GHD Advisory

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Hamilton - Waikato - Waipa Metropolitan Area - Southern Metro Wastewater Detailed Business Case - Wastewater Treatment Short-list Options Report

Metro Wastewater Project Partners

April 2021

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Purpose

The purpose of this report is to provide more detail on the shortlisted southern wastewater treatment plants (WWTPs).

Option 2A consists of:

- A centralised southern plant to service the southern communities of hamilton South, Matangi, Airport Industrial precinct, Ohaupo and Cambridge (site not yet confirmed)
- Tauwhare Pa (standalone plant) to be upgraded
- Te Awamutu/Kihikihi (standalone plant) to be upgraded.

Option 4A was progressed as the stand alone option. This option consists of the following southern plants:

- Southern plant to service small southern communities of Matangi, Airport Industrial precinct and Ohaupo (site not yet confirmed)
- Tauwhare Pa (standalone plant) to be upgraded
- New plant at Cambridge (standalone plant)
- Te Awamutu/Kihikihi (standalone plant) to be upgraded.

The methodology followed was:

- Based on the treatment and growth assumptions as outlined within the Longlist Options Report, develop process flow and size assumptions.
- Confirm the Treatment processes which are to be reassessed as part of the shortlisting process. WWTPs have varying levels of treatment dependent on population size at 2061, however it is likely for each considered option that the full treatment process proposed based on population size will not be required within the next 10 years. Some treatment processes only become feasible once flows reach a certain level.
- Information on some technical risks and issues is provided in this report to assist the assessment of the treatment component of the southern shortlist options assessment. Further assessment will be carried out as part of the site selection and discharge options work and will be documented in the southern shortlist assessment report.

Conveyance

For Option 2A the parts of Hamilton that could be diverted to the south were investigated. In the short term diverting Peacocke and Fitroy/Te Anau and Splitt south via N4/N12 pump stations is recommended, to be confirmed once preferred WWTP site is selected. Once this area is diverted, maximising the use of the Peacocke rising mains is recommended by diverting as much as feasible of the Hillcrest/Riverlea area in the vicinity of Clyde Street. Diverting more of the upper Western catchment is reasonably difficult due to limited service corridors but this could be considered as part of the optioneering for Lorne and Normandy pump station upgrades/storage to address capacity issues.

Longer term there are opportunities to use the Peacocke mains between Clyde and Snells to divert parts of those catchments north. Diverting south areas in the CBD (potentially Hillsborough) and upper Western catchment (potentially in conjunction with southern links) via new rising mains may provide additional capacity to service infill growth in these areas and address network issues.

Treatment

The level of treatment selected for discharges to water:

- 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).

Flow assumptions were based on using the RITS[1] standard per capita ADF flow approach of 200L/p/d for the population equivalent associated with each plant at each design time interval. The peak flow to each plant was assumed as four times the ADF. The raw wastewater quality assumptions made for the shortlisting are as carried forward from the longlisting assumptions, based on typical values for New Zealand raw wastewater.

The proposed treatment processes for the new WWTPs are outlined below.

Table 1-1 Treatment Concept Development

Size	Population Equivalent Step (PE)	Flow Step (m^3/d)	Liquid Processes	Solids Processes
	All	All	Inlet Works	-
Small – Tauwhare Pa WWTP	0 – 4,000	0 – 800	Package MBR or Secondary treatment if land disposal	Thickening, transfer to larger WWTP
Medium – Southern sub-regional WWTP (Airport) 4A	4000 – 40,000	800 – 8,000	Reactor Membrane separation UV	Screw Press Dewatering
Large – Cambridge WWTP, Southern sub-regional WWTP 2A	40,000 – 150,000	8,000 – 30,000	Primary Treatment Reactor Membrane separation UV Centrate Treatment	Digester Centrifuge Dewatering

Staging considerations

Process sizing was initially developed for the WWTPs for the 2061 horizon and then base staging was developed for key processes including screens, primary sedimentation tanks (PSTs), reactors, digesters and membrane trains.

Installation of the PSTs and Digesters could be delayed for both the Sub-regional southern 2A WWTP and Cambridge stand alone WWTP, however additional reactor capacity would need to be installed. It may be possible to design reactors that could be converted to PSTs later. If PSTs/Digesters were delayed, operating

[1] Regional Infrastructure Technical Specifications

costs would increase as energy is not recovered and biosolids volumes for disposal are higher. A lower TN target would reduce reactor sizing and energy requirements.

Delaying the introduction of Ohaupo and Matangi would have minimal impact on treatment process capacity required as the flows from those communities are such as small component of the total flows.

Delaying the introduction of South Hamilton flows (if practical from a conveyance perspective) could reduce the number of reactors, membrane trains and digesters required to be built at the start for the 2A sub-regional WWTP. However, some components such as civil works, transfer pipes and buildings are generally built at the start at a new site with more limited potential to stage.

Significant wet industry flows have been allowed for at the airport industrial area (1,750 m^3/day by 2061). 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 4A southern sub-regional has a high level of risk around industry flows, timing and composition as there are only very small residential flows for this option.

A new site 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 is advisable to mitigate potential odour and noise issues. Process equipment can be added over time as flows increase due to residential and industrial growth.

While a new site can be selected with more favourable ground conditions, some ground improvements are likely to be required. Larger WWTPs provide more redundancy with their processes and equipment.

There is uncertainty over the timing and flows likely to be generated at the Pa and potentially from Tauwhare Village. Once a preferred southern option is identified further investigation of Tauwhare Pa options can be undertaken. Soil conditions and environmental effects associated with land discharge will need to be investigated further.

Cost Estimates

A comparative cost exercise was undertaken to establish the order of magnitude capital and operational costs of the various options. We recommend that that these costs are not used for capital appropriation and that a conceptual design of the preferred option be undertaken to confirm the estimated capital and operating costs. A costing exercise has been completed for the four potential WWTPs that form a part of Option 2A and Option 4A. This exercise uses the costing assumptions from Section 2 and develops the potential costs for each of these plants should they be built to their design flow process unit requirements at 2061. The cost estimates are deemed to be Class 5 estimates as per the AACE[2] Cost Estimate Classification System and have an expected accuracy range of -30% / +50%.

The table below summarises the capital costs for Option 2A and Option 4A respectively to build a WWTP to service flows at 2061. Council internal costs, procurement and consenting costs are excluded from the cost estimates and are incorporated into the financial modelling being undertaken by PWC.

