatment and discharge systems with reconsideration when a pipeline from Matangi is implemented

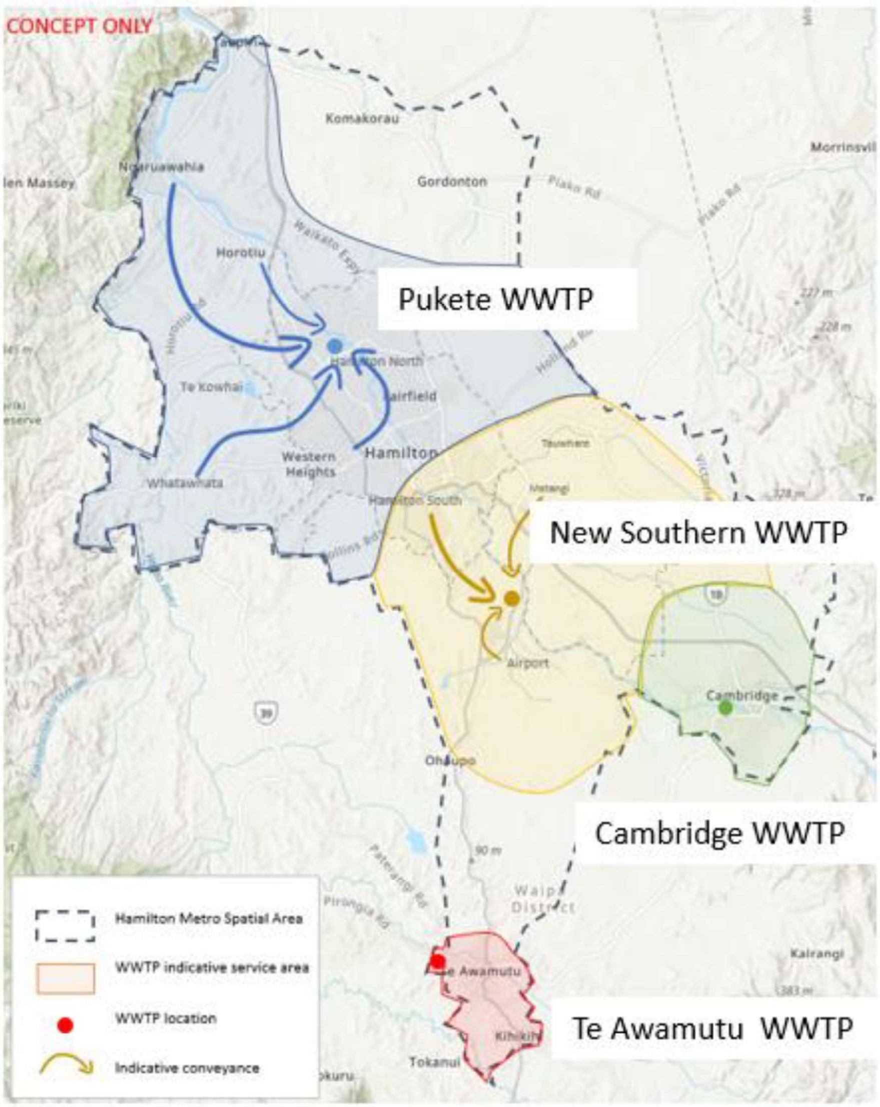


Figure 0-1 Preferred Option Overview

Treatment

The level of treatment adopted for discharges to water is:

- A high level of nutrient removal <4mg/L TN and <1.0mg/L TP (as annual means) and
- A very high pathogen removal (E.coli <14 cfu/100ml as a 95th percentile) and, additional treatment to significantly reduce the discharge of viable viruses.

The level of treatment proposed for discharges to ground, emitted below ground level is:

- TN <20mg/l as an annual mean
- TP No specific limit.
- Pathogens – No specific limit, unless there is a risk of bypass discharge, in which case, UV disinfection would be employed to reduce e.coli to c500 cfu/100ml as a median.

The proposed treatment processes for the Southern WWTPs are outlined below. The treatment concepts developed for the purpose of the DBC reflect known solutions capable of achieving the minimum performance standards agreed for the projects. However, the liquid and solids treatment processes will be further developed and confirmed through preliminary and detailed design phases.

Table 0-1 Treatment Concept Development

Site	Population Equivalent (PE) 2061	Design flow range (m^3/d)	Liquid Processes	Solids Processes	Discharge
Matangi	464	93 (30 in 2021)	Local and communal septic tanks and recirculating sand filter (until 2040). UV if there is a risk of bypass flow	Periodic clean out of septic tanks	Sub-surface drip irrigation to land (until 2040)
Tauwhare Pa WWTP	275	55	Package Secondary treatment with land disposal	Periodic clean out of septic tanks	Sub-surface drip irrigation to land
Southern sub-regional WWTP (Airport) Stage 1	2,000-5,000	400 – 1,000	SBR or package MBR/Secondary system	Transfer thickened sludge to Pukete or Cambridge WWTP	Sub-surface drip irrigation to land
Southern sub-regional WWTP (Airport) Stage 2	5,000-18,000	1,000-3,600	Secondary BNR Reactor Membrane separation UV	Screw Press Dewatering	Discharge to water, restoration or reuse. Stage 1 land discharge could continue for part of flow
Southern sub-regional WWTP (Airport) Stage 3	78,000+	15,500+	Primary Sedimentation Secondary BNR Reactor Membrane separation UV Disinfection Centrate Treatment	Digester[1] Centrifuge Dewatering	Discharge to water, restoration or reuse

[1] The solids stream management ultimately chosen for this population and beyond is likely to be heavily influenced by that ultimately selected for Pukete WWTP.

Site	Population Equivalent (PE) 2061	Design flow range (m^3/d)	Liquid Processes	Solids Processes	Discharge
Cambridge WWTP	25,000-45,000	5,000-9,000	Primary Sedimentation Secondary BNR Reactor Membrane separation UV Disinfection Centrate Treatment	Digester Centrifuge Dewatering	Discharge to water, restoration or reuse. Installation of primary sedimentation and digesters could be delayed with extra reactor capacity required
Te Awamutu WWTP	20,000-36,000	4,000-7,200	Reactor Clarifiers UV	Filter Press (existing)	Discharge to water via rock filter

Conveyance

Matangi would be conveyed to the southern WWTP via a. 9.7km 200 OD PE pipeline. This is assumed to occur around 2041 and will require flows at Matangi that are 3-4 times existing flows so there are less likely to be septicity issues in the pipeline. Increased flow 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.

Diversion of south Hamilton is assumed to occur from 2061. 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.

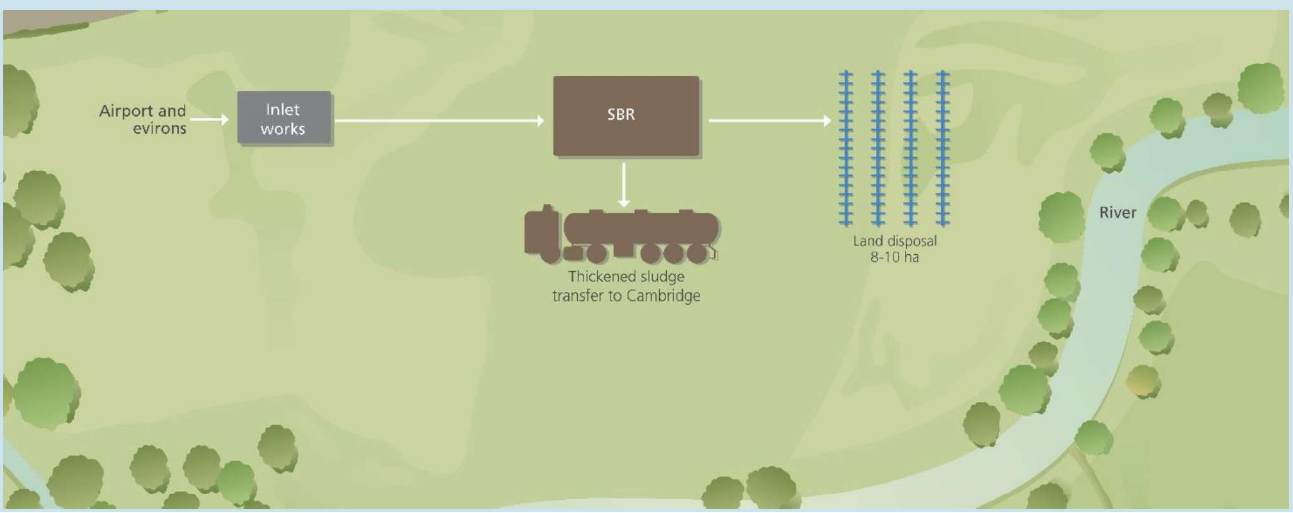
Staging/Triggers

A key element of the preferred option is staged development of a new southern WWTP (likely between Rukuhia and the airport) with the first stage operational within three to five years from 2021. Timing of the new plant is based on:

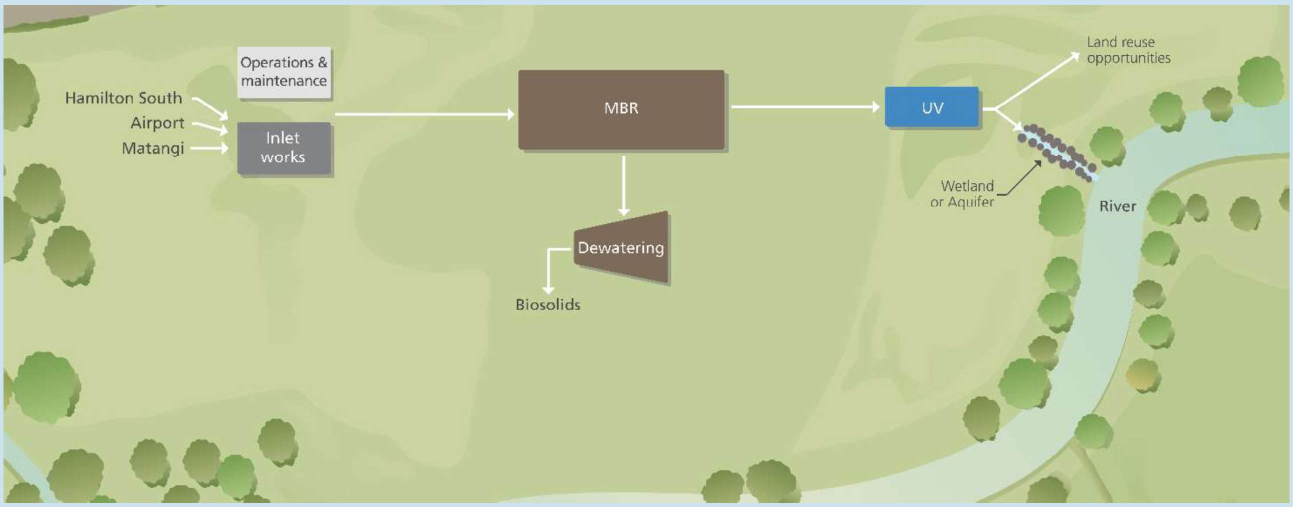
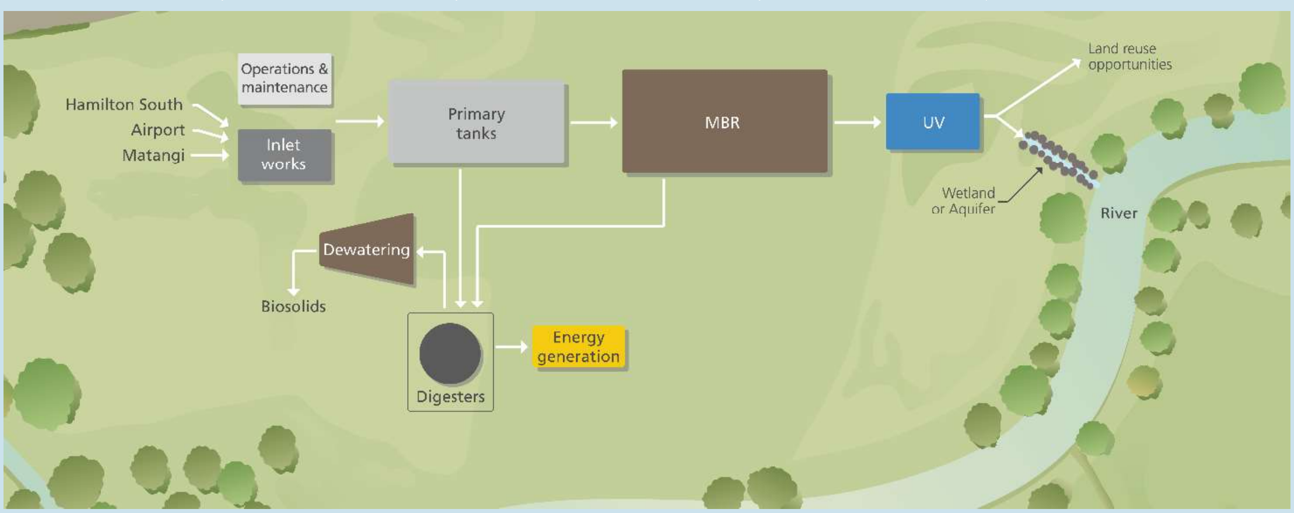
- The extent of land currently developed or consented in and around the airport.
- Avoiding investment in short-term servicing solutions that do not achieve the agreed investment objectives, including many package treatment plants, or storage and tankering options that do not provide long term sustainable solutions.
- Providing for wastewater reticulation and conveyance systems that support land development and are compatible with the medium to long term wastewater servicing solution for the metro area.

More detail on the potential staging of a southern treatment facility is provided below:

Table 0-2 Southern Treatment Concept Staging

Description	Starting Flow	Issues, risks and Opportunities	High level Costs to 2061[2]	Notes
Southern WWTP – Stage 0				
Continue with existing arrangements – a mixture of on-site systems and holding tanks with transfer to Cambridge or Pukete WWTPs	<400 m³/day minimum flow.	Fragmented approach and limits efficient development	Private cost	
Southern WWTP – Stage 1				
Bespoke WWTP – SBR reactor with discharge to land (10-20 ha). Starting flow 400 m^3/day, capacity for 1,000 m^3/day. Transfer thickened sludge to Cambridge WWTP	400m³/day minimum flow. This is equivalent to 2,000 PE	TN<8 g/m^3, land disposal likely to be required. Basic infrastructure only, limited operations facilities Land availability	$9 M *(excluding land purchase and conveyance costs to plant)*	Suitability for wet industry will depend upon the scale of the industrial activity. Intermediate load carrying enhancements can be made to the SBRs without the addition of tankage.
				
Southern WWTP – Stage 2				
Covert SBR into MBR WWTP with discharge to water, Starting flow 1,000 m^3/day	1,000 m^3/day. Or 5,000 PE	Consenting risk as new discharge, Limited spare capacity for wet industry initially. Potential to continue	$45M for 3,600 m^3/day capacity	Interim upgrades between SBR and MBR are available e.g by adding fixed growth carrier media or Nereda granular sludge.

[2] Excludes land purchase, consent costs, procurement and internal council costs

Description	Starting Flow	Issues, risks and Opportunities	High level Costs to 2061[2]	Notes
Provide sludge processing facility and limited operator facilities.		some discharge to land. Reuse structures.		Master plan site so easy to add on reactors as growth occurs.
				
Southern WWTP – Stage 3				
Large scale MBR WWTP with discharge to water	Airport + additional flows from Hamilton 15,600 m^3/day Or ~ 78,000 PE	Reuse structures	$104M	
				

As part of the Preferred Option development, an alternative scenario of commencing the Southern WWTP (SWWTP) at Stage 2 was investigated. Based on the example sizing for SWWTP, this scenario targeted approximately 1,000 m^3/d as seed loading. This involved identifying the initial catchments in the south of Hamilton that could be diverted to provide sufficient demand to operate the SWWTP at Stage 2. In addition to diverting some proposed Peacocke and existing Hamilton South sub-catchments south, some Southern

Links sub-catchments could also be considered for early development, depending upon demand, with servicing by the SWWTP.

The new Cambridge WWTP can also be staged. Additional screens, reactors, primary sedimentation tanks and digestors are added over time in response to residential and industrial growth. Primary sedimentation and digestion processes could be added post 2050 when flows are higher but this would require more reactor capacity and result in less energy recovery. Treatment plant development would need to provide both horizontal and vertical spaces for the process units to be added subsequent to the initial phase of development. Initial process configuration would need to allow vertical and horizontal spaces for the future introduction of primary sedimentation tanks.

Technical Risks

The key technical risks associated with delivering the preferred option include:

- Future transfer of wastewater from Matangi and south Hamilton to a southern WWTP will require protection of the conveyance routes. Allowances for utilities corridors should be considered when designations, sub-divisions and new infrastructure (roads and bridges) are implemented and space in berms alongside existing roads protected.
- A key risk for the project involves the provision of private infrastructure by the developers in the airport precinct which could make it difficult to implement Stage 1 of the southern WWTP.
- Significant wet industry flows have been allowed for at the airport industrial area (1,750 m^3/day by 2061) which could be accommodated at the planned Stage 2 and 3 treatment plants. If wet industry was to not locate to this area or more wet industry arrived than allowed for, process capacity could be delayed or bought forward to match requirements. The sub-regional WWTP in the airport area could be more at risk of impacts from trade waste composition impacting treatment performance as there are only very small residential flows for this option. Trade waste controls and diversion of flows from south Hamilton or Southern Links could mitigate this risk.
- A new site or WWTP offers the opportunity to masterplan a treatment facility to achieve the greatest operational efficiency and be able to adapt quickly and easily to changes. A buffer area around the WWTP will be required to mitigate potential odour and noise issues.
- Matangi flows could conceivably be conveyed through to Hautapu and Cambridge with minimal additional pipe length required. However, this routing would effectively rule out servicing of the Tamahere Hub.
- While a new site can be selected with favourable ground conditions, some ground improvements are likely to be required. During the design process further consideration of seismic risks and resilience can be undertaken.
- Capital costs could be impacted by limited capacity in the construction industry and supply chain issues currently being seen due to Covid impacts.
- Operational costs could increase due to carbon levies or taxes related to energy, biosolids or WWTP emissions. Disposal of biosolids to landfill will be costly. These costs could be reduced if biosolids come to be viewed as a resource and used accordingly.

Nutrient summary

Calculation and comparison of future predicted nutrient (Total Nitrogen (TN) and Total Phosphorus (TP)) mass loads against the baseline nutrient loads from the existing treated wastewater discharges for the southern metro areas has been undertaken to analyse whether the proposed level of wastewater treatment and associated discharges will meet the various policy and statutory requirements, such as Te Ture Whaimana (the Vision and Strategy for the Waikato River) around improving river water quality.

As shown in Figure , when the Cambridge and new Southern WWTP are looked at together, future nutrient loads are substantially less than existing, which is likely to be consistent with policy and statutory requirements around improving water quality.

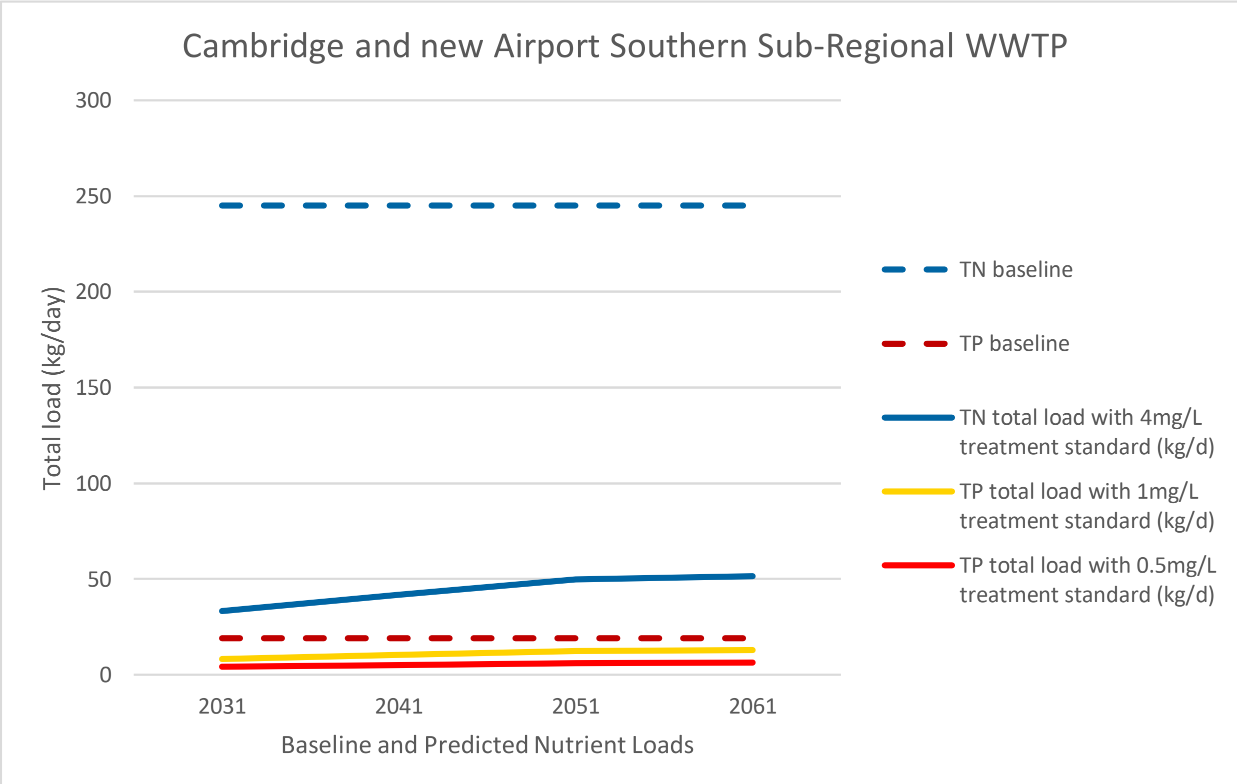


Figure 0-2 - Baseline and Predicted Nutrient Loads for the Cambridge WWTP and Airport Southern Sub-Regional WWTP combined

However, looked at in local geographical isolation, the proposed new Southern WWTP is predicted to exceed the TN and TP (to river) baseline in all treatment scenarios at its point of discharge. This is because the new WWTP will be built in a greenfield growth area. Wastewater generated by the few existing industrial sites in the vicinity is currently disposed to land or trucked offsite (mostly to Cambridge WWTP) and any new discharge to water in the area would be considered against a very low existing baseline if considered standalone (as opposed to consideration of a 'reach of the river'.

Combining the consent processes for Cambridge WWTP or Pukete WWTP and Southern WWTP discharges could be considered as a consenting strategy, i.e taking a more holistic view of the riverine environment through the Metro area. This would also likely be consistent with policy and statutory requirements around improving water quality.

Offsetting is a strategy that could be used to help avoid increasing nutrient loads above the baseline by reducing nutrient loads in other areas of the catchment. This could be achieved in a number of ways, including by planting erosion prone land and undertaking restorative and riparian planting and would contribute towards achieving Te Ture Waimana.

Cost Estimates

Cost estimates representing capital and operating requirements to 2061 were prepared to establish the order of magnitude capital and operational costs for the preferred option. The estimates are developed as part of a Detailed Business Case to provide early estimates for inclusion in budgeting and funding applications for implementation funding. They will need to be refined once a detailed design is developed as part the next stage in the process. The cost estimates are deemed to be Class 5 estimates as per the AACE[3] Cost Estimate Classification System and have an expected accuracy range of -30% / +50%.

Over time the total operational costs increase as flows increase. The large plants that have PSTs and digesters have significantly lower relative costs due to energy recovery and reduced biosolids volumes for disposal. The technology associated with addition of primary sedimentation (PST), digestion and energy recovery increase the capital cost of a treatment plant development or plant upgrade. However, a choice to delay the installation of PSTs and digesters at the Cambridge plant would increase operational costs. Any decision on delaying energy recovery facilities should take into account the whole of life cost implications.

Cost estimates representing capital and operating requirements to 2061 were prepared to establish the order of magnitude capital and operational costs for the preferred option. We recommend that that these costs are not used for capital appropriation and that a conceptual design of the preferred option components be undertaken to confirm the estimated capital and operating costs. The cost estimates are deemed to be Class 5 estimates as per the AACE[4] Cost Estimate Classification System and have an expected accuracy range of -30% / +50%.

Council internal costs, procurement and consenting costs are excluded from these cost estimates and are incorporated into the financial case.

Table 0-3 Base Cost Summary

Treatment			Conveyance	
WWTP name	**WWTP Capital Cost ($ M) up to 2061**	**Operational Cost @ 2061 ($/yr)**	**Capital Cost ($M)**	**Operational Cost ($/yr)**
Southern Sub-Regional WWTP	Stage 1 $9 M Stage 2 -$45 M Stage 3 $104 M	$2.0M (Stage 2) $7.4M (Stage 3)	Matangi $6.6M	$0.1M
			South Hamilton $33M (excludes Southern links, potentially post 2061)	$0.8M
Cambridge	$ 113M	$2.8M		
Matangi	$ 0.5M (short term improvements)	Same as current		
Te Awamutu	$29M	$4.0M		
Tauwhare Pa	$ 2M	$0.04M		

Over time the total operational costs increase as flows increase. The large plants that have PSTs and digesters have significantly lower relative costs due to energy recovery and reduced biosolids volumes for disposal. The technology associated with addition of primary sedimentation (PST), digestion and energy recovery increases the capital cost of a treatment plant development or plant upgrade. However, a choice to

[3] Association for the Advancement of Cost Engineering – Practice No. 18R-97

[4] Association for the Advancement of Cost Engineering – Practice No. 18R-97

delay the installation of PSTs and digesters at the Cambridge plant would increase operational costs. Any decision on delaying energy recovery facilities should take into account the whole of life cost implications.

Implementation

Figure 0- and Figure 0-4 summarise the staging for the preferred option. Triggers have been identified to move between development stages. The Southern WWTP development stages are triggered by local or south Hamilton demand. Matangi conveyance and Cambridge and Te Awamutu WWTP upgrades are triggered by growth and new resource consent requirements. Developer agreements will trigger the need to upgrade at Tauwhare Pa WWTP. Servicing of Ohaupo would be triggered by environmental issues with current on-site wastewater systems or significant increased demand due to higher density development.

Key steps to implement a new Southern WWTP involve:

- Securing land for a new WWTP, buffers and land discharge and designating and consenting the treatment plant and discharge activities in Years 1 to 3 of the LTP.
- Master planning the new site to allow for flows from Hamilton South longer term by repurposing some structures such as the twin rising mains and pump stations of the Peacocke development. PS-N4 for example has included flexibility for such a change to be made some time in the future.
- Stage 1 of the treatment plant development. SBR treatment technology with land disposal (10-20ha) is proposed for the first stage. This technology provides enormous flexibility in terms of flows and load and will provide effluent quality that is suitable for application into or onto land. The first stage would cater for a capacity of between 400m^3/day and up to 1,000m^3/day (but with some flexibility on these limits). However, interim up-rating (beyond nominal maximum load carrying capacity) of the plant can be implemented by the introduction of fixed growth carriers (e.g Kaldness), or granular activated sludge (e.g Nereda). The trigger for moving to Stage 2 would be when the WWTP is at 80% of capacity or conveyance cost to Pukete is too high.
- Stage 2 Treatment Plant Upgrade (design, build and consent) - to provide a step change in treatment capacity and performance as demand requires. When the demand nears 1,000m^3/day, or maximum load carrying capacity, the plant would be upgraded to an MBR system with discharge to water. The MBR system would be able to be configured using the Stage 1 SBR reactor tanks much has been done recently with the conversion of the Pukekohe WWTP from SBR to MBR configuration. This system would provide capacity for 3-4,000 m^3/day. Insufficient land is expected to be available for larger flows to be discharged to land and a discharge to water is assumed for the purpose of the DBC. Part of the Stage 1 land could continue to be used in Stage 2. The trigger for moving to Stage 3 is significant extra demand from Hamilton due to capacity reached at Pukete WWTP or conveyance costs to Pukete are too high.
- Stage 3 Further system upgrades could be undertaken to meet demand.

For the preferred option further investigation and design is recommended as follows:

- Revisit the growth assumptions (including timing and scale of wet industrial activity in and around the Airport Precinct) for the Southern Plant as part of project implementation
- Geotechnical investigations for Cambridge WWTP and Southern WWTP
- Review of redundancy requirements for major process units e.g. screens and reactors
- Investigation of biosolids reuse and disposal options.
- Offsetting and consenting options
- Further investigation of sustainability and capital/operational carbon footprint
- Further refinement of capital, operational and present value analysis
- Master planning for Cambridge and Southern WWTP sites

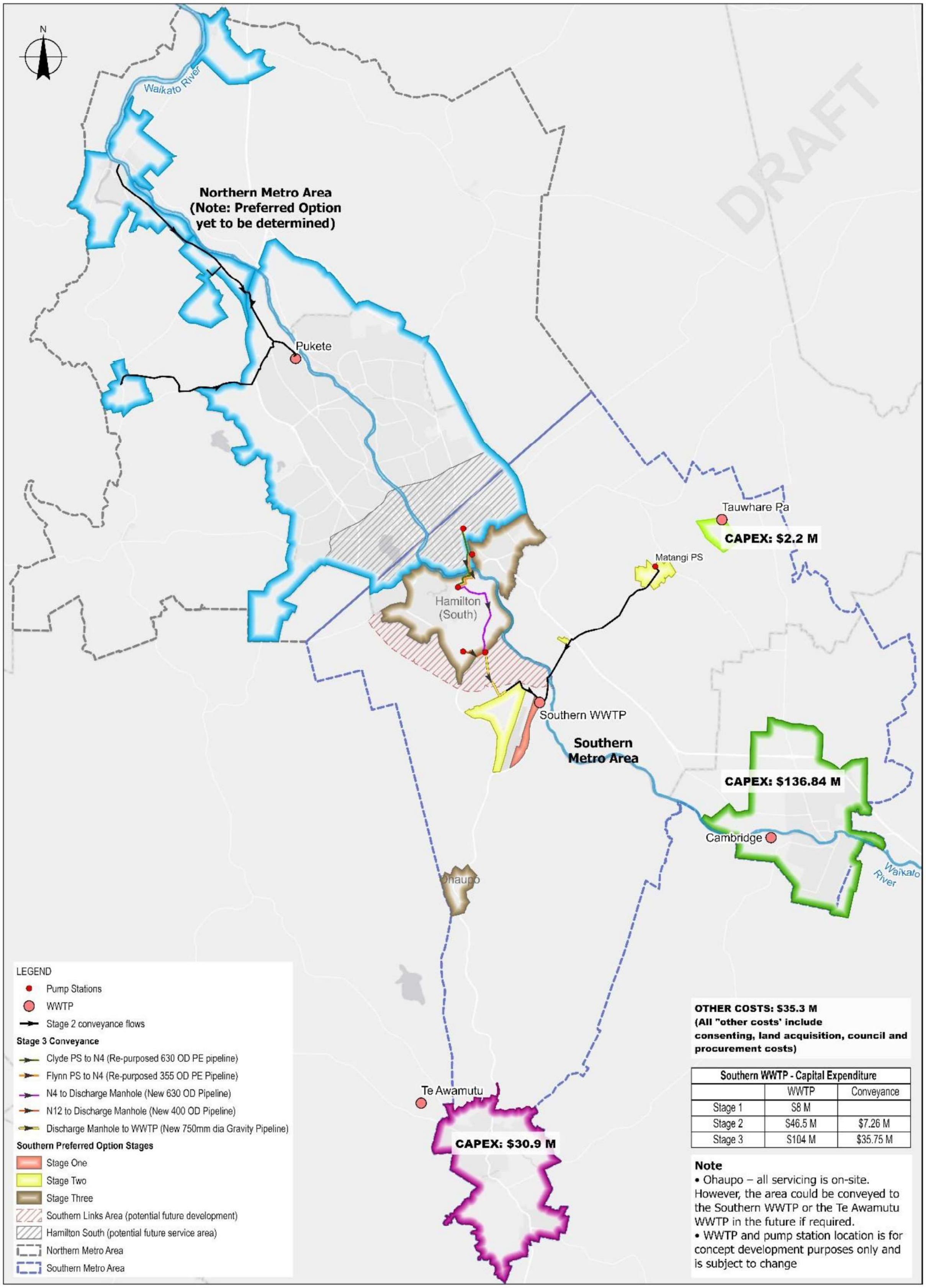


Figure 0-3 – Preferred option summary

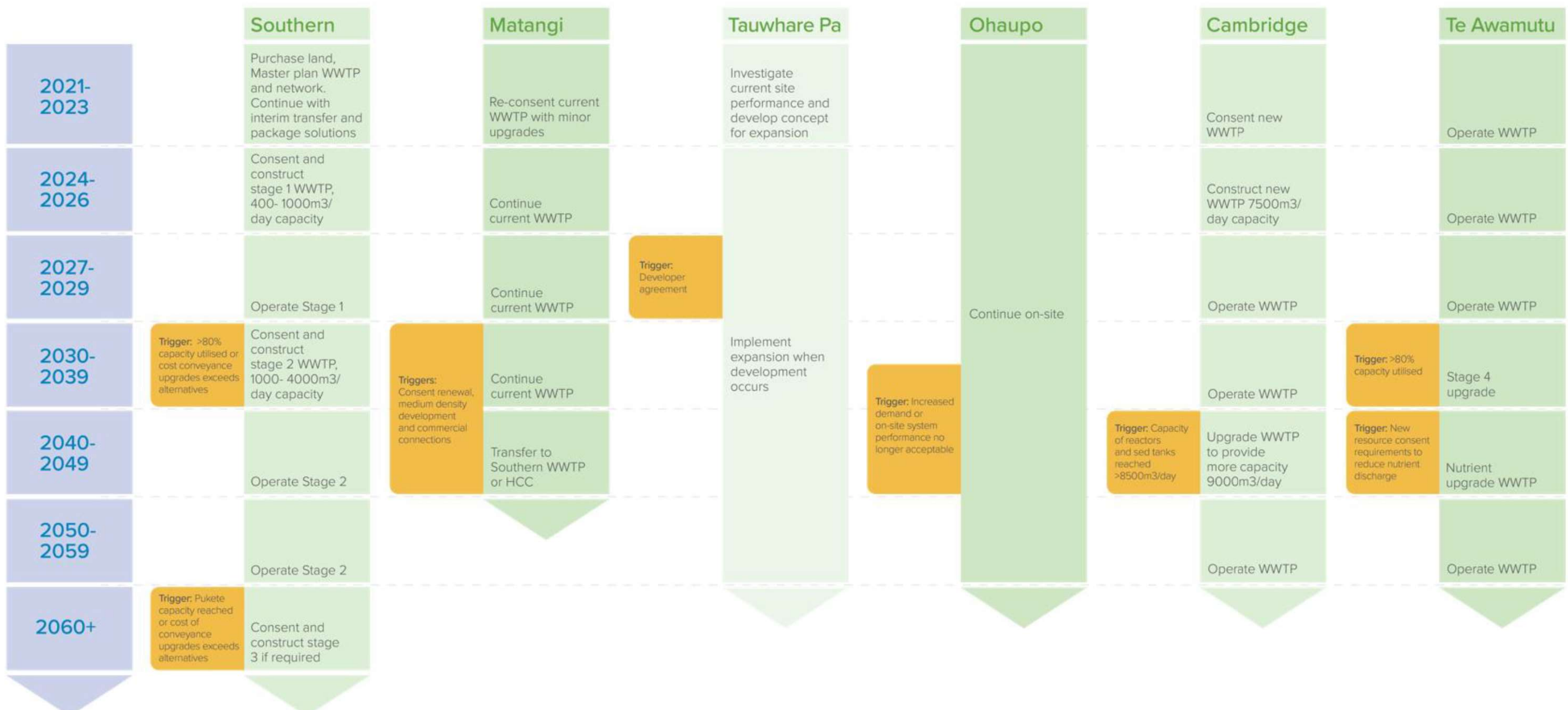


Figure 0-4 – Preferred option staging

Disclaimer

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1 Introduction

1.1 Purpose of the report

This report provides supporting documentation for the Waikato Southern Metro Wastewater Treatment Detailed Business Case (DBC). The purpose of the Preferred Option Report is to provide a description of the preferred option and to inform the implementation plan.

The purpose of the DBC is to determine preferred long term wastewater treatment solutions for the Waikato Hamilton Waipa Metro Area (metro area). This report covers the area from the southern part of Hamilton City, through to Cambridge, Te Awamutu and Kihikihi. The work will be complimented by an equivalent investigation and assessment process for the northern Metro area covering Ngaruawahia, Te Kowhai, Taupiri, Horotiu and the majority of Hamilton City. A longlist to shortlist assessment has already been undertaken. This identified centralised wastewater treatment options as being preferred for both the northern and southern metro areas. In order to determine a preferred option for the southern metro area, treatment and conveyance options for a centralised and partially centralised solution were further investigated and a preferred option selected.

This project has the same vision as the overarching Waikato Sub-regional Three Waters vision:

Tooku awa koiora me oona pikonga he kura tangihia o te maataamuri

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

…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 metro area covers from Taupiri through to Te Awamutu (North - South) and Te Kowhai/Whatawhata to Tauwhare (East - West) and forms part of the Sub-Regional Three Waters Study Area.

This report will only consider the southern metro area, which consists of the following small communities and areas:

- Southern Hamilton
- Peacockes
- Rukuhia
- Matangi (including Tamahere commercial area)
- Tauwhare Pa
- Airport industrial area
- Ohaupo
- Cambridge
- Te Awamutu.

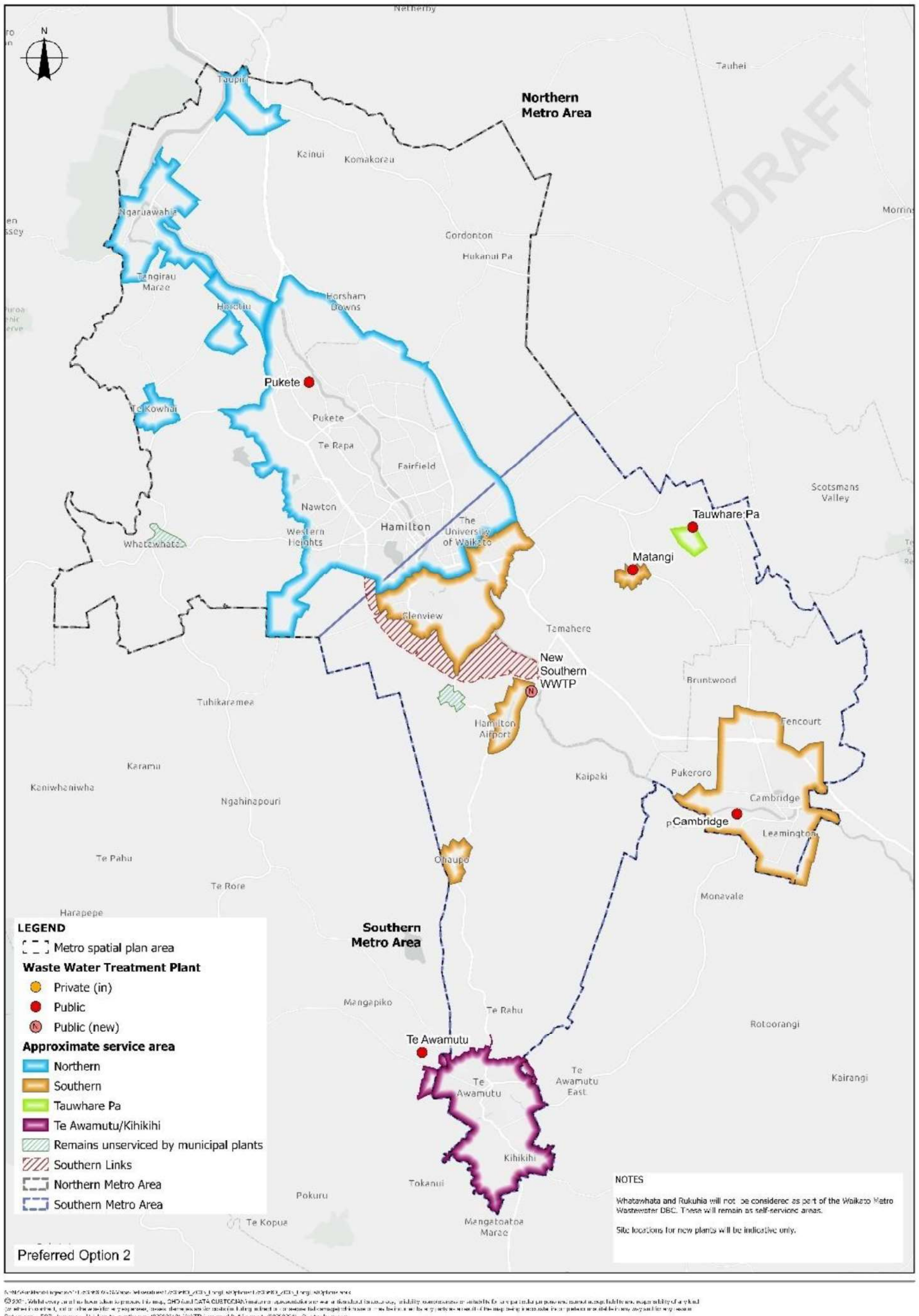


Figure 1-1 Metro DBC area

1.3 Preferred option overview

A range of options were considered through a process detailed in the Long list and Short list MCA reports. Option 4A from the short listing process was selected as the basis for an optimised preferred option.

This option was refined to reflect the finite capacity available at Pukete WWTP and in the Hamilton conveyance network. The refined Preferred Option consists of the following:

- Southern wastewater treatment plant (WWTP) to ultimately service Airport Industrial precinct, Matangi and southern Hamilton with discharge to land initially and to the Waikato River once Stage 2 triggers are reached.
- Existing Tauwhare Pa WWTP to be upgraded with discharge to land
- New WWTP at Cambridge with discharge to the Waikato River
- Te Awamutu/Kihikihi WWTP to be upgraded and continue to discharge via rock channel to the Mangapiko Stream
- Improvements to the existing Matangi WWTP until the wastewater is conveyed to the new southern WWTP or HCC network around 2040
- Ohaupo to continue on-site wastewater systems
- Tamahere hub to continue to utilize on-site wastewater treatment and discharge systems with reconsideration when a pipeline from Matangi is implemented

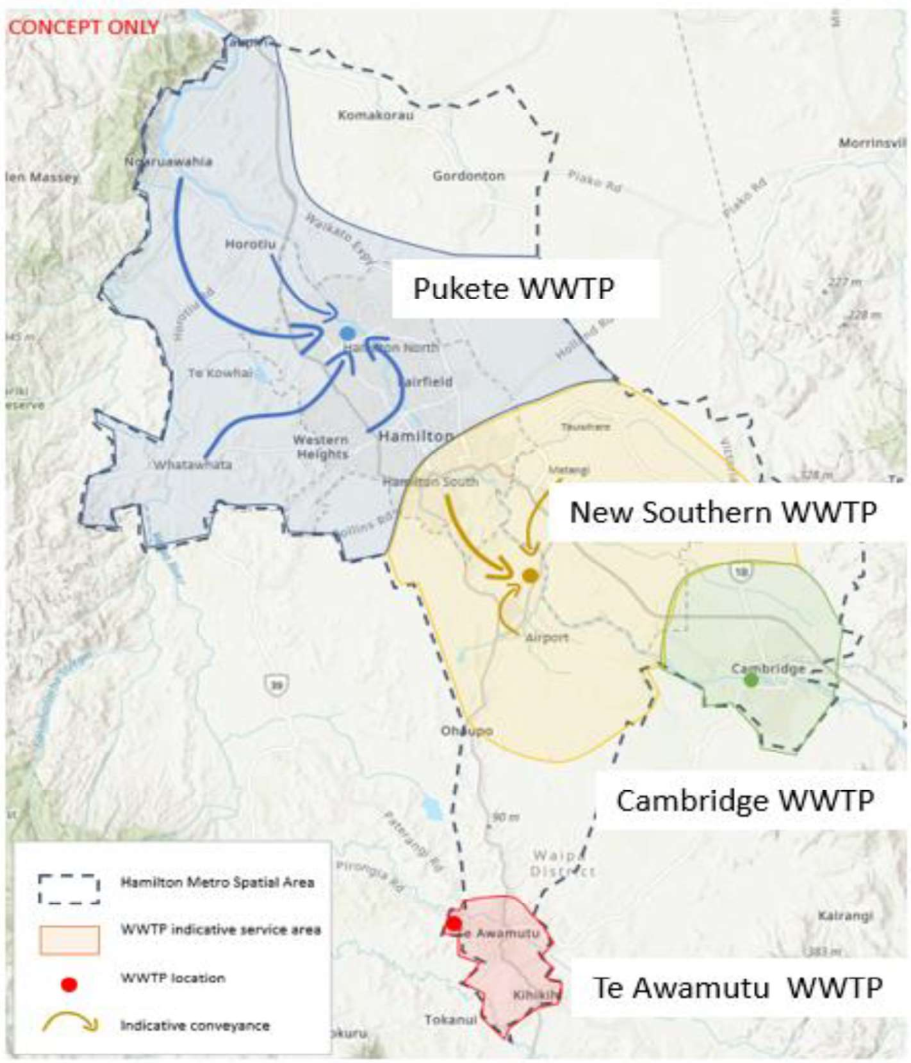


Figure 1-2 Preferred option

2 Population Assumptions and Design Flow and Load

2.1 Population assumptions

Growth assumptions have been developed with reference to the councils and relevant strategic planning documents to inform development of the preferred option. The growth assumptions relevant to the southern area include:

- Population projections from Waikato and Waipa District Councils.
- Population equivalent projections from Hamilton City Council created for Wastewater Master Plan V3.
- Planned industrial development and timing (e.g. Airport, Cambridge / Hautapu).
- Additional infill development as noted in the Metro Spatial Plan.
- “Wet industry” allowances at, Airport and Cambridge. While these allowances have been included in the current DBC work, the most appropriate strategic locations for wet industrial activity in the Metro Area needs to be properly considered and determined by Future Proof.
- The ultimate design horizon also includes 35,000 Population Equivalent (PE) for the area between the Southern Links designation and the current Hamilton City Boundary, and an additional 30,000 PE in the vicinity of Ruakura.
- Existing and known future trade waste/wet industry discharges will be included in the wastewater flow and load projections.
- Industrial activity has been provided for at a population equivalent of 45 per additional hectare as per the RITS unless a different population equivalent is outlined in the growth assumptions memo. Gross industrial areas will be corrected for non-usable areas such as transport corridors based on structure plans where available.
- For areas where wet industry is preferred to occur, an additional flow/load allowance based on 2% of the area used for food processing type wet industry will be assumed. This results in approximately double the flow compared to the standard industrial flow allowances.
- Refinement since short-list has included delaying the wet industry at the airport area until 2051.

The residential and non-residential information was then collated to provide population equivalent at each time horizon for each community as summarised in Table 2-1.

Table 2-1 Population Equivalent Forecasts (Residential and Non-Residential)

		Population Equivalents					
Area	**Serviced from**	**2021**	**2031**	**2041**	**2051**	**2061**	**Ultimate**
Taupiri	Current	2,063	5,176	6,167	6,991	7,256	8,400
Ngaruawahia	Current	6,234	7,407	9,102	10,516	12,016	21,991
Horotiu	Current	1,815	6,778	10,390	13,996	14,156	14,156
Te Kowhai	2031	35	1,301	1,685	2,095	2,371	4,706
Hamilton North	Current	237,642	288,590	306,351	356,325	391,330	600,703
Hamilton South	Current	29,630	36,573	46,511	54,723	59,626	103,633
Tauwhare Pa	Current	140	619	619	619	619	889
Matangi (incl Tamahere commercial)	Current	140	464	464	464	464	1,035
Airport	2031	1,377	4,000	6,000	17,852	17,852	17,852
Ohaupo	Not serviced	547	630	814	1,025	1,031	1,100
Cambridge & Hautapu	Current	22,520	32,940	37,801	42,892	45,031	57,649
Te Awamutu & Kihikihi	Current	24,988	27,989	30,905	34,982	36,001	42,011

2.2 WWTP Design / Flow assumptions

Assumptions were made on the likely wastewater volume and characteristics expected to be received by each WWTP. These assumptions are consistent between WWTPs and are detailed below.

2.2.1 Flow Assumptions

Wastewater flows for each treatment plant were determined using population equivalent projections (table 2.1) and the per population equivalent average daily flow of 200 l/p/d as stipulated in the RITS. The 2020 flows for each WWTP (which include existing trade waste discharges) were used as the base and changes in population equivalent used to adjust this flow over time.

The peak daily flow to each plant was assumed as four times the ADF.

The flow projections associated with each plant are as per Table 2-2.

Table 2-2 Average daily flow per WWTP to 2061

WWTP ADF MLD	2031	2041	2051	2061
Cambridge Standalone WWTP	6.8	7.7	8.6	9.0
Southern WWTP	0.8	1.2	3.6	3.6
Matangi (incl Tamahere Hub from 2041)	0.030	Transfer to Southern WWTP (0.093)		
Te Awamutu	5.6	6.7	7.0	7.2
Tauwhare Pa WWTP	0.06	0.06	0.06	0.06

2.2.2 Influent Wastewater Characteristic Assumptions

The raw wastewater quality assumptions made for the shortlisting are as carried forward from the longlisting assumptions. They were assumed as consistent across all four WWTPs. The concentrations assumed for the incoming wastewater into the shortlisted WWTPs is as per Table 2-3. Nutrient levels are at the higher end of levels found at Pukete WWTP and BOD and TSS slightly lower that Pukete WWTP average data. Sensitivity testing was undertaken to assess the impact of higher BOD and TSS levels.