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

Table 1-2 Capital Costs summary at 2061 (excluding conveyance)

	Option 2A		Option 4A	
Area	**WWTP name**	**WWTP Capital Cost ($ M)**	**WWTP name**	**WWTP Capital Cost ($ M)**
Hamilton south	Southern Sub-Regional WWTP	$ 169M	(to Pukete)	
Matangi			4ASouthern Sub-Regional WWTP	$ 54M
Airport				
Ohaupo				
Cambridge & Hautapu			Cambridge	$ 113M
Te Awamutu & Kihikhi	Te Awamutu	$ 29M	Te Awamutu	$29M
Tauwhare Pa	Tauwhare Pa	$ 6M	Tauwhare Pa	$ 6M

Over time the total operational costs increase as flows increase. The large plants that have PSTs and digesters have significantly lower costs per ML due to energy recovery and reduced biosolids volumes for disposal. Option 4A has slightly higher annual operational costs than Option 2A. Delaying the installation of PSTs and digesters at the 2A sub-regional or Cambridge plants would increase operational costs.

Recommendations

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

- For operational costs and energy, benchmarking with existing performance and costs for Pukete and other sites with MBR or biological nutrient removal
- Further investigate capital and operational cost impacts of lower TN concentration target and delaying installation of PSTs and digesters
- Sensitivity analysis for Hamilton flow split, residential and non-residential greenfield growth, connecting small communities (Ohaupo, Matangi, Tauwhare Pa), wet industry and infill
- Geotechnical investigations for Cambridge WWTP if 4A is the preferred option
- Review of redundancy requirements for major process units e.g. screens and reactors
- Biosolids reuse and disposal options.

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The Cost Estimate has been prepared for the purpose of making a relative assessment of options and must not be used for any other purpose.

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

1 Introduction

1.1 Purpose of the report

The purpose of the Treatment Shortlist Technical Report is to provide documentation of the options development for the treatment options for the southern metro area. This report provides supporting documentation for the Waikato Metro Wastewater Treatment Detailed Business Case (DBC).

The purpose of the DBC is to determine a shortlist of feasible wastewater treatment solutions for the Waikato Hamilton Waipa Metro Area (metro area) and to determine a preferred option for the southern metro area. 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 options for a centralised and partially centralised solution need to be further investigated. This report documents this process.

This project aims to align with 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. Figure 1-1 outlines the metro area, highlighting the WWTPs within this 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 hub commercial area)
- Tauwhare Pa
- Airport industrial area
- Ohaupo
- Cambridge
- Te Awamutu.

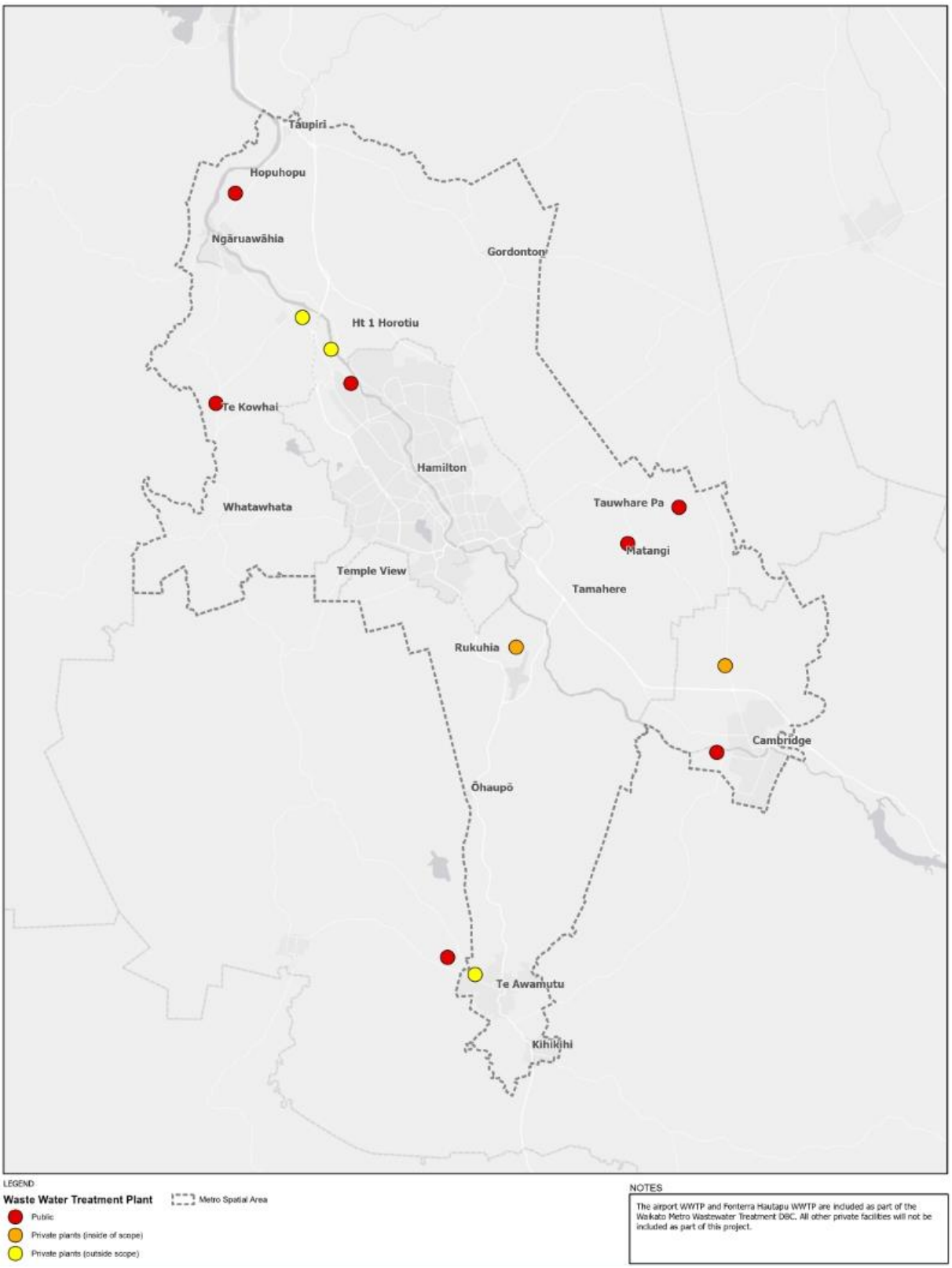

Figure 1-1 Hamilton Waikato Waipā Metro Area

1.3 DBC Methodology

The DBC options development and assessment process is summarised within Figure 1-2.