Table 2-3 Incoming wastewater quality assumptions

Parameter	Value	Units
Total Suspended Solids (TSS)	360	mg/L
Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)	320	mg/L
Chemical Oxygen Demand (COD)	704	mg/L
Total Kjeldahl Nitrogen (TKN)	60	mg/L
Total Phosphorus (TP)	10	mg/L

2.3 Treatment assumptions

The WWTPs developed for this report used the treatment assumptions outlined in the treatment standards memo[5] provided in Appendix A.

2.3.1 Liquid Stream

The level of treatment proposed for discharges to water is:

- A high level of nutrient removal <4mg/L TN and <1.0mg/L TP (as annual means) and
- A very high pathogen removal (E.coli <14 cfu/100ml as a 95th percentile) and, for surface water discharges, additional treatment to significantly reduce the discharge of viable viruses.

The level of treatment proposed for discharges to ground, emitted below ground level is:

- TN <20mg/l as an annual mean
- TP No specific limit.
- Pathogens – No specific limit, unless there is a risk of bypass discharge, in which case, UV disinfection would be employed to reduce e.coli to c500 cfu/100ml as a median.

The treated wastewater quality standards would be introduced by 2031 or when the existing resource consent for the discharge expires. For WWTPs including digestion facilities, primary treatment will also be required. This allows a significant proportion of the calorific value of the waste to be intercepted and captured before being digested aerobically at the expense of much energy purchased externally.

It is expected that future consents, for any water based discharges, would be based on mass loads of nitrogen and phosphorus permitted to be discharged to the subject river. That will provide scope, in early years for plants to be loaded to allow slightly higher effluent concentrations in the discharge and still achieve the objective of significantly lowering point source based nutrients to the river below what is currently discharged. This approach to consenting (similar to existing Ngaruawahia and Huntly consents) would provide transition time for existing treatment plants to be modified and redeveloped to the extent needed to achieve the ultimate objectives.

For discharges to land where the full wastewater stream can be discharged, a lower standard of wastewater treatment can be considered. The actual parameters will depend on nitrogen and phosphorus loads able to be sustainably discharged to the land irrigation system. Secondary treatment would be the minimum requirement and pathogen removal would need to be considered if spray irrigation was used, or bypass flows expected. Otherwise additional pathogen removal may not be required.

2.3.2 Solids Stream

A graduated approach to solids management is proposed with complexity and extent of solids destruction and energy potential realisation increasing in steps with population equivalent served.

For WWTPs up to the digester threshold (currently proposed as 40,000 PE), the extent of treatment would increase to dewatering to a minimum of 19% dry solids, being a 'last resort' standard for landfilling if that had to be adopted temporarily or permanently.

WWTPs above 40,000PE would adopt primary sedimentation (or equivalent) and anaerobic digestion with one or more forms of energy recovery, for example a co-generation engine producing both heat and electrical energy. And above 150,000PE a more advanced form of solids destruction would likely be adopted. For WWTPs with digesters, side stream digestate treatment will be provided for to mitigate the nutrient removal (and consequently energy consumption) burden imposed by the resulting centrate return cycle on the main biological process. The concept intended is that this side stream process would use one

[5] Treated Wastewater Assumptions for Waikato Wastewater Metro DBC, Beca, August 2020

of the modern ‘short circuit’ granular or fixed film biological process based around Anammox or similar bacteria. It should be noted that objectives of very high rates of removal of nitrogen and phosphorus and maximising energy recovery will result in competition for readily degradable carbon substrate and this is likely to result in some compromises being required or a significant amount of supplementary caron substrate imported

2.3.3 Atmospheric emissions

Proposed provisions for atmospheric emissions are reasonably general but all would require best practice to be implemented. The costs of such initiatives are not able to be differentiated at the Class 5 estimating level, apart from large items such as co-generation plant. These initiatives are intended to include:

- Noise mitigation to levels that are safe for operators and which comply with local ordinances at the boundary
- No objectionable odours beyond the boundary. However, it is also assumed that the treatment plant owners will do all in their power to create and maintain odour buffers around the WWTPs
- Process units and equipment will be specified and configured to minimise the release of fugitive greenhouse gas emissions. For example, use of biogas in boilers, furnaces or co-generation engines and providing for very stable nitrogen removal processes that release a minimum of nitrous oxide.
- In all process plant development, life cycle emissions will be given due consideration and it is anticipated that the councils will adopt the zero carbon bill aspirations and optimization of life cycle emissions generally. And that these will be drivers for initiatives, particularly in the larger plants, for processes that drive the plants towards energy neutrality (Scope 2 reductions) and emissions minimisation, whether on site (Scope 1) or off site for residuals management (Scope 3).
- While currently not available, it is anticipated that, by the time these proposals proceed to implementation, New Zealand will have adopted an accepted means whereby comparisons of equivalence of environmental effect can be made between, for example, emissions to surface water and greenhouse gas emissions to the atmosphere.

2.3.4 General

The treatment plants will be configured such that the limit of capability is not fixed at the initial target performance but can be upgraded by augmentation of processes at appropriate times. At this time, it is expected, if TN is immediately targeted 4mg/l or less, that any appreciable upgrading is unlikely to be feasible.

3 Wastewater Treatment

3.1 Methodology

WWTPs on the shortlist were categorised as either small, medium or large based on their design horizon (2061) population equivalent (PE). This allowed them to be allocated a set of treatment processes in order to meet the agreed performance standards. All WWTPs were initially sized at the 2061 design horizon. The relevant population equivalent and flows that correspond to the plant sizes that were determined are detailed below in Table 3-1. The actual process configuration to achieve the performance standards for each community will be further considered and developed during the design phase.

Table 3-1 Allocation of process units based on plant size

Size	Population Step (PE)	Flow Step (m³/d)	Liquid Processes	Solids Processes
	All	All	Inlet Works (flow metering, screening & grit removal)	-
Small	0 – 4,000	0 – 800	Small Membrane Bioreactor (MBR) or other Secondary treatment if land disposal	Thickening, transfer to larger WWTP
Medium	4000 – 40,000	800 – 8,000	Secondary BNR Reactor Membrane separation UV Disinfection	Screw Press Dewatering
Large	40,000 – 150,000	8,000 – 30,000	Primary Treatment Secondary BNR Reactor Membrane separation UV Disinfection Centrate Treatment	Digester Co-Generation Centrifuge Dewatering
	150,000 +	30,000 +	Primary Treatment Secondary BNR Reactor Membrane separation UV Disinfection Centrate Treatment	Digester Centrifuge Dewatering Co-Generation Advanced Solids Destruction

3.2 Process Element Descriptions

Further detail on the wastewater treatment process elements that the plants included in the Southern Metro preferred option may incorporate are as follows:

Inlet Works

An inlet works facility comprising of two (2) packaged pre-treatment systems appropriate for a membrane bioreactor (MBR) plant. Packaged system to include:

- Influent collection chamber
- Raw influent flow metering
- Coarse (5mm aperture), primary band screen
- Aerated grit removal tanks which includes aeration, grit removal conveyors and scum removal
- Grit classifiers
- Fine (1mm aperture), secondary band screen
- Screenings load out conveyors to skip
- Screening washer/compactors if the screens do not include an integral compaction zone
- Scum collection tank including decanting pipework.

Primary Treatment

A primary sedimentation system comprising of:

- Sedimentation tanks for settling removal of colloidal particles via gravity
- An in-tank sludge scraping mechanism for collection of sludge
- A sludge hopper at the entry end of the tank
- Primary sludge pumps and pipework for sludge removal from the hopper
- Surface scum removal system
- An in-ground pump and pipework gallery to house all sludge handling equipment
- As an alternative and perhaps for the duration of one equipment lifespan (say 25 years) mechanical systems such as Salsness filters or cloth pile filters could be employed as the primary clarification devices up front of the MBR and the digesters.

Secondary Activated Sludge Reactors

- Activated sludge reactors (ASRs) configured for carbon wastes, nitrogen and phosphorus removal
- Mixing systems for each reactor zone
- Blowers and diffused aeration system, including internal recycle
- Return activated sludge (RAS) and waste activated sludge (WAS) pumping
- Controls instrumentation
- Alum dosing for phosphorus removal where necessary (the reactors/membrane tanks are set up as 5 stage Bardenpho (or similar) for biological phosphorus removal) but some chemical 'polishing' of final effluent may be required.

Secondary Solids Separation - Membrane Configuration

A membrane separation process (as part of MBR, rather than tertiary membrane filter) will comprise:

- Ultrafiltration membrane separation using submerged hollow fibre membranes. This is to remove particulates, bacteria and organic nitrogen and phosphorus and to enhance the treatment capacity of a given volume of activated sludge tankage.
- Permeate pumps for managing effluent flows through and downstream of the membranes
- A clean in place (CIP) system required for maintaining the membranes

UV

A tertiary UV disinfection system comprising:

- Either an in-channel lamp bank or in-pipe pressurized UV disinfection system. This provides a further barrier for bacteriological compliance and effective inactivation of residual viruses

Centrate Treatment

A centrate treatment system, for the removal of ammonia from the dewatering centrate consisting of:

- An MBBR for Anammox side stream treatment (or equivalent Anammox or other side stream process)
- An effluent transfer pump and wetwell system for pumping back to the inlet works
- Aeration blowers and piping

Digestion

A single stage mesophilic digestion system consisting of:

- A sludge holding tank where primary sludge and WAS are mixed and buffered prior to digestion
- Circular, above ground and insulated digesters for volatile solids destruction and biogas generation
- Sludge mixing system
- Sludge transfer pumps and pipework
- Heat exchangers for regulating digester temperature
- Galleries to access all sludge pumps and pipework for operation and maintenance purposes
- A biogas collection and storage system
- A biogas engine for cogeneration of energy to offset electricity and or natural gas use

Dewatering

A hall containing a dewatering system consisting of either:

- Screw presses for smaller plants, capable of dewatering undigested WAS to ≈19%DS, or
- Centrifuges for larger plants, capable of dewatering co-digested sludge to ≈26-30%DS
- Polymer make-up systems and feed pumps
- Dewatering day tanks for storing digested sludge until the dewatering systems operate
- Sludge pumps and piping to feed dewatering
- Sludge loadout conveyors and skips for removal of dewatered sludge from site.

Other

Other facilities required include:

- Operations building
- Maintenance and stores building
- Entry gate
- Septage disposal system for larger plants
- Security fencing
- Internal roads and carparking
- Electrical transformer and back up generator.
- Buffer and screening planting

3.3 Cambridge WWTP Description

Option description

For the Cambridge WWTP to treat an average daily flow in 2061 of ~9000 m^3/d the following plant features are proposed:

- Inlet works
- Primary Sedimentation
- MBR
- Digestion
- Centrifugal dewatering
- Centrate treatment
- UV treatment.

The process flow diagram (PFD) is shown in Figure 3-1.

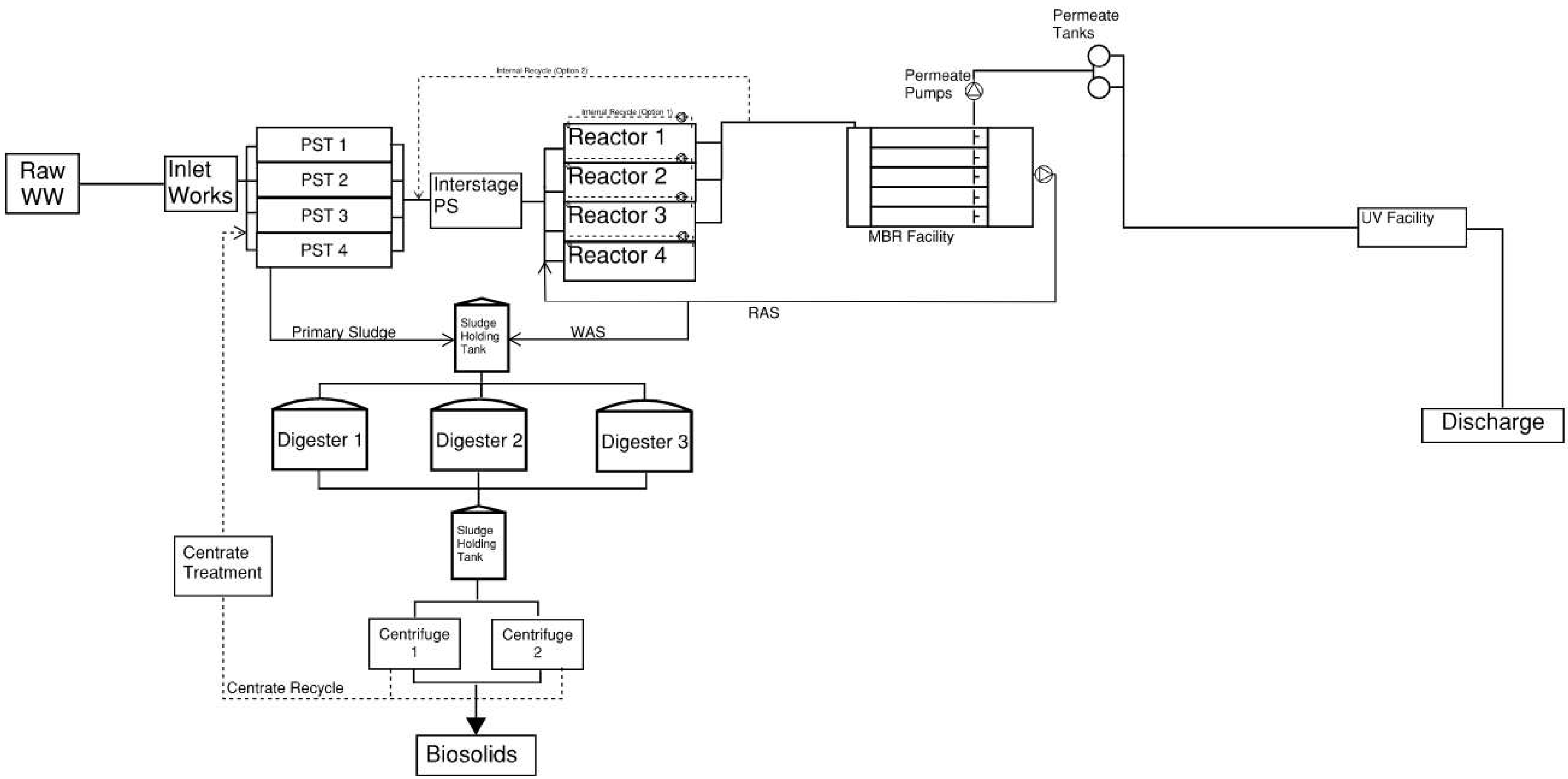


Figure 3-1 Standalone Cambridge WWTP PFD

Layout

The plant is expected to require an approx. 3 ha footprint. The site could be located in the area of the existing site currently used for wetlands or ponds to avoid areas with highest risk geotechnical conditions and be further from the river. A detailed geotechnical investigation is required to confirm suitable sites.

Layout could be compromised by the need to keep the existing WWTP operational and compliant during construction of the new facility.

Temporary relocation of some existing services or unit processes may be required while the new treatment plant is being built.

For the ultimate population of Cambridge, an additional 2 ha of space is recommended to be protected.

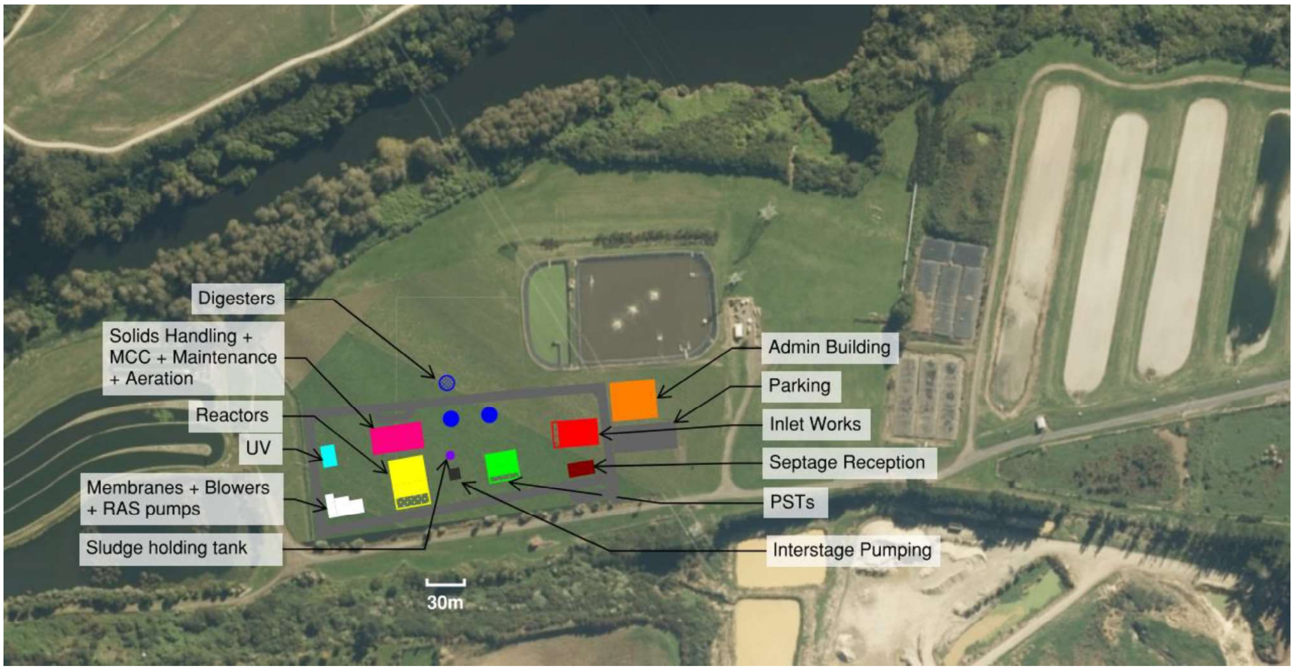


Figure 3-2 Cambridge WWTP Example Layout

Staging

To determine process unit sizing and staging, a steady state activated sludge model (based on the ATV [6]standard guidelines) was used specifically to determine the bioreactor sizes for an effluent TN concentration of 4 mg/L and effluent TP concentration of 1mg/L.

This was modelled including allowance for PSTs, digesters and centrate treatment on the recycle stream to determine a reasonable reactor size suitable for staging. The flows and associated loads were evaluated at each timeframe to estimate the major process units required over time as outlined in Table 3-2:

[6] Abwasser Technische. Vereinigung, the German standard guidelines for design of activated sludge WWTPs

Table 3-2 Cambridge WWTP Process Units Over Time

Asset	Size[7]	2031	2041	2051	2061
Flow	m³/d	6,824	7,678	8,578	9,006
Screens	200L/s	2	2	2	3
PSTs	80m²	3	4	4	4
Reactors	1000m³	3	3	3	4
Membrane Trains	100L/s	4	4	4	5
Digesters	1100m³	2	2	3	3
Dewatering	10m³/hr	2	2	2	2
Biosolids @ 26%DS	m³/d	5.6	5.8	6	6.1

Installation of the PSTs and Digesters could be delayed to be installed at approximately 2051 when the population equivalent is expected to be at the 'target' level typically used for this technology. Extra secondary reactor capacity would be needed in the intervening years which may be able to be designed to convert into primary sedimentation tanks later. However, operating costs would increase as energy is not recovered and biosolids volumes for disposal are higher.

Wet industry flows for Cambridge WWTP are a small proportion of the total flow and are not expected to have a significant impact on staging.

Issues and Risks

The existing Cambridge WWTP site is fairly constrained and is expected to require significant ground improvements.

Constructing a new WWTP on an existing site adds complexity and time to the implementation phase of the project. This will result in additional P&G costs, additional temporary works costs and additional compliance risks.

Process equipment can be added over time as flows increase due to residential and industrial growth.

3.4 Southern Sub-regional Plant

Existing State

[7] Process unit sizes are indicative and will likely change. Designers will refine these and numbers may alter depending upon selected resilience and redundancy policies.

The key reasons for considering the establishment of a southern, sub-regional WWTP include servicing:

- a growing commercial industrial growth cell that is developing, centred around Hamilton Airport
- the potential for wet industry developments in or around the airport precinct. Zoning provides for these but the extent to which they may eventuate is not currently clear
- limits to existing Hamilton conveyance network from the south of the city to Pukete WWTP and finite space available at Pukete WWTP to meet the long term needs of the city and the metro area
- long term sustainably servicing the needs of Matangi and the Tamahere Hub and, potentially Ohaupo
- The need for long term servicing solutions for additional growth in Hamilton city and in the peri-urban environment including the 'Southern Links' area to the south west of the present Hamilton City boundary should these proceed under private plan change processes.

The airport proper, and associated activities such as the Airport Motel, Pacific Aerospace and the International Aviation Academy have been operating in this precinct for many years and are generally serviced by their own, on site wastewater treatment and disposal systems, each of which will have a small treatment plant and an associated discharge to land consent.

The industrial parks around the airport proper (e.g. Titanium Park) have been developing for the past 10 years or so. It is understood that the industrial park precincts are serviced by a combination of on-site systems and tankering of accumulated wastewater to Cambridge for treatment and discharge to the Waikato River.

Individual houses and organisations in the precinct have their own on-site wastewater servicing. These include private housing and organisations such as the pistol club, NZ Honey and the Mystery Creek Fieldays complex.

Details of the mix, extent and cost of waste tankering were not available at the time of writing of this report.

Option description

It is envisaged that a southern sub-regional WWTP would be developed in stages as need arises. Considering the development objectives / reasoning bullet pointed above, this could result in developments of significantly differing scale as time progresses. It will therefore be necessary to select systems and undertake site selection and master planning to provide a high degree of flexibility and minimise disposal of assets before the end of their economic life. With regard to capital works, two techniques that support this approach are:

- Early stage process tankage that is configured such that it is readily repurposed
    - SBR to MBR (Change MLSS from 3,500 to 6,000mg/l)
    - SBR to balance tank or WAS tank
    - Operator facility either not provided at all or slightly larger to accommodate laboratory and extra operators
- Planned obsolescence of mechanical and electrical plant items. Mechanical and electrical plant will typically have an economic life of between 10 and 20 years. For example blowers (20), diffusers (10), pumps & mixers (15), MCC (20). Treatment plant development planning can take into account opportunities for changing to larger scale machines when undertaking renewals.

An early concept has been developed based on a moderate level of treatment (i.e similar Te Awamutu) and subsurface discharge to land. This could be configured in an IDEA configuration (hybrid sequenced batch reactor) starting at or about 400m^3/d, which could serve through to 1200m^3/d or more depending on whether 2 or 3 reactors are employed (see **Stage 1** below), operating at mixed liquor suspended solids up to about 3500mg/l.

Stage 2 and beyond would be based on taking this initial tank infrastructure and converting it for use in membrane Bioreactor (MBR configuration). This would move to the high level of treatment proposed for the

Metro WW servicing scheme and render the effluent suitable for discharge to land or to water (from a western science perspective). The move from 3000 or 3500 mg/l MLSS to 6,000 or 6,600 mg/l would essentially double the carrying capacity of the existing tanks. Alternatively or even further into the future, the SBR could be used as membrane tanks and new, larger bioreactor tanks constructed outside.

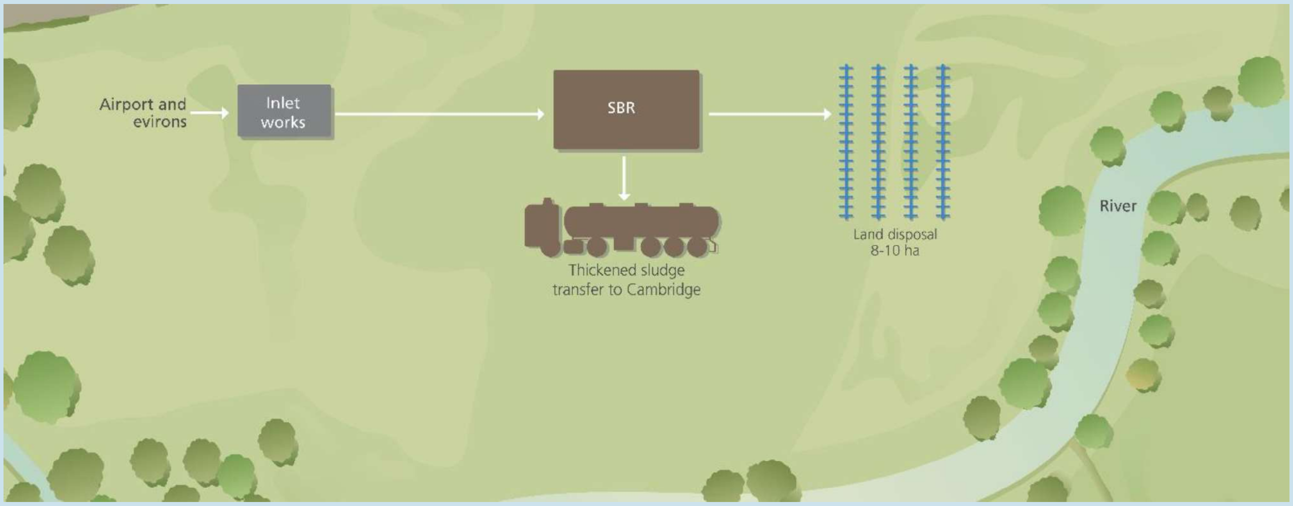
The strategy described above would require a **Stage 0**. Stage 0 would span from the present day until a Stage 1 lower flow threshold (nominally 400m^3/d for now but could be adjusted). The threshold would be determined to a certain extent by when Waipa DC and the users of the tankering facility, together with pending developments that need WW servicing determine that it is no longer logical or cost effective to continue with the tanker operation. As mentioned above, there is currently insufficient information available to the Metro WW team to make a more appropriate estimate of the Stage 1 lower flow threshold or the cost effectiveness of the existing operation. For stage 0 therefore, servicing will continue BAU for existing customers and, if the Metro preferred option is adopted, new airport precinct customers should be connected to and serviced via holding tank and tankering to Cambridge or Hamilton. Daily disposal to land volumes (preferably), which are normally telemetered to WRC, or water consumption (Ok but less accurate) of all customers in the precinct should be monitored carefully. This is so that a reasonable understanding is developed of the amount of wastewater effluent being discharged to ground in parallel to tankering and consequently the wastewater volume growth pattern also.

Option description

The potential staging and triggers for a southern treatment facility is provided below and in Figure 3-3,Figure 3-4 and Figure 3-5:

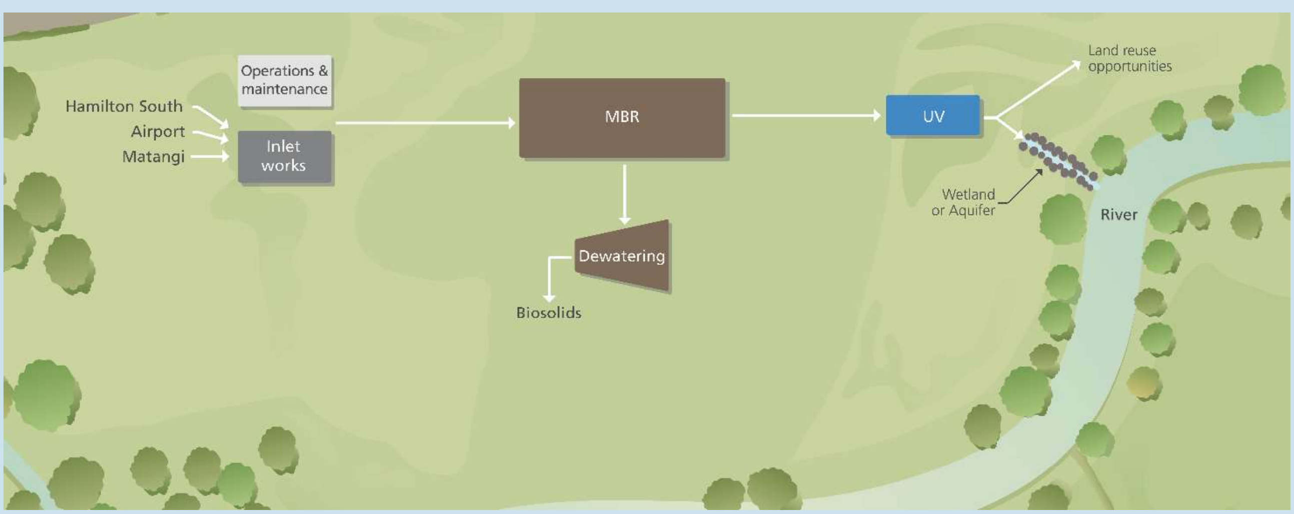
Table 3-3 Southern Treatment Concept Staging

Description	Starting flows	Issues, risks and Opportunities	High level Costs	Notes
		Southern WWTP – Stage 0		
Continue with existing arrangements – a mixture of on-site systems and holding tanks with transfer to Cambridge or Pukete WWTPs	<400 m^3/day minimum flow.	Fragmented approach and limits efficient development	Private cost	
		Southern WWTP – Stage 1		
Bespoke WWTP – SBR reactor with discharge to land (10-20 ha). Starting flow 400 m^3/day. Transfer thickened sludge to Cambridge WWTP	400m^3/day minimum flow. This is equivalent to 44 ha std industry or 66 ha light industrial land development or 2,000 PE	TN<8 g/m^3, land disposal likely to be required. Basic infrastructure only, limited operations facilities Land availability	$9 M *(excluding land purchase and conveyance costs to plant)*	Unlikely to be suitable scale for wet industry connections.

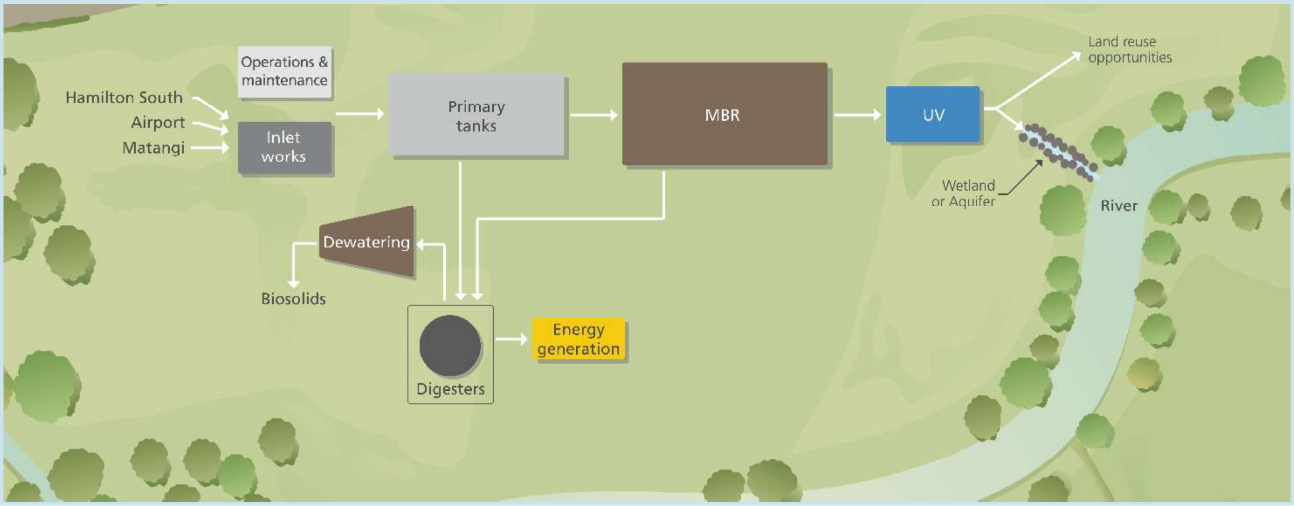


Southern WWTP – Stage 2

Description	Starting flows	Issues, risks and Opportunities	High level Costs	Notes
Covert SBR into MBR WWTP with discharge towater, Starting flow 1,000 m^3/day, upgradable to 8,000 m^3/day. Provide sludge processing facility and limited operator facilities.	150 ha light industry or 111 ha std industry allowance for 1,000 m^3/day. Or 10,000 PE	Consenting risk as new discharge, Limited spare capacity for wet industry initially. Potential to continue some discharge to land. Reuse structures where possible	$45M for 3,600 m^3/day capacity *(excluding land purchase and conveyance)*	Master plan site so easy to add on reactors as growth occurs.



Description	Starting flows	Issues, risks and Opportunities	High level Costs	Notes
		Southern WWTP – Stage 3		
Large scale MBR WWTP with discharge to water	Airport + additional flows from Hamilton 15,600 m^3 Or ~ 78,000 PE	Reuse structures where possible	$104M	



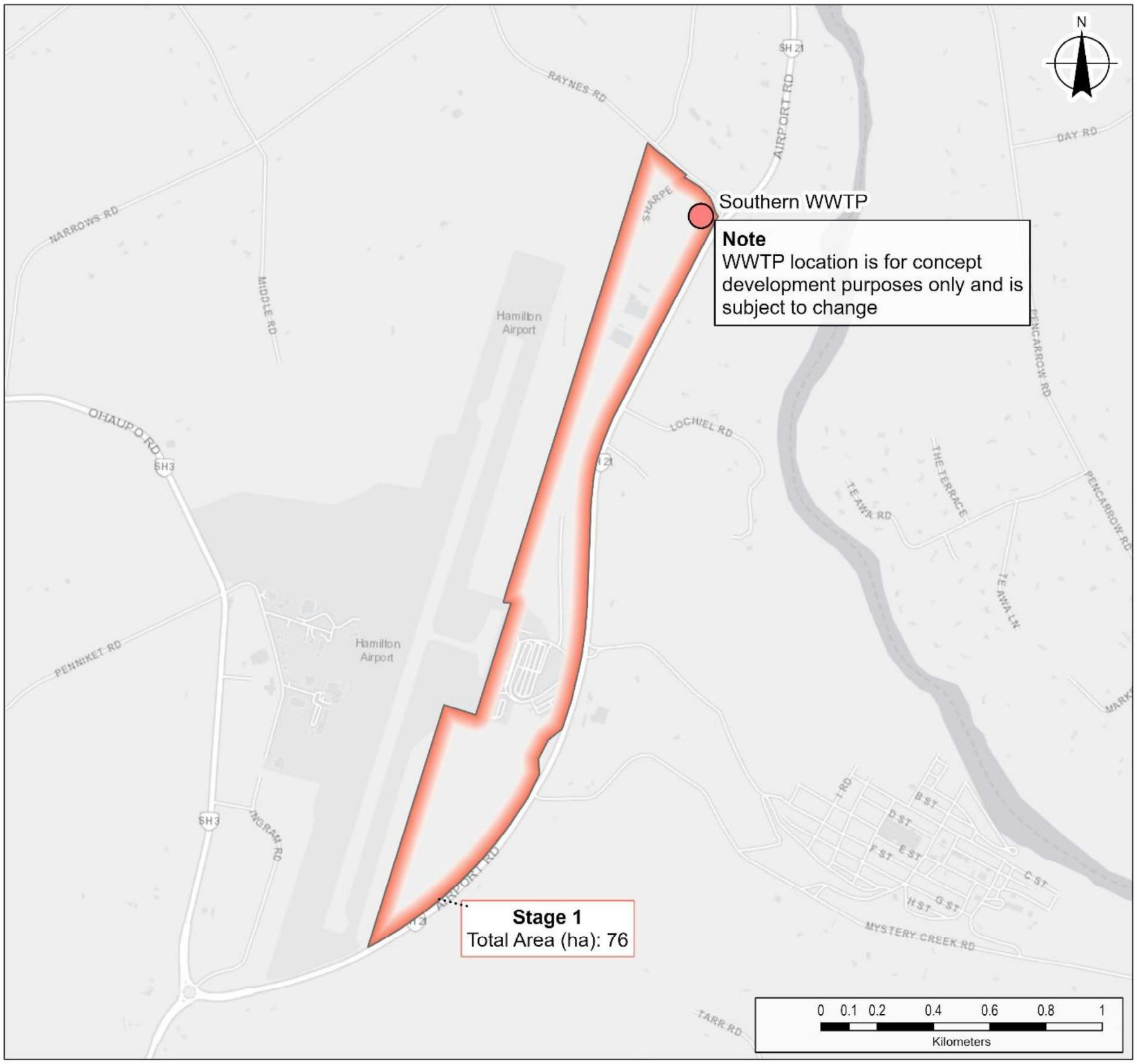


Figure 3-3 – Southern WWTP Stage 1 servicing area

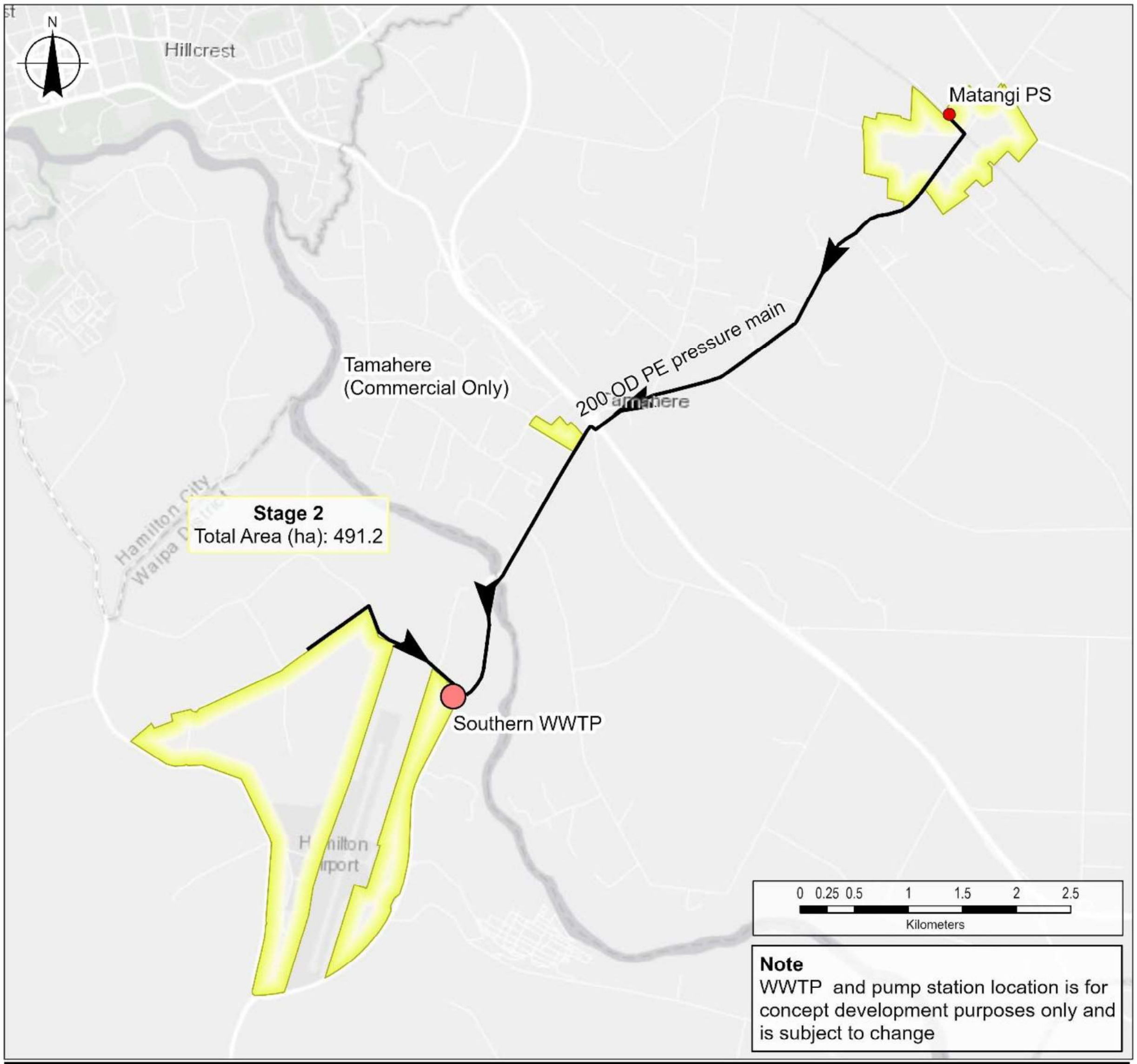


Figure 3-4 – Southern WWTP Stage 2 servicing area

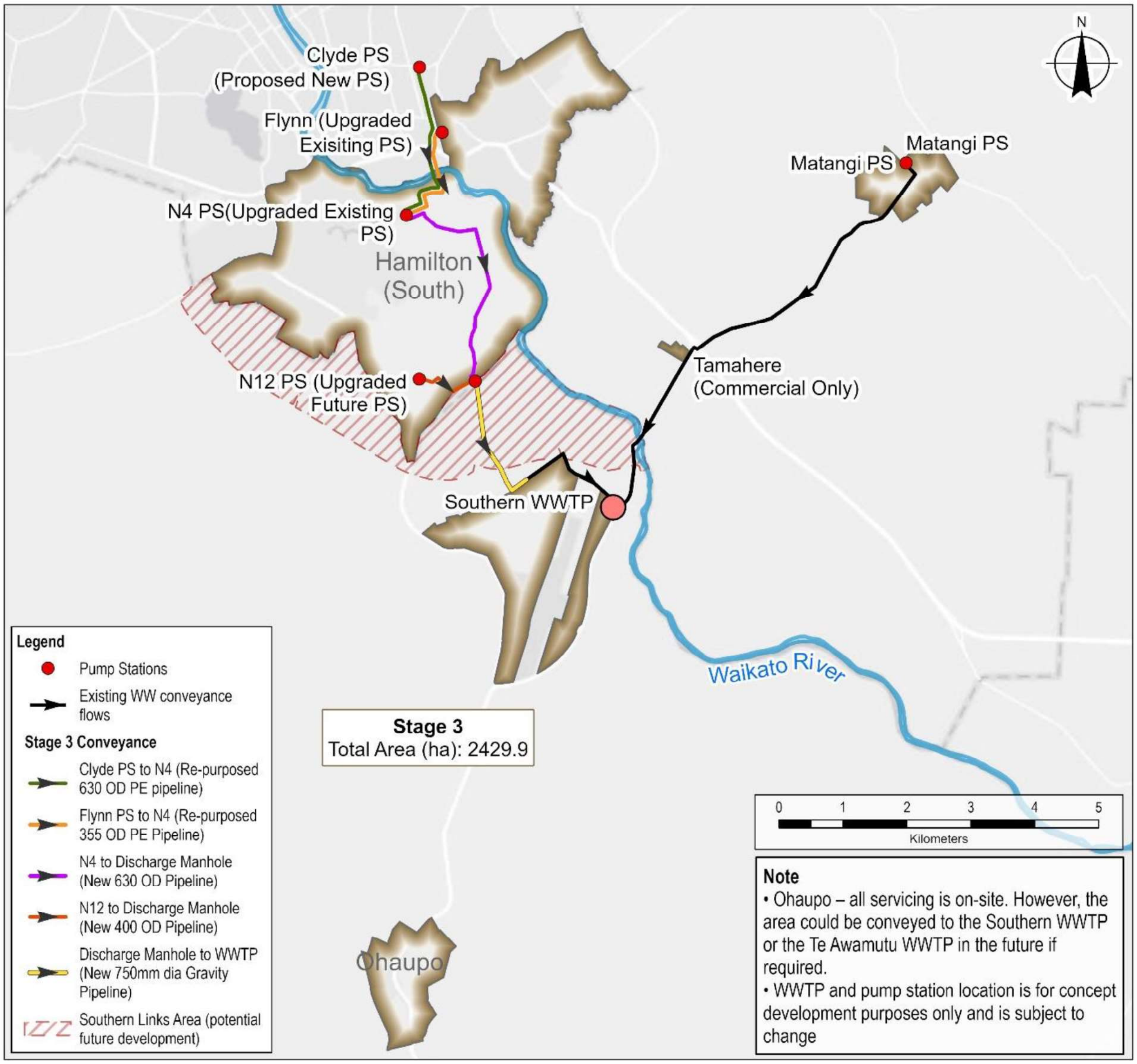


Figure 3-5 – Southern WWTP Stage 3 servicing area

For the Southern sub-regional WWTP Stage 2 to treat an average daily flow in 2061 of ~3,500 m^3/d to the nominated effluent quality, the following plant features are proposed:

- Inlet Works
- Secondary MBR process
- UV disinfection
- Screw Press dewatering

The process flow diagram (PFD) for the Stage 2 WWTP is shown in Figure 3-6.

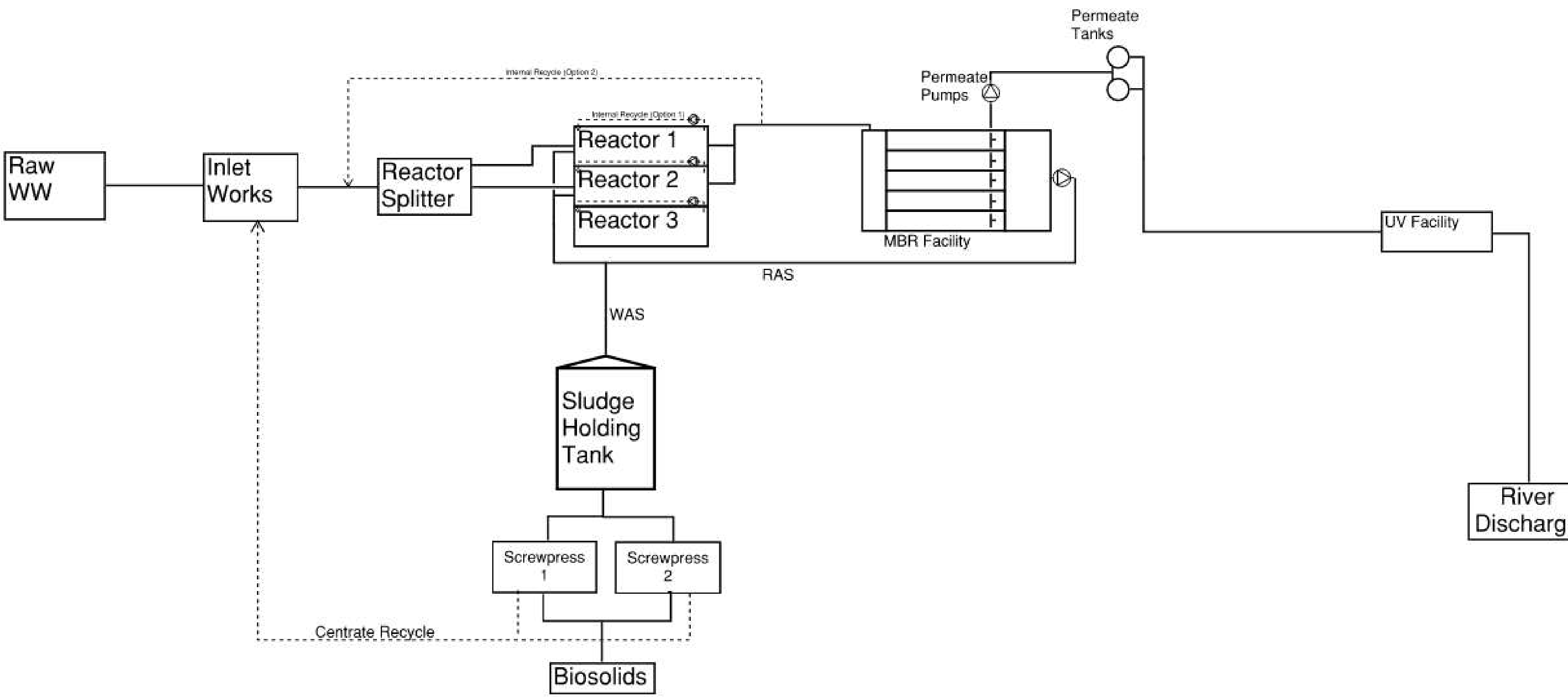


Figure 3-6 Southern Sub-regional WWTP Process Flow Diagram – Stage 2

Layout

The Stage 2 plant is expected to require an approx. 3 ha footprint. This does not include buffer areas for the WWTP. It is recommended that a site of minimum 15 ha is acquired. This will provide significant area for future uprating of the plant. In addition to this an area of approx. 200m around the site would need to have some restrictions to use.

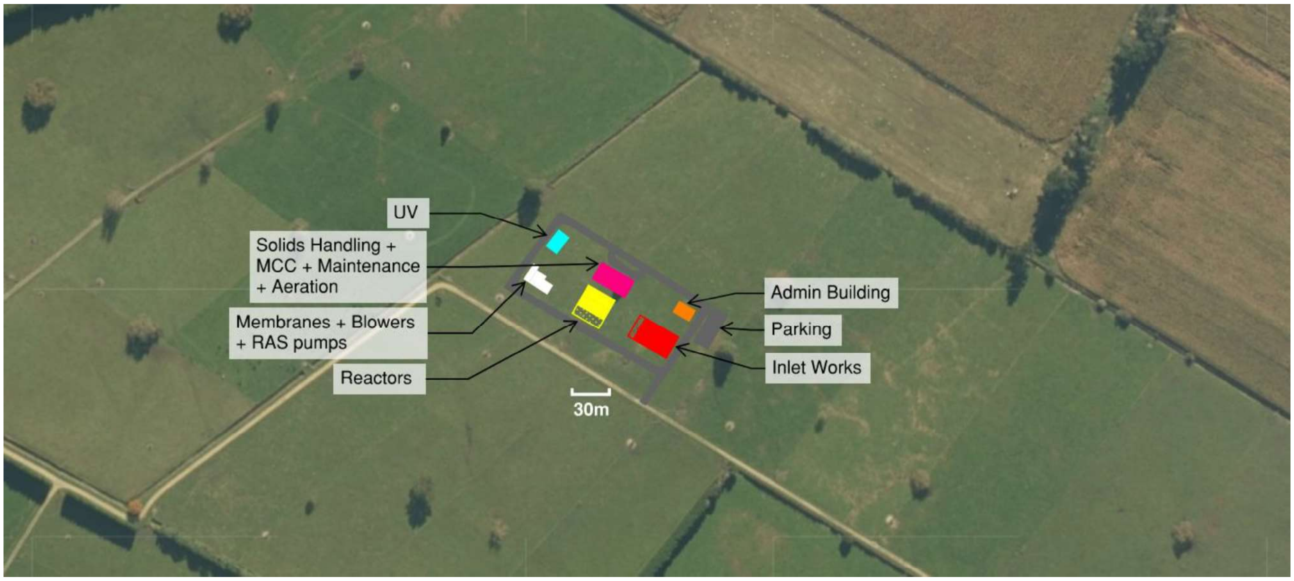


Figure 3-7 Southern WWTP (Stage 2) Example Layout

Staging

To determine process unit sizing and staging, a steady state activated sludge model (based on the ATV [8]standard guidelines) was used specifically to determine the bioreactor sizes for an effluent TN concentration of 4 mg/L and effluent TP concentration of 1mg/L.

The flows and associated loads were evaluated at each timeframe to estimate the major process units required over time as outlined in Table 3-4. A minimum of 2 screens and 2 reactors would likely be required at start up to provide a level of operational redundancy. A third reactor could be added in 2051 when wet industry is assumed to commence or when the area developed is sufficient to trigger this.

Table 3-4 Southern WWTP Process Units Over Time

	Size/Unit	2031	2041	2051	2061
Flow	MLD	0.8	1.2	3.6	3.6
Screens	100L/s	1	2	2	2
Reactors	800m³	1	2	3	3
Membrane Trains	50L/s	2	2	4	4
Biosolids volume @ 26%DS	m³/d	2	2	6	6

The above staging assumes the development of the Airport industrial precinct occurs by 2051 with 45 PE per hectare as an average wastewater generation level and 1,750 m^3/day of additional wet industry wastewater.

[8] Abwasser Technische. Vereinigung, the German standard guidelines for design of activated sludge WWTPs

Industrial activities have a wide range of wastewater generation rates and at this time, the timing of and nature of industrial development is currently unknown. The provision of significant capacity (approx. 50%) in advance of uncertain demand is a significant risk.

Issues and Risks

A new site offers the opportunity to masterplan a treatment facility to achieve the greatest operational efficiency and able to adapt quickly and easily to changes.

This WWTP is most sensitive to uncertainty and changes in demand and does not have a significant starting base flow other than the domestic waste from the existing airport terminal and the surrounding light industrial facilities.

As described for Stage 0 above, it is possible that the existing airport terminal and the light industrial facilities of Titanium Park and surrounds are already at the point where they require a revised solution to wastewater management rather than the current tankering operation and small on-site systems. Details of the mix, extent and cost of waste tankering have not been available at the time of writing of this report. If this is the case earlier action may be required.

Commencing the Southern WWTP at Stage 2

As part of the Preferred Option development, an alternative scenario of commencing the Southern WWTP (SWWTP) at Stage 2 was investigated. Based on the example sizing for SWWTP, this scenario targeted approximately 1,000 m^3/d as seed loading. This involved identifying the initial catchments in the south of Hamilton that could be diverted to provide sufficient demand to operate the SWWTP at Stage 2. This scenario is separate to that considered below in section 4.1 which was based around a more organic growth pattern across Hamilton and over a longer term. Information available on this concept is summarised in Appendix C.

These catchments are shown in the figure below and involve the following changes to the current wastewater network and proposed Peacocke wastewater network:

- Turn N12 pump station (700m^3/d) to face south and pump to SWWTP. Increase design flow from 80 to 172 l/s
- Divert N17 rising main to top end of N12 catchment. Increase design flow from 15 to 75 l/s
- Te Anau pump station (500 – 580 m^3/d) would move away from N4 pump station to N17 catchment
- Consider redirecting N8 away from N3 and across to SL4 – Probably a lower priority and later time frame
- Overall package reduces N4 catchment by approximately 53%. So make up flows are required to N4. But this also provides further opportunity to reduce the flow pressure on the western interceptor.
- Route Bruce Ave pump station to N4 pump station
- Consider if Splitt pump station should be routed to Bruce or Te Anau

In addition to diverting some proposed Peacocke and existing Hamilton South sub-catchments south, some Southern links sub-catchments could also be considered for early development, depending upon demand, with servicing by the SWWTP:

- SL2 and SL3/3a in figure 3-5 below, drained to a central pump station SL-PS1 then pumped via the Rukuhia Ridge to a gravity main draining into SWWTP
- SL4 draining by gravity to SWWTP
- A section pump station SL-PS2 pumping flows form SL5 & SL6 via SL4 or direct to a gravity main across the northern portion of the airport precinct. This would likely be a longer term proposition.

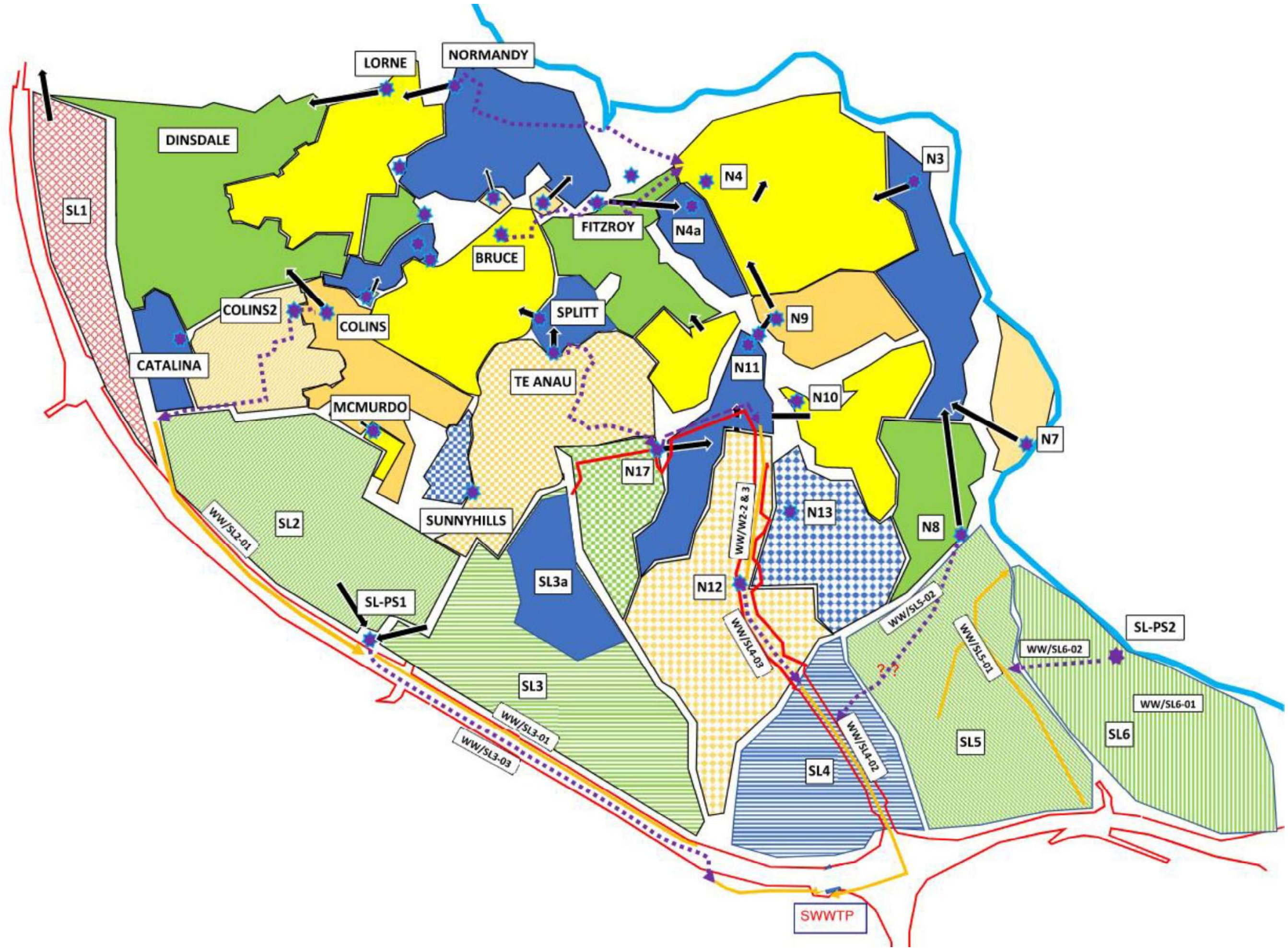


Figure 3-8: Potential Catchment Diversions to Southern WWTP for Stage 2

The benefits of commencing the Southern WWTP at Stage 2 includes:

- Makes funding for development of a long term facility for the south more certain if HCC take lead agency role
- More certainty for Waipa DC and WRAL that duplication of funding burden can be avoided
- Provides for early unlocking of additional development areas to and in the South West of Hamilton
- Provides for an alternative partial relief of capacity issues in the southern reach of the HCC Western Interceptor

The risks associated with commencing the Southern WWTP at Stage 2 include:

- Development to move the scheme beyond initial seed loading does not eventuate. Infrastructure, mechanical kit etc ends up being too large and rates income is not close to balancing funding and operational income
- Risk of inability to obtain consent to discharge to River for higher flows. However, this could also be an opportunity to link with consent processes for Pukete and Cambridge and to consider Cambridge to Ngaruawahia as a single Reach from a consenting perspective
- Risk that WRAL and partners reject proposal to buy into a new scheme up to 2km further away from the airport than they might have proposed if establishing their own facility
- Risk that stage 2 consenting and development period goes beyond what will be manageable for WRAL / WDC in the status quo operational mode. Insufficient information currently available to properly assess this

- Land availability. Will the crown be willing to part with the preferred land in the required time frame. Does the procurement process used by the crown allow the land to be on-sold for a different purpose?
- Sunk costs associated with Peacocke infrastructure installation
- Unknown extent of liability for developing other infrastructure required for the development areas that would be unlocked by the resulting alternative wastewater conveyance system
- Low flows in new pipes leading to septicity
- Geotechnical challenges with Rukuhia ridge (high pump head vs long HDD)
- Costs of additional / early trunk conveyance in the South West of Hamilton
- Complications with timing of funding for development of other Southern Links infrastructure, form and timing of transfer of SL areas into city management / control and timing of Waka Kotahi development of various lengths of the SL trunk roads. However, considering the soil type adjacent sub-catchments SL2 and SL3, a local purposes reserve strip is likely to be required for drainage etc independent of the SL Designation corridor.

3.5 Tauwhare Pa WWTP

Option description

The current WWTP at Tauwhare Pa is a package Innoflow system with recirculating textile filters, which discharges secondary treated wastewater to land. Soils in the area have reasonable drainage characteristics and there are limited opportunities for discharge to water.

There is uncertainty over the timing of flow increases likely to be generated at the Pa and potentially from Tauwhare Village. Based on average wastewater generation rates per household, a 55 m^3/day package secondary treatment plant has been sized with discharge to land. It is proposed to upgrade the WWTP by extending the current Innoflow system to provide additional capacity. The upgrade scale could be staged depending on the number of new households.

The plant is expected to require less than 1 ha footprint. An additional 2 ha would be required for land discharge (excluding buffer areas). Further land area would be required in future if provision is made for future servicing of Tauwhare village.

Staging

Staging would depend on the quantum and timing of development at Tauwhare Pa and availability of suitable land. This is indeterminant at this time.

Issues and Risks

Soil conditions and environmental effects associated with land discharge at this site will need to be investigated further.

3.6 Te Awamutu WWTP

Option description

To cater for increasing flows and loads and the requirement of the resource consent, Waipa District Council has recently commissioned ‘Stage 3’ of the planned upgrades to the capacity of Te Awamutu WWTP. The current resource consent requires the TN concentration in the treated wastewater to be 6.6 mg/L and TP of 3.3 mg/L (based on a TP load and expected flow).

The Stage 3 upgrade was principally required to deal with hydraulic issues and some additional biological load processing capability was provided for Waikeria prison flows and from Tokanui village. These two actions will complete the removal of human sourced point source discharges from the Puniu River (a tributary of the Waipa River). The Stage 4 upgrade is principally to deal with increasing biological loads from further development in and around Te Awamutu and Kihikihi with nutrient concentrations continuing as per the current consent. The timing of this upgrade will depend on growth but has been assumed to be between 2030 and 2040.

The plant and process concept selected for the ultimate development was arrived at using a combination of existing systems, process suitability considerations, a multi-criteria analysis and comparative cost estimates on key plant elements at the respective upgrade dates.

The plant and process concept selected is based on two 20m diameter circular secondary clarifiers (the existing (2003) is 20m diameter) and a two train, 5 Stage Bardenpho (or equivalent – the existing (2003) is a Modified UCT process) enhanced biological phosphorus (EBPR) removal, activated sludge plant.

The Stage 4 upgrade proposed includes:

- New Activated sludge reactors (ASRs) configured for biological nitrogen and enhanced biological phosphorus removal (EBPR) including:
    - Anaerobic, anoxic and aerobic ASR cells
    - Anoxic and anaerobic zone mixing
    - Blowers and diffused aeration system.
    - Internal recycle pumps
- New Inlet works mounted on top of ASRs
    - Re-purpose PSN30 to assist with raw sewage lift duties.
    - 3mm perforated plate band screens and screenings compactor.
    - Vortex grit removal unit and grit classifier.
- New Return Activated Sludge (RAS) pumps.
- Decommission existing ASR reactor.

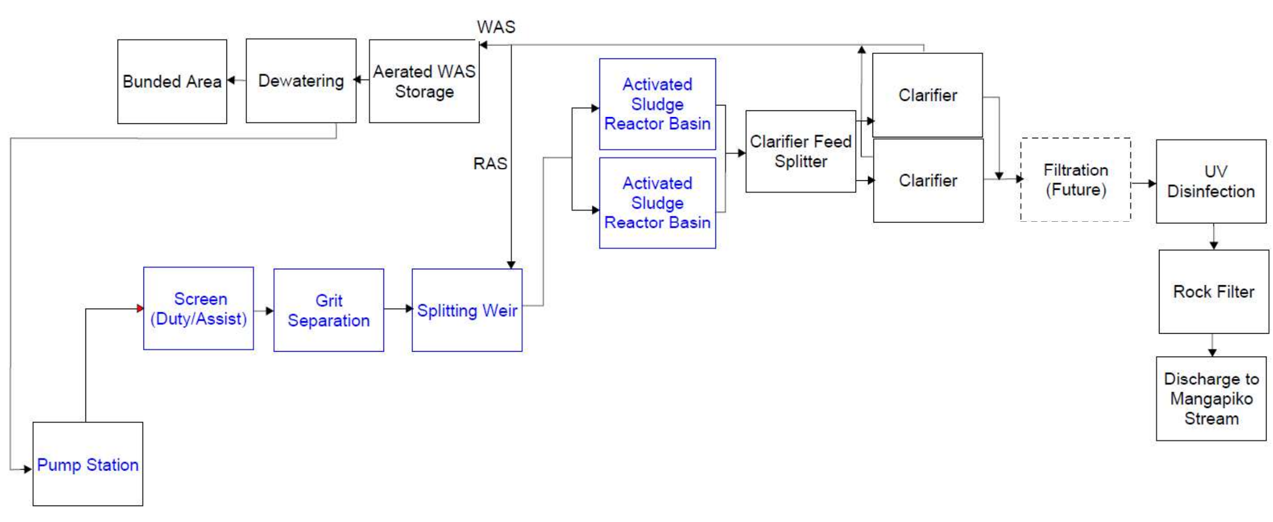


Figure 3-9: Concept Process Flow Diagram for the Te Awamutu WWTP Stage 4 upgrade

At the consent expiry date of 2044, it is expected that a further upgrade will need to be undertaken to reduce the nutrient levels discharged. This could involve retrofitting the clarifiers with membranes, introducing a side stream nitrogen removal process, offsetting or a combination of these. At this point it is assumed that the wastewater quality would meet the requirements outlined in the treatment assumptions – TN <4mg/L and TP <1 mg/L by 2044.

3.7 Matangi WWTP

Option description

The Matangi WWTP receives the liquid portion of household wastewater only, which is pumped by two small pump stations located on Matangi Road and Good Street. Once received, the wastewater undergoes treatment in two 55 m^3 septic tanks (total capacity 110 m^3), where solids settle, and the wastewater is screened by the outlet filter. The effluent then gravitates to a 55 m^3 recirculation tank and is then pumped to a 250 m^2 Recirculating Sand Contactor (RSC). The RSC comprises of sand media and naturally occurring micro-organisms to reduce solids, organic matter and nutrients in the wastewater. Because of the ideal environmental conditions on sand media, nitrifying microorganisms can grow and therefore convert part of ammonia in the wastewater to nitrates.

After receiving treatment in the RSC, the wastewater then gravity feeds back to a recirculation/splitter ball float valve installed on the top of the recirculation tank that will direct the treated wastewater either down into the recirculation tank for another pass over the RSC or across to the treated wastewater pump tank. Final treated wastewater is then pumped out for sequential disposal to the disposal zones.

High wet weather flows and diurnal peak flows are balanced by two flow balancing tanks (with a total capacity of 60 m^3 (30 m^3 each)). A high-level discharge pump is installed in the recirculation tank to manage high recirculation flows. When the balancing tanks are full, the flow is discharged to the bypass Disposal trench.

A schematic diagram of Matangi WWTP is provided in Figure 3-10.

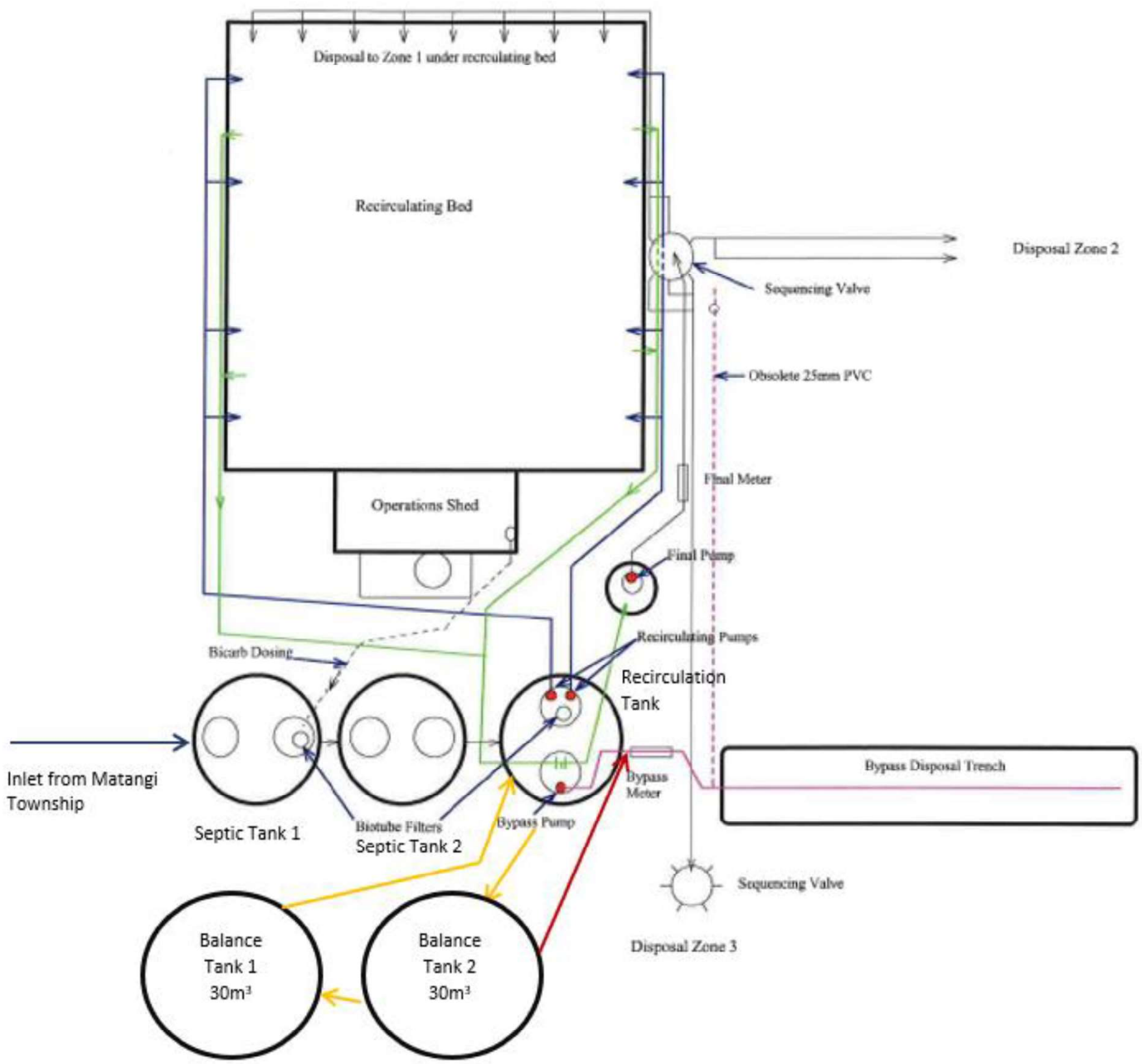


Figure 3-10 Matangi WWTP process schematics

The Matangi WWTP discharge consent has expired and is operating under section 124 of the Resource Management Act until a decision is made on the new application for discharge of wastewater to land. A Matangi WWTP technical assessment was completed in April 2021 to inform what improvements in the network and WWTP are likely to be required to obtain resource consent for a term of 15-20 years. Key conclusions of this assessment to date are as follows:

- Limited information is available on the current WWTP incoming flows and treatment performance
- The wastewater network seems to be in poor condition (suspected infiltration via private septic tanks) – an I&I investigation is needed to address this as there is uncertainty regarding current and future incoming wastewater flows
- The disposal field is under-sized and experiences surface ponding in winter
- Downgradient groundwater monitoring has shown nitrate-N and faecal coliforms are generally low and similar to background concentrations, but there are occasional higher concentrations detected, which are potentially related to the treated wastewater discharge

- The treatment plant hydraulic capacity is restricted to up to 40 m^3/d and is below original design capacity. Minor operational changes are required to increase hydraulic capacity.

The key improvements planned to be implemented to obtain consent for the medium term (15-20 years) were:

- Reduce infiltration and inflow in the private septic tanks and network
- Optimise the existing treatment process to reduce TN levels (consistent with the treatment assumption relating to discharge to land for this DBC)
- Assess condition of the discharge system and repair or supplement with additional storage, sub-surface drip irrigation system area or convert all or part of the irrigation system into a trench irrigation system.
- Consider UV disinfection

Approaching the expiry date of the next resource consent (assumed to be around 2040), it is expected that the Matangi wastewater would be transferred to the new Southern WWTP or the Hamilton wastewater network. To mitigate the risk of long retention times in the pipe network, the commercial area in Matangi and the remainder of the small sections in the village should be connected to the public wastewater network. A rising main to the Southern WWTP would likely pass through or adjacent to the Tamahere commercial 'Hub'. The pipe would facilitate wastewater servicing of the 'Hub' and the inclusion of those flows would assist in mitigating the risk of long retention times in the pipeline. Should more dense residential or commercial development occur in Matangi prior to 2040 (e.g. private plan change), the timing of the pipework installation could be reviewed.

4 Conveyance

4.1 Conveyance assumptions

4.1.1 General conveyance assumptions

The Regional Infrastructure Technical Specification (RITS) sets out design specifications for constructing transportation, water supply, wastewater, stormwater and landscaping infrastructure in the Waikato Local Authority Shared Services (WLASS) participating councils' areas[9].

The RITS guidance for wastewater infrastructure has been used together with average daily flow (ADF) data to inform the conveyance assumptions of the Metro Wastewater DBC shortlisted options. 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, which results in PDF and PWWF values that are approximately 5-10xADF and 10-20xADF respectively.

Recent catchment ADF data provided by the Councils was considered, for comparison. The peak flows calculated using RITS were found to be significantly higher than those that would be expected if developed using a typical infrastructure methodology. 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 correlate with flow data more accurately for the current scenarios and then scaled to future design horizons using predicted growth numbers. 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. This led to peaking factors that were significantly smaller than those calculated under RITS, averaging 5xADF for PDF and 10xADF for PWWF. Note – these revised estimates for Conveyance Peak Flow are representative of actual flow data, these differ from the RITS calculations which can provide overly conservative flow rates for large catchments.

For all areas with a Population Equivalent <10,000, the RITS calculations were used verbatim to calculate the PDF and PWWF.

In order to develop the preferred option, the following assumptions have been made in regard to the conveyance routes as described in Section 4.2.

- The sub-regional southern WWTP will be located north of Hamilton airport
- It is assumed that the Airport area will be responsible for providing its own local reticulation to the new plant and have therefore these elements not been included in the conveyance design
- Conveyance routes from communities to the southern plant, will follow public road corridors wherever practical
- The most direct route practical has been used
- All pipelines will pump directly to the wastewater treatment plant (i.e. no discharge into existing interceptor sewers, as capacity is unknown). This is conservative and can be refined during design development
- Daisy-chaining of pump stations has been avoided. This approach can be refined during design development

[9] WLASS, 2021. *Regional Infrastructure Technical Specifications (RITS).* Retrieved 11 Feb 2021, from https://waikatolass.co.nz/shared-services/regional-infrastructure-technical-specifications/

- 2061 agreed as basis of cost estimating, and pipe sizes do not increase significantly over time
- 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
- 2061 agreed as basis of cost estimating. Sizing of infrastructure to service growth beyond this timeframe would be subject to great uncertainty and has not been undertaken
- Staging of pipelines has not been considered in detail at this stage. Where multiple pipes may be 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, pipe sizes do not increase significantly over time. It is expected that further work will be undertaken during design to refine flow rates and pipe sizing, including consideration of operational storage, flushing regimes, chemical dosing requirements and high-head pump arrangements.
- 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.

4.1.2 Route specific assumptions

A range of specific conveyance assumptions have been made for the routes as described below.

Matangi to Southern WWTP:

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.

South Hamilton to Southern WWTP

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.

Flows from the overall gravity catchment served by the N4 and N12 pump stations are split 50/50 between the two pump stations, i.e. 155 L/s each. 155 L/s of gravity flow from local catchment is included in N4 PWWF (578 L/s).

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 associated with the proposed assets. Flows from the N4 catchment will only be pumped once, rather than twice, and the N12 pump station is significantly smaller than it would be if it also had to lift flows from N4 (which gravitate directly to the WWTP under the preferred option). Reduced energy usage should result in reduced operation 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 and flows from southern links.

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[10].

The network configuration assumed for concept design is illustrated Figure 4-1.

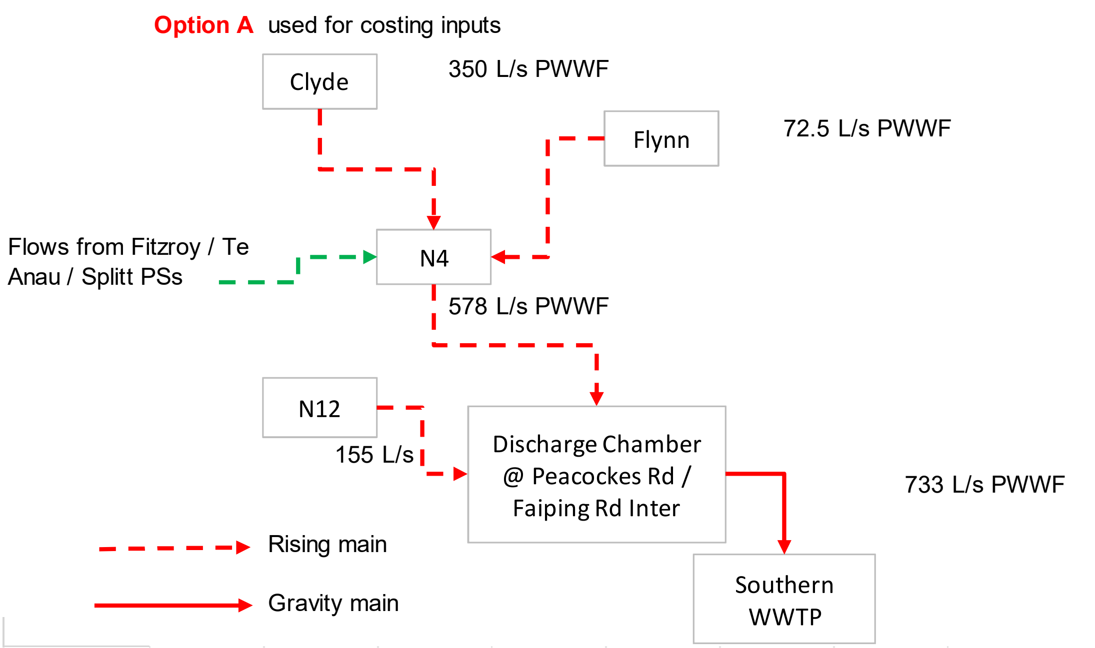


Figure 4-1 Southern Hamilton Re-direction Schematic

[10] Catchment flows were provided by Stepanka Vajlikova (AECOM) via Manjit Devgun (HCC) on 9th December 2020.

4.2 Pipeline Alignments

Key details for the pipelines described below are included in the Concept Design Summary Table in Section 4.3.

The route alignment of the rising main pipeline between a new Clyde pump station and the N4 pump station (designed by others, currently in implementation phase) is illustrated below. The elevation profile starts at Clyde pump station.

Figure 4-2 Route Sketch – Clyde to N4

The route alignment for the rising main pipeline between an upgraded Flynn pump station and the N4 pump station (currently at tender) is illustrated below. The elevation profile starts at Flynn pump station.

Figure 4-3 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 4-4. The elevation profile starts at N4 pump station. The alignment follows existing road corridors

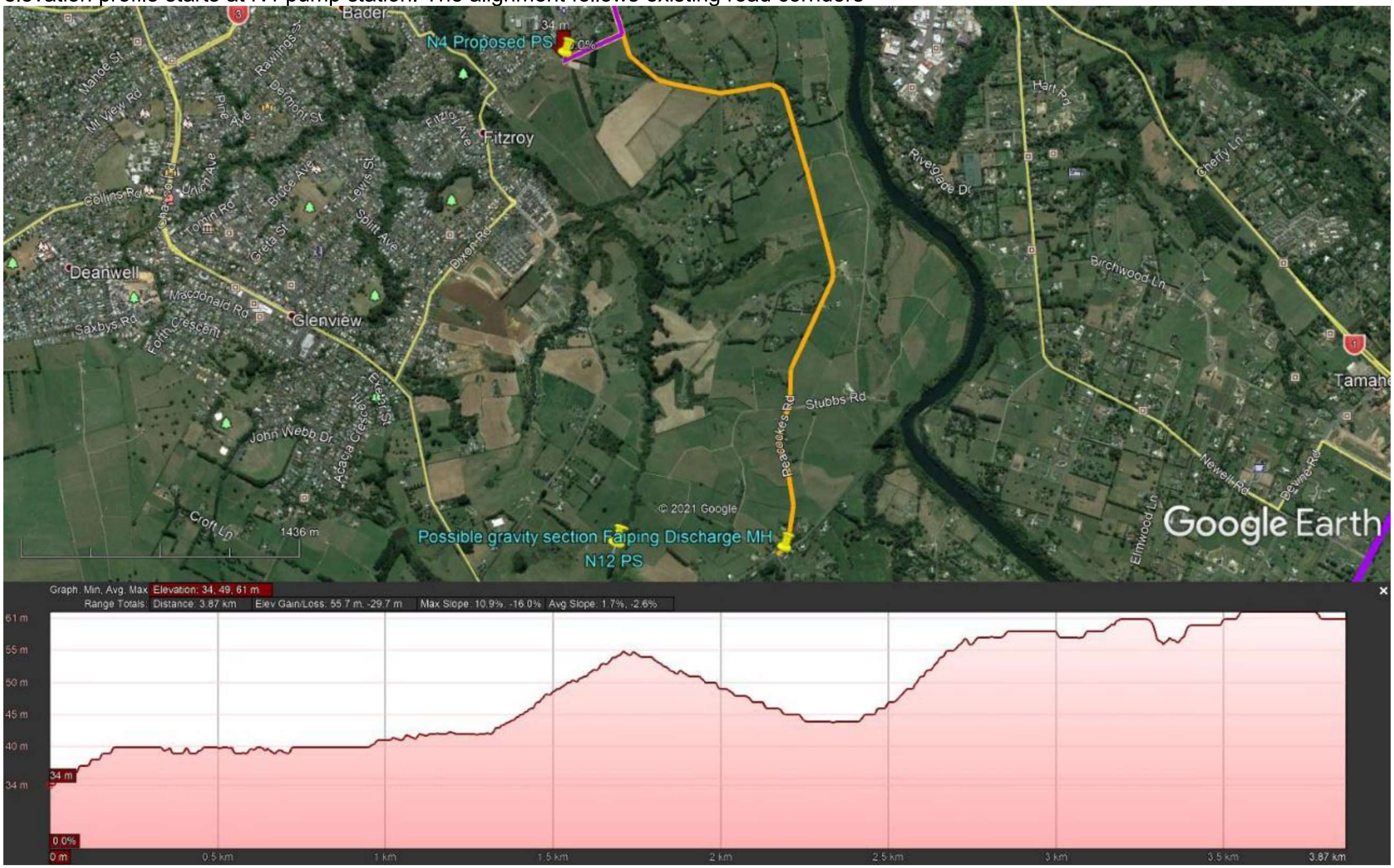


Figure 4-4 Route Sketch – N4 to Discharge Chamber

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 4-5. The elevation profile starts at N12 pump station.

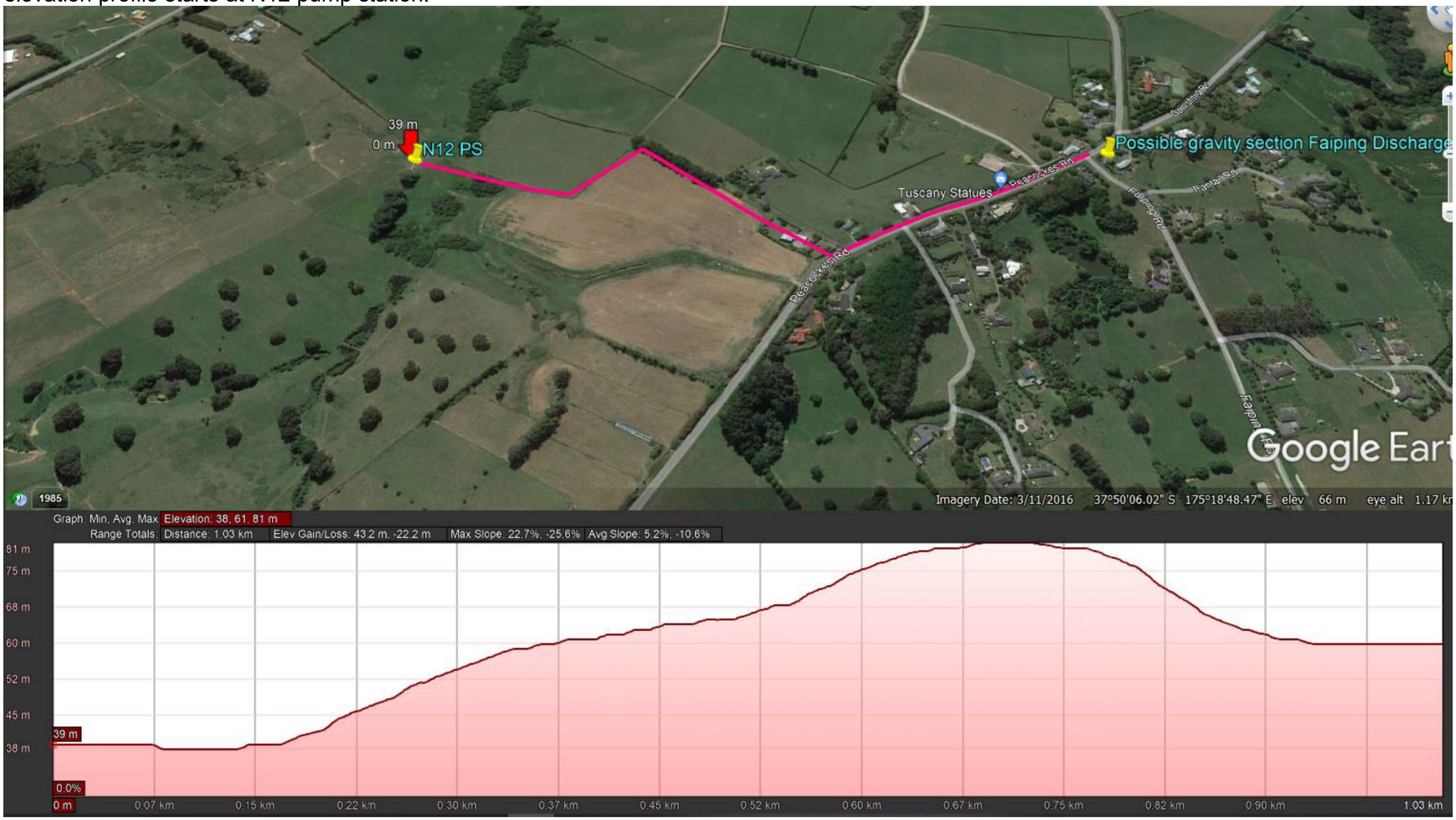


Figure 4-5 Route Sketch – N12 to Discharge Chamber

The route alignment selected for the gravity sewer between the Faiping Road discharge chamber and the Southern WWTP is illustrated in Figure 4-6.

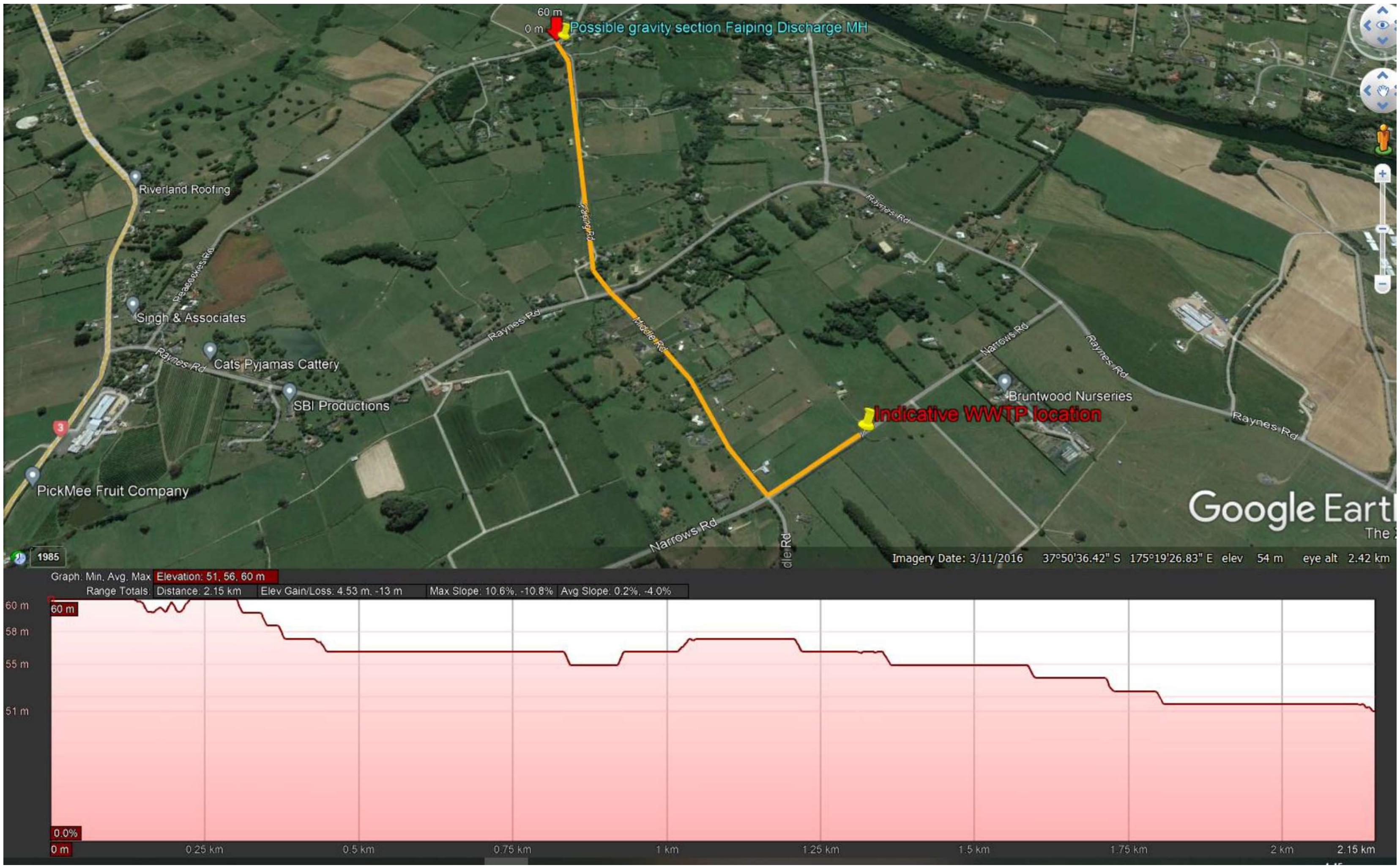


Figure 4-6 Route Sketch – Discharge Chamber to Southern WWTP

The route alignment selected for the rising main pipeline between Matangi and the proposed Southern WWTP is illustrated in Figure 4-7. The elevation profile starts at Matangi.

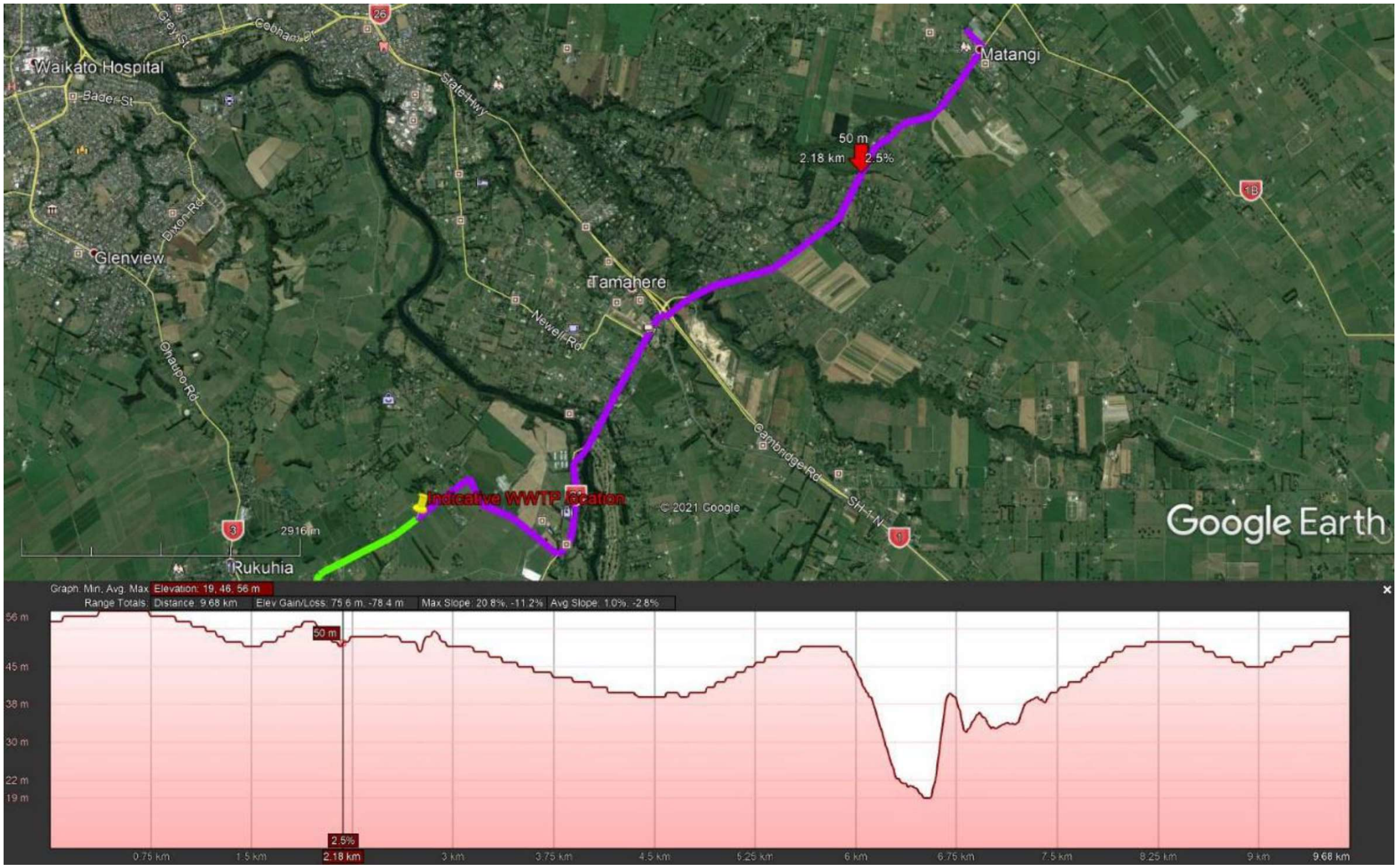


Figure 4-7 Route Sketch – Matangi to Southern WWTP (purple line

4.3 Concept Design

Concept design of the pump stations and pipelines associated with the 2061 design horizon is documented in Table 4-1.

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 4-1 Preferred Option 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)	Note: Matangi cannot feasibly be pumped in 2021. DN200 pipe can be made from 2xDN160 (additional DN160 in 2051)
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

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
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 second stage – complex PS	Peacocke Pump Station may need to be upgraded to suit	210 (20% of total catchment)	Twin rising mains to the Faiping gravity section
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)	Alternative RM Installation options to avoid HP
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

5 Risks

5.1 Technical Risk Summary

The key technical risks and suggested mitigation actions are summarised in Table 5-1. The Consenting Strategy also outlines risks specific to the consenting process and other risks relating to land availability and management matters are covered in the management case section of the DBC.

Table 5-1 Technical Risk Summary

Risk Area	Description	Cause	Consequences	Mitigation measures
Change in rate of growth	Lack of or excess WWTP/network capacity	Change in rate of growth compared to assumptions	Limits growth (need to accelerate future stages) or financial burden of underutilized assets	Regular reviews of actual growth and development plan submissions. Flexibility in process unit sizing at WWTPs. Generous sizing and master planning of pipelines/sites
Change in wastewater composition	Lack of or excess WWTP capacity	Change in wastewater composition compared to assumptions	Limits growth (need to accelerate future stages) or financial burden of underutilized assets	Regular reviews of actual characterization of wastes (flow & load) Flexibility in process unit sizing. Generous sizing and master planning of sites
Biosolids	Limited options for biosolids reuse/disposal	No coordinated approach to Biosolids reuse/disposal. Research around emerging contaminants such as hormonal compounds, pharmaceuticals and micro-plastics leads to widespread rejection.	Increased operating cost, lost opportunities for resource recovery. Increased greenhouse gas emissions	Plan to minimise biosolids mass to be removed from site Treatment process operation to maximise destruction of harmful organics. Remain adaptable to treatment methods that improve Biosolids quality
Construction market	Increased capital cost (no commercial tension)	Saturated construction market, lack of resource available	Increased cost, delays to project implementation	Early market engagement with attractively configured packages of work. This can be attractive small packages and large packages and those with a narrow scope that suit certain specialist contractors.
Ground conditions	More extensive ground improvements required	Poor ground conditions. Liquefaction potential	Increased capital costs	Early investigation of likely sites. Well before concept design and before it is too late to change site or alter plant configuration. Ideally should be done as part of due diligence for land acquisition and easements

Risk Area	Description	Cause	Consequences	Mitigation measures
Greenhouse gas emissions	Increased cost of energy, chemicals and biosolids disposal	Typically, GHG emissions have largely been given lip service in comparison to other effects of an activity. Change in zero carbon legislation/targets (introduction of carbon taxes/levies) Liquid and solids discharges concerns 'trump' concerns around greenhouse gas emissions. Reluctance to invest in energy recovery technology.	Increased capital costs and operating costs Increased rather than decreased GHG emissions over what is a readily achievable 'Baseline'.	Develop a sound, useable and agreeable methodology for comparing the relative effects of whole of life cost, atmospheric emissions, emissions to water and emissions to land. The effects compared need to include those of Cultural, Western Science, Social and economic
Site Layout	Inefficient site development	Limited or poor master planning of WWTP sites	Limits population that can be served. Increased cost, H&S issues	Certainty around potential development areas & types Adequate resourcing of Master Planning process and subsequent reviews
Conveyance corridors	Pipeline routes take time to secure	Some or all conveyance corridors secured (to WWTP and from WWTP to river)	Time delay to projects	Cooperative, 'give and take' approach to landowner relationships and negotiations

6 Nutrient Summary

6.1 Baseline Nutrient Loads

Calculation and comparison of future predicted nutrient loads against the baseline nutrient loads for existing treated wastewater discharges in the metro area is required to analyse whether the proposed level of wastewater treatment and associated discharges will meet the various policy and statutory requirements around improving water quality.