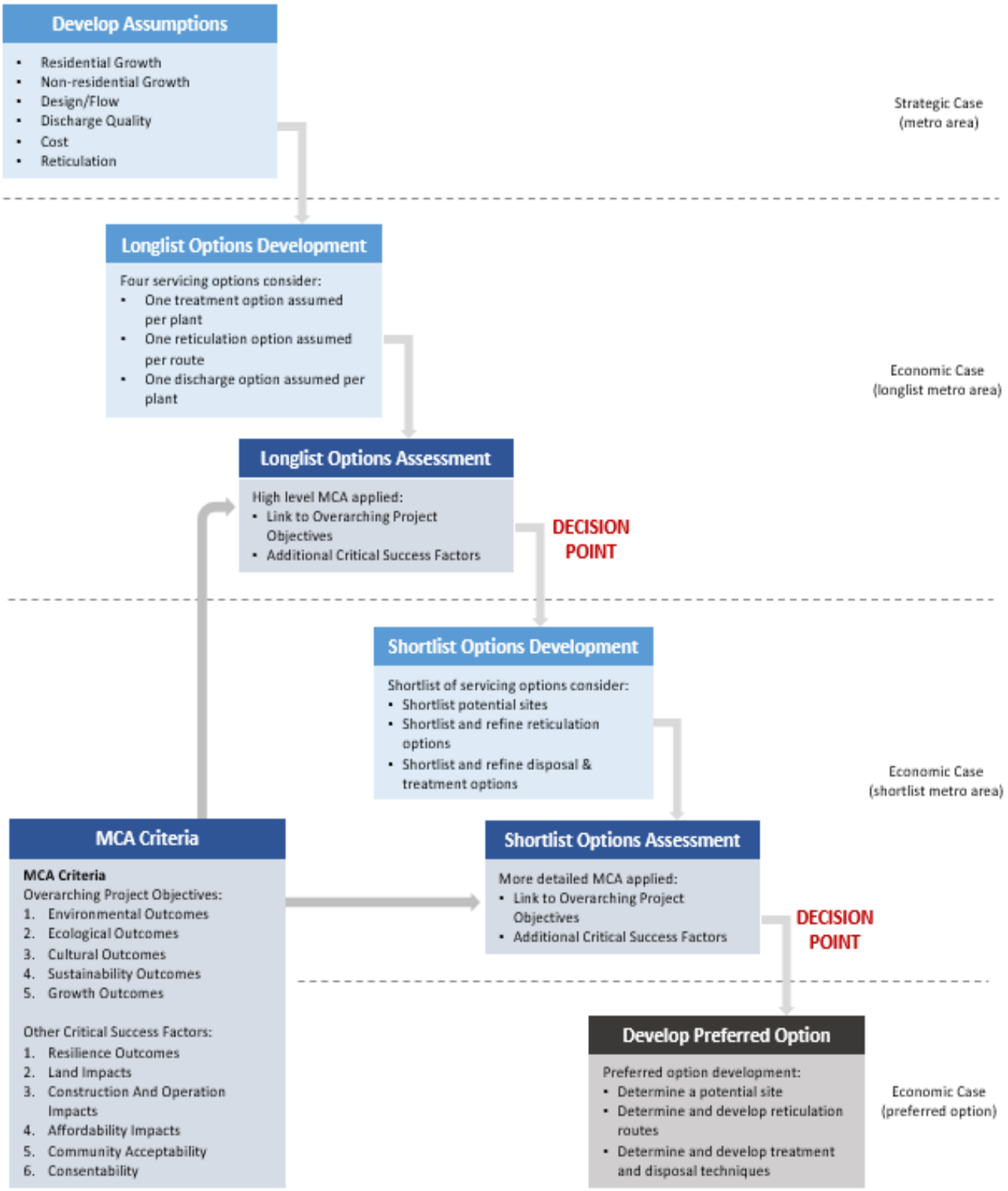

Figure 1-2 DBC option development and assessment methodology

The methodology for the treatment shortlist option development is as follows:

Step 1: Outline Treatment/Discharge assumptions

Based on the treatment and growth assumptions[3] as outlined within the Longlist Options Report, develop process flow and size assumptions.

Step 2: Confirm Treatment to be considered in greater detail

Confirm the treatment processes which are to be reassessed as part of the shortlisting process. WWTPs have varying levels of treatment dependent on projected population size at 2061, however it is likely for each considered option that the full treatment process proposed based on population size will not be required within the next 10 years. Some treatment processes only become feasible once flows reach a certain level.

Step 3: Assess the southern metro WWTP options

Information on some technical risks and issues is provided in this report to assist the assessment of the treatment component of the southern short list. Further assessment will be carried out as part of the site selection and discharge options work and will be documented in the southern shortlist assessment report.

1.4 Short list options overview

The longlist option assessment process identified the following options for shortlisting:

- Option 2A as a centralised option
- Option 4A (refined with staging limitations) as a partially centralised option.

OPTION 2A: Centralised southern plant (new site)

Option 2A consists of one centralised southern plant to service the following southern communities (plant located south of Hamilton):

- Hamilton (South)
- Matangi (at appropriate time, 2031 assumed)
- Hamilton Airport
- Ohaupo (at appropriate time, 2051 assumed)
- Cambridge.

The following southern WWTPs would also be upgraded:

- Tauwhare Pa (standalone plant) to be upgraded
- Te Awamutu/Kihikihi (standalone plant) to be upgraded – this WWTP will receive flow from Waikeria from 2021.

This option consists of five facilities to service the wider metro area, with four of them serving the southern metro area (refer to Figure 1-3). The longlist assessment identified Option 2A as the most preferred option under all various weightings and sensitivities. This option provides the flexibility to masterplan an efficient facility on a new site. A site selection process is required to determine potential new locations for the new plant. Some benefits of this option are related to a centralised location between south Hamilton and Cambridge. The conveyance alignment and cost will change depending on the location of the site.

[3] Treated Wastewater Assumptions for Waikato Wastewater Metro DBC, Beca, August 2020. Growth Assumptions for Waikato Metro Wastewater DBC, December 2020.