Historical nutrient loads for the past five years were analysed from the treated wastewater discharge data for WWTPs in the metro area (including: Pukete, Cambridge, Te Awamutu, Ngaruawahia, Matangi, Tauwhare Pa and Te Kowhai) in order to select the most appropriate baseline dataset. Average nutrient loads were calculated for each WWTP by multiplying the average monthly treated wastewater flow with average monthly TN and TP concentrations in the treated wastewater based on the available monitoring records (see Table 1 below).

Table 6-1 : Annual Average Baseline nutrient loads for wastewater discharges in the metro area

Nutrient loads	TN (kg/day)			TP (kg/day)		
	To river	To land	Total load [a]	To river	To land	Total load [a]
Ngaruawahia WWTP	20	-	20	0.8	-	0.8
Pukete Northern Sub-Regional WWTP [b]	596	< 1	596	49	< 1	49
Tauwhare WWTP	-	< 1	< 1	-	< 1	< 1
Cambridge WWTP	244	-	244	19	-	19
Southern Sub-Regional WWTP [c]	-	1	1	0	< 1	< 1
Te Awamutu WWTP [d]	74	-	74	18	-	18
Total (all Metro WWTPs)	**934**	**2**	**936**	**86**	**< 1**	**87**

Notes: Northern Sub-Regional includes Te Kowhai, Southern Sub-Regional includes Matangi and Ohaupo

6.2 Future Nutrient Levels

For the purposes of the Metro DBC, it has been agreed that an assumption around high levels of treatment at the WWTPs in the metro area is appropriate. The following treatment standards have been adopted for this assessment (annual means):

- 4 mg/L Total Nitrogen (TN)
- 1 mg/L or 0.5 mg/L Total Phosphorus (TP)

However, as the Te Awamutu WWTP has an existing discharge consent in place, the consented treatment standards of 6.6 mg/L TN and 3.3 mg/L TP (converted from mass load equivalents in the consent) have been used for the years 2031 and 2041 (till the expiry of the existing consent).

These treatment assumptions represent advanced wastewater treatment processes and biological nutrient removal with membranes operating toward the current limits of readily obtainable biological technology. Predicted future nutrient loads associated with these treatment standards are considered in the graphs below which allow for an increase in wastewater flows in line with growth. As a 1 mg/L TP treatment standard results in an exceedance against the baseline TP loads for the wider metro area, a 0.5 mg/L TP treatment standard was also considered.

Figure 6-1 shows a TP concentration of 0.5 mg/L would be required to reduce TP mass loads to below baseline levels beyond 2030 (approximately).

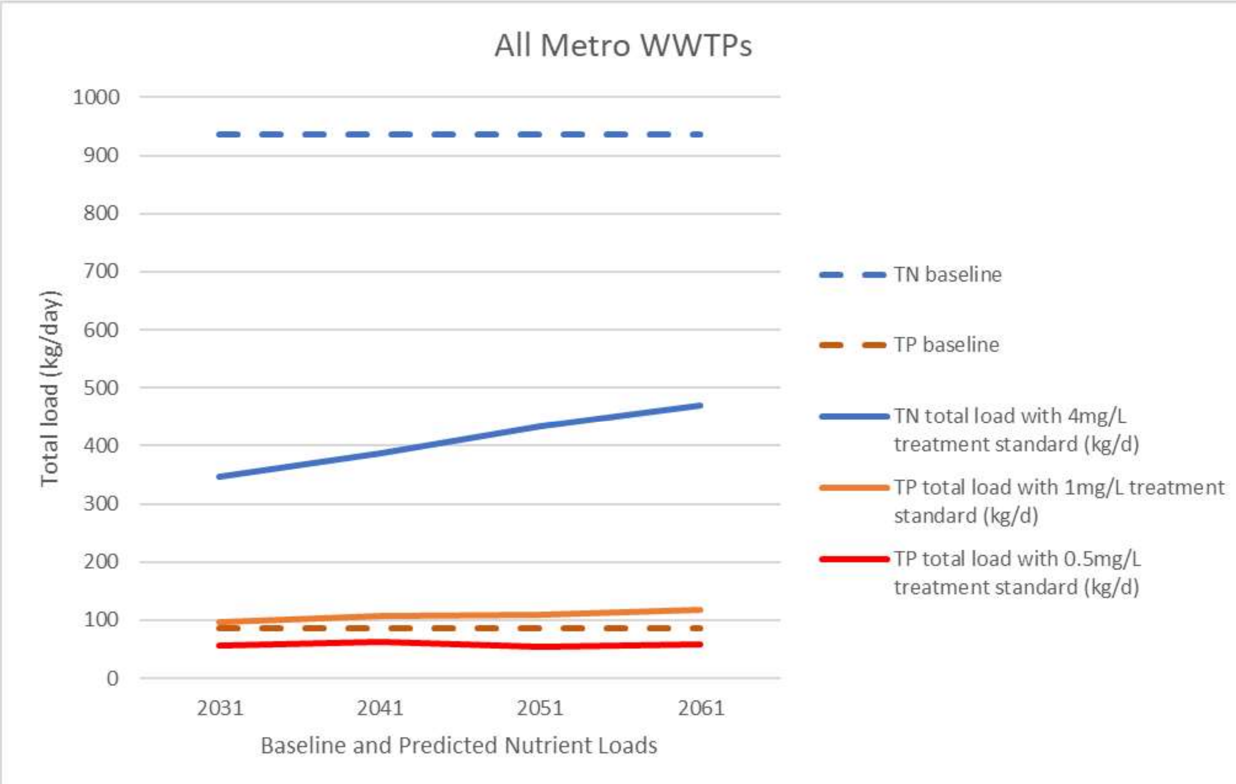


Figure 6-1 **:** Baseline and Predicted Nutrient Loads for the Entire Metro Area (excluding large independent industrials)

Southern Metro Nutrient Loads

Figure 6-2, Figure 6-3 and Figure 6-4 assess baseline and future nutrient loads for three scenarios:

1. Combined Cambridge and Southern Airport WWTP;
2. Cambridge WWTP standalone; and
3. Southern Airport WWTP standalone.

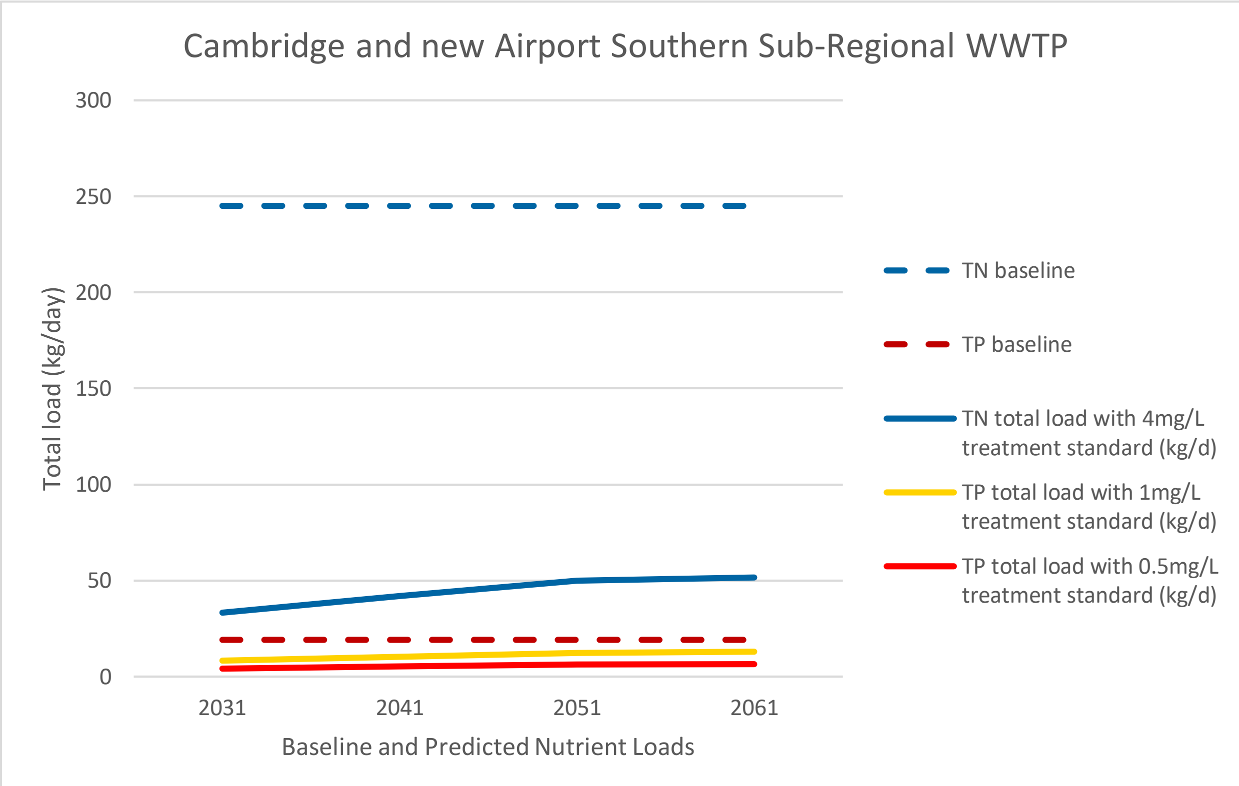


Figure 6-2 Baseline and Predicted Nutrient Loads for the Cambridge WWTP and Airport Southern Sub-Regional WWTP combined

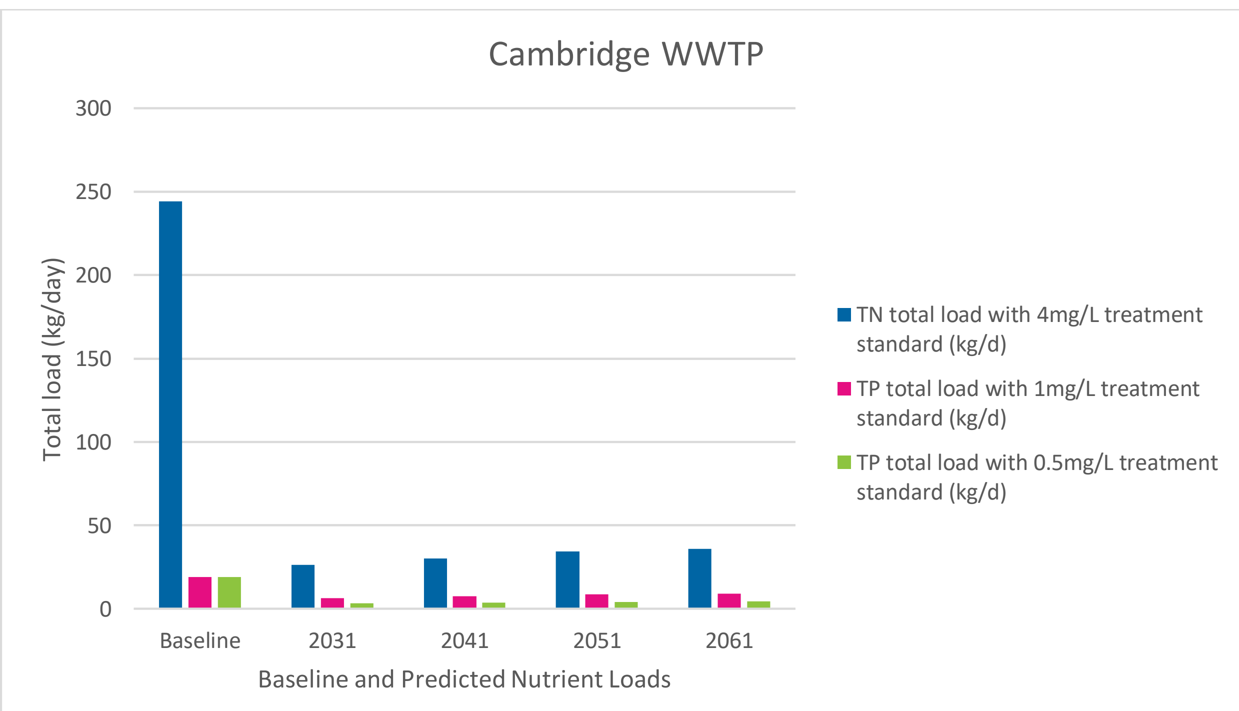


Figure 6-3 : Baseline and Predicted Nutrient Loads for the Cambridge WWTP

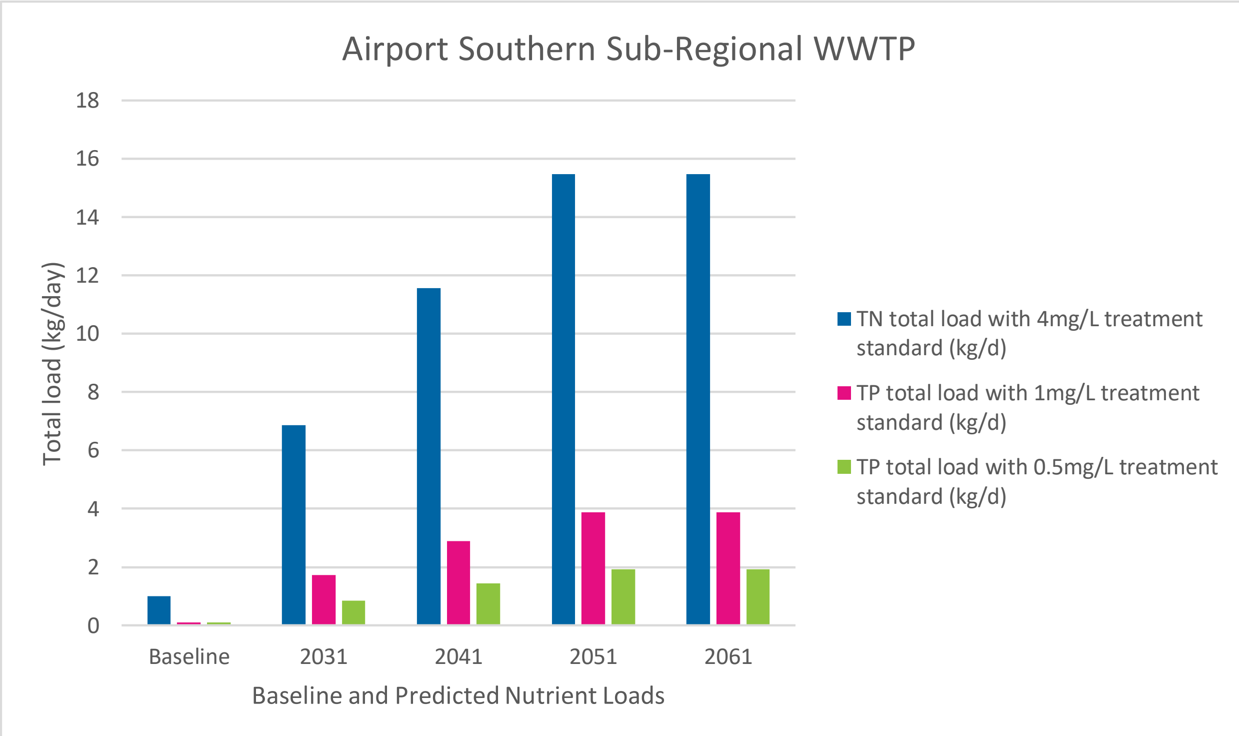


Figure 6-4 : Baseline and Predicted Nutrient Loads for the Airport Southern Sub-Regional WWTP

When all WWTP discharges are looked at together future nutrient loads are less than existing, even at the 1 mg/L TP concentration.

However, looked at in isolation, the proposed new Southern WWTP will exceed the TN and TP baseline in all treatment scenarios. This is because the new WWTP will be built in a greenfield growth area, where wastewater generated by the few existing industrial sites in the vicinity is currently trucked offsite (mostly to Cambridge WWTP) or discharged to land. Any growth in the area would be considered against a very low existing baseline if considered standalone.

If the new WWTP was not built, wastewater flows associated with the new growth area near the airport would need to be directed to either Cambridge WWTP or treated on-site. From a nutrient mass load perspective, it is therefore appropriate to consider the new Southern Sub-Regional WWTP and the Cambridge WWTP together. This approach also provides a more integrated assessment of catchment activities.

In addition to employing a high performance standard, investment in restoration may also be required to deliver “betterment” of the Waikato river. This could be achieved in a number of ways, including by planting erosion prone land and undertaking riparian planting.

If the Cambridge WWTP and the new Southern Sub-Regional WWTP are not considered together for consenting purposes, then offsetting would likely be required when consenting the discharges from new Southern Sub-Regional WWTP, as it has very low nutrient mass load baselines for TN and TP.

7 Sustainability

7.1 Energy

It is possible for wastewater treatment plants to be energy neutral, or even produce more energy than they require. This is not necessarily possible at all sizes as the influence of fixed power requirements or minimum sized machines becomes more pronounced as the plant size decreases. There are not known to be any energy neutral WWTPs in New Zealand at this time, although Watercare has set this as an objective that the Mangere and Rosedale WWTPs be energy neutral by 2025.

The heart of the energy efficiency system is the anaerobic digestion process. This process has typically not been incorporated into New Zealand WWTPs below population equivalents of about 40,000 (or 8,000 m^3/day inflow). Biogas is collected from the Pukete WWTP digesters but currently its quality, quantity, and use are not optimised. Areas to focus on for optimising energy efficiency should include:

- Optimising digester mixing and capacity use
- Biogas collection and storage.
- Scrubbing (remove H_2O, H_2S, CO_2, siloxanes, other contaminants).
- Use of all gas in a co-generation facility, in boilers or other heating systems, or compressed and used in a vehicle fleet.
- Optimising co-gen machine sizing

Other measures for best practice energy efficiency include:

- Machines with high electro-mechanical efficiency such as turbo blowers (Te Maunga WWTP – Tauranga City Council)
- Machines with low power alternatives such as screw presses instead of centrifuges (New Plymouth and Te Maunga WWTPs).
- Instrument driven, precise aeration control (Luggage Point – Brisbane).
- Diffused rather than surface aeration (Pukete WWTP).
- High efficiency panel diffusers with efficiency c0.7%/m of bubble rise cf 0.5 – 0.6 for conventional or tube diffusers.
- Importation of raw, high calorific value substrate to augment digester feed and biogas production. This is very common in British Columbia (e.g Anasis Is WWTP) and is being considered for several sites in NZ e.g Palmerston North.

Contemporary **energy saving enhancements** now include:

- Side stream ‘shortcut’ nitrogen removal processes on the digester returns stream, e.g. Anammox. This saves much of the energy used in a conventional nitrification process by the bacteria converting ammonia into inert nitrogen without the need for any organics being added, and without any biological Nox emissions being generated. This technology has become ‘mainstream’ in the USA and Europe just within the past 5 years. Watercare is currently planning for implementation of side-stream Anammox at its Mangere WWTP.
- Membrane Aerated Bio-Reactor (MABR) is a new technology which can be used in conjunction with membranes for solid/liquid separation with at least two commercial providers represented in New Zealand. Membranes are submerged in the mixed liquors and oxygen is diffused out through the membranes to support nitrifying biomass growth on the outside of the membrane. Much energy (c25%) is saved because the process relies on intimate contact between the oxygen molecules and bacteria rather than comparatively large bubbles being generated to rise through the water column to transfer oxygen to bacteria that they randomly contact.

7.2 Carbon Footprint

The Zero Carbon Act 2020 will encourage all councils to focus on reducing the carbon emissions from activities they undertake on behalf of their communities.

Emissions improvements are typically available in these areas:

- Selecting materials and methods of construction, at the time of design, that minimise the capital phase emissions profile.
- Selecting mechanical equipment and control systems, at the time of design, that minimise the operational phase emissions profile. Key examples are air diffusion efficiency and control of the nitrification / denitrification processes to minimise the emission of N_2O gas which has a GHG potency some 300 times that of CO_2.
- Reuse rather than flaring of biogas.
- Reducing the mass of wet sludge transported by bringing forward installation/sludge treatment capacity of a solar sludge dryer, which would considerably reduce the weight of water taken to landfill.
- Minimising the use of chemicals in the treatment and hence their associated, embedded carbon.
- Reduce distance travelled for sludge disposal.
- Alternative transportation fuel (biomethane or electric vehicles instead of diesel).

7.3 Contaminants of Emerging Concern (CECs)

The term 'Contaminants of Emerging Concern' (CECs) refers to many different chemicals including pharmaceuticals, personal care products, micro-plastics, endocrine disrupting compounds, herbicides, pesticides and per- and polyfluoroalkyl substances (PFAS).

The performance of conventional secondary treatment WWTPs is mixed with regard to the removal of CECs. Some of these complex organic compounds can be broken down by microbial actions, others are transferred to the solids stream (waste sludge) and there is typically 50 – 90 % removal from the liquid stream. Solid phase extraction is difficult and expensive and there is little data to compare how much is destroyed and how much is simply retained in the solid phase.

Advanced oxidation processes (e.g using ozone, titanium dioxide and UV irradiation) show considerable promise in dealing with CEC residuals, at least in the liquid phase. In Europe, there is an increasing tendency to incinerate dewatered biosolids as a precautionary approach to management of CECs. Reverse osmosis commonly employed for potable use recycling of wastewater, also removes essentially all large molecule compounds from the liquid stream.

8 Cost Estimates

A costing exercise has been completed for the four potential WWTPs that form a part of the preferred option and the conveyance routes required to transfer wastewater to these WWTPs. This exercise uses the costing assumptions below and develops the potential costs for each of these plants should they be built to their design flow process unit requirements at 2061. The treatment concepts developed for the purpose of the DBC reflect known solutions capable of achieving the minimum performance standards agreed for the projects. However, the liquid and solids treatment processes will be further developed and confirmed through preliminary and detailed design phases. These cost estimates have an estimation accuracy range of -30% / +50% of which is standard at Conceptual Appraisal stage.

8.1 Cost assumptions

The following items have been included in the comparative capital costs included in this report for the DBC:

- Operations and maintenance facilities
- Land purchase for new WWTPs
- Process items and structures
- Mechanical and electrical installation
- Instrumentation and control
- Site civil works (platform preparation, roading, drainage, fencing etc.)
- Project costs (P+G, contractor margins, forex risk)
- Consultant fees (Investigation/Design/Engineering)
- Discharge locations as outlined in Section 3
- A contingency allowance.

The following items have been excluded from the comparative capital costs included in this report but are included in the DBC Economic case and Financial case modelling separately:

- Client management/overhead costs
- Consenting costs
- Procurement costs
- Legal fees
- Client insurances
- Escalation after 2nd quarter 2020
- Site decommissioning and restoration
- Goods and Services Tax.

Further design of the preferred option will need to be prepared to confirm the estimated capital and operating costs. We have allowed for an estimating tolerance to account for general unknowns in the design and for any discrepancies in the design information prepared to date. The cost estimates are deemed to be Class 5 estimates as per the AACE Cost Estimate Classification System and have an expected accuracy range of -30% / +50%.

8.2 Capital Costs

Table 8-1 summarises the base capital costs for the preferred option. The detail is provided in Appendix B. As outlined in the costing assumptions Council internal costs, procurement and consenting costs are excluded from the cost estimates.

Table 8-1 Preferred Option Base Capital Costs summary (before staging considerations)

WWTP name	WWTP Capital Cost to 2061 ($ M)	Conveyance Capital Cost ($M)
Matangi	Improvements to existing WWTP and discharge $0.5M	
Southern Sub-Regional WWTP (including discharge)	Stage 1 $9M Stage 2 -$45M Stage 3 - $104M	$6.6M Matangi $33M South Hamilton
Cambridge	$ 113M	
Te Awamutu	$29M (includes Stage 4 capacity upgrade and $10M allowance for improved treated wastewater quality following consent renewal)	
Tauwhare Pa	$ 2M	

Table 8-2 outlines the indicative base staging for the Southern and Cambridge WWTP construction costs considering the process requirements over time in response to growth. An additional 10% has been added to costs in later years from 2041 to cover the extra costs expected due to multiple construction periods (including design, some rework and construction supervision). Staging for Tauwhare Pa would depend on development timing and flows being confirmed.

Table 8-2 Indicative Capital Costs Staging

WWTP name	WWTP Capital Cost 2031 ($ M)	WWTP Capital Cost 2041 ($ M)	WWTP Capital Cost 2051 ($ M)	WWTP Capital Cost 2061 ($ M)
Cambridge WWTP	$ 95.2M	$ 3.9M	$ 5.5M	$ 9.8M
Southern WWTP	$ 9M (Stage 1)	$ 30M (Stage 2)	$ 15M (Stage 2)	$ 104M (Stage 3)

8.3 Operational Costs

Table 8-3 outlines the details of the operational costs for the preferred option for 2031, 2041, 2051 and the 2061 flows. Over time the total operational costs increase as flows increase. The large plants that have PSTs and digesters have significantly lower costs due to energy recovery and reduced biosolids volumes for disposal. Assumptions are outlined in Appendix B. These amounts provide a relative indication of OPEX between the plant options. They could be refined and the OPEX costs rendered more accurate with some verification or similar contemporary operational cost data from the HCC and WDC operations teams.

The components included for operational costs were:

- Electricity (50% recovery assumed for WWTPs that have PSTs and digesters)
- Chemicals (CIP, alum, caustic, polyelectrolyte)
- Operators
- General maintenance
- UV lamp replacement
- Biosolids and screenings disposal (landfill disposal assumed)
- Compliance monitoring
- Renewals expenditure is excluded from the operational costs.

Table 8-3 Operational Costs summary

Location	Size of plant	Operational Cost 2031 ($ M)	Operational Cost 2041 ($ M)	Operational Cost 2051 ($ M)	Operational Cost 2061 ($ M)
Airport Southern Sub-Regional	Small - Medium	$ 0.5M Stage 1 (0.8MLD)	$ 0.7M Stage 2 (1.2 MLD)	$ 2.1M Stage 2 (3.6 MLD)	$ 7.4M Stage 3 (24 MLD)
Cambridge	Large	$ 2.0M	$ 2.3M	$ 2.7M	$ 2.8M
Te Awamutu	Medium	$ 3.1M	$ 3.5M	$ 3.9M	$ 4.0M
Tauwhare Pa	Small	$ 0.04M	$ 0.04M	$ 0.04M	$ 0.04M
Matangi conveyance		$ 0.1M			
Southern Hamilton conveyance		$ 0.8M			
TOTAL		**$ 5.6M**	**$ 6.5M**	**$ 8.7M**	**$ 8.9M**

9 Implementation Plan

The implementation plan is summarised in Figure 9-1. Triggers have been identified to move between development stages. The Southern WWTP development stages are triggered by local or south Hamilton demand. Matangi conveyance and Cambridge and Te Awamutu WWTP upgrades are triggered by growth and new resource consent requirements. Developer agreements will trigger the need to upgrade at Tauwhare Pa WWTP. Servicing of Ohaupo would be triggered by environmental issues with current on-site wastewater systems or significant increased demand due to higher density development.

Key implementation steps to implement a new Southern WWTP involve:

- Stage 0 **–** develop understanding of the existing and short term flows that will need to be managed before Stage 1 is operational. Coordination with the Airport and other developers to develop a servicing concept and input into master plans for developments.
- Securing land for a new WWTP, buffers and land discharge in Years 1 to 3 of the LTP
- Master planning of site could allow for flows from Hamilton South longer term by repurposing some structures such as the twin rising mains and pump stations of the Peacocke development. PS-N4 for example has included flexibility for such a change to be made some time in the future. This option has flexibility to adapt to development.
- Designating and consenting the treatment plant and discharge activities.
- Commencing Stage 1 of the treatment plant development. SBR treatment technology with land disposal (10-20ha) is proposed for the first stage. This technology provides enormous flexibility in terms of flows and load and will provide effluent quality that is suitable for application into or onto land. The first stage would cater for a capacity of between 400m^3/day and up to 1,000m^3/day (but with some flexibility on these limits). Soils will need to be suitable for low rate irrigation year round.
- Stage 2 Treatment Plant Upgrade - to provide a step change in treatment capacity and performance as demand requires. When the demand nears 1,000m^3/day the plant would be upgraded to an MBR system with discharge to water. The MBR system would be able to be configured using the Stage 1 SBR reactor tanks. This system would provide capacity for 3-4,000 m^3/day. This would also open up opportunities for re-use of treated wastewater by selected industries.
- Further system upgrades would be undertaken to meet demand including Stage 3 upgrade to cater for Hamilton South flows.

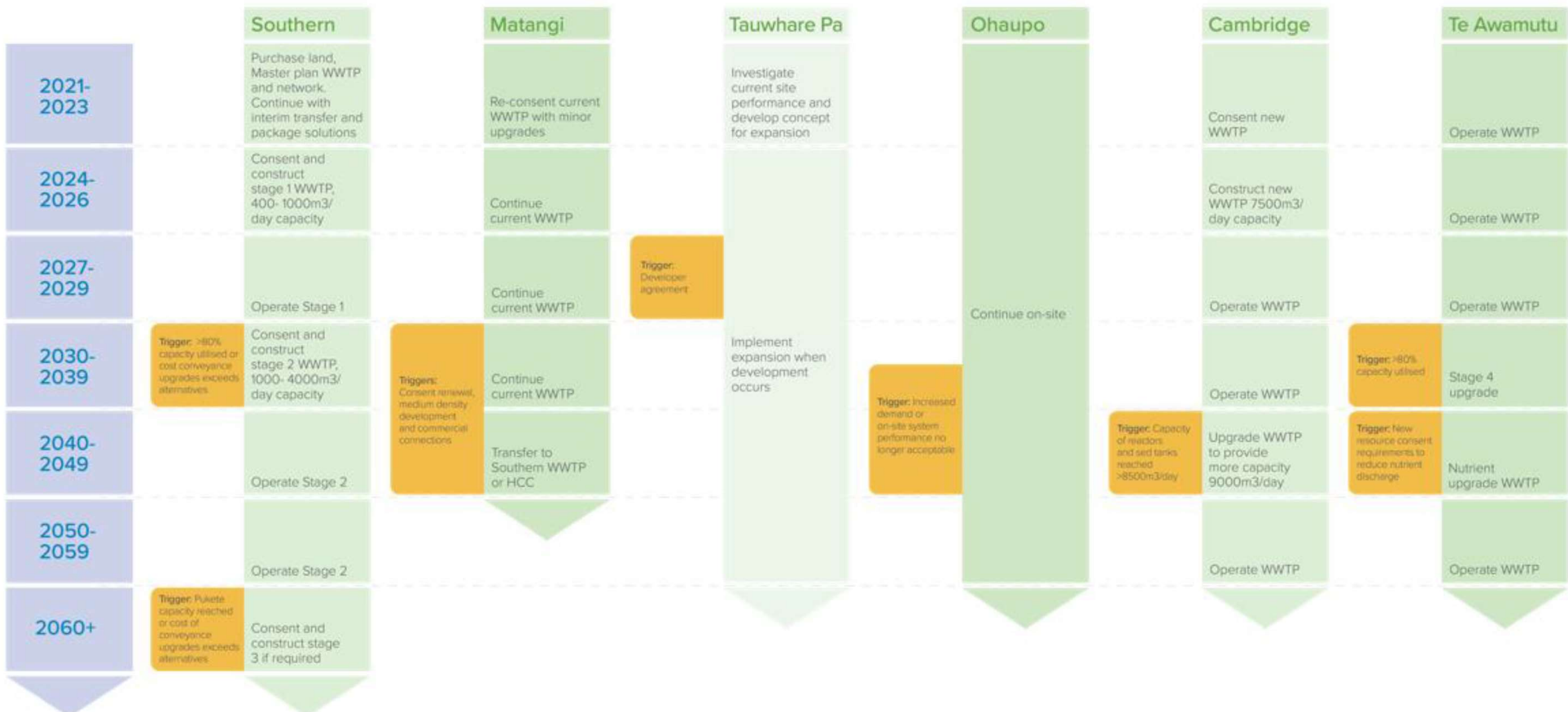


Figure 9-1 – Preferred option staging

9.1 Master Planning

Master Planning requirements for the new southern plant will typically include development of the following to a pre-concept design level. That is the basic size and location of the unit processes expected to be included in the ultimate development of the site:

- Hydraulic grade line
- Process horizontal and vertical sizing, layout and anticipated staging
- Vehicle circulation and utilities / process pipe corridors
- Ultimate utility requirements (electricity, water, gas, communications, stormwater, operator facilities)
- Preferences for redundancy
- Seismic risk management
- Biosolids management
- Buffers and conceptual planting plan for odour, noise and visual mitigation
- Conveyance corridor alignments and design

9.2 Further investigations required

For the preferred option further investigation and design is recommended as follows:

- Revisit the growth assumptions (including timing and scale of wet industrial activity in and around the Airport Precinct) for the Southern Plant as part of project implementation
- Geotechnical investigations for Cambridge WWTP and Southern WWTP
- Review of redundancy requirements for major process units e.g. screens and reactors
- Investigation of biosolids reuse and disposal options.
- Offsetting and consenting options
- Further investigation of sustainability and capital/operational carbon footprint
- Further refinement of capital, operational and present value analysis
- Master planning for Cambridge and Southern WWTP sites

Appendices

Appendix A – Treatment Assumptions

Memorandum

14 August 2020

To	Waikato Metro Wastewater DBC Control Group Hamilton City Council		
Copy to	Jackie Colliar		
From	John Crawford		
Reviewed by	Garrett Hall	Approved by	Kristina Hermens
Subject	**Wastewater Treatment Assumptions for Waikato Metro Wastewater DBC**	Job no.	12533660/3257177

1 Purpose

The purpose of this technical note it to outline the wastewater treatment assumptions proposed to be used for the metro long list and southern short list options stages of the Waikato Metro Wastewater Detailed Business Case (DBC). The DBC will explore potential wastewater strategic options for the wider Hamilton Waikato Waipa Metro Area (the metro area) and determine a preferred wastewater treatment solution within the southern metro area.

To develop the long list and short list of wastewater servicing options for the Waikato Metro area, assumptions need to be made on the quality of the discharges from the wastewater treatment plants (WWTPs). During the DBC, treated wastewater quality targets will be used to size the treatment processes for high level costing and assess environmental effects in order to compare options.

This technical note outlines potential options and the proposed approach.

2 Introduction

Te Ture Whaimana o Te Awa o Waikato: The Vision and Strategy (V&S) for the Waikato River guides improved environmental, social and cultural outcomes through policy and practical actions. The Waikato-Tainui Raupatu Claims (Waikato River) Settlement Act 2010 requires the Vision and Strategy to have prime importance in decision making for wastewater discharge consent applications in the Waikato Region.

Objectives of the V&S include (amongst others):

- The restoration of water quality within the Waikato River so that it is safe for people to swim in and take food from over its entire length.
- Recognition and avoidance of adverse cumulative effects, and potential cumulative effects, of activities undertaken both on the Waikato River and within its catchments.
- The recognition that the Waikato River is degraded and should not be required to absorb further degradation as a result of human activities.

The Waikato Regional Policy Statement and Regional Plan sets out the objectives, policies and rules for decision making for consent applications for discharges of treated wastewater. Proposed Plan Change 1 (PC1) to the Waikato Regional Plan is also now at the decisions stage (subject to appeal) and includes short and long-term water quality targets for the Waikato River. Point source discharges need to demonstrate a proportional contribution to the restoration of water quality of the Waikato River to achieve the objectives of PC1. With respect to this, the effects of the existing discharges can be used as a starting point to measure future improvements.

It is important to note that PC1 seeks to give effect to some objectives of the Vision and Strategy (related to water quality of the Waikato River) and does not in itself fulfill all obligations set out in the Vision and Strategy.

The National Policy Statement (NPS) - Freshwater and the soon to be released National Environmental Standards for Fresh Water/Wastewater Discharges are not expected to be more onerous than PC1 with respect to the four key contaminants the PC1 focuses on. It is also not expected to be more onerous than the Vision and Strategy. Resource Management Act reforms also indicate a shift towards minimum environmental standards for discharges, however it should be noted that in the event of any inconsistency between other NPS and the Vision and Strategy that the more onerous requirement/i.e. the higher standard prevails.

There is currently a wide variety of standards for treated wastewater discharge quality in the region due to different technology used. The key contaminants of concern that have a known impact on public health and the Waikato River are pathogens (e.g. bacteria and viruses) and nutrients (nitrogen and phosphorus).

Other typical contaminants in treated wastewater include Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS), ammoniacal nitrogen and nitrate nitrogen. BOD has potential effects on dissolved oxygen concentrations, whilst TSS has potential effects on visual clarity. Both ammoniacal nitrogen and nitrate nitrogen are potential toxicants.

Emerging Organic Contaminants (EOCs) are becoming more important to our considerations in water and wastewater treatment as they increase in number and extent and as we are better able to measure them and understand their effects. EOCs, some persistent and some biodegradable, consist of thousands of complex organic compounds of many different types and uses. EOCs have become a point of concern in most contemporary discharge consent processes. However, the majority, that are not destroyed in the biological process, end up in the solids phase residuals rather than the liquid phase discharge.

The wastewater discharge consenting process in New Zealand has historically placed the majority of its emphasis on the liquid stream discharge from a site, a significantly lesser emphasis on atmospheric discharges (and normally only in terms of the manifestation of noise or odour effects) and almost nil attention to solids phase residuals and their wider environmental and economic effects.

In the future changes of approach to wastewater management are likely to change this balance (or imbalance as the case may be):

a) A significantly greater emphasis on climate change and associated management of actual cradle to grave atmospheric emissions,

b) The associated emissions and economic performance regarding the large quantities of residual solids produced daily from the rapidly increasing use of high-performance wastewater treatment processes, and

c) A greater focus on the fate of EOCs in and leaving the WWTP.

Therefore, it is proposed that atmospheric and solids system performance should be given equivalence with liquid phase discharges in conceptualizing and Master Planning the site options.

3 Treated (Liquid Stream) Wastewater Discharge – Approach Options

The core parameters proposed for adoption for conceptualization and costing of the liquid stream process performance (treated wastewater quality) are: Total nitrogen (TN), Total phosphorus (TP) and E.coli. Whilst BOD, TSS and ammonia are important in terms of assessing effects, due to the high typical rate of removal through modern treatment processes, these are not considered key contaminants of concern for the purposes of this project at this initial stage. This is because a) The total nitrogen, total phosphorus and pathogen limits adopted so strongly dominate the treatment plant design and operation that BOD, TSS and ammonia automatically have to, by association, have been reduced to such low levels that they (BOD, TSS, NH_4-N) cease to be an issue from an effects and consenting perspective, and b) it is assumed that any potential residual adverse effects related to these contaminants can be mitigated adequately. By contrast, influent loads of these three contaminants are directly relevant to the sizing and cost estimating process involved in this business case.

By contrast, nitrogen and phosphorous accumulate in the Waikato River and the effects of these contaminants are realised on a catchment wide basis. Both of these contaminants are key contaminants for this level of investigation. Pathogen concentrations are directly related to effects on contact recreation (swimming and boating etc.) and food gathering so are also considered a key contaminant of concern for this investigation.

Typical performance for different wastewater treatment plant technology types are outlined in Table 3-1.

Table 3-1 WWTP Liquid stream performance summary

WWTP Type	Pathogen Removal	Nutrient Removal	Examples
Basis	95th percentile	Annual mean	
Oxidation pond/aerated lagoon	Variable removal performance, improved with tertiary solids removal or wetlands prior to UV disinfection	Poor total nitrogen removal <40 mg/L TN Moderate level total phosphorus removal <1 mg/L TP when used in conjunction with chemical dosing and tertiary solids removal	Cambridge WWTP Ngaruawahia WWTP
Activated sludge type plant with UV disinfection	High level performance achieved <200 cfu/100ml E coli	Moderate level total nitrogen removal <12 mg/L TN High level total P removal with chemical dosing or bio P <1 mg/L	Te Awamutu WWTP Pukete WWTP

WWTP Type	Pathogen Removal	Nutrient Removal	Examples
Advanced biological nutrient removal, (using membranes or clarifier plus UV)	Very high level of performance <14 cfu/100ml E coli,	High level total nitrogen removal <7 mg/L with supplementary rbCOD dosing. High level total P removal with chemical dosing and or bio P processes <1.0 mg/L TP	Queenstown & Pauanui WWTP following upgrades (neither of which actually use membranes)
Current limit of technology – advanced biological nutrient removal with membranes, supplementary chemical dosing and UV. Tertiary GAC or similar filtration could potentially be considered as a measure for removing some EOCs	Very high level of performance <10 cfu/100ml E coli consentable but performance typically <1 cfu/100ml	Very high level of total nitrogen removal <3.5 mg/L High level total P removal with chemical dosing plus bio P processes <0.1 mg/L TP	Pukekohe & Rotorua WWTPs standard after current MBR upgrades implemented
Primary Treatment	For all treatment plant options that meet the lower threshold (currently proposed to be 40,000PE) for inclusion of digestion and energy recovery facilities, primary treatment will be included to capture raw solids that would otherwise be destroyed in the secondary process with both the consequent loss of energy potential and consumption of additional aeration power. Plants that start below the threshold but which are likely to surpass it will be provided with space on the ground and vertically in the hydraulic grade line to allow future incorporation of the primary tanks. A secondary benefit of future addition of simple primary tanks is that more complex and expensive aeration tank augmentation can be deferred by a substantial period.		

For reference, two exemplar treatment plants that have recently been consented and design standards as shown in Table 3-2. In both of these examples, nitrogen and phosphorus are load based consents and the design concentrations are back calculated from the ultimate loading case with a design factor of safety applied.

Table 3-2 : Te Awamutu and Pukekohe consent and design basis

	Te Awamutu (Waipa DC) Granted 2018 – for 25 years		Pukekohe (Watercare) Granted 2017 – for 35 years	
Context	Consent	Design	Consent	Design
Total nitrogen	7.5* mg/l	7.5 mg/l	4.1* mg/l	3.5 mg/l
Total phosphorus	1.2* mg/l	1.2*** mg/l	1.0* mg/l	1.0*** mg/l
E.coli	126 cfu/100ml	10** cfu/100ml	50 cfu/100ml	1 cfu/100ml
$cBOD_5$ (med)	5 mg/l	5 mg/l	5 mg/l	5 mg/l
NH_4-N	0.5 mg/l	0.5 mg/l	1 mg/l	1 mg/l
TSS	15 mg/l	15 mg/l	5 mg/l	2 mg/l

* Based on a back calculation from consented load using predicted flows at the end of the consenting period

** Calculated on clarifier effluent minus $3\log_{10}$

*** These can be trimmed accurately with supplementary chemical dosing.

Five options have been developed for the different approaches to treated wastewater quality assumptions for discharges to water. The options are outlined in Table 3-3.

For discharges to land (generally for smaller flows), a site-specific set of treatment standards would need to be developed depending on soils and land use. These discharges are expected to have a minimal impact on the Waikato River, although this is dependent on the type of soils, land use and ability to operate in winter conditions.

For the purposes of this business case, it will be assumed that the treatment plants need to configured, at least initially for a higher quality discharge to water. A further document will provide an indication of treatment requirements to be assumed for potential discharge to land options.

Table 3-3 WWTP Approach Options

Option	Approach	Comments	Option Differences
1. Consistent treated wastewater quality for all WWTP discharges to water – moderate nutrient removal	As consents come up for renewal or new consents are applied for, a consistent set of conditions is set. All WWTPs would aim for Activated Sludge WWTP with UV disinfection which includes good standard of pathogen removal. Nitrogen and phosphorus removal would be incorporated but not to advanced levels.	• Total nutrient discharges to the river likely to increase due to growth. Inconsistent with V&S. • Limited opportunities for reuse without membrane step in treatment. • Additional offsetting measures likely to be required.	While the other 4 options would be aimed at making significant advancements on 'Business as Usual' Option 1 would really only be adding additional capacity to existing plants, with moderate upgrades and creating more of the same in new plants.
2. Consistent treated wastewater quality for all WWTP discharges to water – high nutrient removal	As consents come up for renewal or new consents are applied for, a consistent set of conditions is set. All WWTPs would aim for advanced biological nutrient removal with membranes. Nitrogen and phosphorus removal would be incorporated but not to limits of technology. Likely start at Te Awamutu level of treatment but with processes upgradable for future move to Pukekohe level of treatment. Supplementary carbon and or metal salts dosing may be required.	• Total nutrient discharges to the river likely to reduce compared to current levels. • Membranes will reduce bacterial and protozoan pathogens to very low levels. • UV can be considered as a second barrier to bacteria and an effective means of inactivating viruses • Opens up opportunities for reuse at all sites. • Additional offsetting measures may be required.	Compared to Option 1, this provides higher performance in terms of nutrient removal and pathogen reduction. It is significantly more costly than option 1. It is more likely (than Option 1) to be consentable from a Western science perspective and to contribute towards achievement of PC1 water quality targets. Timing would depend on the initial quality target's adopted. Provides scope for future improvement of all plants or, conversely for some initial cost mitigation
3. Consistent treated wastewater quality for all WWTP discharges to water – very high nutrient removal	As consents come up for renewal or new consents are applied for, a consistent set of conditions is set. All WWTPs would aim for advanced biological nutrient removal with membranes. Nitrogen and phosphorus removal would be incorporated to limits of technology i.e. Pukekohe standard. Supplementary carbon and or metal salts dosing may be required.	• Total nutrient discharges to the river likely to reduce compared to current levels. • Membranes will reduce bacterial and protozoan pathogens to very low levels. • UV can be considered as a second barrier to bacteria and an effective means of inactivating viruses • Opens up opportunities for reuse at all sites. • Additional offsetting measures may be required, although less likely when compared to other options.	Compared to Options 1 and 2, this provides higher performance in terms of nutrient removal and pathogen reduction. It is significantly more costly than option 1 and more expensive than option 2. It is more likely (than Option 1 and 2) to be consentable from a Western science perspective and to contribute towards achievement of PC1 water quality targets and achieve consistency with the Vision and Strategy. Timing would depend on the initial quality target's adopted.
4. Treated wastewater quality target dependent on community size served	As consents come up for renewal or new consents are applied for, larger WWTPs (>40,000 PE) would provide advanced biological nutrient removal using membranes with high level of nutrient and pathogen removal.	• Higher gains for river on nutrient load basis if larger plants have highest treated wastewater quality. • Additional offsetting measures may be required.	Option 4 is more suitable for treatment strategies where there are one or more small plants involved (e.g. Te Kowhai or Airport) which would have permanent performance level similar to existing TA performance.

Option	Approach	Comments	Option Differences
	Smaller sites would provide Activated Sludge WWTP with UV disinfection.	• Opens up opportunities for reuse at larger sites only.	May not meet PC1 requirement unless the sub-catchment can be considered holistically and not on the basis of individual plants.
5. Treated wastewater quality optimised between WWTPs to achieve net improvement in nutrient load for combined discharges.	All WWTPs provide a minimum level of pathogen removal to low level. Nutrients reduced where most cost effective to do so to – in effect taking a catchment wide approach. Advanced nutrient removal likely to be required at some sites.	• Uncertainty around water quality improvement over time due to changing growth patterns. • Highest quality effluent may not be available where demand for reuse is expected to occur. • Optimises use of existing assets. • Additional offsetting measures may be required.	Option 5 provides maximum upgrades / technology to specific plants to optimize the amount of nutrient removal at the least cost. This is only feasible if the initial nutrient mass balance indicates that the difference between existing performance and proposed performance is such that there is latitude for some plants to be configured lesser nitrogen removal performance. There is a higher risk of a strategy failure if the growth patterns vary significantly from those assumed.

4 Atmospheric Discharges

Our proposed approach, for all scheme options, to expected discharges to atmosphere is reasonably general but would be in line with relevant policies of the Councils and RMA regulations. Current expectations are:

- No objectionable odours at or beyond the treatment plant site boundary
- Expectation that the councils would work toward establishing, maintaining and enhancing odour buffers surrounding the site/s over time and that planning rules would give effect to these.
- Operational noise limits within the limits of existing noise ordinances.
- Emissions management systems that minimise the discharge of greenhouse gases (direct at the plant or from residuals) and, in particular, those such as methane and nitrous oxide that are at the higher end of the carbon equivalence scale
- For plants greater than 40,000PE. biogas use rather than flaring and, where feasible, extraction of gas generation capacity from solids and liquids for management before they leave the site. The level of sophistication would depend upon plant scale.
- For plants above 150,000PE (cut-off tbc), provision will be made for advanced solids destruction and reduction (e.g Thermal Hydrolysis, drying etc). From an emissions perspective this provides for Scope 2 emissions reductions due to the increase in site generated power and Scope 3 emissions reductions by reducing the amount of a) trucking away of biosolids and b) the amount of biosolid that eventually decomposes (whether it be aerobically (CO_2) or anaerobically (CH_4) somewhere of site, either beneficially reused or landfilled.

5 Solids Phase Discharges

An outline of the intended levels of solids residuals treatment follows. This may change with participant feedback and as and if the level of project maturity identifies more pragmatic stage limits:

- Screenings washed and compacted suitable for landfilling. Reduce mass for transport and landfill charges.
- Grit washed and classified suitable for landfilling. Reduce putrescible material and odour potentials.
- Biosolids minimum standard 19% dry solids (preferably 26% or more) to enable disposal to landfill as a last resort. This recognises that for some long list options, small plants without primary sedimentation are a possibility and that 19% is an achievable standard for dewatering pure, undigested waste activated sludge (WAS). 26-27% dry solids is readily achievable for a co-digested sludge.
- Where scale permits (nominally 40,000PE for the purpose of this study), a minimum of anaerobically digested biosolid with: a) energy resource extracted, b) mass substantially reduced from primary/WAS state, c) substantially stabilised to enable further reuse or stabilisation options to be implemented.
- For plants above 150,000PE (cut-off tbc), provision will be made for advanced solids destruction and reduction (e.g Thermal Hydrolysis, drying etc). See Section 4 above.
- Plants that are large enough to include digestion, and especially those that also incorporate a process such as hydrolysis, are likely to also require a side stream process to deal with the high concentrations of returned nitrogen and phosphorus before they reach the main stream process units.

- The presence of heavy metals in biosolids is a key determinand in the identification and adoption of acceptable beneficial reuse outcomes for the resource. Arsenic is the metal of key concern for Hamilton biosolids. A significant proportion of the arsenic is sourced from water treatment plant (WTP) sludges from WTPs treating Waikato River water to potable standard. This concern would apply to all WWTPs that receive WTP sludges, of Waikato River origin, via the sewer system. The arsenic is natural and derives from geothermal water sources such as the Wairakei power station and other geothermal streams. The power station sourced arsenic may disappear when the power station is decommissioned. However, for the purpose of this work, it is assumed that the WTP sludges will be removed from the sewers and dealt with separately. This involves provision of storage, thickening and dewatering systems at the WTP and, likely, trucking of the sludge to landfill, where it may be suitable as capping material. Depending upon the level of metal contamination, it may be suitable for other purposes as it does not come with the added complication of being of human waste origin.
- Emerging Organic Compounds (EOCs – discussed in Section 6 below) that are not destroyed in the secondary process or pass out in the final effluent will be bound up in the solids residual. Research does not make it clear what proportion of each type is destroyed and what is bound up in the biosolid. This is because it is very difficult and very expensive to undertake, in the laboratory, the extractions from the solids phase to an accurately measurable state. At this time, it is not possible to target specific sludge treatment initiatives to significantly reduce EOCs as a group. Northcott Research Consultants are recognised experts in this area of measurement and are based in Hamilton. An opportunity exists for local research to be undertaken to inform a 'way forward' in this regard, for example identifying and priority compounds in this area for more detailed consideration around longer-term management of biosolids in this regard.

6 Emerging Organic Contaminants

EOCs are many and are highly varied in their make up and their persistence in the environment. A lot of research has been carried out on the presence of EOCs in wastewater and less on the effectiveness of various treatment processes in removing them. The sources of EOCs are varied with many coming in the form of trade wastes (e.g plasticisers and quaternary ammonium compounds) and many coming from domestic sources such as pharmaceuticals, skin care and micro-plastics.

In the more commonly used forms of secondary treatment, EOC destruction or removal performance is highly variable depending upon the compound and operating conditions. One process will work well for one group of compounds but fail miserably on another group. Some compounds are reasonably readily destroyed in the secondary process. However, some even concentrate, with an apparently negative removal rate.

Most research has focussed on the removal of EOCs from the final liquid effluent stream. However, those compounds that are not destroyed in the biological processes generally end up attached to or embedded in the sludge flocs and so are discharged with the sludge, leaving a legacy contamination there.

Despite the research, there is, as yet, no commonly accepted process or processes for targeting all or specific EOCs. And, because of the large number of EOCs that could be present continuously or from time to time, it is not possible to recommend a set of standard removal targets of specific processes to adopt.

What does seem apparent is that the longer the solids retention time (Sludge age, SRT) and the longer the hydraulic retention time, the more EOC's will be removed from the liquid stream and the more that will be destroyed rather than simply embedding in the sludge mass. Fixed film processes and moving bed bioreactors (fixed film biomass in/on free floating carriers) appear promising, as do other long SRT processes such as a generously sized MBR. Tertiary filtration using granular activated carbon is also affective for some compounds. Autotrophic nitrifying bacteria are also better in this regard than are the more common heterotrophic organisms. The Metro plants will be required to be fully nitrifying and as such will also run reasonably long SRTs.

While it will not be possible to target specific EOC performance in the plants conceptualised now, favourable conditions can be provided, as well as sufficient space for the introduction of tertiary processes at inception or in the future.

7 Discussion

A consistent set of treated wastewater quality standards makes comparing options less complex and less reliant on growth forecasts. The Vision and Strategy for the Waikato River, PC1 and Central Government policies indicate that significant treated wastewater quality improvements are likely to be required to all existing discharges over time. While the limits of technology may be feasible from a purely technical perspective, this is a large step change compared to the current discharges.

A catchment wide approach is consistent with the key themes of the V&S but may mean some WWTPs have lower treatment standards than others. If each resource consent is considered on a case by case basis there may be some resistance by individual stakeholders/submitters involved. Lower treated wastewater quality at some sites will also limit opportunities for reuse.

For some WWTPs, or perhaps in the early years of implementation of this Metro DBC, it may be necessary to start with a lower standard but with the WWTP configured for relatively easy uprating to a very high standard, such as that adopted at Pukekohe. For example, starting at the Te Awamutu WWTP level of treatment but with the ability to transition to the Pukekohe WWTP level of treatment.

Wastewater treatment technology is constantly developing. Over the last 10 years membranes have become more cost effective and enhancements to nutrient removal processes are developing. It is foreseeable that membranes will become the predominant liquid / solid separation technology in modern advanced wastewater treatment technology. They have particular advantages in providing high levels of solids and pathogens removal. However, this will need to be in conjunction with flow buffering in the conveyance network and potentially the retention of some conventional clarifiers (as a fourth line of defence) to help manage residual wet weather peaking that cannot be managed via membrane redundancy, storage and infiltration and inflow reduction measures.

At this early stage, the proposed treatment plant performance standards, to be adopted under an Option 3 treatment strategy (see Section 3 above) assume that the mass balance to be carried out on nutrients currently discharged to the Waikato river (within the study reach) will permit a mean total nitrogen concentration of < 4 mg/L.

Differential Summer / Winter consent standards are a distinct possibility when the selected wastewater scheme or strategy is finally consented. However, this document is not a consent strategy and so that level of detail is not covered here. Process sizing, for the purposes of site selection, layout master planning and cost estimating will conservatively assume winter reactor temperatures (increases reactor size). If this can be relaxed in future, it extends the design horizon of biological process units either in time or in EP capacity.

Given the above, at this stage, annual consented mass loads for TN and TP will be considered for decision making purposes. This is consistent with PC1 where water quality targets are based on annual values (averaged over five years).

In terms of effects of climate change on Waikato River flows and potential reduction in assimilative capacity of the receiving environment, this matter has not been assessed as part of the water quality modelling that was undertaken for PC1 and was identified as an information gap during the PC1 hearings held in 2019. It was generally agreed that whilst this matter is important, it will be considered in future plan changes when improved climate change modelling capabilities are available.

In a similar vein, it is possible that some land disposal options may eventuate and or be selected for use as part of the scheme. From a food industry perspective, there is still a long way to go before beneficial irrigation of agricultural land in New Zealand is generally accepted. Although there is no doubt that there are some such schemes already operating. Therefore it is likely that treatment plant development will be required in advance of land disposal options being available. On that basis, and to be conservative in the DBC context, 'discharge to water' requirements would dominate plant design. Progressing to land application in future may allow significant reductions in chemical addition (for N&P polishing). But that is an operational issue rather than a capital issue and that level of detail is beyond the scope of the current work.

PC1, in its current form, also suggests that 'offsetting' may be used by an applicant to offset the residual adverse environmental effects of a future discharge. This concept is in its infancy in the Waikato Region and New Zealand however, this may include measures such as riparian planting, wetland restoration or retiring marginal farmland. These measures will be considered at later stages in the process.

Objective K from the Vision and Strategy for the Waikato River states "*The restoration of water quality within the Waikato River so that it is safe for people to swim in and take food from over its entire length*". PC1 has determined an 80-year period is appropriate for this to be achieved across the entire length of the Waikato River (although PC1 is subject to appeals in the Environment Court currently). The western science definition of objective K was subject to lengthy debate at the PC1 Council hearings held in 2019 and was also the subject of expert witness conferencing.

With respect to the effects of treated wastewater discharges, the term 'swim in' relates to the effects of pathogens (i.e. is the water clean enough so you don't get sick), but also effects on visual clarity (i.e. is the water clear enough to swim in). Visual clarity effects are related the concentration of TSS in the discharge but also the amount of algae in the water, which results from inputs of nitrogen and phosphorus.

The term 'safe to take food from', refers to both the effects of pathogens in terms of public health effects (i.e. is the food safe to eat), but also the wider environment of the Waikato River and whether the ecological health of the River is healthy enough to support a diverse range of flora and fauna. The health of mahinga kai species is an important aspect of this. This is recognised in objective I of the Vision and Strategy which states "*The protection and enhancement of significant sites, fisheries, flora and fauna*".

Whilst the above matters are the subject of some debate, the overall direction for the Vision and Strategy is one of improvement from the current state. Whilst all options could be considered to contribute towards the achievement of the Vision and Strategy the overarching aim of which is to restore and protect the health and wellbeing of the Waikato River, at this stage option 3 provides a robust starting point for the assessment as it achieves:

1. A significant level of improvement in the quality of the discharge when compared to the existing performance; and

2. The possibility to refine/further develop future treatment options as technology progresses over time.

Notwithstanding the above, further work is required to determine the likely future flows and mass loads of nutrients discharged to the Waikato River as a result of population growth (albeit with a much higher treatment standard). Should the future mass loads discharged be higher than the existing mass loads this would be inconsistent with the Vision and Strategy and further interventions will be required at that stage (i.e. adopting a higher level of nutrient removal or investigating offsetting opportunities). It is proposed with respect to offsetting, that it may be appropriate to provide some capital allowance for potential offsetting (if required) for both nutrients and future emissions obligations (it is possible that a given mitigation measure may cover both such potential obligations).

It is also considered that option 3 appropriately aligns with the Vision and Strategy objective F which states "*The adoption of a precautionary approach towards decisions that may result in significant adverse effects on the Waikato River, and in particular those effects that threaten serious or irreversible damage to the Waikato River*".

8 Recommendations

Liquid Stream: It is recommended that for the Metro DBC, a consistent standard of treated wastewater quality is adopted for all WWTP discharges to water (Option 3). It is proposed that the level of treatment within that option would provide:

- a high level of nutrient removal <4mg/L TN and <1.0mg/L TP (as annual means) and
- A very high pathogen removal (E.coli <14 cfu/100ml as a 95^{th} percentile).

The treated wastewater quality standards would be introduced by 2031 or when the existing resource consent for the discharge expires. For WWTPs including digestion facilities, primary treatment will also be included.

It should be noted that the treated wastewater qualities initially adopted for the preferred Southern Area solution will be confirmed at a later stage of the DBC based on the nutrient loading assessment and scale of facilities initially included as part of the preferred solution.

Solids Stream: A graduated scale of solids management is proposed with complexity and extent of solids destruction and energy potential realisation increasing in steps with population equivalent served.

For very small plants (in some options) such as Te Kowhai, the solids stream treatment may be as simple as thickening waste activated sludge followed by tankering to a larger facility for further treatment.

For WWTPs up to the digester threshold (currently proposed as 40,000 PE), the extent of treatment would increase to dewatering to a minimum of 19% dry solids, being a 'last resort' standard for landfilling if that had to be adopted temporarily or permanently.

WWTPs above 40,000PE (tbc) would adopt anaerobic digestion with one or more forms of energy recovery, for example a co-generation engine producing both heat and electrical energy. And above 150,000PE a more advanced form of solids destruction would be adopted. For WWTPs with digesters, side stream digestate treatment will be provided for.

Atmospheric emissions: Proposed provisions for atmospheric emissions are reasonably general but all would require best practice to be implemented. The costs of such initiatives are not able to be differentiated at the Class 5 estimating level, apart from large items such as co-generation plant. These initiatives include:

- Noise mitigation to levels that are safe for operators and which comply with local ordinances at the boundary
- No objectionable odours beyond the boundary. However, it is assumed that the owners will do all in their power to create and maintain odour buffers around the WWTPs.
- Process units and equipment will be specified and configured to minimise the release of fugitive greenhouse gas emissions. For example, use of biogas in boilers, furnaces or co-generation engines and providing for very stable nitrogen removal processes that release a minimum of nitrous oxide.
- In all process plant development, life cycle emissions will be given due consideration and it is anticipated that the councils will adopt the zero carbon bill aspirations and optimization of life cycle emissions generally. And that these will be drivers for initiatives, particularly in the larger plants, for processes that drive the plants towards energy neutrality (Scope 2 reductions) and emissions minimisation, whether on site (Scope 1) or off site for residuals management (Scope 3).

General: The treatment plants will be configured such that the limit of capability is not fixed at the initial target performance but can be upgraded by augmentation of processes at appropriate times.

The treatment standards will be reviewed for the preferred southern option once further information is available on effects, staging and costs.

Version Control

Version	Author		Reviewer	Approver
Draft v1	John Crawford	31/7/2020	Garrett Hall	Kristina Hermens
Draft v2	John Crawford	14/8/2020	Garrett Hall	Kristina Hermens

Appendix B – Cost Estimates

Waikato Metro DBC Southern Shortlist - Conveyance

Comparative Concept Cost Estimate Summary

Ref	Description	Capital Costs - Option 2A		Capital Costs - Option 4A	
		Most Likely Estimate	P95 Estimate	Most Likely Estimate	P95 Estimate
1.0	**Conveyance**				
1.1	Peacocke to Southern WWTP:				
1.1.1	Clyde to Flynn	$9,710,000	$11,010,000		
1.1.2	N4 to Faiping Rd Gravity	$13,180,000	$15,190,000		
1.1.3	N12 to Faiping Gravity	$3,540,000	$3,960,000		
1.1.4	Faiping Gravity to Southern WWTP	$6,080,000	$7,270,000		
1.2	Cambridge to Southern WWTP	$41,890,000	$49,610,000		
1.3	Matangi to Southern WWTP	$6,570,000	$7,580,000	$6,570,000	$7,580,000
1.4	Ohaupo to Southern WWTP	$7,230,000	$8,430,000	$7,230,000	$8,430,000
	TOTAL ESTIMATE - Rounded	**$88,200,000**	**$103,050,000**	**$13,800,000**	**$16,010,000**

Waikato Metro DBC Southern Shortlist - Conveyance

Comparative Concept Cost Estimate Summary

General Estimate Exclusions

0.0 Goods and services Tax (GST).
0.1 Incurred costs to date.
0.2 Fast track or accelerated programme.
0.3 Work outside normal working hours.
0.4 Costs associated with staging of the works.

Project Specific Exclusions

0.5 Client internal project-related costs including project management, communications, cost of finance, legal, and accounting fees.
0.6 Consenting costs.
0.7 Procurement costs.
0.8 Contaminated ground and hazardous materials.
0.9 Relocating existing services. Subject to further investigations
1.10 Power supply network upgrades. Pump station estimates assume sufficient capacity is available at site boundary.
1.11 Ground improvements and piling beneath pump station and other structures.
1.12 Architectural treatment to exterior of buildings and structures.
1.13 Landscaping to proposed pump station sites. Estimates includes allowances for restoring surfaces disturbed by construction works with topsoil and grass.
1.14 Costs of impacts associated with extraordinary global events (such as the current COVID-19 outbreak).

Assumptions

1.15 All quantities and dimensions are approximate and are subject to design development.
1.16 The basis of the estimate is the GHD concept design information received via email on 23/12/2020. This includes details for the pipelines and pump stations and approximate scheme alignment plans.
1.17 Elements of cost included within this estimate are based on costs from similar projects and other Beca cost benchmarks.
1.18 We assume that projects will be undertaken by a single 'Main Contractor' through a single contract for the project.
1.19 We assume that a robust tendering process will be followed and that a minimum of 3 sub-contractor tenders (where possible) are received for the project as part of the agreed procurement process.
1.20 We assume that all works are carried out during normal daytime working hours.
1.21 We assume that the Contractor will have unobstructed access to the whole site throughout the construction phase.
1.22 All base prices are current to January 2021. No allowance for cost escalation has been included in the estimate.

Waikato Metro DBC Southern Shortlist - Conveyance

Comparative Concept Cost Estimate Summary

1.23 The allowances for Professional Fees are high-level indicative allowances only and have not been based on a detailed work breakdown structure.

Expected Estimate Range:

1.24 Estimate range is an indication of the degree to which the final cost outcome for a given project will vary from the estimated cost – it is not an additional Contingency. Range is expressed as a +/- percentage range around the point of estimate after the application of contingency, with a stated level of confidence that the actual cost outcome would fall within this range. As the level of project definition increases and the tender date draws nearer, the expected range of the estimate tends to improve, as indicated by a tighter +/- range.

1.25 The estimates are deemed to be Class 5 estimates in terms of the AACE Cost Estimate Classification System guidelines. The probable accuracy range of the estimate is likely to be no better than -30% to +50%.

Risks

Risks with a potential cost effect include:

1.26 Design development.
1.27 Foreign exchange rates (an allowance for this risk has been included in the estimate).
1.28 General cost escalation.
1.29 Cost associated with sequencing or staging of the works.
1.30 Ground conditions and ground water levels and temporary work requirements; geotechnical requirements.
1.31 Integration with exisiting infrastructure and working around existing services.
1.32 Property costs, specifically land purchase and access (easements etc.).
1.33 Costs of impacts associated with extraordinary global events (such as the current COVID-19 outbreak).

General Considerations and Limitations.

1.34 These estimates are solely for our Client's use for the purpose for which they were intended in accordance with the agreed scope of work. They may not be disclosed to any person other than the Client and any use or reliance by any person contrary to the above, to which Beca has not given its prior written consent, is at that person's own risk.

1.35 The high-level cost estimates presented in this section have been developed solely for the purpose of comparing and evaluating competing options. They are sufficiently accurate to serve this purpose. We recommend that they are not used for budget-setting purposes as common elements between options may have been omitted and/or the works not fully scoped. A functional design should be undertaken if a budget estimate is required.

Sensitivity: General

CONCEPT STAGE COST ESTIMATE

Waikato Metro WW DBC

N4 to Faiping gravity section

Supply and Installation of PE Pipe, pump station and associated equipment and fittings.

Item		Unit	Quantity	Rate	Total - Most Likely
1.0	**WASTEWATER RISING MAINS**				
1.1	Supply and install PE100 PN16 twin rising main generally trenched 0-2.0m deep; including, but not limited to: welding, excavation, bedding, backfilling, and reinstatement outside road.				
1.1A	DN630 PN16	m	3,870	$ 975	$ 3,773,250
1.1B	DN450 PN16	m	3,870	$ 500	$ 1,935,000
1.2	Extra over for additional deeper trenching 2-3m deep.	m	500	$ 300	$ 150,000
1.3	Extra over item to reinstate sealed road.	m	1,935	$ 150	$ 290,250
1.4	Extra over item to reinstate berm/unsealed road.	m	1,935	$ 35	$ 67,725
1.5	Air Valves. Assume offline configuration and located in an above-ground chamber at the side of the road.	each	8	$ 25,000	$ 200,000
1.6	Isolation Valve. Assume direct buried.	each	8	$ 20,000	$ 160,000
1.7	Scour Valves. Assume offline configuration and located in a below-ground chamber at the side of the road.	each	8	$ 27,000	$ 216,000
1.8	Hydrostatic testing of wastewater pipeline.	LS	1	$ 75,000	$ 75,000
	Subtotal - Wastewater Rising Main			**$ 6,867,225**	
2.0	**WASTEWATER PUMP STATION**				
	Peacockes Pump Station upgrade				
2.1	Upgrade of the Peacockes Pump Station to achieve: Stage 1 400 L/s @ 47m TDH (309 KW); Stage 2 578 L/s @ 50m TDH (450 KW) - PS is currently under construction. Provisional allowance only as scope is subject to further investigation.	LS	1	$ 1,000,000	$ 1,000,000
2.2	Twin pipes out of the PS; will be a more complicated design and configuation to allow for initial operation with one pipe and then final operation with twin pipes; initial pumps 309kW 400L/s and 47.2m H and then additional 145kW 178L/s and 49.92m H				
	Subtotal - Wastewater Pump Stations			**$ 1,000,000**	
	Subtotal - Net Construction Cost Estimate				**$ 7,867,225**
3.0	**MAIN CONTRACTOR OVERHEAD COSTS**				
3.1	**On-site Overheads:**				
3.1A	Pipelines	%	15%	$ 6,867,225	$ 1,030,084
3.1B	Pump Stations	%	20%	$ 1,000,000	$ 200,000
3.2	**Off-site Overheads:**				
	Main Contractor Off-site Overheads and Profit Margin is included in the rates.	LS	1		included
	Subtotal - Main Contractor Overheads		16%	**$ 1,230,084**	
	Subtotal - Gross Construction Cost Estimate				**$ 9,097,309**
4.0	**RISK ALLOWANCES**				
4.1	Allowance for Design Development Contingency	%	20%	$ 9,097,309	$ 1,819,462
4.2	Allowance for Construction Phase Risk Contingency	%	10%	$ 9,097,309	$ 909,731
4.3	FOREX risk on cost of PE pipe supply	%	10%	$ 3,308,850	$ 330,885
4.4	General cost escalation	%	2%		excluded
	Subtotal - Risk Allowances		34%	**$ 3,060,078**	
	Subtotal - Construction Budget				**$ 12,157,386**

CONCEPT STAGE COST ESTIMATE					
Waikato Metro WW DBC					
N4 to Faiping gravity section					
Supply and Installation of PE Pipe, pump station and associated equipment and fittings.					
Item		**Unit**	**Quantity**	**Rate**	**Total - Most Likely**
5.0	**FEES**				
5.1	Professional Fees for design and MSQA	%	8%	$ 12,157,386	$ 972,591
5.2	Client project-related internal costs	%		$ 12,157,386	excluded
5.3	Consenting costs	%		$ 12,157,386	excluded
5.4	Procurement costs	%		$ 12,157,386	excluded
	Subtotal - Fees		8%	**$ 972,591**	
6.0	**PROPERTY COSTS**				
6.1	Property costs - land purchase	LS	0	$ 150,000	excluded
6.2	Property costs - easements	LS	1	$ 50,000	$ 50,000
	Subtotal - Property Costs			**$ 50,000**	
	Rounding	LS	1	$ 23	$ 23
	Total Expected Estimate	**Most Likely**			**$ 13,180,000**
				Check:	$ 13,180,000

Summary	Estimate	% of Base
Base Estimate	**10,540,000**	
Most Likely Estimate (P50)	**13,180,000**	**125%**
P95 Confidence Level Estimate	**15,190,000**	**144%**
Maximum Estimate	**18,390,000**	**174%**

CONCEPT STAGE COST ESTIMATE					
Waikato Metro WW DBC					
N12 to Faiping gravity section					
Supply and Installation of PE Pipe, pump station and associated equipment and fittings.					
Item		**Unit**	**Quantity**	**Rate**	**Total - Most Likely**
1.0	**WASTEWATER RISING MAINS**				
1.1	Supply and install PE100 PN16 rising main generally trenched 0-2.0m deep; including, but not limited to: welding, excavation, bedding, backfilling, and reinstatement outside road.				
1.1A	DN400 PN16	m	1,030	$ 485	$ 499,550
1.2	Extra over for additional deeper trenching 2-3m deep.	m	100	$ 135	$ 13,500
1.3	Extra over item to reinstate sealed road.	m	206	$ 110	$ 22,660
1.4	Extra over item to reinstate berm/unsealed road.	m	824	$ 20	$ 16,480
1.5	Air Valves. Assume offline configuration and located in an above-ground chamber at the side of the road.	each	1	$ 20,000	$ 20,000
1.6	Isolation Valve. Assume direct buried.	each	1	$ 15,000	$ 15,000
1.7	Scour Valves. Assume offline configuration and located in a below-ground chamber at the side of the road.	each	1	$ 20,000	$ 20,000
1.8	Hydrostatic testing of wastewater pipeline.	LS	1	$ 10,000	$ 10,000
	Subtotal - Wastewater Rising Mains			**$ 617,190**	
2.0	**WASTEWATER PUMP STATION**				
	New Pump Station N12.				
2.1	Supply and installation of 3.5m diameter, 5-6m deep pre-fabricated GRP wet well, including cover slab & McBerns type cover. Assumes some local gravity network to be intercepted	LS	1	$ 550,000.00	$ 550,000
2.2	Supply and installation of 3 x submersible sewage pumps; 133kW 155 L/s and 52m head.	LS	1	$ 270,000.00	$ 270,000
2.3	Supply and installation of valve chamber including 3 x non-return valves, 3 x isolation valves	LS	1	$ 210,000.00	$ 210,000
2.4	Electrical installation. Including supply and installation of local cabinet/MCC, supply and installation of level instrumentation, power and comms cabling and ducts from main switchboard, emergency generator connection, and flowmeter in chamber.	LS	1	$ 190,000.00	$ 190,000
2.5	Civil site works.	LS	1	$ 100,000.00	$ 100,000
2.6	Commissioning of pump station	LS	1	$ 5,000.00	$ 5,000
	Subtotal - Wastewater Pump Stations			**$ 1,325,000**	
	Subtotal - Net Construction Cost Estimate				**$ 1,942,190**
3.0	**MAIN CONTRACTOR OVERHEAD COSTS**				
3.1	**On-site Overheads:**				
3.1A	Pipelines	%	15%	$ 617,190	$ 92,579
3.1B	Pump Stations	%	20%	$ 1,325,000	$ 265,000
3.2	**Off-site Overheads:**				
	Main Contractor Off-site Overheads and Profit Margin is included in the rates.	LS	1		included
	Subtotal - Main Contractor Overheads		18%	**$ 357,579**	
	Subtotal - Gross Construction Cost Estimate				**$ 2,299,769**
4.0	**RISK ALLOWANCES**				
4.1	Allowance for Design Development Contingency	%	20%	$ 2,299,769	$ 459,954
4.2	Allowance for Construction Phase Risk Contingency	%	10%	$ 2,299,769	$ 229,977

CONCEPT STAGE COST ESTIMATE					
Waikato Metro WW DBC					
N12 to Faiping gravity section					
Supply and Installation of PE Pipe, pump station and associated equipment and fittings.					
Item		**Unit**	**Quantity**	**Rate**	**Total - Most Likely**
4.3	FOREX risk on cost of PE pipe supply	%	10%	$ 218,360	$ 21,836
4.4	General cost escalation	%	2%		excluded
	Subtotal - Risk Allowances		31%	**$ 711,767**	
	Subtotal - Construction Budget				**$ 3,011,535**
5.0	**FEES**				
5.1	Professional Fees for design and MSQA	%	11%	$ 3,011,535	$ 331,269
5.2	Client project-related internal costs	%		$ 3,011,535	excluded
5.3	Consenting costs	%		$ 3,011,535	excluded
5.4	Procurement costs	%		$ 3,011,535	excluded
	Subtotal - Fees		11%	**$ 331,269**	
6.0	**PROPERTY COSTS**				
6.1	Property costs - land purchase	LS	1	$ 150,000	$ 150,000
6.2	Property costs - easements	LS	1	$ 50,000	$ 50,000
	Subtotal - Property Costs			**$ 200,000**	
	Rounding	LS	1	-$ 2,804	-$ 2,804
	Total Expected Estimate	**Most Likely**			**$ 3,540,000**
				Check:	$ 3,540,000

Summary	**Estimate**	**% of Base**
Base Estimate	**2,980,000**	
Most Likely Estimate (P50)	**3,540,000**	**119%**
P95 Confidence Level Estimate	**3,960,000**	**133%**
Maximum Estimate	**4,910,000**	**165%**

CONCEPT STAGE COST ESTIMATE

Waikato Metro WW DBC

Faiping gravity section to Southern WWTP

Supply and Installation of PE Pipe, pump station and associated equipment and fittings.

Item		Unit	Quantity	Rate	Total - Most Likely
1.0	**WASTEWATER GRAVITY MAIN**				
1.1	Supply and install 750mm nom. RCRRJ Class 4 0-3.0m deep; including, but not limited to: excavation, bedding, backfilling, and reinstatement outside road.				
1.1A	750mm nom. RCRRJ Class 4 including 25mm sacrificial liner.	m	2,150	$ 1,290	$ 2,773,500
1.2	Extra over for additional deeper trenching 3-6m deep.	m	500	$ 180	$ 90,000
1.3	Extra over item to reinstate sealed road.	m	2,150	$ 115	$ 247,250
1.4	Extra over item to reinstate berm/unsealed road.	m	0	$ 20	$ -
1.5	New discharge structure (to receive flows from N4 and N12); allow 4m by 5m plan, 3m deep, 3No incoming pipes with penstocks. Divided into 2No chambers with half height baffle wall; single outlet pipe	LS	1	$ 235,000	$ 235,000
1.6	1350mm dia manholes (assume one every 150 m plus at bends)	each	19	$ 15,000	$ 285,000
1.7	Green dome odour control at discharge structure	each	1	$ 10,000	$ 10,000
	Subtotal - Wastewater Gravity Main			**$ 3,640,750**	
2.0	**WASTEWATER PUMP STATION**				
	None for this section.				
	Subtotal - Wastewater Pump Stations			**$ -**	
	Subtotal - Net Construction Cost Estimate				**$ 3,640,750**
3.0	**MAIN CONTRACTOR OVERHEAD COSTS**				
3.1	**On-site Overheads:**				
3.1A	Pipelines	%	15%	$ 3,640,750	$ 546,113
3.1B	Pump Stations	%	20%	$ -	$ -
3.2	**Off-site Overheads:**				
	Main Contractor Off-site Overheads and Profit Margin is included in the rates.	LS	1		included
	Subtotal - Main Contractor Overheads		15%	**$ 546,113**	
	Subtotal - Gross Construction Cost Estimate				**$ 4,186,863**
4.0	**RISK ALLOWANCES**				
4.1	Allowance for Design Development Contingency	%	20%	$ 4,186,863	$ 837,373
4.2	Allowance for Construction Phase Risk Contingency	%	10%	$ 4,186,863	$ 418,686
4.3	FOREX risk on cost of PE pipe supply	%	10%	$ -	$ -
4.4	General cost escalation	%	2%		excluded
	Subtotal - Risk Allowances		30%	**$ 1,256,059**	
	Subtotal - Construction Budget				**$ 5,442,921**
5.0	**FEES**				
5.1	Professional Fees for design and MSQA	%	8%	$ 5,442,921	$ 435,434
5.2	Client project-related internal costs	%		$ 5,442,921	excluded
5.3	Consenting costs	%		$ 5,442,921	excluded
5.4	Procurement costs	%		$ 5,442,921	excluded
	Subtotal - Fees		8%	**$ 435,434**	
6.0	**PROPERTY COSTS**				
6.1	Property costs - land purchase	LS	1	$ 150,000	$ 150,000
6.2	Property costs - easements	LS	1	$ 50,000	$ 50,000
	Subtotal - Property Costs			**$ 200,000**	

CONCEPT STAGE COST ESTIMATE					
Waikato Metro WW DBC					
Faiping gravity section to Southern WWTP					
Supply and Installation of PE Pipe, pump station and associated equipment and fittings.					
Item		**Unit**	**Quantity**	**Rate**	**Total - Most Likely**
	Rounding	LS	1	$ 1,645	$ 1,645
	Total Expected Estimate	**Most Likely**			**$ 6,080,000**
				Check:	$ 6,080,000

Summary	Estimate	% of Base
Base Estimate	4,920,000	
Most Likely Estimate (P50)	6,080,000	124%
P95 Confidence Level Estimate	7,270,000	148%
Maximum Estimate	8,590,000	175%

CONCEPT STAGE COST ESTIMATE					
Waikato Metro WW DBC					
Route 2 Cambridge to Southern WWTP					
Supply and Installation of PE Pipe, pump station and associated equipment and fittings.					
Item		**Unit**	**Quantity**	**Rate**	**Total - Most Likely**
1.0	**WASTEWATER RISING MAIN**				
1.1	Supply and install PE100 PN10 rising main generally trenched 0-2.0m deep; including, but not limited to: welding, excavation, bedding, backfilling, and reinstatement outside road.				
1.1B	DN710 PN16	m	16,400	$ 1,085	$ 17,794,000
1.2	Extra over for additional deeper trenching 2-3m deep.	m	500	$ 180	$ 90,000
1.3	Extra over item to reinstate sealed road.	m	3,280	$ 115	$ 377,200
1.4	Extra over item to reinstate berm/unsealed road.	m	13,120	$ 20	$ 262,400
1.5	Air Valve. Assume offline configuration and located in an above-ground chamber at the side of the road.	each	17	$ 30,000	$ 510,000
1.6	Isolation Valve. Assume direct buried.	each	3	$ 40,000	$ 120,000
1.7	Scour Valve. Assume offline configuration and located in a below-ground chamber at the side of the road.	each	17	$ 35,000	$ 595,000
1.8	Hydrostatic testing of wastewater pipeline.	LS	1	$ 160,000	$ 160,000
1.9	Allowance for minor stream crossing - none noted	No	0	$ 10,000	$ -
1.10	Allowance for major stream crossing - 2No. Both large culverts/small bridge structures, relatively incised channels. Kaipaki Road and Mystery Creek Road. Separate crossing required, may not be able to be accommodated within existing road reserve. Directional drilling assumed.	No	2	$ 100,000	$ 200,000
	Subtotal - Wastewater Rising Main			**$ 20,108,600**	
2.0	**WASTEWATER PUMP STATION**				
	New Pump Station				
2.1	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 (current diameter doesn't allow for space for the pumps so will be undersized).	LS	1	$ 1,000,000	$ 1,000,000
2.2	Supply and installation of 3 x submersible sewage pumps; 539 kW - 402 L/s and 82m TH.	LS	1	$ 600,000	$ 600,000
2.3	Supply and installation of valve chamber including 3 x non-return valves, 3 x isolation valves.	LS	1		included
2.4	Emergency Storage; 1,689m3, allow for buried GRP tanks manifolded.	LS	1	$ 2,540,000	$ 2,540,000
2.5	Electrical installation. Including supply and installation of local cabinet/MCC, supply and installation of level instrumentation, power and comms cabling and ducts from main switchboard, emergency generator connection, and flowmeter in chamber.	LS	1	$ 400,000	$ 400,000
2.6	Civil site works including a small controls building.	LS	1	$ 200,000	$ 200,000
2.7	Commissioning of pump station.	LS	1	$ 20,000	$ 20,000
	Subtotal - Wastewater Pump Station			**$ 4,760,000**	
	Subtotal - Net Construction Cost Estimate				**$ 24,868,600**
3.0	**MAIN CONTRACTOR OVERHEAD COSTS**				
3.1	**On-site Overheads:**				
3.1A	Pipelines	%	15%	$ 20,108,600	$ 3,016,290

CONCEPT STAGE COST ESTIMATE					
Waikato Metro WW DBC					
Route 2 Cambridge to Southern WWTP					
Supply and Installation of PE Pipe, pump station and associated equipment and fittings.					
Item		**Unit**	**Quantity**	**Rate**	**Total - Most Likely**
3.1B	Pump Stations	%	20%	$ 4,760,000	$ 952,000
3.2	**Off-site Overheads:**				
	Main Contractor Off-site Overheads and Profit Margin is included in the rates.	LS	1		included
	Subtotal - Main Contractor Overheads		16%	**$ 3,968,290**	
	Subtotal - Gross Construction Cost Estimate				**$ 28,836,890**
4.0	**RISK ALLOWANCES**				
4.1	Allowance for Design Development Contingency	%	20%	$ 28,836,890	$ 5,767,378
4.2	Allowance for Construction Phase Risk Contingency	%	10%	$ 28,836,890	$ 2,883,689
4.3	FOREX risk on cost of PE pipe supply	%	10%	$ 11,119,200	$ 1,111,920
4.4	General cost escalation	%	2%		excluded
	Subtotal - Risk Allowances		34%	**$ 9,762,987**	
	Subtotal - Construction Budget				**$ 38,599,877**
5.0	**FEES**				
5.1	Professional Fees for design and MSQA	%	8%	$ 38,599,877	$ 3,087,990
5.2	Client project-related internal costs	%		$ 38,599,877	excluded
5.3	Consenting costs	%		$ 38,599,877	excluded
5.4	Procurement costs	%		$ 38,599,877	excluded
	Subtotal - Fees		8%	**$ 3,087,990**	
6.0	**PROPERTY COSTS**				
6.1	Property costs - land purchase	LS	1	$ 150,000	$ 150,000
6.2	Property costs - easements	LS	1	$ 50,000	$ 50,000
	Subtotal - Property Costs			**$ 200,000**	
	Rounding	LS	1	$ 2,133	$ 2,133
	Total Expected Estimate	**Most Likely**			**$ 41,890,000**
				Check:	$ 41,890,000

Summary	**Estimate**	**% of Base**
Base Estimate	**33,720,000**	
Most Likely Estimate (P50)	**41,890,000**	**124%**
P95 Confidence Level Estimate	**49,610,000**	**147%**
Maximum Estimate	**58,950,000**	**175%**

CONCEPT STAGE COST ESTIMATE					
Waikato Metro WW DBC					
Matangi to Southern WWTP					
Supply and Installation of PE Pipe, pump station and associated equipment and fittings.					
Item		**Unit**	**Quantity**	**Rate**	**Total - Most Likely**
1.0	**WASTEWATER RISING MAIN**				
1.1	Supply and install PE100 PN16 rising main generally trenched 0-2.0m deep; including, but not limited to: welding, excavation, bedding, backfilling, and reinstatement outside road.				
1.1A	DN200 PN16	m	9,680	$ 220	$ 2,129,600
1.2	Extra over for additional deeper trenching 2-3m deep.	m	500	$ 80	$ 40,000
1.3	Extra over item to reinstate sealed road.	m	1,936	$ 95	$ 183,920
1.4	Extra over item to reinstate berm/unsealed road.	m	7,744	$ 10	$ 77,440
1.5	Air Valves. Assume offline configuration and located in an above-ground chamber at the side of the road.	each	10	$ 15,000	$ 150,000
1.6	Isolation Valve. Assume direct buried.	each	3	$ 10,000	$ 30,000
1.7	Scour Valves. Assume offline configuration and located in a below-ground chamber at the side of the road.	each	10	$ 16,000	$ 160,000
1.8	Hydrostatic testing of wastewater pipeline.	LS	1	$ 30,000	$ 30,000
1.9	Allowance for minor stream crossing - 3No. along Tauwhare Road. Should be able to be managed within current road reserve	LS	3	$ 10,000	$ 30,000
2.0	Allowance for major stream crossing - 2No. at the Sh1 intersection. Assumed to be managed as a single directional drill underneath SH1. Waka Kotahi may require a carrier pipe to be provided	LS	1	$ 100,000	$ 100,000
2.1	River crossing - assumed a separate pipe bridge required.	LS	1	$ 200,000	$ 200,000
	Subtotal - Wastewater Rising Main			**$ 3,130,960**	
2.0	**WASTEWATER PUMP STATION**				
	New Pump Station.				
2.1	Package PS assumed with integrated wet well 32KW - 58m TH and 20L/s	LS	1	$ 200,000	$ 200,000
2.2	Supply and installation of valve chamber including 2 x non-return valves, 2 x isolation valves.	LS	1	$ 80,000	$ 80,000
2.3	Emergency Storage; 35m3, allow for 1 x buried GRP tank.	LS	1	$ 200,000	$ 200,000
2.4	Electrical installation. Including supply and installation of local cabinet/MCC, supply and installation of level instrumentation, power and comms cabling and ducts from main switchboard, emergency generator connection, and flowmeter in chamber.	LS	1	$ 160,000	$ 160,000
2.5	Civil site works.	LS	1	$ 100,000	$ 100,000
2.6	Commissioning of pump station.	LS	1	$ 5,000	$ 5,000
	Subtotal - Wastewater Pump Stations			**$ 745,000**	
	Subtotal - Net Construction Cost Estimate				**$ 3,875,960**
3.0	**MAIN CONTRACTOR OVERHEAD COSTS**				
3.1	**On-site Overheads:**				
3.1A	Pipelines	%	15%	$ 3,130,960	$ 469,644
3.1B	Pump Stations	%	20%	$ 745,000	$ 149,000
3.2	**Off-site Overheads:**				
	Main Contractor Off-site Overheads and Profit Margin is included in the rates.	LS	1		included

CONCEPT STAGE COST ESTIMATE					
Waikato Metro WW DBC					
Matangi to Southern WWTP					
Supply and Installation of PE Pipe, pump station and associated equipment and fittings.					
Item		**Unit**	**Quantity**	**Rate**	**Total - Most Likely**
	Subtotal - Main Contractor Overheads		16%	**$ 618,644**	
	Subtotal - Gross Construction Cost Estimate				**$ 4,494,604**
4.0	**RISK ALLOWANCES**				
4.1	Allowance for Design Development Contingency	%	20%	$ 4,494,604	$ 898,921
4.2	Allowance for Construction Phase Risk Contingency	%	10%	$ 4,494,604	$ 449,460
4.3	FOREX risk on cost of PE pipe supply	%	10%	$ 532,400	$ 53,240
4.4	General cost escalation	%	2%		excluded
	Subtotal - Risk Allowances		31%	**$ 1,401,621**	
	Subtotal - Construction Budget				**$ 5,896,225**
5.0	**FEES**				
5.1	Professional Fees for design and MSQA	%	8%	$ 5,896,225	$ 471,698
5.2	Client project-related internal costs	%		$ 5,896,225	excluded
5.3	Consenting costs	%		$ 5,896,225	excluded
5.4	Procurement costs	%		$ 5,896,225	excluded
	Subtotal - Fees		8%	**$ 471,698**	
6.0	**PROPERTY COSTS**				
6.1	Property costs - land purchase	LS	1	$ 150,000	$ 150,000
6.2	Property costs - easements	LS	1	$ 50,000	$ 50,000
	Subtotal - Property Costs			**$ 200,000**	
	Rounding	LS	1	$ 2,077	$ 2,077
	Total Expected Estimate	**Most Likely**			**$ 6,570,000**
				Check:	$ 6,570,000

Summary	**Estimate**	**% of Base**
Base Estimate	**5,400,000**	
Most Likely Estimate (P50)	**6,570,000**	**122%**
P95 Confidence Level Estimate	**7,580,000**	**140%**
Maximum Estimate	**9,250,000**	**171%**

CONCEPT STAGE COST ESTIMATE					
Waikato Metro WW DBC					
Route 4 Ohaupo to Southern WWTP					
Supply and Installation of PE Pipe, pump station and associated equipment and fittings.					
Item		**Unit**	**Quantity**	**Rate**	**Total - Most Likely**
1.0	**WASTEWATER RISING MAIN**				
1.1	Supply and install PE100 PN16 rising main generally trenched 0-2.0m deep; including, but not limited to: welding, excavation, bedding, backfilling, and reinstatement outside road.				
1.1A	DN250 PN16	m	10,000	$ 265	$ 2,650,000
1.2	Extra over for additional deeper trenching 2-3m deep.	m	500	$ 95	$ 47,500
1.3	Extra over item to reinstate sealed road.	m	2,000	$ 100	$ 200,000
1.4	Extra over item to reinstate berm/unsealed road.	m	8,000	$ 15	$ 120,000
1.5	Air Valves. Assume offline configuration and located in an above-ground chamber at the side of the road.	each	9	$ 15,000	$ 135,000
1.6	Isolation Valve. Assume direct buried.	each	5	$ 10,000	$ 50,000
1.7	Scour Valves. Assume offline configuration and located in a below-ground chamber at the side of the road.	each	9	$ 16,000	$ 144,000
1.8	Hydrostatic testing of wastewater pipeline.	LS	1	$ 30,000	$ 30,000
1.9	Allowance for minor stream crossing - 2No. minor, should have sufficient space within current road reserve	No	2	$ 10,000	$ 20,000
1.10	Allowance for major stream crossing just south of SH21 intersection, may be able to be managed within road reserve, directional drilling may be required depending on stream levels.	No	1	$ 50,000	$ 50,000
	Subtotal - Wastewater Rising Main			**$ 3,446,500**	
2.0	**WASTEWATER PUMP STATION**				
	New Pump Station.				
2.1	Supply and installation of a packaged pump station with integrated wet well 56KW - 85m TH and 40L/s.	LS	1	$ 250,000	$ 250,000
2.2	Supply and installation of valve chamber including 2 x non-return valves, 2 x isolation valves.	LS	1	$ 90,000	$ 90,000
2.3	Emergency Storage; 77m3, allow for 1 x buried GRP tank.	LS	1	$ 200,000	$ 200,000
2.4	Electrical installation. Including supply and installation of local cabinet/MCC, supply and installation of level instrumentation, power and comms cabling and ducts from main switchboard, emergency generator connection, and flowmeter in chamber.	LS	1	$ 170,000	$ 170,000
2.5	Civil site works.	LS	1	$ 100,000	$ 100,000
2.6	Commissioning of pump station.	LS	1	$ 5,000	$ 5,000
	Subtotal - Wastewater Pump Station			**$ 815,000**	
	Subtotal - Net Construction Cost Estimate				**$ 4,261,500**
3.0	**MAIN CONTRACTOR OVERHEAD COSTS**				
3.1	**On-site Overheads:**				
3.1A	Pipelines	%	15%	$ 3,446,500	$ 516,975
3.1B	Pump Stations	%	20%	$ 815,000	$ 163,000
3.2	**Off-site Overheads:**				
	Main Contractor Off-site Overheads and Profit Margin is included in the rates.	LS	1		included
	Subtotal - Main Contractor Overheads		16%	**$ 679,975**	
	Subtotal - Gross Construction Cost Estimate				**$ 4,941,475**
4.0	**RISK ALLOWANCES**				

CONCEPT STAGE COST ESTIMATE					
Waikato Metro WW DBC					
Route 4 Ohaupo to Southern WWTP					
Supply and Installation of PE Pipe, pump station and associated equipment and fittings.					
Item		**Unit**	**Quantity**	**Rate**	**Total - Most Likely**
4.1	Allowance for Design Development Contingency	%	20%	$ 4,941,475	$ 988,295
4.2	Allowance for Construction Phase Risk Contingency	%	10%	$ 4,941,475	$ 494,148
4.3	FOREX risk on cost of PE pipe supply	%	10%	$ 840,000	$ 84,000
4.4	General cost escalation	%	2%		excluded
	Subtotal - Risk Allowances		32%	**$ 1,566,443**	
	Subtotal - Construction Budget				**$ 6,507,918**
5.0	**FEES**				
5.1	Professional Fees for design and MSQA	%	8%	$ 6,507,918	$ 520,633
5.2	Client project-related internal costs	%		$ 6,507,918	excluded
5.3	Consenting costs	%		$ 6,507,918	excluded
5.4	Procurement costs	%		$ 6,507,918	excluded
	Subtotal - Fees		8%	**$ 520,633**	
6.0	**PROPERTY COSTS**				
6.1	Property costs - land purchase	LS	1	$ 150,000	$ 150,000
6.2	Property costs - easements	LS	1	$ 50,000	$ 50,000
	Subtotal - Property Costs			**$ 200,000**	
	Rounding	LS	1	$ 1,449	$ 1,449
	Total Expected Estimate	**Most Likely**			**$ 7,230,000**
				Check:	$ 7,230,000

Summary	Estimate	% of Base
Base Estimate	**5,880,000**	
Most Likely Estimate (P50)	**7,230,000**	**123%**
P95 Confidence Level Estimate	**8,430,000**	**143%**
Maximum Estimate	**10,220,000**	**174%**

Waikato Metro DBC Southern Preferred option - Treatment Plants

Cost Estimate Summary

Ref	Description	Capital cost		Starting WWTP		Allowance for re-use assets		Net Capital cost Starting WWTP	
		Most Likely Estimate	P95 Estimate	Most Likely Estimate	P95 Estimate	Most Likely Estimate	P95 Estimate	Most Likely Estimate	P95 Estimate
	Wastewater Treatment Plant Upgrades								
	Stage 1 Southern WWTP	$9,000,000		$8,000,000				$8,000,000	
	Stage 2 Southern WWTP	$54,500,000	$61,700,000	$39,000,000	$44,200,000	$9,000,000	$9,000,000	$30,000,000	$35,200,000
	Stage 3 Southern WWTP	$169,100,000	$187,100,000	$137,000,000	$151,600,000	$33,000,000	$37,020,000	$104,000,000	$114,580,000
	Cambridge WWTP	$112,700,000	$125,000,000	$95,200,000	$105,600,000			$95,200,000	$105,600,000
	Tauwhare Pa Package WWTP (excludes irrigation)	$5,800,000	$7,300,000					$5,800,000	$7,300,000
	TOTAL ESTIMATE	**$351,100,000**	**$381,100,000**						

General Estimate Exclusions

0.0 Goods and services Tax (GST).
0.1 Incurred costs to date.
0.2 Fast track or accelerated programme.
0.3 Work outside normal working hours.
0.4 Professional fees other than those listed.
0.5 Client cost of finance, legal, and accounting fees
0.6 Costs associated with staging of the works.

Project Specific Exclusions

0.7 Council internal costs and Procurement costs (included in PWC cost elements)
0.8 Consenting costs (included in PWC cost elements)
0.9 Relocating existing services. Subject to further investigations
0.10 Restoration work at existing sites
0.11 Landscaping.
0.12 Architectural treatment to exterior of buildings and structures.
0.13 Cost of land purchase and access (easements etc.).
0.14 Costs of impacts associated with extraordinary global events (such as the current COVID-19 outbreak).