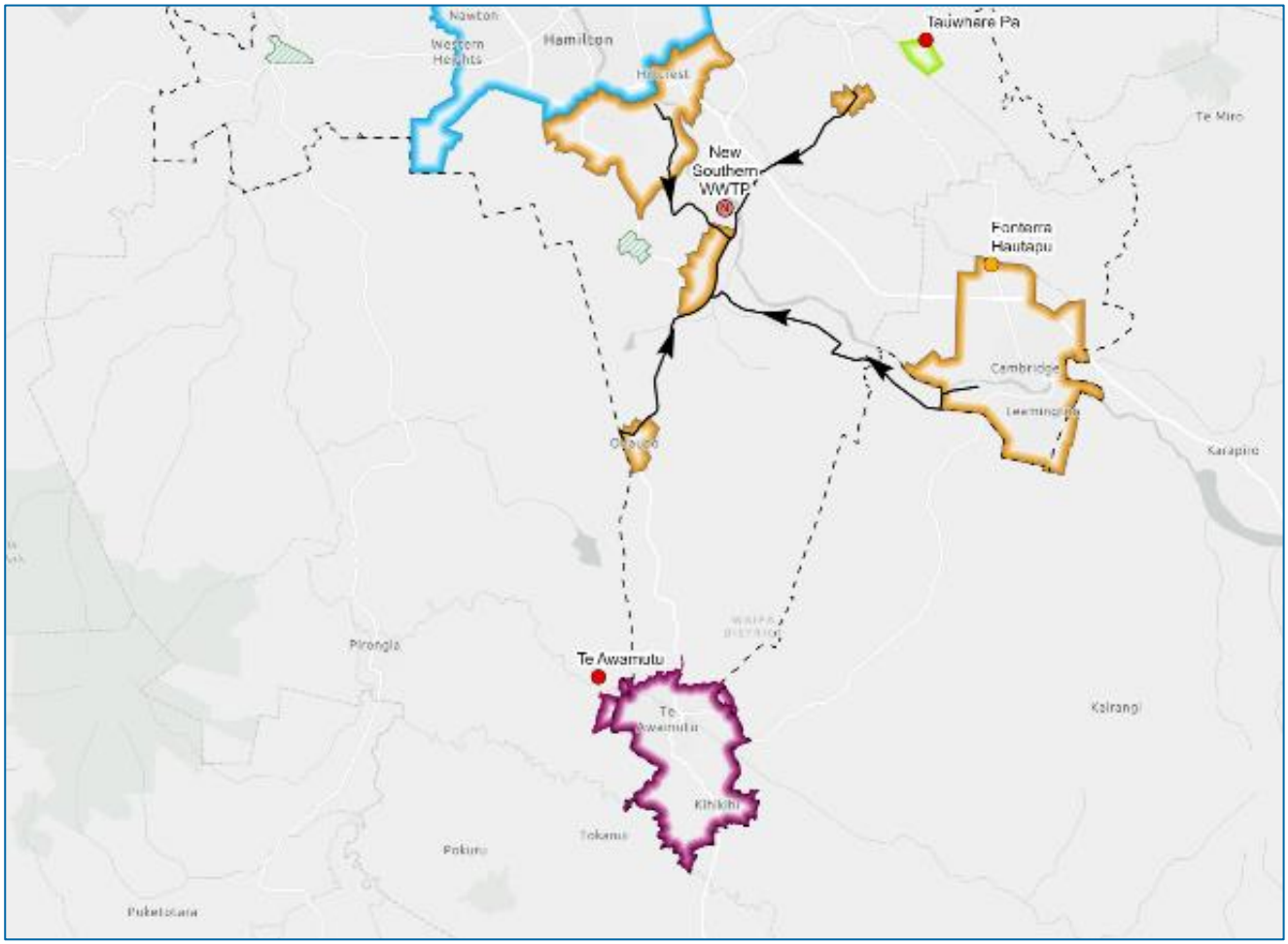

Figure 1-3 Option 2A – Centralised southern plant (site yet to be determined)

OPTION 4A: Partially Centralised option

Option 4A was progressed as the partially centralised option. This option consists of the following southern plants:

- Southern plant to service small southern communities (plant located south of Hamilton):
  - Matangi (at appropriate time, 2031 assumed)
  - Hamilton Airport
  - Ohaupo (at appropriate time, 2051 assumed)
- Tauwhare Pa (standalone plant) to be upgraded
- New plant at Cambridge (standalone plant)
- Te Awamutu/Kihikihi (standalone plant) to be upgraded– this WWTP will receive flow from Waikeria from 2021.

This option consists of seven plants to service the wider metro area, with four serving the southern metro area (refer to Figure 1-4). It is proposed that this option is refined to allow for growth considerations. A new southern plant to service the airport will be master planned to cater for Matangi and Ohaupo. However, both communities will only be connected once flows are large enough to minimise retention risks and the servicing option is needed to reduce environmental impacts of alternatives. In the interim, the Matangi plant is likely to require short to medium term upgrades. This option also maintains areas of benefit defined by existing council boundaries other than for Matangi.

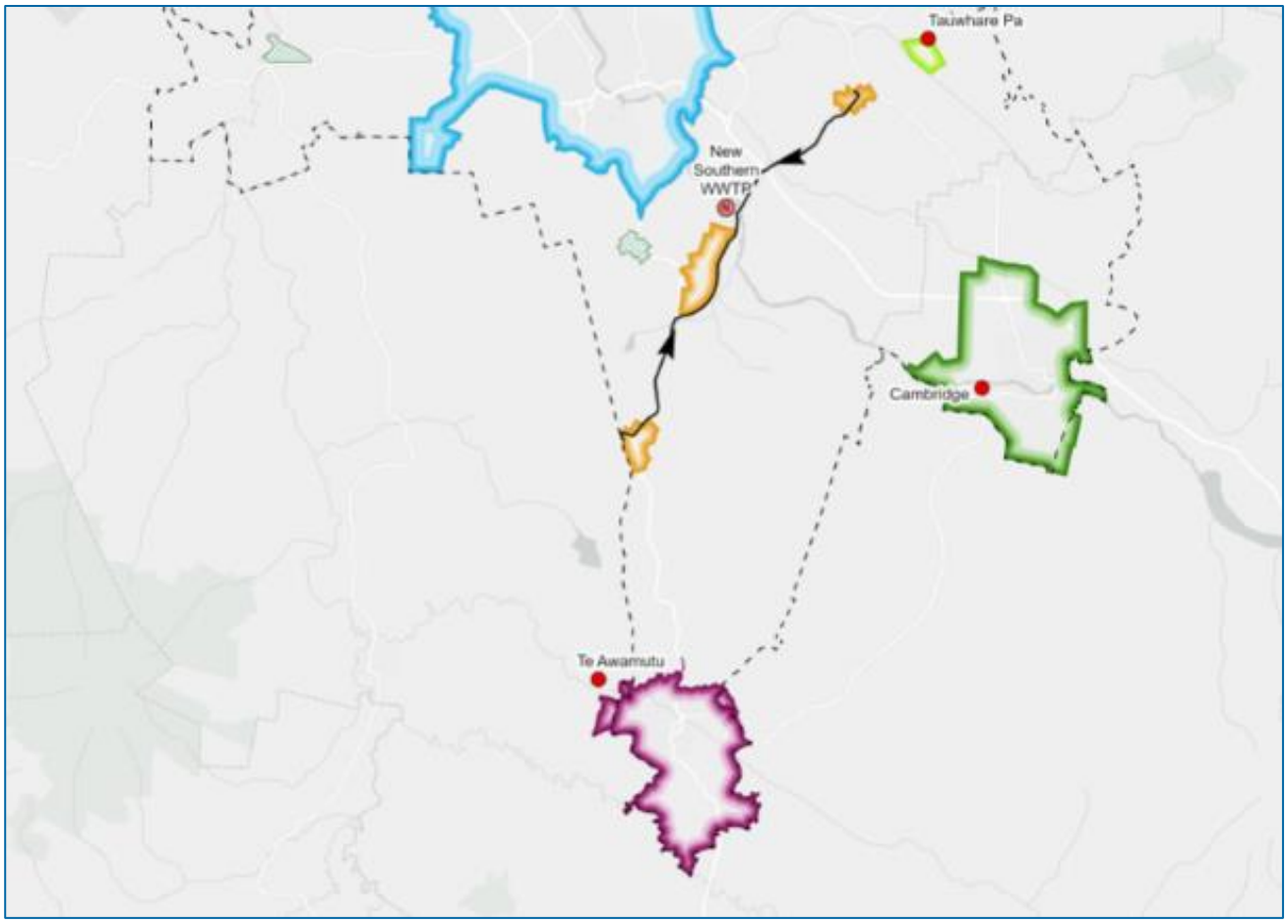

Figure 1-4 Option 4A Partially centralised option

2 Assumptions

The plants included as part of this study include the following:

- Option 2A – Large Southern WWTP
- Option 4A – Small Southern WWTP
- Option 4A – Cambridge Standalone WWTP
- Tauwhare Pa Package MBR Plant WWTP

2.1 Population assumptions

The following relevant residential and non-residential growth assumptions have been taken into account as developed in the Population and Growth Assumptions Memo:

- Growth assumptions have been collated based on information available as of 12th August 2020.
- An 'ultimate' growth capacity scenario has been identified which reflects the largest household projection for an area based on known development areas and expected density and is generally indicative of a 60-100 year growth period.
- Population projections for 10 year incremental periods have been collated starting in 2021 and finishing in 2061 (i.e. 2021, 2031, 2041, 2051 and 2061).
- The residential projections collated for this project focus on the "connected" population to be serviced by wastewater infrastructure.
- Maximum growth capacity is informed by zones in District Plans and additional areas indicated in growth strategies, private plan changes and submissions to Proposed District Plans as at August 2020.
- Significant industrial facilities with private wastewater treatment systems and discharge consents (such as Fonterra Te Rapa, Hautapu and Te Awamutu Plants and AFFCO Horotiu) within the Metro Area are not included in the population equivalent or trade waste flows.
- For Waikato and Waipa Districts, non-residential growth will be based on the areas outlined in the growth memo spread over expected development timeframes and the population equivalent (PE) factor.
- For Hamilton City, non-residential growth information has been incorporated into the PE forecasts for the Wastewater Master Plan V3.
- Existing and known future trade waste/wet industry discharges will be included in the wastewater flow and load projections.
- 45 population equivalent per hectare is used per additional hectare of industrial activity as per the RITS unless a different population equivalent is outlined in the growth assumptions memo. Gross 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.

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

		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	1301	1685	2095	2371	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	68,633
Tauwhare Pa	Current	140	619	619	619	619	889
Matangi (incl Tamahere commercial)	Current	140	464	464	464	464	1,035
Airport	2031	1377	6869	12,360	17,852	17,852	17,852
Ohaupo	2051	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
Sub - Totals	-	*327,131*	*415,336*	*463,169*	*542,480*	*587,753*	*839,125*

2.2 Design / Flow assumptions

To be able to assess each WWTP short listed, assumptions were made on the likely wastewater volume and quality expected to be received by each WWTP. These assumptions are consistent between WWTPs and are detailed below.

2.2.1 Flow Assumptions

Flow assumptions for the work completed, as per the long listing work was to use the RITS standard per capita ADF (average daily flow) approach of 200L/p/d for the population equivalent associated with each plant at each design time interval.

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

The flow projections associated with each plant considered in the shortlisting are as per Table 2-2 and Table 2-3.

Table 2-2 Average daily flow per WWTP to 2061

WWTP ADF (m^3/d)	2031	2041	2051	2061
Option 2A Southern WWTP	15,575	19,525	23,381	24,791
Option 4A Cambridge Standalone WWTP	6,824	7,678	8,578	9,006
Option 4A Southern WWTP	1,562	2,707	3,858	3,859
Tauwhare Package WWTP	55	55	55	55

Table 2-3 Peak instantaneous flow per WWTP to 2061

WWTP PIF (L/s)	2031	2041	2051	2061
Option 2A Southern WWTP	730	910	1,090	1,150
Option 4A Cambridge Standalone WWTP	320	360	400	420
Option 4A Southern WWTP	80	130	180	180
Tauwhare Package WWTP	10	10	10	10

2.2.2 Quality Assumptions

The raw wastewater quality assumptions made for the shortlisting are as carried forward from the longlisting assumptions, based on typical values for New Zealand raw wastewater but with nutrients at upper end of typical range. They were assumed as consistent across all four WWTPs. The concentrations assumed for the incoming wastewater into the shortlisted WWTPs is as per Table 2-4.

Table 2-4 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 Kjedahl Nitrogen (TKN)	60	mg/L
Total Phosphorus (TP)	10	mg/L

2.3 Treatment assumptions

The WWTPs developed for this short list report used the treatment assumptions outlined in the treatment standards memo.

2.3.1 Liquid Stream

The level of treatment for discharges to water:

- A high level of nutrient removal <4mg/L TN and <1.0mg/L TP (as annual means)
- A very high pathogen removal (E.coli <14 cfu/100ml as a 95th 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 is expected that future consents, for any river 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.

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, 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 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 of the modern 'short circuit' granular or fixed film biological process based around Anammox or similar bacteria.

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).

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 concentration is immediately targeted 4mg/l or less, that any appreciable upgrading is unlikely to be feasible.