Assumptions

0.15 All quantities and dimensions are approximate and are subject to design development.
0.16 The basis of the estimate is the Beca concept design information in the treatment options report including high level layouts and process details.
0.17 Elements of cost included within this estimate are based on costs from similar projects and other Beca cost benchmarks.
0.18 We assume that all of the work will be undertaken by a single ‘Main Contractor’ through a single contract for the project.

Waikato Metro DBC Southern Preferred option - Treatment Plants

Cost Estimate Summary

0.19 We assume that a robust tendering process will be followed and that a minimum of 3 sub-contractor tenders (where possible) are received for the project as part of the agreed procurement process.

0.20 We assume that all works are carried out during normal daytime working hours.

0.21 We assume that the Contractor will have unobstructed access to the whole site throughout the construction phase.

0.22 All base prices are current to November 2020. No allowance for cost escalation has been included in the estimate.

0.23 Professional fees and consent fees are yet to be developed. We have included an allowance in the estimate to cover these anticipated costs.

Expected Estimate Range:

0.24 Estimate range is an indication of the degree to which the final cost outcome for a given project will vary from the estimated cost – it is not an additional Contingency. Range is expressed as a +/- percentage range around the point of estimate after the application of contingency, with a stated level of confidence that the actual cost outcome would fall within this range. As the level of project definition increases and the tender date draws nearer, the expected range of the estimate tends to improve, as indicated by a tighter +/- range.

0.25 The WWTP estimates are deemed to be Class 5 estimates in terms of the AACE Cost Estimate Classification System guidelines. The probable accuracy range of the estimate is likely to be no better than -30% to +50%.

Risks

Risks with a potential cost effect include:

0.26 Design development.

0.27 Geotechnical design development.

0.28 Foreign exchange rates (an allowance for this risk has been included in the estimate).

0.29 General cost escalation.

0.30 Cost associated with revised sequencing or staging of the works.

0.31 Ground conditions and ground water levels and temporary work requirements.

0.32 Working around existing services.

0.33 Cost of land purchase and access (easements etc.).

0.34 Costs of impacts associated with extraordinary global events (such as the current COVID-19 outbreak).

General Considerations and Limitations.

0.35 The estimates above are deemed to be high-level comparative estimates intended for options appraisal.

0.36 These estimates are solely for our Client’s use for the purpose for which they were intended in accordance with the agreed scope of work. They may not be disclosed to any person other than the Client and any use or reliance by any person contrary to the above, to which Beca has not given its prior written consent, is at that person's own risk.

0.37 The high-level cost estimates presented in this section have been developed solely for the purpose of comparing and evaluating competing options. They are sufficiently accurate to serve this purpose. A functional design should be undertaken if a budget estimate is required.

	Project	**Metro DBC Southern WWTPs Development**	
	Phase	Preferred option	
stimate Su	Version	Cambridge Standalone WWTP	
	Purpose	Cost estimation	
	Estimate Class	5	
	Quantities Prepared by	C McRobie	11/11/2020
	Rates Prepared by	C McRobie; J Crawford	11/11/2020
	Reviewed By	R Verbeek	30/11/2020
	Amended		

Basic Dimensions of Plant

Cambridge site	Length:	Width:	Area:	Perim:	Water Depth	Total Volume
Walls		0.4		3620		
Total Site (approx)	368	80	29440	1034		
Inlet Works	30	20	600	100	-	
Primary Treatment	24.0	20	480	88	5	2400
MBR Fine Screens	15.0	10	150			
Reactors	27.0	27.0	729	108	5	3645
Blower/MCC Room	30.0	8.0	240			
MBR tank	18.8	9.4	176	56		
MBR building	38.1	18.8	716	114		
Dewatering Building	40	20	800	120		
Admin Building	20	20	400	80		
Digesters		11.5	499	36	5.75	
Anitamox	12	6	72	36		
Carpark	40	20	800	120		
Maintenance/MCC E	20	20	400	80		
UV Channels	12	3	36	30	2.4	
Current Ponds for fill in			21675			
UV building	6	5	30	22		
Cogen Building	8	6	48	28		

Cambridge WWTP

	Plant Area	Description	Type	Size or Capacity	Unit	Quantity Min	Quantity ML	Quantity Max	Rate Min	Rate ML	Rate Max	Most Likely
1	**Siteworks and Civil**										Civil Subtotal	$10,532,876
1.1	Form & Maintain temporary site access for construction purposes.		C		m2	200	400	800	$25	$30	$45	$12,000
	Council internal costs and Procurement costs (included in PWC cost elements)											
1.2	Platform Development	Site stripping & Tree Removal	C	Unlikely to be any, cambridge site well established	m2	0	736	1,472	$1.50	$3.00	$5.00	$2,208
1.3		Strip contaminated topsoil to landscaping bunds within the site	C	Likely to be majority of site - leftover from previous WWTP	m2	26,496	29,440	29,440	$5.00	$6.00	$7.00	$176,640
1.4		Undercut to stockpile all process unit and building site to -1m	C	Assume 1m deep. Cut to waste on site.	m3	6,860	7,620	8,380	$10	$12	$15	$91,440
		Foundation improvement below subgrade formation level to mitigate potential liquifaction and provide for IL3 structural solution	C		Sum	1	1	1	$3,000,000	$5,000,000	$10,000,000	$5,000,000

	Cambridge WWTP											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
1.5		Supply, place and compact in layers imported fill. Assume AP65 or similar.	C	Assume AP65 or similar - sourced locally.	m3	5,140	5,715	6,860	$70	$90	$100	$514,350
1.6		Recompact excavated granular fill	C	Uplift and place from stockpile immediately adjacent excavation	m3	1,720	1,905	1,520	$10	$12	$15	$22,860
1.7		Allow to install two layers geogrid in recompacted fill	C	Quantitiy multiplies treated area by 2. So, total area of geogrid used.	m2	3,440	3,810	3,040	$5.00	$7.00	$9.00	$26,670
1.8		Spread and roll surplus excavated material somewhere on the wider site <500m.	C		m3	5,140	5,715	17,145	$10	$12	$15	$68,580
		Desludging of existing polishing ponds Majority of site to exist on current pond area. Reclamation of entire pond system.	C	Excavate solids from lagoon (as practicable, based on level of dryness), transport approximately 25 km to Te Awamutu WWTP (569 Paterangi Rd) and dispose in monofill. Include removal of brush in excavation.	m³				$16	$17	$20	$0
		Fill in of ponds	C	assume ponds 2m deep avg Fill with AP65 or similar sourced locally	m³				$70	$90	$100	$0
		Upgrade to formal Entry Gate	C		Sum	1	1	1	$50,000	$65,000	$80,000	$65,000
			C									
1.9	Internal Circulation Road	Around new reactor, PSTs, dewatering MBR and admin building - sealed	C	Allow for basecourse, tarseal & flush nib kerb (but no drainage) 8m wide	m2	3,751	4,689	5,627	$150	$180	$190	$844,038
1.10	Internal Circulation Road	Around plant perimeter - unsealed	C	Allows for basecourse and surfacing (but no nib kerb nor drainage) 8m wide	m2	6,800	7,520	8,300	$30	$45	$200	$338,400
1.11	Security Fencing	Temporary for construction period	C	Including double gates, say 12 months, internal "new" site only	m	827	1,034	1,344	$50	$60	$70	$62,040
1.12	Security Fencing	Upgrade fencing of entire existing site	C	From new access area to behind inlet work. Include two sets of double gates. Manual. Whole site.	m	1,810	3,620	4,706	$75	$120	$180	$434,400
1.13	Create Influent Calamity Pond	Earthworks to form Bund. Grassed, no liner, within existing oxidation pond	C	Likely able to use existing aeration pond, anaerobic pond or other - therefore no upgrade required	m3	0	0	0	$25	$30	$40	$0

	Cambridge WWTP											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
1.14		Sump for return pumping + return ps	C	concrete sump say 3m diameter x 6m deep with apron	Sum	1	1	1	$400,000	$500,000	$1,000,000	$500,000
1.15		Return to ILW Pipeline	C	400mm PE. From sump	m	56	70	140	$300	$400	$450	$28,000
1.16	Operator Building	3604 house: Lab, Lunch room, Bathroom, Operator station, Hall	C		m2	300	400	600	$2,500	$3,000	$3,500	$1,200,000
	Visitor and Staff Car parking		C		m2	640	800	960	$250	$400	$500	$320,000
	Maintenance and Store Building		C		m2	320	400	800	$1,500	$2,000	$2,500	$800,000
1.17	Misc Plant Slabs	Miscellaneous 30MPa 250mm thick plant slabs not allowed for elsewhere.	C	30MPa RC	m2	40	60	100	$375	$438	$500	$26,250
2	**Inlet works**										ILW Subtotal	$4,749,660
2.1	Screening Structure	Includes: Construction, inlet works equipment, odour control system & daywaorks - installed	S	All concrete structures, per linked drawing	Sum	1	1	1	$1,769,062	$1,879,360	$1,989,659	$1,879,360
2.2	Grit	Supply and install new Vortex Grit System Complete Channels, Vortex Chamber, Grit pum. Classifier	M	All SS Construction. Standing on floor of anoxic reactors	Sum	1	1	1	$179,200	$224,000	$291,200	$224,000
2.3		Post Grit Flow Splitter	M	Short SS Channel	Sum	1	1	1	$8,000	$10,000	$20,000	$10,000
2.4		Biofilter	C		Sum	1	1	1	$40,000	$300,000	$660,000	$300,000
2.5		Incoming Flow Meters Incoming x 1, Recycles x 2	I	Average 600mm Mag in Riser to ILW on reactor end wall. No chambers	Sum	2	3	5	$21,600	$27,000	$32,400	$81,000
	Septage receival system	Allowance for upgrade / tie in to existing	C		Sum	1	1	1	$300,000	$500,000	$700,000	$500,000
2.5		Incoming Flow Meters Incoming CBWWTP x 1, Recycles x 2	I	Average 300mm Mag in Riser to ILW on reactor end wall. No chambers	Sum	2	3	5	$17,600	$22,000	$26,400	$66,000
4.01	Pretreatment Structural	Pre treatment area	S	Incl: Fine screening facility, washpress slab, covers, Access stairways and platforms	Sum	1.0	1.0	1.0	$202,400	$253,000	$303,600	$253,000

	Cambridge WWTP											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
4.02	Pretreatment Mechanical	New MBR Fine Screens	M	Centreflow municipal bandscreens (based on 2 screens capable of treating 1800L/s total)	Ea	3	3	4	$91,200	$114,000	$136,800	$342,000
4.03		Launder	M	Supply to site 316L screening launder and receiving distribution box to convey flume water/screenings from the screens to wash presses, c/w screening discharge control knife gates and DN250/300 pipework.	Ea	1	1	1	$125,000	$150,000	$200,000	$150,000
4.04		New screening handling equipment	M	DUTY/STANDBY unit - sized based on feedback from Brickhouse	Ea	2	2	2	$70,000	$88,000	$95,000	$176,000
4.05		Installation of new equipment for pretreatment area only	M		%	10%	15%	20%	$286,200	$352,000	$431,800	$52,800
4.06		Penstocks (pneumatic) Includes: Frames, gates and pneumatic actuators	M	Supply to site 1.5mx3.5m penstock valves for isolation purposes, c/w support frame and supports.	Ea	3	3	3	$19,200	$24,000	$28,800	$72,000
4.07		Stoplogs Includes: SS frames and UHMV polyethylene side seals and neoprene flush invert seal.	M	Supply to site 1.2mx3.5m aluminium stoplogs for isolation purposes	Ea	4	6	6	$8,800	$11,000	$13,200	$66,000
4.08		Redirecting influent from the IPS to the screening facility	M	2x DN450 lines - A/G SS and U/G 475mm PE	m	15	25	35	$2,500	$3,000	$4,500	$75,000
4.09		Redirecting effluent from the facility to the bioreactors	M	2x600-1000mm SS lines - gravtiy lines	m	15	25	35	$5,000	$7,500	$8,500	$187,500
4.10		Isolating valves	M	Valves on redirected influent and effluent lines	Sum	1	1	1	$35,000	$47,000	$71,000	$47,000
4.11		Washwater pipework	M	New SS316 washwater network for equipment	Sum	1	1	1	$8,000	$11,000	$15,000	$11,000
4.12		Odour Control	M	BTF Unit - 12ACH and rated for 1500m3/hr. Inclusive of ducting and fans	Sum	1	1	1	$79,000	$94,000	$110,000	$94,000
4.13	Pretreatment Electrical & Instrumentatio	Electrical general	E	incl. motor control centre to finescreen, allowance for site wide power, instrument and control cabling, cable support and ducting, general lighting and small power	Sum	1	1	1	$95,200	$119,000	$142,800	$119,000
4.14		Instrumentation	I	Software dev. & integration	Sum	1	1	1	$8,000	$16,000	$24,000	$16,000
4.15			I	Flowmeters	ea	1	2	2	$7,000	$8,000	$11,000	$16,000
4.16			I	General instrumentation allowances for level	Sum	1	1	1	$13,000	$12,000	$12,000	$12,000
3	**Primary Treatment**										Primary Subtotal	$5,826,575
	PST Tank Structure	Floors	S	Reinforced Concrete to floors inclusive of concrete, reinforcing and formwork includes strip ftgs	m³	192	240	288	$1,850	$2,000	$2,200	$480,000
		Walls	S	Reinforced Concrete to walls inclusive of concrete, reinforcing and formwork including tall narrow walls	m³	153	191	229	$3,000	$3,500	$4,000	$669,200
		Scum Hopper	S	Allowance for scum hopper concrete works at higher rate than standard floor slab	m³	36	45	53	$2,000	$2,500	$3,000	$111,250
		Galleries / Access Area Allowance	S	On per metre basis	m	16	20	24	$22,000	$25,000	$28,000	$500,000

	Cambridge WWTP											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
	PST Mechanical	Scum hopper	M	Collector with helical mechanism and collection chamber	Sum	4	4	4	$11,200	$14,000	$16,800	$56,000
		Scum scrapers	M	PST longitudinal and cross scrapers	Sum	4	4	4	$53,600	$67,000	$80,400	$268,000
		Primary Effluent discharge weirs	M	Longitudinal V-Notch weirs 316 SS or FRP rectangular weirs * say 15m long. Section say 300 side walls and 300 base width	Sum	4	6	8	$15,000	$20,000	$25,000	$120,000
		Primary sludge pumps	M	Progressive cavity, 2 per PST	ea	8	8	8	$11,200	$14,000	$16,800	$112,000
		PS suction pipework	M	DN150 SS SCH 10	m	40	80	160	$1,250	$2,000	$2,500	$160,000
		PS discharge pipework	M	DN150 SS SCH 10	m	115	130	150	$1,250	$2,000	$2,500	$260,000
		PS discharge valves	M	150mm plug valves	ea	8	8	8	$2,500	$3,500	$4,500	$28,000
		Primary scum pump	M	air driven diaphragm pump, nominal allowance and include connection to compressed air line	ea	4	4	4	$4,000	$5,000	$6,000	$20,000
		Primary scum pipework and valves	M	DN100, discharge into PST line	m	4	4	4	$1,250	$2,000	$2,500	$8,000
		PST drainage system	M	DN150 PVC piping into sump system with pump. Underneath galleries with a DN2000 sump and 2x small drainage pumps. Water returned to headworks.	Sum	4	4	4	$20,000	$25,000	$30,000	$100,000
		Scum removal header and pipework in PST	M		Sum	4	4	4	$24,000	$30,000	$36,000	$120,000
		Scum removal blower	M	2 x blowers per PST to be installed	Sum	8	8	8	$6,400	$8,000	$9,600	$64,000
		Water spray system	M		Sum	4	4	4	$16,000	$20,000	$24,000	$80,000
		PST installation of mechanical equipment	M	PST equipment inside the tank only	%	10%	15%	20%	$64,800	$212,500	$97,200	$31,875
		Vendor support	M		%	5%	10%	15%	$64,800	$212,500	$97,200	$21,250
	PST Electrical	General Electrical Upgrade / PST	E		Sum	4	4	4	$75,000	$100,000	$125,000	$400,000
		Programming and Commissioning	I	PLC SCADA P&C	Sum	4	4	4	$20,000	$30,000	$40,000	$120,000
	PST Testing and Commissioning	Hydrostatic testing	I		Sum	1	1	1	$10,000	$10,000	$15,000	$10,000
		Commissioning of PST	I		Sum	1	1	1	$30,000	$50,000	$65,000	$50,000
	Interstage Pumpstation	Allowance for IPS	M	PST to Reactors	Sum	1	1	1	$1,629,600	$2,037,000	$2,444,400	$2,037,000
3	**Reactor**										Reactor Subtotal:	$8,034,492
3.01	Reactor Structure	Reinforced Concrete to floors inclusive of concrete, reinforcing and formwork	S	Total tank block area x 0.5 500mm floor thickness	m3	333	365	437	$1,850	$2,000	$2,200	$729,000
3.02		Reinforced Concrete to walls inclusive of concrete, reinforcing and formwork	S	400mm wall thickness	m3	492	546	656	$3,000	$3,500	$4,000	$1,912,680
3.03		Walkways between reactor zones	S	Webforge open grating 4kPa, all MSG	m2	90	108	162	$1,000	$1,100	$1,500	$118,800
3.04		Handrails around reactor walkways	S	Mono wills, 2m c-c, 2 Rail + Kicker MSG	m	180	216	324	$350	$400	$500	$86,400
3.05		2 x Staircase from ground level 6m up towalkways on top of reactor walls	S	Webforge open grating 4kPa, all MSG	m rise	10	11	12	$3,500	$3,720	$4,000	$40,920

	Cambridge WWTP												
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
3.09		R/C Tilt slab blower & MCC building	S	30m x 8m (1 x 50m wall shared with reactor), 12m x 8m blowers + 8m x 8m for MCC. Metal roofing on steel framing with precast walls on concrete slab.	m2	192	240	288	$2,500	$3,000	$3,500	$720,000
3.06	Reactor Mech.	Mixers	M	1 per pre-annox, 2 per main reactor	ea	10	12	18	$18,000	$25,000	$40,000	$300,000
3.07	Reactor Mech.	Internal A-Recycle pipe Laid on reactor base)	M	900mm dia, PN8 PE pipe length of reactor. Laid on reactor floor through wall penetrations.	m	99	123	148	$750	$1,000	$1,250	$123,200
3.08	Reactor Mech.	A-Recycle pump & strap on flow meter	M	Supply and install	ea	4	4	4	$24,000	$30,000	$36,000	$120,000
3.10	Reactor Mech.	Blowers, complete with hot air extraction system/cooling fans, air inlet louvres, silencers and acoustic shrouds, isolation & NRVs	M	55 kW Blowers - from ATV model	ea	4	4	4	$50,000	$73,000	$125,000	$292,000
3.07	Reactor Mech.	Diffusers and main aeration pipework complete with grid pipework, support system, control valves & isolation valves	M	Supply and install	Sum	4	4	4	$310,400	$388,000	$465,600	$1,552,000
3.08	Reactor Mech.	MLSS Line from Reactors to MBR	M	assume 600mm diameter	m	40	47	56	$2,500	$3,000	$4,500	$141,000
3.09	Reactor Mech.	Instrumentation	I		Sum	1	1	1	$96,000	$120,000	$144,000	$120,000
3.11	Reactor Mech.	Weir plates	M		Sum	1	1	1	$5,000	$7,500	$10,000	$7,500
3.08	Reactor Mech.	Pipework, valves etc.	M		Sum	4	4	4	$93,600	$117,000	$140,400	$468,000
3.09	Reactor Mech.	Penstocks, valves etc.	M		Sum	4	4	4	$31,200	$39,000	$46,800	$156,000
	Reactor Electrical	Upgrade of the electrical system	E		Sum	4	4	4	$147,000	$163,000	$211,000	$652,000
	Reactor Electrical	Programming and commissioning	E		Sum	4	4	4	$25,000	$33,000	$41,000	$132,000
	Reactor Electrical	Hardware (MCC Drives, Starters PLC IO)	E		Sum	4	4	4	$26,000	$31,045	$62,091	$124,181
	Reactor Electrical	Cabling (Power and control incl installation)	E		Sum	4	4	4	$13,000	$15,523	$31,045	$62,091
	Reactor Electrical	Installation labour	E		Sum	4	4	4	$20,000	$23,881	$47,762	$95,524
	Reactor Electrical	PLC/SCADA P&C	E		Sum	4	4	4	$17,000	$20,299	$40,598	$81,196
4	**MBR**										MBR Subtotal:	$14,780,696
4.17		Includes: Concrete structure floor slab with reinforcing and allowances for formwork	S	New MBR tank to suit the requirements of the MBR system vendor Assume 3 trains, 0.35 thk	m³	53	62	74	$1,850	$2,000	$2,200	$123,319

	Cambridge WWTP											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
4.18	MBR Tank Structural	Includes: Concrete structure reinforced walls with allowances for formwork and tall narrow channel dividing walls	S	300mm thick walls	m³	112	123	135	$3,000	$3,500	$4,000	$429,615
4.19		Foundation ring beam - Includes: Concrete structure floor slab with reinforcing and allowances for formwork	S	800 to 1000mm x 350mm ground beams	m³	16	20	24	$1,850	$2,000	$2,200	$39,436
4.20		Coating System to concrete	S	Coating system to be applied to all walls and floors in the MBR flow splitter & membrane tanks	Sum	1	1	1	$1,040,000	$1,040,000	$1,386,667	$1,040,000
4.21		Overhead Crane	S	Overhead crane over the MBR Tank area	Sum	1	1	1	$237,000	$356,000	$474,000	$356,000
4.22		Handrail	S		m	56	56	75	$350	$400	$500	$22,535
4.23		Staircases and Platforms	S	Access staircase onto tank	Sum	1	2	3	25,000	$50,000	$75,000	$100,000
4.24		Grating system over tank	S	FRP or equivalent	m2	159	159	174	$725	$1,000	$1,500	$158,553
4.25		Mechanical Equipment	M	Sump pumps and mixers	Sum	1	1	1	$271,000	$323,000	$338,000	$323,000
4.26		Stoplogs and Penstocks	M	SS Penstocks and Aluminium stoplogs	Sum	1	1	1	$79,000	$110,000	$157,000	$110,000
4.27	MBR Process Building Structural	Steel structure with PC Panel construction - building to house all MBR equipment. Rate inclusive of HVAC, fire protection and plumbing and drainage.	S	38m x 18m building	m²	358	716	860	$2,000	$3,000	$3,500	$2,148,840
4.28	Permeate Tank Foundations	Includes: Concrete structure floor slab with reinforcing and allowances for formwork	S	12x15m slab - 300mm thick	m³	54	54	81	$1,850	$2,000	$2,200	$108,000
4.29	RAS Pumpstation Foundations	Includes: Concrete structure floor slab with reinforcing and allowances for formwork	S	12x18m slab - 200mm thick	m³	43	43	65	$1,850	$2,000	$2,200	$86,400
4.30	MBR Tank Mechanical	MBR Equipment, RAS pumps and permeate tanks	M	incl. UF Filtration system - cassette hollow fibre units with all necessary pumping equipment, valves and controls Dry mount submersible pumps 30kL SS304 tanks	Sum	1.0	1.0	1.0	$3,958,000	$4,609,000	$6,189,000	$4,609,000
4.31		Installation of above	M		%	10%	13%	20%	$4,609,000	$4,609,000	$4,609,000	$599,170
4.32		Permeate Pipework from Cassettes to Pumps	M	SS316 Sch10 pipework - rate to include supports. Pipes nominal 3m in the air DN500 pipes	m	72	90	108	$1,250	$1,750	$2,500	$157,500
4.33		Permeate Pipework from Pumps with connection to Final Effluent Line - Above ground	M	SS316 Sch10 pipework - rate to include supports. Pipes nominal 3m in the air DN800 FRP or SS header	m	20	30	40	$1,200	$4,000	$6,400	$120,000
4.34		Permeate Pipework from Pumps with connection to Final Effluent Line - Belowground	M	FRP Pipework DN1000 FRP	m	72	90	135	$2,500	$3,000	$5,000	$270,000
4.35		MBR Aeration Pipework	M	SS316 Sch10 pipework - rate to include supports - pipes nominal 3m in the air 2 x DN 600	m	86	96	144	$2,500	$3,000	$4,500	$288,000

	Cambridge WWTP											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
4.36		RAS pumpstation pipework	M	SS316 Sch10 pipework - rate to include supports - pipes nominal 3m in the air 4 x 500mm SS lines from PS above ground	m	240	300	360	$3,750	$5,000	$5,500	$1,500,000
4.37		RAS pumpstation pipe bridge	M	HDG MS Pipe bridge. Rate to include foundations	Ea	8	12	16	$15,000	$25,000	$30,000	$300,000
4.38		Valves	M	Manual isolating valves	Sum	1	1	1	$300,000	$590,000	$880,000	$590,000
4.39		Stopboards	M	Aluminium stoplogs/boards - nominal 4-5m deep	Sum	1	1	1	$170,000	$240,000	$400,000	$240,000
		MBR Mech Installation Allowance	M	Installation of the above mech. Items	%	10%	13%	20%	$871,750	$871,750	$871,750	$113,328
4.40	MBR Electrical	Electrical general incl. MCC, cable supports, cables, materials, effort	E	All sums scaled down from Pukete using 2/3 power law. Most instrumentation will be provided with MBR system already	Sum	1	1	1	$470,000	$783,000	$1,565,000	$783,000
4.41		Instrumentation	I		Sum	1	1	1	$32,000	$47,000	$63,000	$47,000
4.42		Controls	I		Sum	1	1	1	$16,000	$47,000	$63,000	$47,000
4.43		Programming and FAT	I		Sum	1	1	1	$16,000	$24,000	$32,000	$24,000
4.44		Process Commissioning	I		Sum	1	1	1	$32,000	$47,000	$63,000	$47,000
5	**Tertiary Treatment**										UV Subtotal	$2,830,250
5.1	Disinfection											
5.2	UV Channel	Bottom of channel, incl 1 x channels	S	RC Slab 350mm thick	m³	15	16	24	$1,850	$2,000	$2,200	$32,550
5.3		2 x Channel walls + allowance for inlet and outlet structures	S	RC walls 250mm thick	m³	14	16	19	$2,000	$3,000	$3,500	$47,700
5.4	UV Plant House	Allowance for UV Plant House	S	3604 100mm Mesh Slab. 90x45 Framing, PB insulated, Ply Lining, Steel cladding. No windows. Heat pump.	m2	24	30	36	$1,000	$2,000	$3,500	$60,000
5.5	UV Disinfection Plant	Supply and Install UV Modules.	M	Trojan Signa Modules ex Napier quote	Sum	1	1	1	$508,500	$565,000	$734,500	$565,000
5.6	UV Electrical	Electrical General	E	General allowance for non-included electrical; tie-in	Sum	1	1	1	$100,000	$125,000	$150,000	$125,000
	Outfall / Disposal											
5.7	Outfall pipeline		C	PE DN600	m	400	500	800	$2,000	$3,000	$4,000	$1,500,000
5.8	Outfall Diffuser	Allowance for complete outfall diffuser	C	Installed in river	Sum	1	1	1	$400,000	$500,000	$1,000,000	$500,000
6	**Digestion & Gas**										Digestion Subtotal	$11,894,564
6.01			S	Site Concrete	m²	415	415	789	$20	$50	$75	$20,774

	Cambridge WWTP											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
6.02	4 x 600m3 Digesters Structural	11.5m diameter tank - ring beam foundations	S	RC Floor Slab (400 thick)	m³	665	665	1263	$2,000	$2,200	$2,500	$1,462,474
6.03			S	Ring Beam (1.5m wide and 750mm thick)	m³	184	184	368	$2,000	$2,200	$2,500	$404,323
6.04		Precast Panels -supply and errect (250mm t	S	11.5m Diameter Tank - Precast panels with post tensioning. Tank walls are 6m high. Walls are insulated	m³	117	130	264	$2,000	$3,000	$3,500	$351,101
6.05		Post tensioning of walls	S		Sum	3	4	5	$75,000	$100,000	$150,000	$400,000
6.06		DIGESTER ROOF	S	11.5m diameter - min & max to include floating and membrane options	Ea	4	4	4	$67,000	$460,000	$750,000	$1,840,000
6.06		Digester Insulation - excluding cladding	S		Sum	3	4	5	$59,586	$71,503	$94,587	$286,012
6.07		Staircase and platform allowances	S		Sum	1	1	1	$50,250	$67,000	$83,750	$67,000
6.08		Architectural Features	S		Sum	4	4	4	$80,800	$101,000	$121,200	$404,000
6.09		Allowance for gallery	S	Allowance for gallery or like	Sum	1	1	1	$65,000	$95,000	$125,000	$95,000
6.10	Digester Pump Room Structural	Pump room based on Pukete Acid Digester Pump Room and scaled up for digestion volume of 6000m³ total - refer to existing drawings for information assume 22 x 17m	S	Insitu Site Concrete	m²	374	374	374	$20	$50	$75	$18,700
6.11			S	Insitu RC Floor Slab (500 thick)	m³	187	187	187	$1,850	$2,000	$2,200	$374,000
6.12		Pump room based on Acid Digester Pump Room - refer to existing drawings for information	S	Precast Panels -supply and errect (350mm average thickness	m³	98	98	147	$2,000	$3,000	$3,500	$294,000
6.13			S	Precast Panels for the roof -supply and errect (300mm average thick)	m2	280	280	420	$3,000	$4,000	$4,500	$1,120,280
6.14		Allowances for building structure ontop of pum	S	Tilt slab panel system with architectural features	m³	158	158	237	$3,500	$4,000	$4,500	$632,400
6.15		Sludge Feed Pumps	M	Borger Pumps	ea	4	6	6	$8,800	$11,000	$13,200	$66,000
6.16		Digester Outlet/Supernatant pumps	M	Submersibles	ea	4	6	6	$5,600	$7,000	$8,400	$42,000
6.17		Heat exchangers	M	Lackeryby or Spiral	ea	3	4	5	$51,200	$64,000	$76,800	$256,000
6.18		Recirculation pumps	M	Submersibles	ea	3	4	5	$5,600	$7,000	$8,400	$28,000
6.19		Hotwater Circulation Pumps	M	Single stage centrifugal	ea	4	6	6	$3,200	$4,000	$4,800	$24,000

	Cambridge WWTP												
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
6.20	Digester Mechanical	Digester Mixing Pumps	M	Dry mounted submersibles per existing	ea	12	16	16	$9,000	$ 20,000.00	$30,000	$320,000
6.21		Supernatant wetwell	M	FRP wet well with external pumps	Sum	1	1	1	$50,000	$75,000	$100,000	$75,000
6.22		Digester feed pipework	M	SS Sch 10 piping - DN150	m	50	125	150	$1,000	$1,250	$1,500	$156,250
6.23		Digester Supernatant pipework	M	SS Sch 10 piping - DN150	m	50	65	70	$1,000	$1,250	$1,500	$81,250
6.24		Digester Mixing pipework	M	SS Sch 10 piping - DN150 - Fully insulated	Sum	3	4	5	$ 87,000.00	$ 106,000.00	$ 125,000.00	$424,000
6.25		Hotwater Circulation Network	M	Insulated mild steel pipework - DN150	m	100	250	300	$1,000	$1,500	$2,000	$375,000
6.26		Isolation valves - digester valving only	M	Plug valves	ea	60	80	100	$2,500	$3,500	$5,000	$280,000
6.27		Tie into existing system	M	Various tie-ins	Sum	1	1	1	$20,000	$30,000	$40,000	$30,000
6.28		Installation of mechanical equipment	M		%	10%	15%	20%	736,000	736,000	736,000	$110,400
	Digester Electrical	Electrical upgrades	E		Sum	1	1	1	$93,600	$117,000	$140,400	$117,000
		Instrumentation and Controls	I		Sum	1	1	1	$80,800	$101,000	$121,200	$101,000
		Programming and FAT	I		Sum	1	1	1	$76,000	$95,000	$114,000	$95,000
		Digestion Process Commissioning	E		Sum	1	1	1	$80,800	$101,000	$121,200	$101,000
	Gas Handling	Cogen Building	S		m²	43	48	72	$3,500	$4,000	$4,500	$192,000
		RC Slab	S	250mm thk	m³	11	12	18	$1,850	$2,000	$2,200	$21,600
		Mechanical Equipment. Based on 110kW electricity available in ATV model digester sheet	M	Incl: Biogas scrubber/gas conditioning, Biogas Engine, Heat dump, installation, and pipework	Sum	1	1	1	$577,000	$961,000	$1,963,000	$961,000
		Electrical - General for Cogen	E	Incl: General tie into main MCC, P&C, instrumentation, power change over and controls.	Sum	1	1	1	$169,000	$268,000	$422,000	$268,000
7	**Solids Handling**										Dewatering Subtotal	$4,922,000
7.01	Dewatering Building		S		m²	720	800	960	$2,500	$3,000	$3,500	$2,400,000
7.02	Dewatering Mechanical	FRP Pumpstation	M	Allowance for FRP Pumpstation	Sum	1	1	1	$180,000	$200,000	$240,000	$200,000
7.03	Dewatering	Polymer Make up and feed system	M		Sum	1	1	1	$1,537,600	$1,922,000	$2,883,000	$1,922,000
7.04		Allowance for drainage facilities	C									
7.05		Centrifuges	M									
7.06		Load Out Screws	M									
7.07		Dewatered Cake skips	M	12m3 Skip bin for moving by hook Truck		3	4	5	$50,000	$100,000	$150,000	$400,000
7.08		Sludge Holding Tank	M	2 tanks, 2 days storage from digestion	Sum	2	2	2	$59,200	$74,000	$88,800	$148,000

	Cambridge WWTP											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
	Odour destruction System	use same as for inlet works										
8	**Anitamox Centrate Treatment**										Anitamox Subtotal	$2,216,650
8.1	Insitu Concrete - for tank											
	Site Concrete	5x10m tank which is 3m tall x 2	S		m2	100	110	209	$20	$50	$75	$5,000
	RC Floor Slab (250 thick)		S		m³	25	28	52	$1,850	$2,000	$2,200	$50,000
	Ring Beam (1.5m wide and 500mm th		S		m³	45	50	94	$1,850	$2,000	$2,200	$90,000
	Precast Concrete- for tank											
	Precast Panels -supply and errect (25(	Precast panels . Tank walls are 4m high	S		m³	24	26	39	$2,000	$3,000	$3,500	$70,875
	Staircase and platform allowances	Per around the digester	S		Sum	1	1	1	$75,000	$100,000	$125,000	$100,000
	Insitu Concrete - for blower building											
	Site Concrete	5x5m building - to be acoustically treated	S		m2	6	6	11	$20	$50	$75	$275
	RC Floor Slab (250 thick)		S		m³	1	2	3	$1,850	$2,000	$2,200	$2,750
	Building - moderate construction		S		m³	20	25	35	$2,500	$3,500	$4,000	$70,000
	MBBR Equipment	MBBR equipment for Anammox side stream treatment	M	Based on quotation from Veolia - ANITA MOX process	Sum	1	1	1	$1,168,200	$1,298,000	$1,947,000	$1,298,000
	Effluent tranfer wetwell	FRP wet well with external pumps	M	2m diameter - assume 3m deep	Sum	1	1	1	$34,000	$51,000	$68,000	$51,000
	Pumps to transfer the effluent from the MBBR tank back to the headworks	Submersibles	M		ea	2	3	3	$3,333	$5,000	$6,667	$15,000
	Aeration Blowers	Nominal allowance - 3000m3/hr - 30kW blowers	M		ea	2	3	3	$4,714	$11,000	$15,714	$33,000
	Aeration piping	SS Sch 10 piping - DN300	M	10-25m of pipework	m	10	25	50	$1,500	$2,000	$2,500	$50,000
	Tie into existing system	Various tie-ins	M	Nominal allowance for connecting to existing system	Sum	1	1	1	$6,667	$10,000	$13,333	$10,000
	Installation of mechanical equipment		M		%	1,210,248	1,365,000	2,037,381	10%	15%	20%	$204,750
	Pipework from the new pumpstation to tl	New 225 PE100 return line - includes trenching	M		Sum	1	1	1	$8,000	$16,000	$24,000	$16,000
	Electrical upgrades		E		Sum	1	1	1	$31,333	$47,000	$62,667	$47,000
	Instrumentation and Controls		I		Sum	1	1	1	$16,000	$32,000	$48,000	$32,000
	Programming and FAT		I		Sum	1	1	1	$16,000	$24,000	$32,000	$24,000
	Process Commissioning		E		Sum	1	1	1	$31,333	$47,000	$266,667	$47,000
6	**Electrical & Control**										Electrical General Subtotal	$1,821,000
6.1	Electrical - General	MCC	E	1000kVa	Sum	1	1	1	$628,800	$786,000	$1,021,800	$786,000
6.2		Incomer	E									
6.3		Software	E									
6.4		Allowance for Site wide power, Instrument and control cabling, cable support & ducting	E									
6.5		General Lighting and small power	E	Small DBs, task & security lighting, 3 Ph task outlets								
6.6	Control	Instrumentation, HMI, SCADA, PLC, Telemetry	I			1	1	1	$240,000	$300,000	$390,000	$300,000

	Cambridge WWTP											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
6.7		Software	I		Sum	1	1	1	$93,000	$173,000	$259,000	$173,000
					Sum							
6.7	Electrical Ancilliaries	Standby Generator	M	1000kVA	Sum	1	1	1	$419,400	$466,000	$605,800	$466,000
6.8		Fire Prevention or Extinguisher System	M	VESDA Early Alarm system + Inert Gas Supression system	Sum	1	1	1	$20,000	$30,000	$120,000	$30,000
6.9		Transformer Blast wall	S		m2	6	9	12	$300	$1,000	$1,200	$9,000
6.10		Allowance to have Network company supply new 1000kVA transformer	E	1000kVA	sum	1	1	1	0	$57,000	$113,000	$57,000
7	**Other Utilities**											
7.1		Misc site services, drainage, etc	C		Sum	1	1	1	$20,000	$25,000	$50,000	$25,000
8	**Sub-Total - Physical Works**									%		**$67,781,763**
8.1	Contractor Preliminary & General		OH		%	$67,781,763	$67,781,763	$67,781,763	20%	25%	30%	$16,945,441
	Brown Field Development	Allow ance for greenfield development complications, temporary pipes, temporary process configurations, non ideal plant layout	OH		%	$0	$0	$0	3%	7%	10%	$0
8.2	Design and Project Management	Concept design	F		Sum	$84,727,204	$84,727,204	$84,727,204	1%	2%	3%	$1,694,544
8.3		Preliminary & detailed design	F			$84,727,204	$84,727,204	$84,727,204	6.0%	7.5%	11%	$6,354,540
8.4		Procurement	F			$84,727,204	$84,727,204	$84,727,204				$0
8.5		Construction supervision	F			$84,727,204	$84,727,204	$84,727,204	3%	4%	6%	$3,389,088
8.6		Council Internal costs	F			$84,727,204	$84,727,204	$84,727,204				$0
	Consents & Investigations											
8.7		Site Survey & Prep Terrain Model	F		Sum	1	1	1	$6,000	$6,000	$10,000	$6,000
8.8		HAIL Investigation & Consent	F		Sum	1	1	1	$16,000	$18,000	$26,000	$18,000
		Site Designation	F		Sum				$0	$0	$0	$0

	Cambridge WWTP											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
8.9		Discharge Consent	F		Sum				$1,000,000	$1,400,000	$1,800,000	$0
8.1		Geotechnical Investigations & Interpretation	F		Sum	1	1	1	$30,000	$40,000	$60,000	$40,000
9	**Gross Construction Cost Estimate**											**$96,229,377**
10	**Allowances for Risk Register Items and Residual Uncertainty**											
10.1	Saturated construction market		RA		Sum	$96,229,377	$96,229,377	$96,229,377	0	5%	10%	$4,811,469
10.2	FOREX Risk	Foreign exchange risk on imported M&E plant	RA		Sum	$30,007,764	$30,007,764	$30,007,764	-10%	5%	15%	$1,500,388
10.3	Allowance for Design Development Contingency		CA		Sum	$96,229,377	$96,229,377	$96,229,377	0%	5%	10%	$4,811,469
10.4	Allowance for Construction Phase Risk Contingency		CA		Sum	$96,229,377	$96,229,377	$96,229,377	0%	5%	10%	$4,811,469
		GAS Storage vessel - risk allowance	M	If need additional storage to digester roof	Sum	0	1	1	$400,000	$500,000	$600,000	$500,000
11	**Total Expected Cost Estimate**										19%	**$112,664,171**

Cambridge WWTP

Plant Area	Description	Type	Size or Capacity	Unit	Quantity Min	Quantity ML	Quantity Max	Rate Min	Rate ML	Rate Max	Most Likely
Asset Type Totals - Most Likely		**Code**			**Respread**	**Total**				**Cost Breakdown (Direct only)**	
Direct Works	Civil	C	$ 13,357,876	12%	$8,682,475	$22,040,351	20%			Civil	$10,532,876
	Structural	S	$ 23,035,123	20%	$14,972,581	$38,007,704	34%			Inlet Works	$4,749,660
	Mechanical	M	$ 26,510,773	24%	$17,231,716	$43,742,488	39%			Primary Treatment	$5,826,575
	Electrical	E	$ 3,996,992	4%	$2,598,002	$6,594,993	6%			Reactors	$8,034,492
	Control & Instrumentation	I	$ 1,381,000	1%	$897,635	$2,278,635	2%			MBR	$14,780,696
										UV+ outfall	$2,830,250
Indirect Works	Main Contractor Overheads	OH	$ 16,945,441	15%						Digestion	$11,894,564
	Fees & Investigations	F	$ 11,502,173	10%						Solids Handling	$4,922,000
	Discrete Risk Allowances	RA	$ 6,311,857	6%						Electrical General	$1,821,000
	Contingency Allowances	CA	$ 9,622,938	9%						Other Utilities	$25,000
	Direct Works Total		**$ 68,281,763**	61%							
	Indirect Works Total		**$ 44,382,408**	39%							
	Total Expected Cost Estimate		**$ 112,664,171**	100%		**$112,664,171**	100%				
		Check 1:	$0								
		Check 2:	$0								

		% of Base
Base Estimate	**91,819,076**	
Most Likely Estimate (P50)	**112,664,171**	**123%**
P95 Confidence Level Estimate	**124,964,566**	**136%**
Maximum Estimate	**178,700,002**	**195%**

	Project	**Metro DBC Southern WWTPs Development**	
	Phase	Preferred option	
stimate Su	Version	Southern WWTP - Stage 2	
	Purpose	Cost estimation	
	Estimate Class	5	
	Quantities Prepared by	C McRobie	11/11/2020
	Rates Prepared by	C McRobie, J Crawford	11/11/2020
	Reviewed By	R Verbeek	30/11/2020
	Amended		

Basic Dimensions of Plant

Southern site	Length:	Width:	Area:	Perim:	Water Depth	Total Volume
Walls		0.4				
Total Site	200	140	28000	680		
Inlet Works	20	20	400	80	-	
Primary Treatment			0	0		0
MBR Fine Screens	12.0	8	96	40		
Reactors	23.2	22.5	522	91	4.5	2349
Blower/MCC Room	25.0	8.0	200	66		
MBR tank	18.8	6.2	117	50		
MBR building	18.5	17.4	322	72		
Dewatering Building	30	15	450	90		
Carpark	20	30	600	100		
Admin Building	15	10	150	50		
SHT		4	60	13	4	241
UV Building	12	6	72	36		
Maintenance/MCC b	20	20	400	80		

Southern WWTP Stage 2 - Airport and Matangi

	Plant Area	Description	Type	Size or Capacity	Unit	Quantity Min	Quantity ML	Quantity Max	Rate Min	Rate ML	Rate Max	Most Likely
1	**Siteworks and Civil**										Civil Subtotal	$6,765,818
1.1	Form & Maintain temporary site access for construction purposes.		C		m2	100	200	400	$25	$30	$45	$6,000
1.2	Platform Development	Site stripping & Tree Removal	C	Site not decided, as little as zero and as much as whole site	m2	0	14,000	28,000	$1.50	$3.00	$5.00	$42,000
		Strip contaminated topsoil to landscaping bunds within the site	C		m2	0	14,000	28,000	$5.00	$6.00	$7.00	$84,000
0.1		Undercut to stockpile all process unit and building site to -1m	C	Assume 1m deep. Cut to waste on site.	m3	3,370	3,740	4,490	$10	$12	$15	$44,880
		Foundation improvement below subgrade formation level to mitigate potential liquifaction and provide for IL3 structural solution	C		Sum	1	1	1	1,500,000	2,000,000	4,000,000	$2,000,000
0.2	Council internal costs and Procurement	Supply, place and compact in layers imported fill. Assume AP65 or similar.	C	Assume AP65 or similar - sourced locally.	m3	2,520	2,805	3,370	$70	$90	$100	$252,450
0.3		Recompact excavated granular fill	C	Uplift and place from stockpile immediately adjacent excavation	m3	850	935	1,120	$10	$12	$15	$11,220

	Southern WWTP Stage 2 - Airport and Matangi											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
0.4		Allow to install two layers geogrid in recompacted fill	C	Quantitiy multiplies treated area by 2. So, total area of geogrid used.	m2	1,700	1,870	2,240	$5.00	$7.00	$9.00	$13,090
0.5		Spread and roll surplus excavated material somewhere on the wider site <500m.	C		m3	2,520	2,805	8,415	$10	$12	$15	$33,660
		Entry from Public Road	C	Allow for basecourse, tarseal & flush nib kerb (but no drainage) 8m wide	m2	1,000	2,000	8,000	$150	$180	$190	$360,000
		Ditto - Drainage for entry	C		m	125	250	1,000	$100	$150	$300	$37,500
		Formal Entry Gate	C		Sum	1	1	1	$50,000	$65,000	$80,000	$65,000
0.6	Internal Circulation Road	Around new reactor, PSTs, dewatering MBR and admin building - sealed	C	Allow for basecourse, tarseal & flush nib kerb (but no drainage) 8m wide	m2	3,131	3,914	4,697	$150	$180	$190	$704,568
1.10	Internal Circulation Road	Around plant perimeter - unsealed	C	Allows for basecourse and surfacing (but no nib kerb nor drainage) 8m wide	m2	4,900	5,440	6,000	$30	$45	$200	$244,800
1.11	Security Fencing	Temporary for construction period	C	Including double gates, say 12 months	m	544	680	884	$50	$60	$70	$40,800
1.12	Security Fencing	Fencing of the new site	C	From new access area to behind inlet work. Include two sets of double gates. Manual. Whole site.	m	340	680	884	$75	$120	$180	$81,600
1.13	Create Influent Calamity Pond	Earthworks to form Bund. Grassed, no liner, within existing oxidation pond	C	Approx 9000 m3 storage x ave 1.5m deep 150m long bund, 2m high, 2:1 side slopes and 4m top width	Sum	0	1	1	$400,000	$600,000	$1,200,000	$600,000
1.13		Sump for return pumping	C	Fully formed concrete sump say 3m diameter x 3m deep with apron	Sum	1	1	1	$300,000	$400,000	$800,000	$400,000
1.14		Return to ILW Pipeline	C	400mm PE approx	m	56	70	140	$300	$400	$450	$28,000
	Visitor and Staff Car parking		C		m2	480	600	720	$250	$400	$500	$240,000
	Maintenance and Store Building		C		m2	320	400	800	$2,000	$2,500	$3,500	$1,000,000
1.15	Operator Building	3604 house: Lab, Lunch room, Bathroom, Operator station, Hall	C		m2	113	150	225	$2,500	$3,000	$3,500	$450,000