2.4 Cost assumptions

The following items have been included in the comparative capital costs:

- 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)
- A contingency allowance.

The following items have been excluded from the comparative capital costs:

- Client management/overhead costs (to be provided by PWC)
- Consenting costs (to be provided by PWC)
- Procurement costs (to be provided by PWC)
- Legal fees
- Client insurances

- Escalation after 2nd quarter 2020
- Site decommissioning and restoration
- Goods and Services Tax.

A conceptual 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%.

2.5 Hamilton North South Split

HCC network

The HCC Wastewater Master Plan V3 (2020) outlines the areas of the Hamilton wastewater network under most pressure due to asset deterioration, infiltration and inflow and growth. The Masterplan proposed storage on the Eastern Interceptor and Upper Western Interceptor along with pump station upgrades and diversions as illustrated in Figure 2-1.

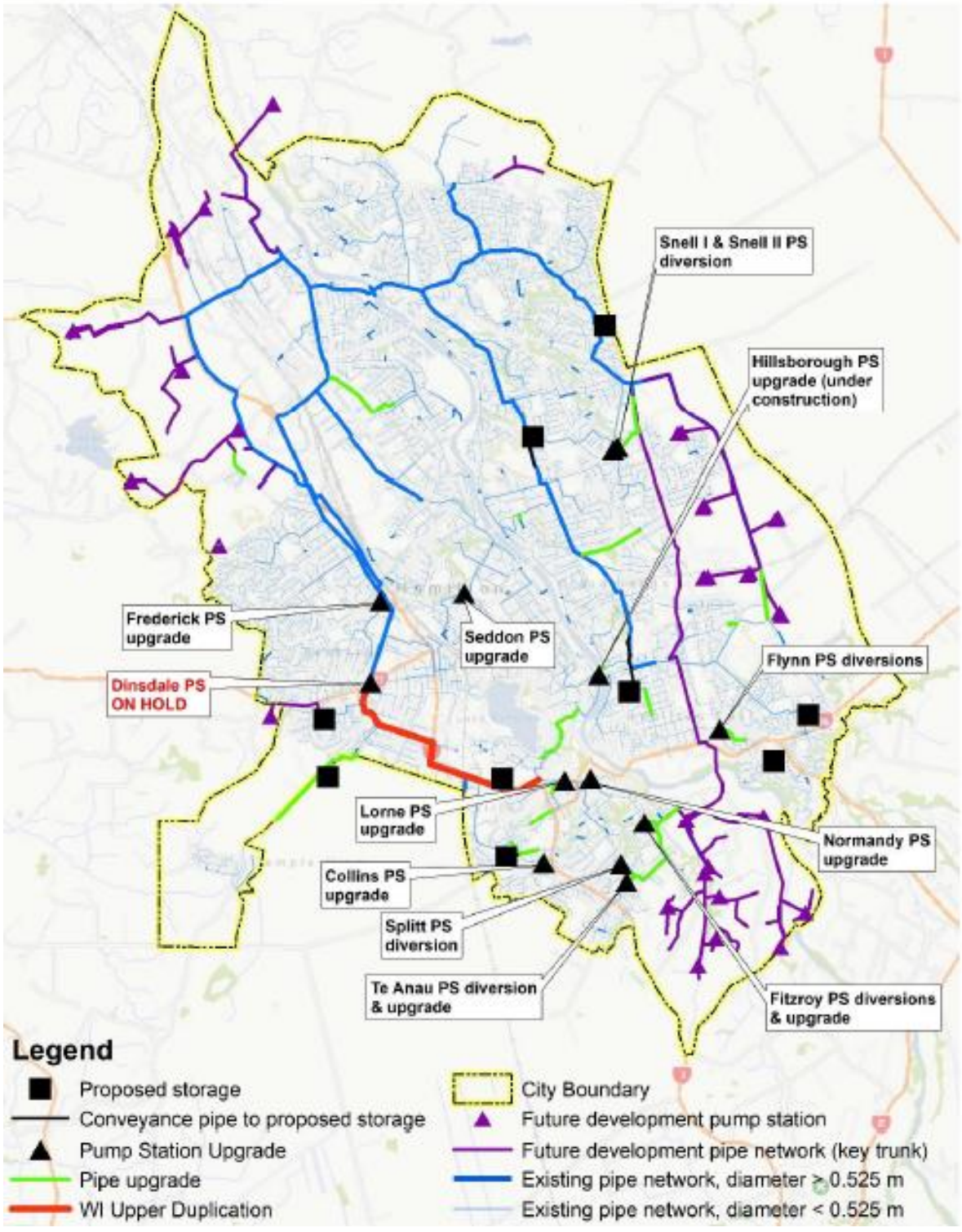

Figure 2-1 Hamilton Wastewater Master Plan V3 Proposed upgrades

Population equivalent data for 2021 to 2081 and for 'City Full' scenario was collated for the HCC network model for the areas outlined in Figure 2-2 and Table 2-5. For the purpose of the long list assessment it was assumed that areas 9,10 and 11 are diverted to the southern sub-regional WWTP from 2031 as outlined in Table 2-6. These areas were selected for the following reasons:

- Area 9 – Hillcrest/Riverlea – there is significant infill expected in these areas and they could use (in reverse) the rising main no longer required by Peacocke area when diverted south. Diverting these areas could reduce the need for network storage on the eastern interceptor (Steel Park, Donny Park) and free up capacity for infill. The population equivalent by 2061 is 13,276.
- Area 10 – Peacocke – this new greenfield area is under development and has a terminal pump station N4 which sends the wastewater north via a 6 km rising main to the Far Eastern Interceptor (FEI). During the design development for the N4 pumps station, the ability of the pump station to divert south instead of north was considered. Diverting this flow south could reduce the need for future storage on the FEI. The population equivalent by 2061 is 25,489.
- Area 11 – Glenview – the catchments of Splitt, Te Anau and Fitzroy will be diverted to the Peacocke N4 pump station in the next few years. The upper Western Interceptor (WI) is under pressure and requires storage and pump station upgrades at Lorne, Normandy and Collins. The population equivalent by 2061 is 19,081.

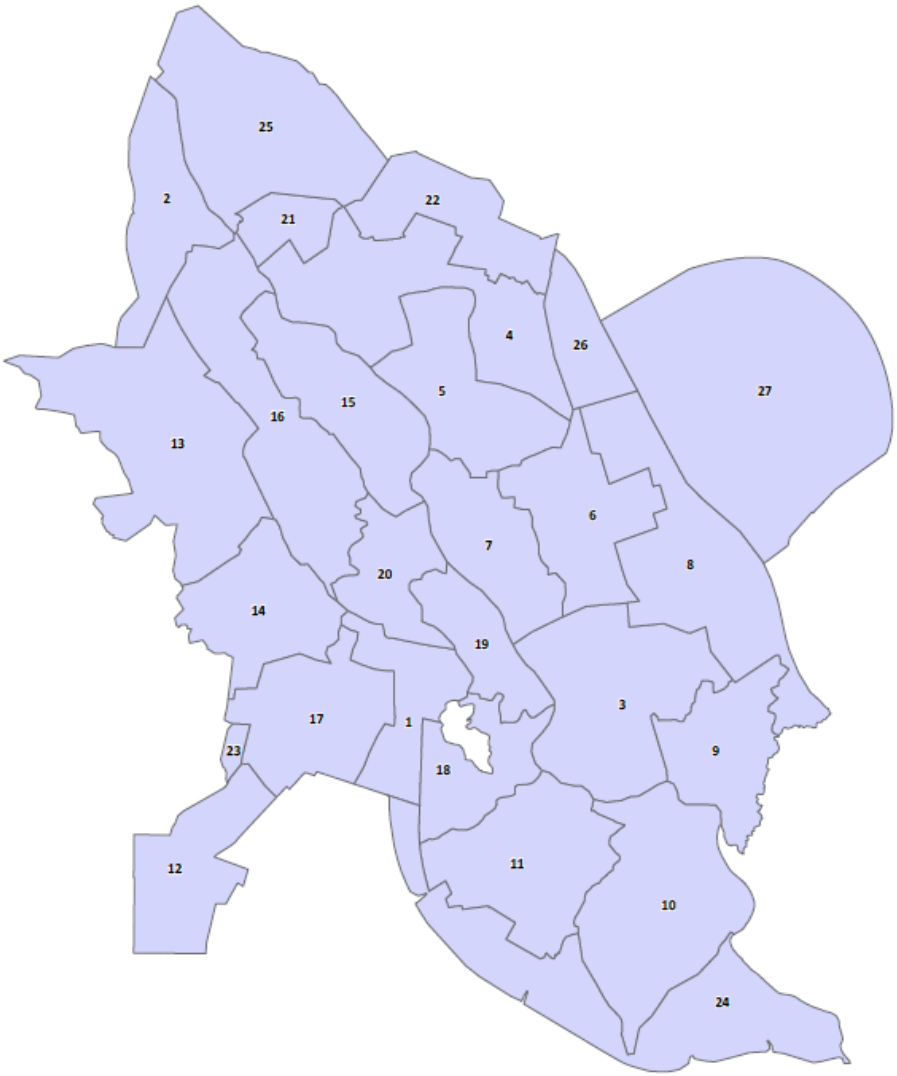

Figure 2-2 Hamilton wastewater model areas

Table 2-5 Hamilton Population Equivalent Breakdown

Area	PE_2021	PE_2031	*PE_2041*	*PE_2051*	PE_2061	City Full
1	7,567	8,118	*8,690*	*9,283*	9,958	20,222
2	1,167	9,073	*9,677*	*10,280*	10,884	15,898
3	24,730	25,020	*24,786*	*25,373*	24,658	28,584
4	21,763	21,928	*20,622*	*21,720*	21,002	23,301
5	11,996	11,943	*11,843*	*12,087*	11,824	14,107
6	15,637	16,318	*16,606*	*16,894*	17,182	18,814
7	10,958	11,589	*12,091*	*12,715*	12,488	14,506
8	6,816	10,127	*13,965*	*17,014*	25,697	28,769
9	11,371	11,967	*13,178*	*15,084*	13,276	15,562
10	1,346	6,532	*14,161*	*18,648*	25,489	25,607
11	16,913	17,820	*18,409*	*19,720*	19,081	20,732
12	2,031	2,681	*3,550*	*4,419*	5,289	15,860
13	2,897	9,129	*9,567*	*19,913*	21,570	31,624
14	15,181	15,375	*15,537*	*15,700*	15,863	17,546
15	11,940	12,188	*12,406*	*12,413*	12,468	14,283
16	13,892	15,003	*15,993*	*17,290*	19,168	39,698
17	16,181	17,605	*17,728*	*17,852*	17,976	20,349
18	9,238	10,098	*10,358*	*10,617*	10,877	15,022
19	21,625	27,762	*32,271*	*36,655*	37,997	64,800
20	8,386	8,747	*9,118*	*10,042*	10,426	11,951
21	3,464	4,538	*4,532*	*4,526*	4,520	4,547
22	6,969	10,627	*10,536*	*10,446*	10,355	10,737
23	0	0	*0*	*0*	0	1,000
25	0	0	*0*	*8,398*	16,796	33,591
26	179	179	179	*4,725*	9,450	9,450

Table 2-6 Proposed North/South flow splits

Area	PE_2021	PE_2031	*PE_2041*	*PE_2051*	PE_2061	City Full
Hamilton directed north to Pukete WWTP (excluding wet industry)	242,272	256,040	266,251	308,675	343,680	553,053
Hamilton directed south to sub-regional WWTP (areas 9-11)		36,573	46,511	54,723	59,626	68,633
Additional infill Hamilton Remainder		2,057	6,171	10,286	14,400	65,545
Additional infill Hamilton 9-11 (University)		254	763	1,271	1,780	6,733
Potential area east of the Expressway						30,000

Area	PE_2021	PE_2031	*PE_2041*	*PE_2051*	PE_2061	City Full
Potential % Diverted south	0%	13%	15%	15%	15%	12%
Total Hamilton (excluding wet industry)	242,272	292,612	312,762	363,398	403,306	621,686

Potential areas for diversion

Discussions were undertaken with HCC operations and planning staff at a workshop on 28 October 2020 to refine the assumptions on the north/south split for Hamilton. The draft Hamilton North/South split section in this report was provided to the workshop attendees for feedback and comments incorporated.