	Southern WWTP Stage 2 - Airport and Matangi											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
1.16	Misc Plant Slabs	Miscellaneous 30MPa 250mm thick plant slabs not allowed for elsewhere.	C	30MPa RC	m2	40	60	100	$375	$438	$500	$26,250
2	**Inlet works**										ILW Subtotal	$3,650,700
2.1	Screening Structure	Includes: Construction, inlet works equipment, odour control system & daywaorks - installed	S	All concrete structures, per linked drawing	Sum	1	1	1	$1,003,000	$1,065,500	$1,128,000	$1,065,500
2.2	Grit	Supply and install new Vortex Grit System Complete Channels, Vortex Chamber, Grit pum. Classifier	M	All SS Construction. Standing on floor of anoxic reactors	Sum	1	2	2	$84,000	$105,000	$136,500	$210,000
2.3		Post Grit Flow Splitter	M	Short SS Channel	Sum	1	1	1	$20,000	$30,000	$40,000	$30,000
2.4		Biofilter	C		Sum	1	1	1	$40,000	$300,000	$660,000	$300,000
2.5		Incoming Flow Meters Incoming x 1, Recycles x 2	I	Average 300mm Mag in Riser to ILW on reactor end wall. No chambers	Sum	3	4	5	$14,400	$18,000	$21,600	$72,000
4.01	MBR Pretreatment Structural	Pre treatment area	S	Incl: Fine screening facility, washpress slab, covers, Access stairways and platforms	Sum	1.0	1.0	1.0	$115,200	$144,000	$172,800	$144,000
4.02		New MBR Fine Screens	M	Centreflow municipal bandscreens (based on 2 screens capable of treating 1800L/s total)	Ea	2	3	4	$240,000	$300,000	$360,000	$900,000
4.03		Launder	M	Supply to site 316L screening launder and receiving distribution box to convey flume water/screenings from the screens to wash presses, c/w screening discharge control knife gates and DN250/300 pipework.	Ea	1	1	1	$125,000	$150,000	$200,000	$150,000
4.04		New screening handling equipment	M	DUTY/STANDBY unit - sized based on feedback from Brickhouse	Ea	2	2	2	$70,000	$88,000	$95,000	$176,000
4.05		Installation of new equipment for pretreatment area only	M		%	10%	15%	20%	$435,000	$538,000	$655,000	$80,700
4.06		Penstocks (pneumatic) Includes: Frames, gates and pneumatic actuators	M	Supply to site 1.5mx3.5m penstock valves for isolation purposes, c/w support frame and supports.	Ea	3	3	3	$11,200	$14,000	$16,800	$42,000
4.07	MBR Pretreatment Mechanical	Stoplogs Includes: SS frames and UHMV polyethylene side seals and neoprene flush invert seal.	M	Supply to site 1.2mx3.5m aluminium stoplogs for isolation purposes	Ea	4	6	6	$4,800	$6,000	$7,200	$36,000
4.08		Redirecting influent from the IPS to the screening facility	M	2x DN450 lines - A/G SS and U/G 475mm PE	m	15	25	35	$2,500	$3,000	$4,500	$75,000
4.09		Redirecting effluent from the facility to the bioreactors	M	2x600-1000mm SS lines - gravtiy lines	m	15	25	35	$5,000	$7,500	$8,500	$187,500
4.10		Isolating valves	M	Valves on redirected influent and effluent lines	Sum	1	1	1	$20,000	$27,000	$41,000	$27,000

	Southern WWTP Stage 2 - Airport and Matangi											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
4.11	MBR Pretreatment Electrical & Instrume	Washwater pipework	M	New SS316 washwater network for equipment	Sum	1	1	1	$5,000	$7,000	$9,000	$7,000
4.12		Odour Control	M	BTF Unit - 12ACH and rated for 1500m3/hr. Inclusive of ducting and fans	Sum	1	1	1	$45,000	$54,000	$63,000	$54,000
4.13		Electrical general	E	incl. motor control centre to finescreen, allowance for site wide power, instrument and control cabling, cable support and ducting, general lighting and small power	Sum	1	1	1	$54,400	$68,000	$81,600	$68,000
4.14		Instrumentation	I	Software dev. & integration	Sum	1	1	1	$5,000	$9,000	$14,000	$9,000
4.15			I	Flowmeters	ea	1	2	2	$4,000	$5,000	$7,000	$10,000
4.16			I	General instrumentation allowances for level	Sum	1	1	1	$4,000	$7,000	$7,000	$7,000
3	**Reactor**										Reactor Subtotal:	$6,477,190
3.01	Reactor Structure	Reinforced Concrete to floors inclusive of concrete, reinforcing and formwork	S	Total tank block area x 0.5 500mm floor thickness	m3	261	313	376	$1,850	$2,000	$2,200	$626,400
3.02		Reinforced Concrete to walls inclusive of concrete, reinforcing and formwork	S	400mm wall thickness	m3	337	375	450	$3,000	$3,500	$4,000	$1,311,100
3.03		Walkways between reactor zones	S	Webforge open grating 4kPa, all MSG	m2	76	91	137	$1,000	$1,100	$1,500	$100,540
3.04		Handrails around reactor walkways	S	Mono wills, 2m c-c, 2 Rail + Kicker MSG	m	152	183	274	$350	$400	$500	$73,120
3.05		2 x Staircase from ground level 6m up towalkways on top of reactor walls	S	Webforge open grating 4kPa, all MSG	m rise	9	10	12	$3,500	$3,720	$4,000	$37,200
3.09		R/C Tilt slab blower & MCC building	S	25m x 8m (1 x 25m wall shared with reactor), 12m x 8m blowers + 8m x 8m for MCC. Metal roofing on steel framing with precast walls on concrete slab.	m2	160	200	240	$2,500	$3,000	$3,500	$600,000
3.06	Reactor Mech.	Mixers	M	1 per pre-annox, 2 per main reactor	ea	7	9	14	$18,000	$25,000	$40,000	$225,000
3.07		Internal A-Recycle pipe Laid on reactor base)	M	450mm dia, PN8 PE pipe length of reactor. Laid on reactor floor through wall penetrations.	m	72	90	108	$750	$1,000	$1,250	$89,600
3.08		A-Recycle pump & strap on flow meter	M	Supply and install	ea	3	3	3	$36,000	$45,000	$54,000	$135,000
3.10		Blowers, complete with hot air extraction system/cooling fans, air inlet louvres, silencers and acoustic shrouds, isolation & NRVs	M	30 kW Blowers - from ATV model	ea	5	5	6	$30,000	$49,000	$100,000	$245,000
3.07		Diffusers and main aeration pipework complete with grid pipework, support system, control valves & isolation valves	M	Supply and install	Sum	4	4	4	$264,000	$330,000	$396,000	$1,320,000

	Southern WWTP Stage 2 - Airport and Matangi											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
3.08		MLSS Line from Reactors to MBR	M	assume 600mm diameter	m	56	70	84	$650	$750	$1,000	$52,500
3.09		Instrumentation	I		Sum	1	1	1	$108,000	$135,000	$162,000	$135,000
3.11		Weir plates	M		Sum	1	1	1	$5,000	$7,500	$10,000	$7,500
3.08		Pipework, valves etc.	M		Sum	4	4	4	$80,000	$100,000	$120,000	$400,000
3.09		Penstocks, valves etc.	M		Sum	4	4	4	$27,200	$34,000	$40,800	$136,000
	Reactor Electrical	Upgrade of the electrical system	E		Sum	4	4	4	$125,000	$139,000	$180,000	$556,000
		Programming and commissioning	E		Sum	4	4	4	$21,000	$28,000	$35,000	$112,000
		Hardware (MCC Drives, Starters PLC IO)	E		Sum	4	4	4	$23,000	$27,463	$54,926	$109,853
		Cabling (Power and control incl installation)	E		Sum	4	4	4	$12,000	$14,329	$28,657	$57,315
		Installation labour	E		Sum	4	4	4	$17,000	$20,299	$40,598	$81,196
		PLC/SCADA P&C	E		Sum	4	4	4	$14,000	$16,717	$33,433	$66,867
4	**MBR**										MBR Subtotal:	$8,838,490
4.17	MBR Tank Structural	Includes: Concrete structure floor slab with reinforcing and allowances for formwork	S	New MBR tank to suit the requirements of the MBR system vendor	m³	35	41	49	$1,850	$2,000	$2,200	$82,213
4.18		Includes: Concrete structure reinforced walls with allowances for formwork and tall narrow channel dividing walls	S	300mm thick walls, 2 trains	m³	82	90	99	$3,000	$3,500	$4,000	$315,066
4.19		Foundation ring beam - Includes: Concrete structure floor slab with reinforcing and allowances for formwork	S	800 to 1000mm x 350mm ground beams	m³	14	18	21	$1,850	$2,000	$2,200	$35,062
4.20		Coating System to concrete	S	Coating system to be applied to all walls and floors in the MBR flow splitter & membrane tanks	Sum	1	1	1	$690,000	$690,000	$920,000	$690,000
4.21		Overhead Crane	S	Overhead crane over the MBR Tank area	Sum	1	1	1	$181,000	$272,000	$362,000	$272,000
4.22		Handrail	S		m	50	50	67	$350	$400	$500	$20,036
4.23		Staircases and Platforms	S	Access staircase onto tank	Sum	1	2	3	25,000	$50,000	$75,000	$100,000
4.24		Grating system over tank	S	FRP or equivalent	m2	106	106	116	$725	$1,000	$1,500	$105,702
4.25		Mechanical Equipment	M	Sump pumps and mixers	Sum	1	1	1	$91,000	$109,000	$103,000	$109,000
4.26		Stoplogs and Penstocks	M	SS Penstocks and Aluminium stoplogs	Sum	1	1	1	$45,000	$63,000	$89,000	$63,000

	Southern WWTP Stage 2 - Airport and Matangi											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
4.27	MBR Process Building Structural	Steel structure with PC Panel construction - building to house all MBR equipment. Rate inclusive of HVAC, fire protection and plumbing and drainage.	S	12m x 38m building	m²	322	322	386	$2,000	$3,000	$3,500	$965,543
4.28	Permeate Tank Foundations	Includes: Concrete structure floor slab with reinforcing and allowances for formwork	S	5 x 8m slab - 300mm thick	m³	12	12	18	$1,850	$2,000	$2,200	$24,000
4.29	RAS Pumpstation Foundations	Includes: Concrete structure floor slab with reinforcing and allowances for formwork	S	6x9m slab - 200mm thick	m³	11	11	16	$1,850	$2,000	$2,200	$21,600
4.30	MBR Tank Mechanical	MBR Equipment, RAS pumps and permeate tanks	M	incl. UF Filtration system - cassette hollow fibre units with all necessary pumping equipment, valves and controls Dry mount submersible pumps 30kL SS304 tanks	Sum	1.0	1.0	1.0	$2,250,000	$2,620,000	$3,518,000	$2,620,000
4.31		Installation of above	M		%	10%	13%	20%	$2,620,000	$2,620,000	$2,620,000	$340,600
4.32		Permeate Pipework from Cassettes to Pumps	M	SS316 Sch10 pipework - rate to include supports. Pipes nominal 3m in the air DN400 pipes	m	42	52	78	$1,429	$2,000	$2,857	$104,000
4.33		Permeate Pipework from Pumps with connection to Final Effluent Line - Above ground	M	SS316 Sch10 pipework - rate to include supports. Pipes nominal 3m in the air DN600 FRP or SS header	m	20	30	40	$900	$3,000	$4,800	$90,000
4.34		Permeate Pipework from Pumps with connection to Final Effluent Line - Belowground	M	FRP Pipework DN800 FRP	m	32	40	60	$1,667	$2,000	$3,333	$80,000
4.35		MBR Aeration Pipework	M	SS316 Sch10 pipework - rate to include supports - pipes nominal 3m in the air 2 x DN 600	m	88	110	132	$2,500	$3,000	$4,500	$330,000
4.36		RAS pumpstation pipework	M	SS316 Sch10 pipework - rate to include supports - pipes nominal 3m in the air 3 x 450mm SS lines from PS above ground	m	196	245	294	$3,500	$4,750	$5,250	$1,163,750
4.37		RAS pumpstation pipe bridge	M	HDG MS Pipe bridge. Rate to include foundations	Ea	6	9	12	$15,000	$25,000	$30,000	$225,000
4.38		Valves	M	Manual isolating valves	Sum	1	1	1	$170,000	$335,000	$500,000	$335,000
4.39		Stopboards	M	Aluminium stoplogs/boards - nominal 4-5m deep	Sum	1	1	1	$90,000	$140,000	$230,000	$140,000
		MBR Mech Installation Allowance	M	Installation of the above mech. Items	%	10%	13%	20%	$514,750	$514,750	$514,750	$66,918
4.40	MBR Electrical	Electrical general incl. MCC, cable supports, cables, materials, effort	E	All sums scaled down from Pukete using 2/3 power law. Most instrumentation will be provided with MBR system already	Sum	1	1	1	$267,000	$445,000	$890,000	$445,000
4.41		Instrumentation	I		Sum	1	1	1	$18,000	$27,000	$36,000	$27,000
4.42		Controls	I		Sum	1	1	1	$9,000	$27,000	$36,000	$27,000

	Southern WWTP Stage 2 - Airport and Matangi											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
4.43		Programming and FAT	I		Sum	1	1	1	$9,000	$14,000	$18,000	$14,000
4.44		Process Commissioning	I		Sum	1	1	1	$18,000	$27,000	$36,000	$27,000
5	**Tertiary Treatment**										UV Subtotal	$3,836,000
5.1	Disinfection											
5.2	UV Plant House	Allowance for UV Plant House	S	3604 100mm Mesh Slab. 90x45 Framing, PB insulated, Ply Lining, Steel cladding. No windows. Heat pump.	m2	97	108	162	$1,500	$2,000	$3,500	$216,000
5.3	UV Disinfection Plant	Supply and Install UV Reactor, floor mounted, enclosed	M	Trojan Signa Modules ex Gisborne quote	Sum	1	1	1	$625,500	$695,000	$903,500	$695,000
5.4	UV Electrical	Electrical General	E	General allowance for non-included electrical; tie-in	Sum	1	1	1	$100,000	$125,000	$150,000	$125,000
6	**Outfall / Disposal**											
	Outfall pipeline	From WWTP to river (site TBC)	C	PE DN450	m	500	1000	2000	$2,000	$2,300	$3,000	$2,300,000
	Outfall Diffuser	Allowance for complete outfall diffuser	C	Installed in river	Sum	1	1	1	$400,000	$500,000	$1,000,000	$500,000
7	**Solids Handling**										Dewatering Subtota	$3,006,000
7.1	Dewatering Building		S		m²	405	450	540	$2,500	$3,000	$3,500	$1,350,000
7.2	Dewatering Mechanical	FRP Pumpstation	M	Allowance for FRP Pumpstation	Sum	1	1	1	$180,000	$200,000	$240,000	$200,000
7.3	Dewatering	Polymer Make up and feed system	M		Sum	1	1	1	$744,000	$930,000	$1,395,000	$930,000
7.4		Allowance for drainage facilities	C									
7.5		***Screwpresses***	M									
		Feed Pumps	M									
		Pipework, valves etc.	M									
7.6		Load Out Screws	M									
7.7		Dewatered Cake skips	M	12m3 Skip bin for moving by hook Truck		3	4	5	$50,000	$100,000	$150,000	$400,000
7.8		Sludge Holding Tank	M	2 tanks, 2 days storage forWAS approx 400m³	Sum	2	2	2	$50,400	$63,000	$75,600	$126,000
	Odour destruction System	use same as for inlet works										
6	**Electrical & Control**										Electrical General Sub	$1,496,000
6.1	Electrical - General	MCC	E	500kVa.	Sum	1	1	1	$468,000	$585,000	$760,500	$585,000
6.2		Incomer	E									
6.3		Software	E									
6.4		Allowance for Site wide power, Instrument and control cabling, cable support & ducting	E									
6.5		General Lighting and small power	E	Small DBs, task & security lighting, 3 Ph task outlets								
6.6	Control	Instrumentation, HMI, SCADA, PLC, Telemetry	I			1	1	1	$240,000	$300,000	$390,000	$300,000

	Southern WWTP Stage 2 - Airport and Matangi											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
6.7		Software	I		sum	1	1	1	$68,000	$126,000	$189,000	$126,000
6.7	Electrical Ancilliaries	Standby Generator	M	300kVa., assume 1000kW	Sum	1	1	1	$306,000	$340,000	$442,000	$340,000
6.8		Fire Prevention or Extinguisher System	M	VESDA Early Alarm system + Inert Gas Supression system	Sum	1	1	1	$80,000	$100,000	$120,000	$100,000
6.9		Transformer Blast wall	S		m2	6	9	12	$300	$1,000	$1,200	$9,000
6.10		Allowance to have Network company supply new 500kVA transformer	E	500kVA	sum	1	1	1	0	$36,000	$71,000	$36,000
7	**Other Utilities**											
7.1		Misc site services, drainage, etc	C		Sum	1	1	1	$20,000	$25,000	$50,000	$25,000
8	**Sub-Total - Physical Works**									%		**$34,095,197**
8.1	Contractor Preliminary & General		OH		%	$34,095,197	$34,095,197	$34,095,197	15%	20%	25%	$6,819,039
8.2	Design and Project Management	Concept design	F		Sum	$40,914,237	$40,914,237	$40,914,237	1%	2%	3%	$818,285
8.3		Preliminary & detailed design	F			$40,914,237	$40,914,237	$40,914,237	6%	8%	10%	$3,273,139
8.4		Procurement	F			$40,914,237	$40,914,237	$40,914,237				$0
8.5		Construction supervision	F			$40,914,237	$40,914,237	$40,914,237	3%	4%	6%	$1,636,569
8.6		Council Internal costs	F			$40,914,237	$40,914,237	$40,914,237				$0
	Consents & Investigations											
8.7		Site Survey & Prep Terrain Model	F		Sum	1	1	1	$6,000	$6,000	$10,000	$6,000
8.8		HAIL Investigation & Consent	F		Sum	1	1	1	$16,000	$18,000	$26,000	$18,000
		Site Designation	F		Sum				$300,000	$500,000	$700,000	$0
8.9		Discharge Consent	F		Sum				$600,000	$1,000,000	$1,400,000	$0
8.1		Geotechnical Investigations & Interpretation	F		Sum	1	1	1	$30,000	$40,000	$60,000	$40,000
9	**Gross Construction Cost Estimate**											**$46,706,230**
10	**Allowances for Risk Register Items and Residual Uncertainty**											
10.1	Saturated construction market		RA		Sum	$46,706,230	$46,706,230	$46,706,230	0	5%	10%	$2,335,311
10.2	FOREX Risk	Foreign exchange risk on imported M&E plant	RA		Sum	$15,286,297	$15,286,297	$15,286,297	-10%	5%	15%	$764,315
10.3	Allowance for Design Development Contingency		CA		Sum	$46,706,230	$46,706,230	$46,706,230	0%	5%	10%	$2,335,311

	Southern WWTP Stage 2 - Airport and Matangi											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
10.4	Allowance for Construction Phase Risk Contingency		CA		Sum	$46,706,230	$46,706,230	$46,706,230	0%	5%	10%	$2,335,311
11	**Total Expected Cost Estimate**										19%	**$54,476,479**

Southern WWTP Stage 2 - Airport and Matangi

Plant Area	Description	Type	Size or Capacity	Unit	Quantity Min	Quantity ML	Quantity Max	Rate Min	Rate ML	Rate Max	Most Likely
Asset Type Totals - Most Likely		**Code**			**Respread**	**Total**				**Cost Breakdown (Direct only)**	
Direct Works	Civil	C	$ 9,890,818	18%	$5,912,491	$15,803,308	29%			Civil	$6,765,818
	Structural	S	$ 8,164,082	15%	$4,880,290	$13,044,373	24%			Inlet Works	$3,650,700
	Mechanical	M	$ 13,044,068	24%	$7,797,427	$20,841,495	38%			Reactors	$6,477,190
	Electrical	E	$ 2,242,230	4%	$1,340,351	$3,582,580	7%			MBR	$8,838,490
	Control & Instrumentation	I	$ 754,000	1%	$450,723	$1,204,723	2%			UV & outfall	$3,836,000
										Solids Handling	$3,006,000
Indirect Works	Main Contractor Overheads	OH	$ 6,819,039	13%						Electrical General	$1,496,000
	Fees & Investigations	F	$ 5,791,993	11%						Other Utilities	$25,000
	Discrete Risk Allowances	RA	$ 3,099,626	6%							$34,095,197
	Contingency Allowances	CA	$ 4,670,623	9%							
	Direct Works Total		**$ 34,095,197**	63%							
	Indirect Works Total		**$ 20,381,282**	37%							
	Total Expected Cost Estimate		**$ 54,476,479**	100%		**$54,476,479**	100%				
		Check 1:	$0								
		Check 2:	$0								

		% of Base
Base Estimate	**42,842,966**	
Most Likely Estimate (P50)	**54,476,479**	**127%**
P95 Confidence Level Estimate	**61,614,836**	**144%**
Maximum Estimate	**90,252,138**	**211%**

	Project	**Metro DBC Southern WWTPs Development**	
	Phase	Preferred option	
stimate Su	Version	Southern WWTP Stage 3	
	Purpose	Cost estimation	
	Estimate Class	5	
	Quantities Prepared by	C McRobie	11/11/2020
	Rates Prepared by	C McRobie; J Crawford	11/11/2020
	Reviewed By	R Verbeek	30/11/2020
	Amended		

Basic Dimensions of Plant

Southern site	Length:	Width:	Area:	Perim:	Water Depth	Total Volume
Walls		0.4				
Total Site	250	220	55000	940		
Inlet Works	30	20	600	100	-	
Primary Treatment	40.0	30	1200	140	5	6000
MBR Fine Screens	15.0	10	150	50		
Reactors	50.0	40.0	2000	180	5	10000
Blower/MCC Room	30.0	8.0	240	76		
MBR tank	18.8	21.9	411	81		
MBR building	38.1	18.8	718	114		
Dewatering Building	45	15	675	120		
Admin Building	20	20	400	80		
Anitamox	16	8	128	48		
Digesters		16	965	50		
Carpark	40	20	800	120		
Maintenance/MCC F	30	20	600	100		
UV Channels	13	4	52	34	2.4	
UV Building	6	5	30	22		
Cogen Building	9	7	63	32		

Stage

Southern WWTP Stage 3 - Airport, Matangi and Southern Hamilton

	Plant Area	Description	Type	Size or Capacity	Unit	Quantity Min	Quantity ML	Quantity Max	Rate Min	Rate ML	Rate Max	Most Likely
											Civil Subtotal	$10,006,123
0.1	Form & Maintain temporary site access for construction purposes.		C		m2	200	400	800	$25	$30	$45	$12,000
0.2	Council internal costs and Procurement	Site stripping & Tree Removal	C	Site not decided, as little as zero and as much as whole site	m2	0	27,500	55,000	$1.50	$3.00	$5.00	$82,500
0.3		Strip contaminated topsoil to landscaping bunds within the site	C		m2	0	27,500	55,000	$5.00	$6.00	$7.00	$165,000
0.4		Undercut to stockpile all process unit and building site to -1m	C	Assume 1m deep. Cut to waste on site.	m3	10,050	11,170	12,290	$10	$12	$15	$134,040
		Foundation improvement below subgrade formation level to mitigate potential liquifaction and provide for IL3 structural solution	C		Sum	1	1	1	$2,000,000	$3,000,000	$5,000,000	$3,000,000

	Southern WWTP Stage 3 - Airport, Matangi and Southern Hamilton											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
0.5		Supply, place and compact in layers imported fill. Assume AP65 or similar.	C	Assume AP65 or similar - sourced locally.	m3	7,540	8,378	10,050	$70	$90	$100	$753,975
0.6		Recompact excavated granular fill	C	Uplift and place from stockpile immediately adjacent excavation	m3	2,510	2,793	2,240	$10	$12	$15	$33,510
0.7		Allow to install two layers geogrid in recompacted fill	C	Quantitiy multiplies treated area by 2. So, total area of geogrid used.	m2	5,020	5,585	4,480	$5.00	$7.00	$9.00	$39,095
0.8		Spread and roll surplus excavated material somewhere on the wider site <500m.	C		m3	7,540	2,234	6,702	$10	$12	$15	$26,808
		Entry from Public Road	C	Allow for basecourse, tarseal & flush nib kerb (but no drainage) 8m wide	m2	1,000	2,000	8,000	$160	$180	$190	$360,000
		Drainage for entry	C		m	125	250	1,000	$150	$250	$300	$62,500
		Formal Entry Gate	C		Sum	1	1	1	$50,000	$65,000	$80,000	$65,000
0.9	Internal Circulation Road	Around new reactor, PSTs, dewatering MBR and admin building - sealed	C	Allow for basecourse, tarseal & flush nib kerb (but no drainage) 8m wide	m2	5,512	6,890	8,268	$160	$180	$190	$1,240,245
1.10	Internal Circulation Road	Around plant perimeter - unsealed, max sealed	C	Allows for basecourse and surfacing (but no nib kerb nor drainage) 8m wide	m2	6,800	7,520	8,300	$30	$50	$200	$376,000
1.11	Security Fencing	Temporary for construction period	C	Including double gates, say 12 months	m	752	940	1,222	$50	$60	$70	$56,400
1.12	Security Fencing	Fencing of the new site	C	From new access area to behind inlet work. Include two sets of double gates. Manual. Whole site.	m	470	940	1,222	$75	$120	$180	$112,800
1.13	Create Influent Calamity Pond	Earthworks to form Bund. Grassed, no liner, within existing oxidation pond	C	Approx 9000 m3 storage x ave 1.5m deep 150m long bund, 2m high, 2:1 side slopes and 4m top width	Sum	0	1	1	$400,000	$600,000	$1,200,000	$600,000
1.14		Sump for return pumping	C	Fully formed concrete sump say 3m diameter x 3m deep with apron	Sum	1	1	1	$400,000	$500,000	$1,000,000	$500,000

	Southern WWTP Stage 3 - Airport, Matangi and Southern Hamilton											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
1.15		Return to ILW Pipeline	C	400mm PE approx	m	80	100	200	$300	$400	$450	$40,000
1.16	Operator Building	3604 house: Lab, Lunch room, Bathroom, Operator station, Hall	C		m2	300	400	600	$2,500	$3,000	$3,500	$1,200,000
	Visitor and Staff Car parking		C		m2	640	800	960	$250	$400	$500	$320,000
	Maintenance and Store Building		C		m2	320	400	800	$1,500	$2,000	$2,500	$800,000
1.17	Misc Plant Slabs	Miscellaneous 30MPa 250mm thick plant slabs not allowed for elsewhere.	C	30MPa RC	m2	40	60	100	$375	$438	$500	$26,250
2	**Inlet works**										ILW Subtotal	$9,252,583
2.1	Screening Structure	Includes: Construction, inlet works equipment, odour control system & dayworks - installed	S	All concrete structures, per linked drawing	Sum	1	1	1	$3,574,517	$3,797,383	$4,020,249	$3,797,383
2.2	Grit	Supply and install new Vortex Grit System Complete Channels, Vortex Chamber, Grit pum. Classifier	M		Sum	1	2	2	$298,400	$373,000	$484,900	$746,000
2.3		Post Grit Flow Splitter	M		Sum	1	1	1	$20,000	$30,000	$40,000	$30,000
2.4		Biofilter	C		Sum	1	1	1	$80,000	$600,000	$1,850,000	$600,000
2.5		Incoming Flow Meters Incoming x 1, Recycles x 2	I	Average 800mm Mag in Riser to ILW on reactor end wall. No chambers	Sum	2	3	5	$25,600	$32,000	$38,400	$96,000
	Septage receival system	Full septage reception w/ below ground pit, and pump station	C	Allowance for septage reception per Gisborne costs: incl Huber facility	Sum	1	1	1	$900,000	$1,000,000	$1,200,000	$1,000,000
4.01	MBR Pretreatment Structural	Pre treatment area	S	Incl: Fine screening facility, washpress slab, covers, Access stairways and platforms	Sum	1.0	1.0	1.0	$407,200	$509,000	$610,800	$509,000
4.02		New MBR Fine Screens	M	Centreflow municipal bandscreens (based on 3 screens capable of treating 1800L/s total)	Ea	3	3	4	$240,000	$300,000	$360,000	$900,000
4.03		Launder	M	Supply to site 316L screening launder and receiving distribution box to convey flume water/screenings from the screens to wash presses, c/w screening discharge control knife gates and DN250/300 pipework.	Ea	1	1	1	$125,000	$150,000	$200,000	$150,000

	Southern WWTP Stage 3 - Airport, Matangi and Southern Hamilton											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
4.04	MBR Pretreatment Mechanical	New screening handling equipment	M	DUTY/STANDBY unit - sized based on feedback from Brickhouse	Ea	2	2	2	$70,000	$88,000	$95,000	$176,000
4.05		Installation of new equipment for pretreatment area only	M		%	10%	15%	20%	$435,000	$538,000	$655,000	$80,700
4.06		Penstocks (pneumatic) Includes: Frames, gates and pneumatic actuators	M	Supply to site 1.5mx3.5m penstock valves for isolation purposes, c/w support frame and supports.	Ea	3	3	3	$38,400	$48,000	$57,600	$144,000
4.07		Stoplogs Includes: SS frames and UHMV polyethylene side seals and neoprene flush invert seal.	M	Supply to site 1.2mx3.5m aluminium stoplogs for isolation purposes	Ea	4	6	6	$16,800	$21,000	$25,200	$126,000
4.08		Redirecting influent from the IPS to the screening facility	M	2x DN450 lines - A/G SS and U/G 475mm PE	m	15	25	35	$2,500	$3,000	$4,500	$75,000
4.09		Redirecting effluent from the facility to the bioreactors	M	2x600mm SS lines - gravtiy lines	m	15	25	35	$5,000	$7,500	$8,500	$187,500
4.10		Isolating valves	M	Valves on redirected influent and effluent lines	Sum	1	1	1	$70,000	$95,000	$142,000	$95,000
4.11		Washwater pipework	M	New SS316 washwater network for equipment	Sum	1	1	1	$16,000	$23,000	$29,000	$23,000
4.12		Odour Control	M	BTF Unit - 12ACH and rated for 1500m3/hr. Inclusive of ducting and fans	Sum	1	1	1	$158,000	$189,000	$221,000	$189,000
4.13	MBR Pretreatment Electrical & Instrumentation	Electrical general	E	incl. motor control centre to finescreen, allowance for site wide power, instrument and control cabling, cable support and ducting, general lighting and small power	Sum	1	1	1	$192,000	$240,000	$288,000	$240,000
4.14		Instrumentation	I	Software dev. & integration	Sum	1	1	1	$16,000	$32,000	$48,000	$32,000
4.15			I	Flowmeters	ea	1	2	2	$13,000	$16,000	$23,000	$32,000
4.16			I	General instrumentation allowances for level	Sum	1	1	1	$13,000	$24,000	$24,000	$24,000
3	**Primary Treatment**										Primary Subtotal	$9,853,675
		Floors	S	Reinforced Concrete to floors inclusive of concrete, reinforcing and formwork includes strip ftgs	m³	600	600	720	$1,850	$2,000	$2,200	$1,200,000

Southern WWTP Stage 3 - Airport, Matangi and Southern Hamilton												
Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
					Min	**ML**	**Max**	**Min**	**ML**	**Max**	
PST Tank Structure	Walls	S	Reinforced Concrete to walls inclusive of concrete, reinforcing and formwork including tall narrow walls	m³	229	287	344	$3,000	$3,500	$4,000	$1,003,800
	Scum Hopper	S	Allowance for scum hopper concrete works at higher rate than standard floor slab. 25m wide total, 2m x 1m deep	m³	60	65	70	$3,000	$3,500	$4,000	$225,750
	Galleries / Access Area Allowance	S	On per metre basis	m	24	28	32	$22,000	$25,000	$28,000	$700,000
PST Mechanical	Scum hopper	M	Collector with helical mechanism and collection chamber	Sum	4	4	4	$18,400	$23,000	$27,600	$92,000
	Scum scrapers	M	PST longitudinal and cross scrapers	Sum	4	4	4	$91,200	$114,000	$136,800	$456,000
	Primary Effluent discharge weirs	M	Longitudinal V-Notch weirs 316 SS or FRP rectangular weirs * say 15m long. Section say 300 side walls and 300 base width	ea	4	6	8	$15,000	$20,000	$25,000	$120,000
	Primary sludge pumps	M	Progressive cavity, 2 per PST	ea	8	8	8	$18,400	$23,000	$27,600	$184,000
	PS suction pipework	M	DN150 SS SCH 10	m	40	80	160	$1,250	$2,000	$2,500	$160,000
	PS discharge pipework	M	DN150 SS SCH 10	m	115	130	150	$1,250	$2,000	$2,500	$260,000
	PS discharge valves	M	150mm plug valves	ea	8	8	8	$2,500	$3,500	$4,500	$28,000
	Primary scum pump	M	air driven diaphragm pump, nominal allowance and include connection to compressed air line	ea	4	4	4	$6,400	$8,000	$9,600	$32,000
	Primary scum pipework and valves	M	DN100, discharge into PST line	m	4	4	4	$1,250	$2,000	$2,500	$8,000
	PST drainage system	M	DN150 PVC piping into sump system with pump. Underneath galleries with a DN2000 sump and 2x small drainage pumps. Water returned to headworks.	Sum	4	4	4	$34,400	$43,000	$51,600	$172,000
	Scum removal header and pipework in PST	M		Sum	4	4	4	$40,800	$51,000	$61,200	$204,000
	Scum removal blower	M	2 x blowers per PST to be installed	Sum	8	8	8	$10,400	$13,000	$15,600	$104,000

	Southern WWTP Stage 3 - Airport, Matangi and Southern Hamilton											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
		Water spray system	M		Sum	4	4	4	$26,400	$33,000	$39,600	$132,000
		PST installation of mechanical equipment	M	PST equipment inside the tank only	%	10%	15%	20%	$304,500	$304,500	$304,500	$45,675
		Vendor support	M		%	5%	10%	15%	$304,500	$304,500	$304,500	$30,450
	PST Electrical	General Electrical Upgrade / PST	E		Sum	4	4	4	$75,000	$100,000	$125,000	$400,000
		Programming and Commissioning	I	PLC SCADA P&C	Sum	4	4	4	$20,000	$30,000	$40,000	$120,000
	PST Testing and Commissioning	Hydrostatic testing	I		Sum	1	1	1	$10,000	$10,000	$15,000	$10,000
		Commissioning of PST	I		Sum	1	1	1	$30,000	$50,000	$65,000	$50,000
	Interstage Pumpstation	Allowance for IPS	M	PST to Reactors	Sum	1	1	1	$3,292,800	$4,116,000	$4,939,200	$4,116,000
3	**Reactor**										Reactor Subtotal:	$12,926,684
3.01	Reactor Structure	Reinforced Concrete to floors inclusive of concrete, reinforcing and formwork	S	Total tank block area x 500mm floor thickness	m3	833	1,000	1,200	$1,850	$2,000	$2,200	$2,000,000
3.02		Reinforced Concrete to walls inclusive of concrete, reinforcing and formwork	S	400mm wall thickness	m3	788	876	1,051	$3,000	$3,500	$4,000	$3,064,600
3.03		Walkways between reactor zones	S	Webforge open grating 4kPa, all MSG	m2	150	180	270	$1,000	$1,100	$1,500	$198,000
3.04		Handrails around reactor walkways	S	Mono wills, 2m c-c, 2 Rail + Kicker MSG	m	300	360	540	$350	$400	$500	$144,000
3.05		2 x Staircase from ground level 6m up towalkways on top of reactor walls	S	Webforge open grating 4kPa, all MSG	m rise	10	11	12	$3,500	$3,720	$4,000	$40,920
3.09		R/C Tilt slab blower & MCC building	S	30m x 8m (1 x 50m wall shared with reactor), 12m x 8m blowers + 8m x 8m for MCC. Metal roofing on steel framing with precast walls on concrete slab.	m2	192	240	288	$2,500	$3,000	$3,500	$720,000
3.06	Reactor Mech.	Mixers	M	1 per pre-annox, 2 per main reactor	ea	10	12	18	$18,000	$25,000	$40,000	$300,000
3.07		Internal A-Recycle pipe Laid on reactor base)	M	900mm dia, PN8 PE pipe length of reactor. Laid on reactor floor through wall penetrations.	m	130	162	195	$750	$1,000	$1,250	$162,400
3.08		A-Recycle pump & strap on flow meter	M	Supply and install	ea	4	4	4	$36,000	$45,000	$90,000	$180,000
3.10		Blowers, complete with hot air extraction system/cooling fans, air inlet louvres, silencers and acoustic shrouds, isolation & NRVs	M	110 kW Blowers - from ATV model	ea	5	5	6	$100,000	$116,000	$150,000	$580,000
3.07		Diffusers and main aeration pipework complete with grid pipework, support system, control valves & isolation valves	M	Supply and install	Sum	4	4	4	$472,000	$590,000	$708,000	$2,360,000

	Southern WWTP Stage 3 - Airport, Matangi and Southern Hamilton											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
3.08		MLSS Line from Reactors to MBR	M	assume 600mm diameter SS above ground	m	80	100	110	$2,500	$3,000	$4,500	$300,000
3.09		Instrumentation	I	Reactor instrumentation allowance	Sum	1	1	1	$144,000	$180,000	$216,000	$180,000
3.11		Weir plates	M	Nominal allowance for weir plates.	Sum	1	1	1	$5,000	$7,500	$10,000	$7,500
3.08		Pipework, valves etc.	M		Sum	4	4	4	$142,400	$178,000	$213,600	$712,000
3.09		Penstocks, valves etc.	M		Sum	4	4	4	$48,000	$60,000	$72,000	$240,000
	Reactor Electrical	Upgrade of the electrical system	E		Sum	4	4	4	$223,000	$247,000	$322,000	$988,000
		Programming and commissioning	E		Sum	4	4	4	$38,000	$50,000	$62,000	$200,000
		Hardware (MCC Drives, Starters PLC IO)	E		Sum	4	4	4	$40,000	$47,762	$95,524	$191,048
		Cabling (Power and control incl installation)	E		Sum	4	4	4	$20,000	$23,881	$47,762	$95,524
		Installation labour	E		Sum	4	4	4	$30,000	$35,822	$71,643	$143,286
		PLC/SCADA P&C	E		Sum	4	4	4	$25,000	$29,851	$59,703	$119,405
4	**MBR**										MBR Subtotal:	$26,025,212
4.17	MBR Tank Structural	Includes: Concrete structure floor slab with reinforcing and allowances for formwork	S	New MBR tank to suit the requirements of the MBR system vendor	m³	123	144	173	$1,850	$2,000	$2,200	$287,745
4.18		Includes: Concrete structure reinforced walls with allowances for formwork and tall narrow channel dividing walls	S	300mm thick walls, 7 trains assumption	m³	231	254	279	$3,000	$3,500	$4,000	$887,809
4.19		Foundation ring beam - Includes: Concrete structure floor slab with reinforcing and allowances for formwork	S	800 to 1000mm x 350mm ground beams	m³	23	28	34	$1,850	$2,000	$2,200	$56,932
4.20		Coating System to concrete	S	Coating system to be applied to all walls and floors in the MBR flow splitter & membrane tanks	Sum	1	1	1	$1,760,000	$1,760,000	$2,346,667	$1,760,000
4.21		Overhead Crane	S	Overhead crane over the MBR Tank area	Sum	1	1	1	$417,000	$626,000	$834,000	$626,000
4.22		Handrail	S		m	81	81	108	$350	$400	$500	$32,533
4.23		Staircases and Platforms	S	Access staircase onto tank	Sum	1	2	3	25,000	$50,000	$75,000	$100,000
4.24		Grating system over tank	S	FRP or equivalent	m2	411	452	497	$725	$1,000	$1,500	$452,170
4.25		Mechanical Equipment	M	Sump pumps and mixers	Sum	1	1	1	$547,000	$646,000	$676,000	$646,000
4.26		Stoplogs and Penstocks	M	SS Penstocks and Aluminium stoplogs	Sum	1	1	1	$158,000	$221,000	$315,000	$221,000

	Southern WWTP Stage 3 - Airport, Matangi and Southern Hamilton											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
4.27	MBR Process Building Structural	Steel structure with PC Panel construction - building to house all MBR equipment. Rate inclusive of HVAC, fire protection and plumbing and drainage.	S	38m x 18m building assumed building to house all membrane trains	m²	359	718	862	$2,000	$3,000	$3,500	$2,154,869
4.28	Permeate Tank Foundations	Includes: Concrete structure floor slab with reinforcing and allowances for formwork	S	12x15m slab - 300mm thick	m³	54	54	81	$1,850	$2,000	$2,200	$108,000
4.29	RAS Pumpstation Foundations	Includes: Concrete structure floor slab with reinforcing and allowances for formwork	S	12x18m slab - 200mm thick	m³	43	43	65	$1,850	$2,000	$2,200	$86,400
4.30		MBR Equipment, RAS pumps and permeate tanks	M	incl. UF Filtration system - cassette hollow fibre units with all necessary pumping equipment, valves and controls Dry mount submersible pumps 30kL SS304 tanks	Sum	1.0	1.0	1.0	$7,970,000	$9,280,000	$12,461,000	$9,280,000
4.31		Installation of above	M		%	10%	13%	20%	$9,280,000	$9,280,000	$9,280,000	$1,206,400
4.32		Permeate Pipework from Cassettes to Pumps	M	SS316 Sch10 pipework - rate to include supports. Pipes nominal 3m in the air DN500 pipes	m	144	180	360	$1,250	$1,750	$2,500	$315,000
4.33		Permeate Pipework from Pumps with connection to Final Effluent Line - Above ground	M	SS316 Sch10 pipework - rate to include supports. Pipes nominal 3m in the air DN1000 FRP or SS header	m	20	30	40	$1,200	$4,000	$6,400	$120,000
4.34		Permeate Pipework from Pumps with connection to Final Effluent Line - Belowground	M	FRP Pipework DN1400 FRP	m	32	40	60	$2,400	$3,000	$4,800	$120,000
4.35	MBR Tank Mechanical	MBR Aeration Pipework	M	SS316 Sch10 pipework - rate to include supports - pipes nominal 3m in the air 2 x DN 600	m	100	134	170	$2,500	$3,000	$4,500	$402,000
4.36		RAS pumpstation pipework	M	SS316 Sch10 pipework - rate to include supports - pipes nominal 3m in the air 4 x 800mm SS lines from PS above ground	m	350	400	500	$5,000	$6,750	$7,750	$2,700,000
4.37		RAS pumpstation pipe bridge	M	HDG MS Pipe bridge. Rate to include foundations	Ea	8	12	16	$15,000	$25,000	$30,000	$300,000
4.38		Valves	M	Manual isolating valves	Sum	1	1	1	$610,000	$1,500,000	$1,780,000	$1,500,000
4.39		Stopboards	M	Aluminium stoplogs/boards - nominal 4-5m deep	Sum	1	1	1	$340,000	$490,000	$810,000	$490,000
		MBR Mech Installation Allowance	M	Installation of the above mech. Items	%	10%	13%	20%	$2,033,500	$2,033,500	$2,033,500	$264,355
4.40		Electrical general incl. MCC, cable supports, cables, materials, effort	E		Sum	1	1	1	$945,000	$1,575,000	$3,150,000	$1,575,000
4.41		Instrumentation	I		Sum	1	1	1	$63,000	$95,000	$126,000	$95,000

	Southern WWTP Stage 3 - Airport, Matangi and Southern Hamilton											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
4.42	MBR Electrical	Controls	I	All sums scaled down from Pukete using 2/3 power law. Most instrumentation will be provided with MBR system already	Sum	1	1	1	$32,000	$95,000	$126,000	$95,000
4.43		Programming and FAT	I		Sum	1	1	1	$32,000	$48,000	$63,000	$48,000
4.44		Process Commissioning	I		Sum	1	1	1	$63,000	$95,000	$126,000	$95,000
5	**Tertiary Treatment**										UV Subtotal	$6,466,905
5.1	Disinfection											
5.2	UV Channel	Bottom of channel, incl 2 x channels	S	RC Slab 350mm thick	m³	17	18	28	$1,850	$2,000	$2,200	$36,680
5.3		3 x Channel walls + allowance for inlet and outlet structures	S	RC walls 250mm thick	m³	32	36	43	$2,000	$3,000	$3,500	$108,225
5.4	UV Plant House	Allowance for UV Plant House	S	3604 100mm Mesh Slab. 90x45 Framing, PB insulated, Ply Lining, Steel cladding. No windows. Heat pump.	m2	24	30	36	$1,500	$2,000	$3,500	$60,000
5.5	UV Disinfection Plant	Supply and Install UV Modules.	M	Trojan Signa Modules ex Napier quote	Sum	1	1	1	$1,023,300	$1,137,000	$1,478,100	$1,137,000
5.6	UV Electrical	Electrical General	E	General allowance for non-included electrical; tie-in	Sum	1	1	1	$100,000	$125,000	$150,000	$125,000
6	**Outfall / Disposal**											
	Outfall pipeline	From WWTP to river, distrance TBC	C	PE DN900	m	500	1000	2000	$3,000	$4,000	$5,000	$4,000,000
	Outfall Diffuser	Allowance for complete outfall diffuser	C	Installed in river	Sum	1	1	1	$800,000	$1,000,000	$2,000,000	$1,000,000
6	**Digestion & Gas**										Digestion Subtotal	$17,409,024
6.01	4 x Digesters Structural	14.8m diameter tank - ring beam foundations	S	Site Concrete	m²	804	804	1528	$20	$50	$75	$40,212
6.02			S	RC Floor Slab (400 thick)	m³	1287	1287	2445	$2,000	$2,200	$2,500	$2,830,952
6.03			S	Ring Beam (1.5m wide and 750mm thick)	m³	247	247	495	$2,000	$2,200	$2,500	$544,281
6.04		Precast Panels -supply and erect (250mm th	S	14.8m Diameter Tank - Precast panels with post tensioning. Tank walls are 8m high. Walls are insulated	m³	204	226	484	$4,500	$5,000	$6,000	$1,017,684
6.05		Post tensioning of walls	S		Sum	3	4	5	$75,000	$100,000	$150,000	$400,000
6.06		DIGESTER ROOF	S	14.8m diameter - min & max to include floating and membrane options	Ea	4	4	4	$129,000	$544,000	$750,000	$2,176,000
6.07		Digester Insulation - excluding cladding	S		Sum	3	4	5	$109,758	$131,710	$174,230	$526,839
6.08		Staircase and platform allowances	S		Sum	1	1	1	$92,250	$123,000	$153,750	$123,000

	Southern WWTP Stage 3 - Airport, Matangi and Southern Hamilton											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
6.09		Architectural Features	S		Sum	2	2	2	$125,000	$185,000	$250,000	$370,000
6.10		Allowance for gallery	S	Allowance for gallery or like	Sum	1	1	1	$65,000	$93,000	$125,000	$93,000
6.11	Digester Pump Room Structural	Pump room based on Pukete Acid Digester Pump Room and scaled up for digestion volume of 6000m³ total - refer to existing drawings for information assume 22 x 17m	S	Insitu Site Concrete	m²	374	374	374	$20	$50	$75	$18,700
6.12			S	Insitu RC Floor Slab (500 thick)	m³	187	187	187	$1,850	$2,000	$2,200	$374,000
6.13		Pump room based on Acid Digester Pump Room - refer to existing drawings for information	S	Precast Panels -supply and errect (350mm average thickness	m³	98	98	147	$2,000	$3,000	$3,500	$294,000
6.14			S	Precast Panels for the roof -supply and errect (300mm average thick)	m2	280	280	420	$3,000	$4,000	$4,500	$1,120,280
6.15		Allowances for building structure ontop of pump room	S	Tilt slab panel system with architectural features	m³	158	158	237	$3,500	$4,000	$4,500	$632,400
	Digester Mechanical	New meso LP blowers	M	15kW motor	ea	4	6	6	$30,000	$40,000	$50,000	$240,000
		LP Gas pipework	M	Pipework to be gas compliant and includes fire rated valves DN150 SCH10 Gas lines from the digester roofs to suction side of blowers - allowances for manifold and centralised location of blowers	m	50	75	85	$2,000	$2,500	$3,000	$187,500
		New slab for blowers at ground level	M	Blowers are 2x1.5m 6x5m - 250mm thick Reinforced concrete slab	m2	15	25	35	$1,000	$1,500	$2,000	$37,500
		Installation of the blowers/ mechanical equipme	M		%	10%	15%	20%	$40,000	$40,000	$40,000	$6,000
6.16		Sludge Feed Pumps	M	Borger Pumps	ea	4	6	6	$16,000	$20,000	$24,000	$120,000
6.17		Digester Outlet/Supernatant pumps	M	Submersibles	ea	4	6	6	$9,600	$12,000	$14,400	$72,000
6.18		Heat exchangers	M	Lackeryby or Spiral	ea	3	4	5	$93,600	$117,000	$140,400	$468,000
6.19		Recirculation pumps	M	Submersibles	ea	3	4	5	$9,600	$12,000	$14,400	$48,000
6.20		Hotwater Circulation Pumps	M	Single stage centrifugal	ea	4	6	6	$4,800	$6,000	$7,200	$36,000
6.21		Digester Mixing Pumps	M	Dry mounted submersibles per existing	ea	12	16	16	$16,000	$ 20,000.00	$30,000	$320,000
6.22		Supernatant wetwell	M	FRP wet well with external pumps	Sum	1	1	1	$50,000	$75,000	$100,000	$75,000
6.23		Digester feed pipework	M	SS Sch 10 piping - DN150	m	50	125	150	$1,000	$1,250	$1,500	$156,250
6.24		Digester Supernatant pipework	M	SS Sch 10 piping - DN150	m	50	65	70	$1,000	$1,250	$1,500	$81,250
6.25		Digester Mixing pipework	M	SS Sch 10 piping - DN150 - Fully insulated	Sum	3	4	5	$ 106,000.00	$ 131,000.00	$ 156,000.00	$524,000

	Southern WWTP Stage 3 - Airport, Matangi and Southern Hamilton											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity Min**	**Quantity ML**	**Quantity Max**	**Rate Min**	**Rate ML**	**Rate Max**	**Most Likely**
6.26		Hotwater Circulation Network	M	Insulated mild steel pipework - DN150	m	100	250	300	$1,000	$1,500	$2,000	$375,000
6.27		Isolation valves - digester valving only	M	Plug valves	ea	60	80	100	$2,500	$3,500	$5,000	$280,000
6.28		Tie into existing system	M	Various tie-ins	Sum	1	1	1	$20,000	$30,000	$40,000	$30,000
6.29		Installation of mechanical equipment	M		%	10%	15%	20%	2,585,500	2,585,500	2,585,500	$387,825
	Digester Electrical	Electrical upgrades	E		Sum	1	1	1	$200,000	$216,000	$250,000	$216,000
		Instrumentation and Controls	I		Sum	1	1	1	$150,000	$185,000	$200,000	$185,000
		Programming and FAT	I		Sum	1	1	1	$75,000	$95,000	$115,000	$95,000
		Digestion Process Commissioning	E		Sum	1	1	1	$150,000	$185,000	$200,000	$185,000
	Gas Handling	Cogen Building	S	Building to house all Cogen equipment	m²	57	63	95	$3,500	$4,000	$4,500	$252,000
		RC Slab	S	250mm thk	m³	14	16	24	$1,850	$2,000	$2,200	$28,350
		Mechanical Equipment. Based on 307kW electricity available in ATV model digester sheet	M	Incl: Biogas scrubber/gas conditioning, Biogas Engine, Heat dump, installation, and pipework	Sum	1	1	1	$1,146,000	$1,910,000	$3,903,000	$1,910,000
		Electrical - General for Cogen	E	Incl: General tie into main MCC, P&C, instrumentation, power change over and controls.	Sum	1	1	1	$336,000	$532,000	$838,000	$532,000
7	**Solids Handling**										Dewatering Subtota	$6,699,000
7.1	Dewatering Building		S		m²	608	675	810	$2,500	$3,000	$3,500	$2,025,000
7.2	Dewatering Mechanical	FRP Pumpstation	M	Allowance for FRP Pumpstation	Sum	1	1	1	$180,000	$200,000	$240,000	$200,000
7.3	Dewatering	Polymer Make up and feed system	M		Sum	1	1	1	$3,030,400	$3,788,000	$5,682,000	$3,788,000
7.4		Allowance for drainage facilities	C									
7.5		Centrifuges	M									
7.6		Load Out Screws	M									
7.7		Dewatered Cake skips	M	12m3 Skip bin for moving by hook Truck		3	4	5	$50,000	$100,000	$150,000	$400,000
7.8		Sludge Holding Tank	M	2 tanks, 2 days storage from digestion 1100m³ storage	Sum	2	2	2	$114,400	$143,000	$171,600	$286,000
8	**Anitamox Centrate Treatment**										Anitamox Subtotal	$4,494,250
8.1	Insitu Concrete - for tank											
	Site Concrete	8x16m tank which is 4m tall x 2	S		m2	256	282	535	$20	$50	$75	$12,800
	RC Floor Slab (250 thick)		S		m³	64	70	134	$1,850	$2,000	$2,200	$128,000
	Ring Beam (1.5m wide and 500mm th		S		m³	72	50	94	$1,850	$2,000	$2,200	$144,000
	Precast Concrete- for tank											
	Precast Panels -supply and errect (25(	Precast panels . Tank walls are 4m high	S		m³	49	54	81	$4,000	$5,000	$6,000	$243,000
	Staircase and platform allowances	Per around the digester	S		Sum	1	1	1	$75,000	$100,000	$125,000	$100,000
	Insitu Concrete - for blower building											

Southern WWTP Stage 3 - Airport, Matangi and Southern Hamilton

	Plant Area	Description	Type	Size or Capacity	Unit	Quantity Min	Quantity ML	Quantity Max	Rate Min	Rate ML	Rate Max	Most Likely
	Site Concrete	5x5m building - to be acoustically treated	S		m2	25	28	52	$20	$50	$75	$1,250
	RC Floor Slab (250 thick)		S		m³	6	7	13	$1,850	$2,000	$2,200	$12,500
	Building - moderate construction		S		m³	20	25	35	$2,500	$3,500	$4,000	$70,000
	MBBR Equipment	MBBR equipment for Anammox side stream treatment	M	Based on quotation from Veolia - ANITA MOX process	Sum	1	1	1	$2,494,800	$2,772,000	$4,158,000	$2,772,000
	Effluent tranfer wetwell	FRP wet well with external pumps	M	2m diameter - assume 3m deep	Sum	1	1	1	$34,000	$51,000	$68,000	$51,000
	Pumps to transfer the effluent from the MBBR tank back to the headworks	Submersibles	M		ea	2	3	3	$7,333	$11,000	$14,667	$33,000
	Aeration Blowers	Nominal allowance - 3000m3/hr - 30kW blowers	M		ea	2	3	3	$10,286	$24,000	$34,286	$72,000
	Aeration piping	SS Sch 10 piping - DN300	M	10-25m of pipework	m	10	25	50	$1,500	$2,000	$2,500	$50,000
	Tie into existing system	Various tie-ins	M	Nominal allowance for connecting to existing system	Sum	1	1	1	$14,000	$21,000	$28,000	$21,000
	Installation of mechanical equipment		M		%	2,546,419	2,858,000	4,274,952	10%	15%	20%	$428,700
	Pipework from the new pumpstation to tl	New 225 PE100 return line - includes trenching	M		Sum	1	1	1	$17,000	$34,000	$51,000	$34,000
	Electrical upgrades		E		Sum	1	1	1	$67,333	$101,000	$134,667	$101,000
	Instrumentation and Controls		I		Sum	1	1	1	$34,000	$68,000	$102,000	$68,000
	Programming and FAT		I		Sum	1	1	1	$34,000	$51,000	$68,000	$51,000
	Process Commissioning		E		Sum	1	1	1	$67,333	$101,000	$266,667	$101,000
6	**Electrical & Control**										Electrical General Subt	$2,196,000
6.1	Electrical - General	MCC	E	1000kVa.	Sum	1	1	1	$848,000	$1,060,000	$1,378,000	$1,060,000
6.2		Incomer	E									
6.3		Allowance for Site wide power, Instrument and control cabling, cable support & ducting	E									
6.4		General Lighting and small power	E	Small DBs, task & security lighting, 3 Ph task outlets								
6.5	Control	Instrumentation, HMI, SCADA, PLC, Telemetry	I			1	1	1	$240,000	$300,000	$390,000	$300,000
6.6		Software	I		sum	1	1	1	$107,000	$200,000	$300,000	$200,000
6.6	Electrical Ancilliaries	Standby Generator	M	assume 1000kvA	Sum	1	1	1	$486,000	$540,000	$702,000	$540,000
6.7		Fire Prevention or Extinguisher System	M	VESDA Early Alarm system + Inert Gas Supression system	Sum	1	1	1	$20,000	$30,000	$120,000	$30,000
6.8		Transformer Blast wall	S		m2	6	9	12	$300	$1,000	$1,200	$9,000

	Southern WWTP Stage 3 - Airport, Matangi and Southern Hamilton											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
6.10		Allowance to have Network company supply new 1000kVA transformer	E	1000kVA	sum	1	1	1	0	$57,000	$113,000	$57,000
7	**Other Utilities**											
7.1		Misc site services, drainage, etc	C		Sum	1	1	1	$20,000	$25,000	$50,000	$25,000
8	**Sub-Total - Physical Works**									%		**$105,354,457**
8.1	Contractor Preliminary & General		OH		%	$105,354,457	$105,354,457	$105,354,457	15%	20%	25%	$21,070,891
8.2	Design and Project Management	Concept design	F		Sum	$126,425,348	$126,425,348	$126,425,348	1%	2%	3%	$2,528,507
8.3		Preliminary & detailed design	F			$126,425,348	$126,425,348	$126,425,348	6%	8%	10%	$10,114,028
8.4		Procurement	F			$126,425,348	$126,425,348	$126,425,348				$0
8.5		Construction supervision	F			$126,425,348	$126,425,348	$126,425,348	3%	4%	6%	$5,057,014
8.6		Council Internal costs	F			$126,425,348	$126,425,348	$126,425,348				$0
	Consents & Investigations											
8.7		Site Survey & Prep Terrain Model	F		Sum	1	1	1	$15,000	$20,000	$25,000	$20,000
8.8		HAIL Investigation & Consent	F		Sum	1	1	1	$16,000	$18,000	$26,000	$18,000
		Site Designation	F		Sum				$300,000	$500,000	$700,000	$0
8.9		Discharge Consent	F		Sum				$1,200,000	$1,600,000	$2,000,000	$0
		Geotechnical Field Investigations	C		Sum	1	1	1	$40,000	$100,000	$200,000	$100,000
8.1		Geotechnical Investigations & Interpretation	F		Sum	1	1	1	$30,000	$40,000	$60,000	$40,000
9	**Gross Construction Cost Estimate**											**$144,302,897**
10	**Allowances for Risk Register Items and Residual Uncertainty**											
10.1	Saturated construction market		RA		Sum	$144,302,897	$144,302,897	$144,302,897	0	5%	10%	$7,215,145
10.2	FOREX Risk	Foreign exchange risk on imported M&E plant	RA		Sum	$52,999,269	$52,999,269	$52,999,269	-10%	5%	15%	$2,649,963
10.3	Allowance for Design Development Contingency		CA		Sum	$144,302,897	$144,302,897	$144,302,897	0%	5%	10%	$7,215,145
10.4	Allowance for Construction Phase Risk Contingency		CA		Sum	$144,302,897	$144,302,897	$144,302,897	0%	5%	10%	$7,215,145
		GAS Storage vessel - risk allowance	M	If need additional storage to digester roof	Sum	0	1	1	$400,000	$500,000	$600,000	$500,000
11	**Total Expected Cost Estimate**										20%	**$169,098,295**

Southern WWTP Stage 3 - Airport, Matangi and Southern Hamilton

Plant Area	Description	Type	Size or Capacity	Unit	Quantity Min	Quantity ML	Quantity Max	Rate Min	Rate ML	Rate Max	Most Likely
Asset Type Totals - Most Likely		**Code**			**Respread**	**Total**				**Cost Breakdown (Direct only)**	
Direct Works	Civil	C	$ 16,731,123	10%	$9,970,957	$26,702,080	16%			Civil	$10,006,123
	Structural	S	$ 33,948,064	20%	$20,231,438	$54,179,503	32%			Inlet Works	$9,252,583
	Mechanical	M	$ 47,170,005	28%	$28,111,089	$75,281,094	45%			Primary Treatment	$9,853,675
	Electrical	E	$ 6,329,264	4%	$3,771,942	$10,101,206	6%			Reactors	$12,926,684
	Control & Instrumentation	I	$ 1,776,000	1%	$1,058,412	$2,834,412	2%			MBR	$26,025,212
										UV	$6,466,905
Indirect Works	Main Contractor Overheads	OH	$ 21,070,891	12%						Digestion	$17,409,024
	Fees & Investigations	F	$ 17,777,549	11%						Solids Handling	$6,699,000
	Discrete Risk Allowances	RA	$ 9,865,108	6%						Electrical General	$2,196,000
	Contingency Allowances	CA	$ 14,430,290	9%						Other Utilities	$25,000
	Direct Works Total		**$ 105,954,457**	63%							
	Indirect Works Total		**$ 63,143,838**	37%							
	Total Expected Cost Estimate		**$ 169,098,295**	100%		**$169,098,295**	100%				
		Check 1:	$0								
		Check 2:	$0								

		% of Base
Base Estimate	**136,753,142**	
Most Likely Estimate (P50)	**169,098,295**	**124%**
P95 Confidence Level Estimate	**187,090,664**	**137%**
Maximum Estimate	**267,545,143**	**196%**

	Project	Metro DBC Southern WWTPs Development	
	Phase	Preferred option	
stimate Su	Version	Tauwhare WWTP Package Plant - All Options	
	Purpose	Cost estimation	
	Estimate Class	5	
	Quantities Prepared by	C McRobie	11/11/2020
	Rates Prepared by	C McRobie; J Crawford	11/11/2020
	Reviewed By	R Verbeek	30/11/2020
	Amended		

Basic Dimensions of Plant

Southern site	Length:	Width:	Area:	Perim:	Water Depth	Total Volume
Walls		0.4				
Total Site	80	80	6400	320		
Inlet Works	10	5	50	30	-	
Primary Treatment			0	0		0
Reactors						0
MBR Package	12.1	2.5	30	29	2.9	88
MBR Tank area		5.0	20	16	2.801126998	55
Dewatering Building						
Admin Building	10	10	100	40		
SHT						
UV Building	14	5	70	38		

Tauwhare WWTP Package WWTP All options

	Plant Area	Description	Type	Size or Capacity	Unit	Quantity Min	Quantity ML	Quantity Max	Rate Min	Rate ML	Rate Max	Most Likely
1	**Siteworks and Civil**										Civil Subtotal	$743,679
1.1	Form & Maintain temporary site access for construction purposes.		C		m2	50	100	200	$25	$30	$45	$3,000
1.2	Platform Development	Site stripping & Tree Removal	C	Site not decided, as little as zero and as much as whole site	m2	0	3,200	6,400	$1.50	$3.00	$5.00	$9,600
1.3		Strip contaminated topsoil to landscaping bunds within the site	C		m2	0	3,200	6,400	$5.00	$6.00	$7.00	$19,200
1.4		Undercut to stockpile all process unit and building site to -1m	C	Assume 1m deep. Cut to waste on site.	m3	310	340	370	$10	$12	$15	$4,080
1.5		Supply, place and compact in layers imported fill. Assume AP65 or similar.	C	Assume AP65 or similar - sourced locally.	m3	230	255	310	$70	$90	$100	$22,950
		Recompact excavated granular fill	C	Uplift and place from stockpile immediately adjacent excavation	m3	80	85	60	$10	$12	$15	$1,020
0.1		Allow to install two layers geogrid in recompacted fill	C	Quantitiy multiplies treated area by 2. So, total area of geogrid used.	m2	160	170	120	$5.00	$7.00	$9.00	$1,190
0.2		Spread and roll surplus excavated material somewhere on the wider site <500m.	C		m3	230	255	765	$10	$12	$15	$3,060
	Council internal costs and Procurement costs (included in PWC cost elements)											
0.3	Internal Circulation Road	Around package MBR and admin building - sealed	C	Allow for basecourse, tarseal & flush nib kerb (but no drainage) 8m wide	m2	736	920	1,104	$150	$180	$190	$165,529
1.10	Internal Circulation Road	Around plant perimeter - unsealed	C	Allows for basecourse and surfacing (but no nib kerb nor drainage) 8m wide	m2	2,300	2,560	2,800	$30	$45	$50	$115,200
1.11	Security Fencing	Temporary for construction period	C	Including double gates, say 12 months	m	256	320	416	$50	$60	$70	$19,200
1.12	Security Fencing	Fencing of the new site	C	From new access area to behind inlet work. Include two sets of double gates. Manual. Whole site.	m	160	320	416	$75	$120	$180	$38,400
1.13		Sump for return pumping (portable pump)	C	Shallow concrete sump say 1.5m diameter x 1.5m deep with apron	Sum	1	1	1	$10,000	$15,000	$20,000	$15,000
1.14	Operator Building	3604 house: Lab, Lunch room, Bathroom, Operator station, Hall	C		m2	75	100	150	$2,500	$3,000	$3,500	$300,000
1.15	Misc Plant Slabs	Miscellaneous 30MPa 250mm thick plant slabs not allowed for elsewhere.	C	30MPa RC	m2	40	60	100	$375	$438	$500	$26,250
2	**Inlet works**										ILW Subtotal	$142,500

	Tauwhare WWTP Package WWTP All options											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity Min	Quantity ML	Quantity Max	Rate Min	Rate ML	Rate Max	Most Likely
2.1	Screening Structure	Includes: Construction, inlet works equipment	M	All stainless steel, incline drum screen	Sum	1	1	1	$58,000	$61,500	$65,000	$61,500
		Slab for Inlet works	S	RC 350mm	m³	18	21	25	$1,850	$2,000	$2,200	$42,000
2.2		Incoming Flow Meters Incoming x 1, Recycles x 2	I	Average 300mm Mag in Riser to ILW on reactor end wall. No chambers	Sum	2	3	5	$10,400	$13,000	$15,600	$39,000
3	**MBR Package Plant**										MBR Subtotal:	$1,029,538
3.01		All Mechanical and Electrical Items	M	Incl: Fine screening facility, containerised MBR plant & electrical equipment supply 2-3 40' shipping containers	Sum	1.0	1.0	1.0	$380,000	$811,207	$2,125,509	$811,207
		Tank slab	S	RC 350mm	m³				$1,850	$2,000	$2,200	$0
3.02	MBR Package Plant	Tanks	S	Assume all raw & treated water storage, concrete tanks 24hrs min storage	Sum	2	2	2	$24,800	$31,000	$37,200	$62,000
3.03		Installation of above mechanical and electrical	M	Installation %	%	10%	15%	20%	$84,221	$126,331	$168,441	$126,331
3.04		Tie-in to system	M	Assumption	Sum	1	1	1	$20,000	$30,000	$40,000	$30,000
4	**Tertiary Treatment**										UV Subtotal	$971,515
4.1	Disinfection											
4.2	UV Plant House	Allowance for UV Plant House	S	3604 100mm Mesh Slab. 90x45 Framing, PB insulated, Ply Lining, Steel cladding. No windows. Heat pump.	m2	61	76	91	$1,000	$2,000	$3,500	$151,515
4.3	UV Disinfection Plant	Supply and Install UV Reactor, floor mounted, enclosed	M	Trojan Signa Modules ex Gisborne quote	Sum	1	1	1	$625,500	$695,000	$903,500	$695,000
4.4	UV Electrical	Electrical General	E	General allowance for non-included electrical; tie-in	Sum	1	1	1	$100,000	$125,000	$150,000	$125,000
5	**Land Disposal Upgrade**											
5.1												
5.2	Pumps		M		m2							$0
5.3	Building		S		Sum							$0
5.4	Irrigation System		M		Sum							$0
5	**Electrical & Control**										Electrical General Sub	$611,000
5.1	Electrical - General	MCC	E	120VAC single phase480/575 VAC, 3 phase, 60 Hz Control circuit								
5.2		Incomer	E									
5.3		Software	E		Sum	1	1	1	$289,600	$362,000	$470,600	$362,000
5.4		Allowance for Site wide power, Instrument and control cabling, cable support & ducting	E									
5.5		General Lighting and small power	E	Small DBs, task & security lighting, 3 Ph task outlets								
5.6	Control	Instrumentation, HMI, SCADA, PLC, Telemetry	I			1	1	1	$80,000	$100,000	$130,000	$100,000
5.7	Electrical Ancilliaries	Standby Generator	M	300kVa., assume 100kW	Sum	1	1	1	$68,000	$85,000	$110,500	$85,000
5.8		Fire Prevention or Extinguisher System	M	VESDA Early Alarm system	Sum	1	1	1	$20,000	$30,000	$120,000	$30,000

	Tauwhare WWTP Package WWTP All options											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
5.9		Transformer Blast wall	S		m2	6	9	12	$300	$1,000	$1,200	$9,000
6.10		Allowance to have Network company supply new 300kVA transformer	E	300kVA	sum	1	1	1	0	$25,000	$50,000	$25,000
7	**Other Utilities**											
7.1		Misc site services, drainage, etc	C		Sum	1	1	1	$20,000	$25,000	$50,000	$25,000
8	**Sub-Total - Physical Works**									%		**$3,523,232**
8.1	Contractor Preliminary & General		OH		%	$3,523,232	$3,523,232	$3,523,232	15%	20%	25%	$704,646
8.2	Design and Project Management	Concept design	F		Sum	$4,227,878	$4,227,878	$4,227,878	1%	2%	3%	$84,558
8.3		Preliminary & detailed design	F			$4,227,878	$4,227,878	$4,227,878	6%	8%	10%	$338,230
8.4		Procurement	F			$4,227,878	$4,227,878	$4,227,878				$0
8.5		Construction supervision	F			$4,227,878	$4,227,878	$4,227,878	3%	4%	6%	$169,115
8.6		Council Internal costs	F			$4,227,878	$4,227,878	$4,227,878				$0
	Consents & Investigations											
8.7		Site Survey & Prep Terrain Model	F		Sum	1	1	1	$6,000	$6,000	$10,000	$6,000
8.8		HAIL Investigation & Consent	F		Sum	1	1	1	$16,000	$18,000	$26,000	$18,000
8.9		Discharge Consent	F		Sum				$700,000	$1,000,000	$1,500,000	$0
8.1		Geotechnical Investigations & Interpretation	F		Sum	1	1	1	$30,000	$40,000	$60,000	$40,000
9	**Gross Construction Cost Estimate**											**$4,883,781**
10	**Allowances for Risk Register Items and Residual Uncertainty**											
10.1	Saturated construction market		RA		Sum	$4,883,781	$4,883,781	$4,883,781	0	5%	10%	$244,189
10.2	FOREX Risk	Foreign exchange risk on imported M&E plant	RA		Sum	$2,351,038	$2,351,038	$2,351,038	-10%	5%	15%	$117,552
10.3	Allowance for Design Development Contingency		CA		Sum	$4,883,781	$4,883,781	$4,883,781	0%	5%	10%	$244,189
10.4	Allowance for Construction Phase Risk Contingency		CA		Sum	$4,883,781	$4,883,781	$4,883,781	0%	5%	10%	$244,189
11	**Total Expected Cost Estimate**										20%	**$5,733,900**

Tauwhare WWTP Package WWTP All options

Plant Area	Description	Type	Size or Capacity	Unit	Quantity Min	Quantity ML	Quantity Max	Rate Min	Rate ML	Rate Max	Most Likely
Asset Type Totals - Most Likely		**Code**			**Respread**	**Total**					
Direct Works	Civil	C	$ 768,679	13%	$482,311	$1,250,990	22%				
	Structural	S	$ 264,515	5%	$165,971	$430,486	8%				
	Mechanical	M	$ 1,839,038	32%	$1,153,913	$2,992,951	52%				
	Electrical	E	$ 512,000	9%	$321,257	$833,257	15%				
	Control & Instrumentation	I	$ 139,000	2%	$87,216	$226,216	4%				
Indirect Works	Main Contractor Overheads	OH	$ 704,646	12%							
	Fees & Investigations	F	$ 655,903	11%							
	Discrete Risk Allowances	RA	$ 361,741	6%							
	Contingency Allowances	CA	$ 488,378	9%							
	Direct Works Total		**$ 3,523,232**	61%							
	Indirect Works Total		**$ 2,210,668**	39%							
	Total Expected Cost Estimate		**$ 5,733,900**	100%		**$5,733,900**	100%				
		Check 1:	$0								
		Check 2:	$0								

		% of Base
Base Estimate	**4,649,396**	
Most Likely Estimate (P50)	**5,733,900**	**123%**
P95 Confidence Level Estimate	**7,207,276**	**155%**
Maximum Estimate	**9,571,588**	**206%**

METRO DBC (Southern) OPERATIONAL COST ASSUMPTIONS

Treatment Plants Assumptions (non BAU)

Capex

Parameter	Description	Population Equivalent		Flow (m^3/d)		Plant Cost ($M)		OPEX	
WWTP Size	Plant Philosophy	Min	Max	Min	Max	Min	Max	$./ML/year	
Small	Pukekohe or better. High level of nutrient, BOD, Solids and pathogen reduction. Land disposal where feasible.	1000	4000	200	800	0	14.04	$ 680,000	
Medium	Pukekohe or better. High level of nutrient, BOD, Solids and pathogen reduction. Discharge to water.	4000	40000	800	8000	14.04	35.88	$ 560,000	
Large	Pukekohe or better. High level of nutrient, BOD, Solids and pathogen reduction. Plus Energy recovery. Facility for other forms of resource recovery in future such as potable recycling, struvite etc but not installed. Discharge to water or re-use.	40000	500000	8000	100000	47	309	$ 310,000	

WWTP Small Opex Capex $M min 9.36

Cost Component	Useage		Throughput		Annual		Unit Cost		Annual Cost	Rounded Annual Cost	
Power (including Tarrifs)	1265	kW.hr/ML	2	ML/D	923450	kW.hr	$ 0.2000	$/kW.hr	$ 184,690	$ 185,000	
Operators & Site Staff	2	FTE					141000	$/FTE	$ 282,000	$ 282,000	
UV Lamp replacement	10						791	$/Lamp	$ 7,913	$ 8,000	
Monitoring & compliance									$ 200,000	$ 200,000	
Maintenance - Civil and Mechanical									$ 190,000	$ 190,000	1.0%
Chemicals CIP	Based on Pukekohe								$ 14,000	$ 14,000	
Caustic for alkalinity	$ -	modelling indicates nil							$ -	$ -	
Alum for P removal	$ 62	kg/ML 30% Alum	123	kg/d	45010	kg/yr	0.52	$/kg	$ 23,608	$ 24,000	
Carbon for DeNit	$ 83	lites 49% Acetic acid / ML	167	Litres / Day	60804	Litres / Year	1.31	$ / Litre	$ 79,731	$ 80,000	
Screenings & Grit	0.10	T/ML	0.2	T/day	73	T/yr	300	$/T	$ 21,900	$ 22,000	
Polymer	11	kg.poly/T.DS	0.3	T.DS/day		kg.poly/yr		$/kg		$ -	
Sludge disposal			1.6	T/day	588	T/yr	$ 400.00	$/T	$ 235,060	$ 235,000	
Sub- Total									$ 1,238,902	$ 1,239,000	
Contingency									$ 123,890		Annual Cost per MLD
Estimated Annual OPEX									**$ 1,362,793**	**$ 1,363,000**	$ 681,500

WWTP Medium Opex Capex $M min 50

Cost Component	Useage		Throughput		Annual		Unit Cost		Annual Cost	Rounded Annual Cost	
Power (including Tarrifs)	1265	kW.hr/ML	5	ML/D	2308625	kW.hr	$ 0.2000	$/kW.hr	$ 461,725	$ 462,000	
Operators & Site Staff	4	FTE					141000	$/FTE	$ 564,000	$ 564,000	
UV Lamp replacement	20						791	$/Lamp	$ 15,826	$ 16,000	
Monitoring & compliance									$ 200,000	$ 200,000	
Maintenance - Civil and Mechanical									$ 500,000	$ 500,000	1.0%
Chemicals CIP	Based on Pukekohe								$ 35,000	$ 35,000	
Alkalinity - Caustic	$ -	modelling indicates nil							$ -		
Alum for P removal	$ 62	kg/ML 30% Alum	308	kg/d	112525	kg/yr	0.52	$/kg	$ 59,021	$ 59,000	
Carbon for DeNit	$ 83	lites 49% Acetic acid / ML	416	Litres / Day	152011	Litres / Year	1.31	$ / Litre	$ 199,328	$ 199,000	
Screenings & Grit	0.10	T/ML	0.5	T/day	183	T/yr	300	$/T	$ 54,750	$ 55,000	
Polymer	11	kg.poly/T.DS	0.8	T.DS/day	3232	kg.poly/yr	$ 12.00	$/kg	$ 38,785	$ 39,000	
Sludge disposal			4.0	T/day	1469	T/yr	$ 300.00	$/T	$ 440,738	$ 441,000	
Sub- Total									$ 2,569,172	$ 2,569,000	
Contingency									$ 256,917		Annual Cost per MLD
Estimated Annual OPEX									**$ 2,826,089**	**$ 2,826,000**	$ 565,200

WWTP Large Opex Capex $M min 160

Cost Component	Useage		Throughput		Annual		Unit Cost		Annual Cost	Rounded Annual Cost	
Power (including Tarrifs)	632.5	kW.hr/ML	30	ML/D	6925875	kW.hr	$ 0.2000	$/kW.hr	$ 1,177,399	$ 1,177,000	
Operators & Site Staff	8	FTE					141000	$/FTE	$ 1,128,000	$ 1,128,000	
UV Lamp replacement	100						791	$/Lamp	$ 79,129	$ 79,000	
Monitoring & compliance									$ 500,000	$ 500,000	
Maintenance - Civil and Mechanical									$ 1,600,000	$ 1,600,000	1.0%
Chemicals CIP	Based on Pukekohe								$ 213,000	$ 213,000	
Alkalinity - Caustic	$ -	modelling indicates nil							$ -		
Alum for P removal	62	kg/ML 30% Alum	1850	kg/d	675152	kg/yr	0.52	$/kg	$ 354,123	$ 354,000	
Carbon for DeNit	83	lites 49% Acetic acid / ML	2499	Litres / Day	912067	Litres / Year	1.31	$ / Litre	$ 1,195,968	$ 1,196,000	
Screenings & Grit	0.1	T/ML	3	T/day	1095	T/yr	300	$/T	$ 328,500	$ 329,000	
Polymer	11	kg.poly/T.DS	3.3	T.DS/day	13159	kg.poly/yr	$ 12.00	$/kg	$ 157,910	$ 158,000	
Sludge disposal			16.4	T/day	5981	T/yr	$ 300.00	$/T	$ 1,794,431	$ 1,794,000	
Sub- Total									$ 8,528,461	$ 8,528,000	
Contingency									$ 852,846		Annual Cost per MLD
Estimated Annual OPEX									**$ 9,381,307**	**$ 9,381,000**	$ 312,700

Preferred Option

Area		Treatment Plant Size 2025 (m^3/d)	WWTP name	Type of plant (2045)	WWTP Operational Cost ($)	Energy used kWhr
Matangi						
Airport	400	400	Airport	Small	272,000	184,690
Ohaupo						
Cambridge & Hautapu	5500	5,500	Cambridge	Large	1,705,000	1,269,744
Te Awamutu & Kihikhi	5598	5,598	Te Awamutu	Medium	3,134,880	2,584,737
Tauwhare	55	55	Tauwhare Pa	Small	37,400	
		-	-	-	7,417,000	

Preferred Option

Area		Treatment Plant Size 2031 (m^3/d)	WWTP name	Type of plant (2045)	WWTP Operational Cost ($)	Energy used kWhr
Matangi						
Airport	800	800	Airport	Small	544,000	369,380
Ohaupo						
Cambridge & Hautapu	6588	6,588	Cambridge	Large	2,042,280	1,520,922
Te Awamutu & Kihikhi	5598	5,598	Te Awamutu	Medium	3,134,880	2,584,737
Tauwhare	55	55	Tauwhare Pa	Small	37,400	
		-	-	-	8,027,000	

Preferred Option

Area		Treatment Plant Size 2041 (m^3/d)	WWTP name	Type of plant (2045)	WWTP Operational Cost ($)	Energy used kWhr
Matangi	93					
Airport	1107	1,200	Airport	Medium	671,888	553,978
Ohaupo						
Cambridge & Hautapu	7560	7,560	Cambridge	Large	2,343,600	1,745,321
Te Awamutu & Kihikhi	6181	6,181	Te Awamutu	Medium	3,461,360	2,853,922
Tauwhare	55	55	Tauwhare Pa	Small	37,400	
		-	-	-	9,398,000	

Preferred Option

Area		Treatment Plant Size 2051 (m^3/d)	WWTP name	Type of plant (2045)	WWTP Operational Cost ($)	Energy used kWhr
Matangi	93					
Airport	1507	1,600	Airport	Medium	895,888	738,668
Ohaupo						
Cambridge & Hautapu	8578	8,578	Cambridge	Large	2,659,180	1,980,339
Te Awamutu & Kihikhi	6996	6,996	Te Awamutu	Medium	3,917,760	1,615,114
Tauwhare	55	55	Tauwhare Pa	Small	37,400	
		-	-	-	10,904,000	

Preferred Option

Area		Treatment Plant Size 2061 (m^3/d)	WWTP name	Type of plant (2045)	WWTP Operational Cost ($)	Energy used kWhr
Matangi	93					
Airport	3570	3,663	Airport	Medium	2,051,392	1,691,391
Ohaupo						
Cambridge & Hautapu	9006	9,006	Cambridge	Large	2,791,922	2,079,194
Te Awamutu & Kihikhi	7200	7,200	Te Awamutu	Medium	4,032,000	1,662,210
Tauwhare	55	55	Tauwhare Pa	Small	37,400	
		-	-	-	16,353,000	

Appendix C - Southern Links Summary

SOUTHERN LINKS DISCUSSIONS SUMMARY

Background

The preferred option for the Metro DBC includes a southern area wastewater treatment plant (SWWTP), in the general vicinity of the Airport Precinct that is able to be developed to service the Airport Precinct itself, parts of southern Hamilton, and eventually Matangi and the Tamahere Hub.

The target areas of Hamilton South are currently undeveloped or are early in their development cycles. For example the south and south western portions of the Peacocke Precinct.

The SWWTP can be developed in a number of stages and depending upon demand. However, this is somewhat of a 'Chicken and Egg' scenario as the development of a plant and trunk conveyance to the south would be the precipitate for development in the areas reachable by that conveyance system.

The SWWTP development identified as Stage 1, was envisaged to service the Airport Precinct itself, which is seen as the more urgent need.

Stage 2 and beyond were envisaged to be developed to service areas of southern Hamilton to:

- Relieve pressure on the Pukete WWTP to service areas further to the north or east
- Relieve pressure on the Hamilton Western trunk WW interceptor
- Facilitate development to the south west of Hamilton and within the Southern Links Designation

Elected members of Hamilton City Council and Waikato District Council have expressed an interest in commencing at Stage 2 to facilitate development of new areas to the south of the city and to ensure that the Waikato DC communities at Taupiri, Hopuhopu, Ngaruawahia, Horotiu and Te Kowhai can be serviced at Pukete. Obviously, such an approach would also allow the Airport Precinct, and surrounding area to be serviced. To do this, and based on a preliminary assessment of likely module sizes, a starting volume of approximately 1,000m^3/d would be targeted.

Four groupings of existing housing, current and future development nodes have been identified that could be diverted to the south to provide base loading for Stage 2. In addition, two groupings of airport developments are identified as potentially serviced by SWWTP but currently identified as intended to be serviced by small package plants to be vested in Waipa DC.

Table 1 below describes the nodes together with estimated areas, potential average day flows and connection pathways. The potential flows are based on the 200 l/PE/d consumption used in the Peacocke design, 2.7 persons/lot occupancy and a conservatively low development density of 11 lots / ha. For reference, the Peacocke design used sub-catchment development densities ranging from 11 to 23 lots/ha, with the majority at approximately 15 lots/ha.

Table 1:Potential Diversions to the South

Group	Node	Area (ha)	Current Status	Assumed Development	Potential Flow (m^3/d)	Connection path
1	Te Anau / Sunnyhills		Existing to Western. Planned diversion to N4	Existing	580	TA-PS to N17 to N12 to SWWTP
	N12	68	Near future. House build starting 2023	15 Lots/ha 1026 Lots	708	N12 - SWWTP
2	SL2	130	Future. Current development interest. Servicing not planned	11 lots/ha 1430 Lots	1065	SL1-SLPS1 – SWWTP
	SL3	160		1760	1310	SL3 Gravity - SWWTP
3	SL4	90	Future	11 Lots/ha 990 Lots	737	Gravity to SWWTP
4	SL5	140	Future. Servicing not planned	11 Lots/ha 1540 Lots	1147	SL5 to N8 SL6 to N8 N8 to SL4 to SWWTP
	SL6	120		1320 Lots	983	
5	Airport Rd	57	Partly developed with new (predominantly dry, logistics type) facilities plus airport and motel. Currently tankered to WDC facility. And airport has own package plant and separate consent. Plan for Airport Co. developed package plant to vest in WDC		c400m^3/d (ult), assuming dry ind.	Local pumped conveyance
6	Airport North - Bardowie (?) Block	40	Future dry development 2- 3 years hence. Considering package WWTP to be vested in WDC			Local pumped conveyance
	N8	43	A possible for turning south	14.7 Lots/ha 630 Lots	437	N8 to SL4 to SWWTP

A further 70ha east and west (50 & 20 ha respectively) of the airport precinct are identified as self-serving with respect to wastewater servicing.

HCC Development Requirements

The following detail has been suggested by Sven Ericksen of HCC as the minimum requirements to facilitate diversion of sufficient flows to the southern wastewater treatment plant (SWWTP) and the consequent effects on the Peacockes wastewater infrastructure system currently being constructed from the Far Eastern Interceptor (Crosby Rd) and back upstream to Pump station N4 and N4a. As presented, the requirements below assume that SWWTP will be situated on (currently) crown owned land to the north west and a short distance outside the airport precinct.

Minimum Development for SWWTP

- Gravity Conveyance System
    - WW/SL4-01
    - WW/SL4-02
    - **WW/W2-2**
    - **WW/W2-3**
- Pumping Stations
    - Upgrade of Te Anau
        - Need to determine if Splitt SPS is relocated or stays running to Bruce?
        - Ideally stay with Bruce so N4 flow loss recovery improved.
        - Upgrade N17
            - Current LOS ~15 L/s PWWF
            - Need to be ~75
    - N12 PS
        - Approximate PWWF level of service
        - => N12 + N17 + N13 + Te Anau
        - => 50 + 30 + 20 + 57
        - => 172 L/s ➔ ~53% of N4 flow expectation
    - Rising Main
        - N12
            - WW/SL4-03 => ?? 400 or 450 PE ??
        - N17 rising main extended to bypass the N11 catchment and discharge to the N12 catchment.
        - Te Anau
            - Diversion to N17 then on to N12 and SWWTP

Table 2 below highlights a number of the key advantages and opportunities, disadvantages and risks associated with diverting existing and proposed sub-catchments south from Hamilton and the Southern links areas to be serviced by a southern WWTP in the short to medium term.

Use of the southern Links areas would obviously be dependent upon negotiations between councils and between councils and developers as to what areas it is appropriate to develop and when.

Table 2: Advantages and Disadvantages of Potential southward diversions

Advantages / Opportunities	**Disadvantages / Risks**
Relief of a significant amount of loading on the Western Interceptor either by direct diversion or by diversion of catchments such as Bruce to recover some of the N4 design loading.	Approximately 53% of flow diverted away from purpose built N4PS and associated rising mains.
Advantage of flow diversion to south and flow recovery from the Bruce/Normandy is that the day 1 infrastructure from N4 to FEI will be at final size configuration. No other development required beyond buying the “on-shelf” standby pump.	N12 at minimum will need to be upsized from 80 to 172 l/s. Worst case is that N12 could ultimately need to be upsized to receive reversed N4 if all of Peacocke area is ultimately (long term) to be turned south.

Opportunity for further development to the east of the city to be routed into the N4 rising mains and or to the FEI.	Southern Links sub-catchments still part of WDC and development aspirations / funding ability differs from HCC.
Growth pressure on Pukete is slowed, allowing a more 'measured' approach to redevelopment of that site.	Changes in the flow to N4 character from the further SPS could mean a strategy change or operation cost increase for Septicity Control.
Capacity of the Pukete site is released to service communities from Horotiu to Taupiri	Potential for southern areas development to be come spread out and inefficient.
Facilitates early development of SWWTP	
Opportunity for some relief from the central south (Hamilton East area) sewers into the feed to the FEI.	

Peacocke Catchment Impacts

Diversion of sufficient flows to the South would likely mean the following short to medium term changes to development of planned pump stations for the Peacocke precinct;

- N4a no change
- N4 loss of ~53% of designed service (not including N8 effect)
- N3 Potential impact from N8 catchment, increase or loss?
- N7 No change
- N8 Potential increase of catchment and discharge direction
- N9 No Change
- N11 No change
- N10 Expecting no change, and flow to remain towards N4.
- N17 Upsize to acter for throughput from upstream Te Anau SPS
- N12 Increase in LOS from 80 to 172 l/s and direction of discharge.
- N13 No change

Flow Recovery for N4

The current HCC investment in pump stations N4 and N4a and the associated rising main to the FEI is substantial. Potential loss to SWWTP is approximately 53% of the N4 design level of service. It would be highly desirable to recover as much of this loss as possible and divert other flows into N4 and potentially downstream of N4. Possibilities include:

- Diversion of Bruce SPS to N4 by rising main
  - 780m to old Fitzroy SPS
  - 645 to designed Te Anau discharge Point to N4.
  - Including Splitt SPS continuing to flow to Bruce
- Diversion of Nomandy SPS to N4
- Dependent upon the rate and pattern of development of growth nodes in the Southern Links areas, flows from N17 and Te Anau, originally diverted to SWWTP, are recoverable to N4 by removing the N11 to N12 bypass.

Development phasing of Southern Links growth area.

The proposed Southern Links (SL) growth area and be divided up into 6 Sub-Cells. General WW service orientation could be as follows:

- SL road corridor designation is relatively narrow, and given the soil types, extensive earthworks to achieve an appropriate road foundation / embankment , would require the WW conveyance to be installed with the Southern Links (SL) road if inside the designation.
- For this and other reasons, it cannot be assumed that the SL designation can be used to WW conveyance infrastructure.
- Therefore, assume that a strip of land will need to be procured to the east of the SL designation for waters services / Local purpose drainage reserve.

There are 6 major sub-catchments making up the Southern links Precinct as follows:

- SL1, north of NIMT line
    - general lay of the land is northward
    - Inclusion of this area would increase the amount of pumping or depth;
    - Probably better to push this north to NW of Dinsdale and the Western Interceptor

- SL2, area between the Colins SPS southern boundary and SL designation
    - Pumped catchment serviced by SL PS1,
    - discharge to SL4 WW catchment trunk gravity sewer
- SL3, area bounded by, SL2 to west, SL designation to South, Peacockes to East, Te Anau to North
    - Pumped catchment serviced by SL PS1
    - discharge to SL4 WW catchment
    - Quick look at contours begs question answered on whether the northern area of SL3 (Figure 3, SL3a) maybe serviceable through to Te Anau Catchment?
- SL4, area bounded by Peacockes, North South arterial, SL designation.
    - Gravity conveyance to SWWTP
- SL5, general lay of the land is a northerly flow direction,
    - heading in the direction of N8.
    - N8 maybe able to service this catchment? Or the other way around?
        - If N8, switches to SWWTP, LOS flow implications (reduced flow) to N3, N4
        - otherwise a separate SPS servicing SL5
- SL6, eastern margin of SL area, marked by old river course channels,
    - level significantly lower than general area.
    - Would require its own SPS (SL-PS2) to convey flows out whether to the north or south

Development of Southern Links Areas 2 & 3

Both areas would be serviced by the SL-PS1 and rising Main out to SL4 or SWWTP

- NOTE:
    - The Long section shown in Figure 1 below is based on the lower of existing ground and SL specimen design levels
    - SL intersection of SH3 at the Rukuhia Ridge, has approximately 10 meters of cut. Waka Kotahi geotechnical information should be requested as the opportunity may exist for the rising main to be drilled under rather than trenched over the ridge, thereby saving considerable operating cost.

The boundary between SL2 & 3 is artificial and they are effectively the same area.

Options will need to be investigated for the provision of minimum flow requirements prior to significant development occurring. If necessary, to maintain flow through to SL PS1 then part of the Colins catchment (currently to top end of Western interceptor) could be split at the intersection of Anderson Road and Mabian Cres. and pumped into the head of the new SL1 gravity conveyance line. There is potential Drainage Reserve for location of a PS.

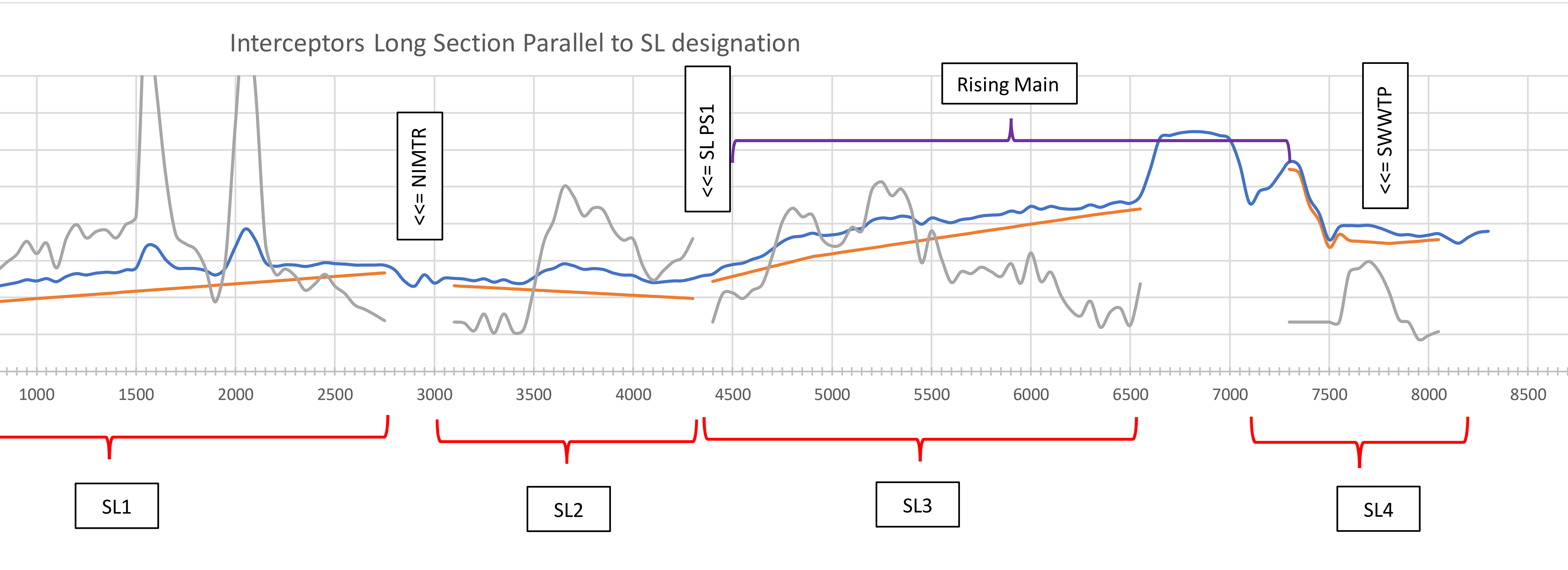
This would allow development to progress through several access fronts – dependent of transport connections.

1. Saxbys Road
2. Forth Cres
3. MacMurdo Ave
4. Houchens Rd

Much of the rest of the development will also require extension or development of access corridors.

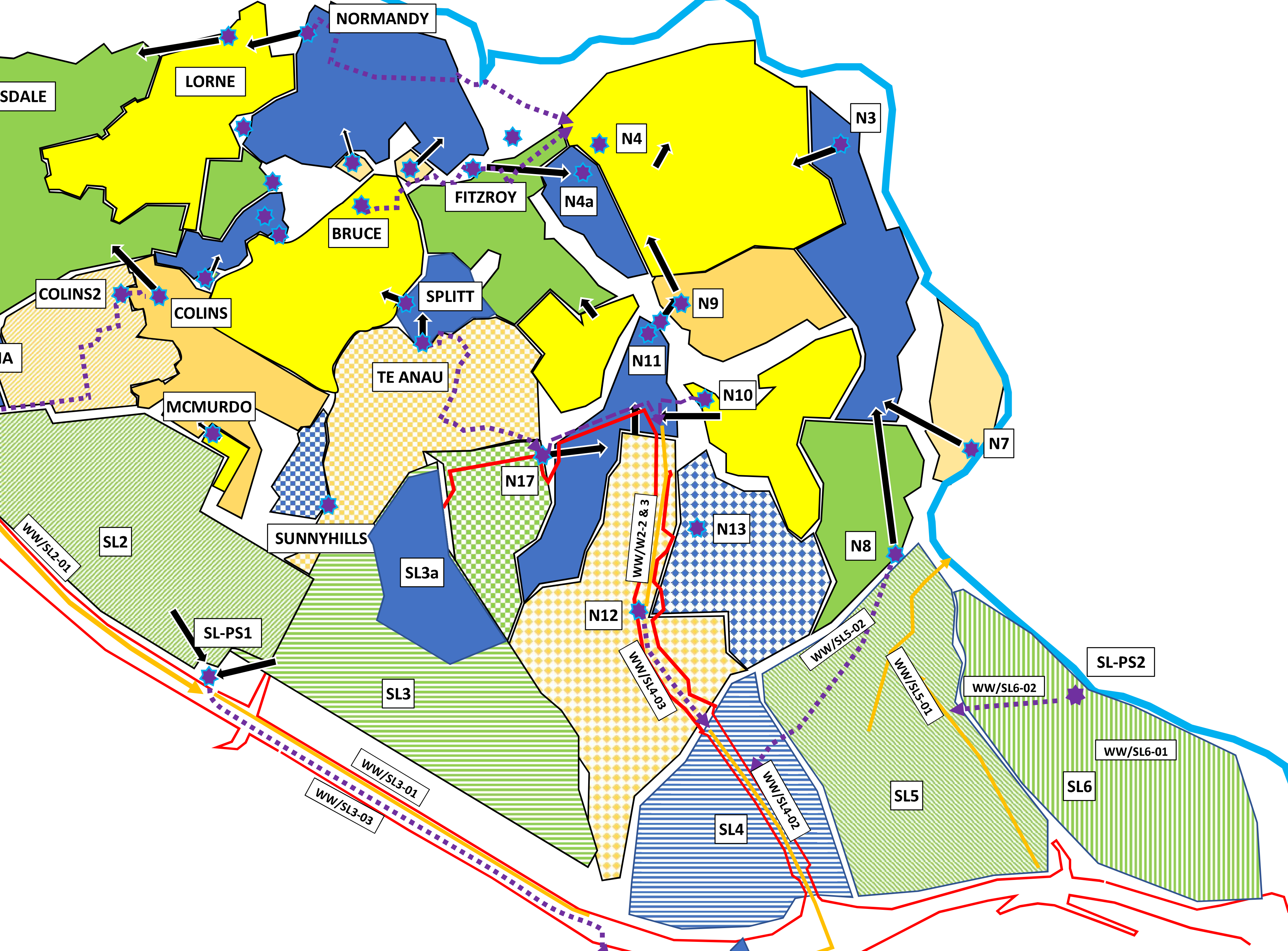
Waka Kotahi control SH3 so there is limited potential for connections access if Southern Links hasn't been built along with the North South arterial (i.e SH3 would still be SH3 with limited access).

Depending on which property is developed "first" in a sub area, then other cross property boundary work is likely to be required to complete the required connectivity.



d potential Conveyance profiles

h Wastewater Sub-Catchment



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