In the short term the simplest area to divert south is the Peacocke area (including the part of Glenview already diverted to Peacocke). The key objective is to maximise the use of what would become the redundant Peacocke rising mains on the eastern side of the river and reduce flow to the upper Western and Eastern interceptors. The options for diversion illustrated in Figure 2-3 by Sven Ericksen HCC include:

- Divert south a significant part of the Hillcrest, Riverlea areas (areas 9 and part of 3) by diverting at Clyde Street/Flynn PS utilising the Peacocke rising mains. This could avoid the need for the proposed Steel and Donny Park storage on the Eastern Interceptor.
- Divert Snells catchments (area 6) south utilising the Peacocke rising mains (this is unlikely to be able to be done at the same time as Hillcrest/Riverlea proposal), this is currently proposed to be diverted from the Eastern to the Far Eastern Interceptor.
- Divert Ruakura catchment south of the railway line and potentially more of Hamilton East either north or south (parts of area 8). This area needs to be pumped as no gravity discharge is available and this option could preserve capacity in the far eastern interceptor or avoid storage at this point. The northern part of the Ruakura development is planned to be serviced by a new gravity main flowing to the Far Eastern Interceptor.
- Divert Peacocke (area 10) south from N12 pump station with current terminal pump station N4 pumping through to N12 and then to the new sub-regional WWTP. Continue to divert Splitt/Fitzroy and Te Anau (via N4) in conjunction with other Peacocke flows.
- Divert Lorne or Normandy pump station (area 11) to N4 pump station in Peacocke or pump directly to the new southern WWTP. This would reduce pressure on the upper western catchment and avoid need for duplication and storage/pump station upgrades at Lorne and Normandy.
- Southern Links, Area 24 – although not expected to develop in the next 30 years, the southern links area could be directed to the Southern WWTP – 35,000 PE, not currently included in the HCC Master Plan.

Wet weather flows at the diversion points and key impacts of these diversions were provided by Aecom[4] as per Table 2-7.

[4] Email received 9/12/20 via Manjit Devgun (prepared by Stepanka Vajlikova Aecom)

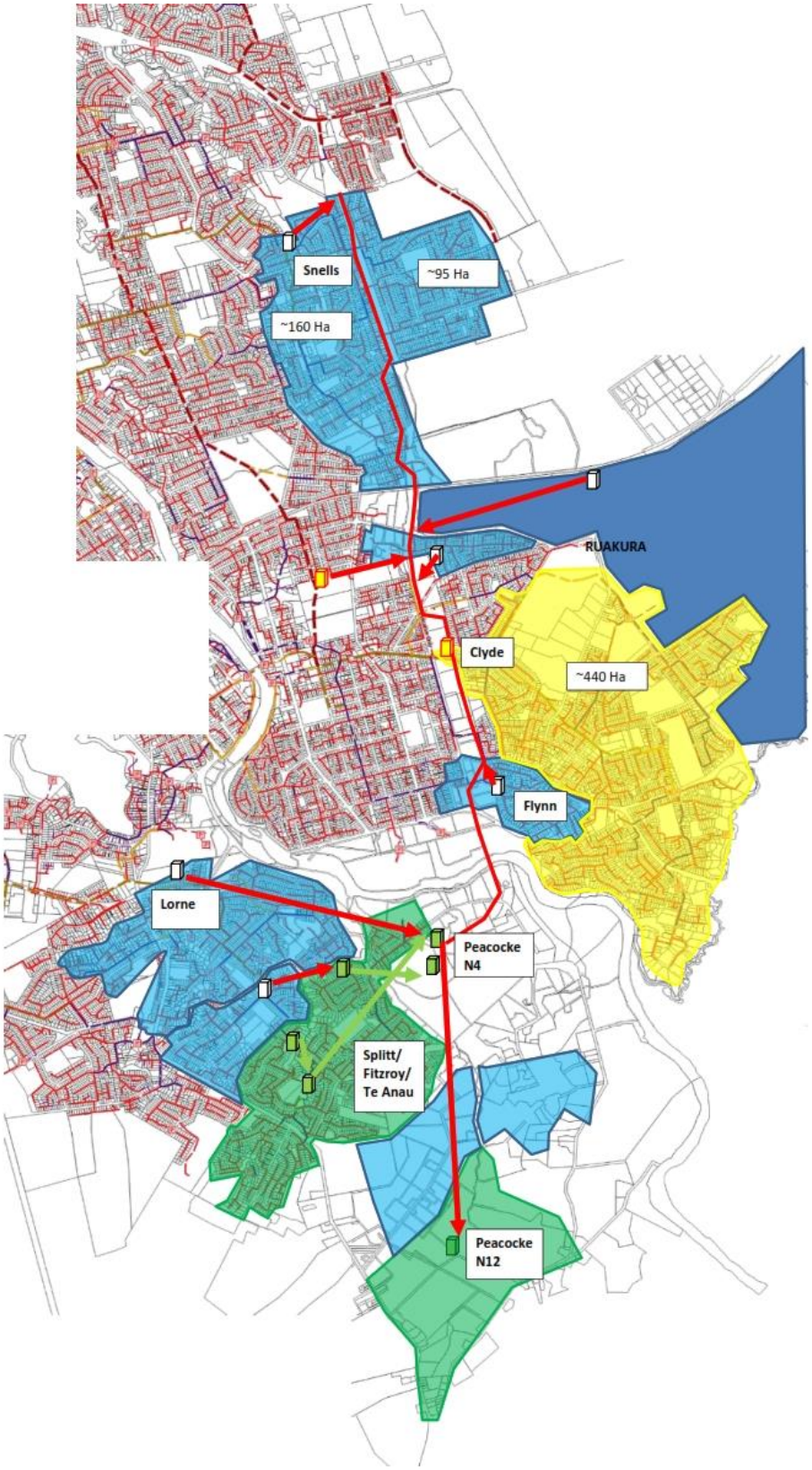

Figure 2-3 Potential diversions south – provided by Sven Ericksen HCC

Table 2-7 Potential diversion location details

Location	Average Wet Weather Flow [L/s]	Peak Wet Weather Flow [L/s]	Benefits	Comments
Flynn PS	23	72.5	Likely elimination or significant decrease of the required storage volume of Steel Park storage and Donny Park storage.	Flow rates are from RM Flynn PS and pipe upgrade upstream of the PS is still required (at 2061).
Hillcrest (at Clyde St)	132	35	Likely elimination or significant decrease of the required storage volume of Steel Park storage and Donny Park storage.	Flow rates are from pipe ID 48081 (WWS23050 to WWS23032) All masterplan upgrades upstream of this pipe are accounted for in the flow rates shown.
Snell 1&2 PSs	62	179	Likely significant decrease of the required storage volume of Darjon Park storage.	Flow rates are combined for both PSs. Flow rates are from RM.
Fitzroy/Te Anau/Splitt PSs	77	139	Ultimately decrease in storage volume or complete elimination of Darjon Park storage.	Te Anau & Fitzroy pump capacity increase as per MP still required. Flow rates presented are combined for all three pump stations.
Peacocke - N4 (Receives flow from N12, Fitzroy/Te Anau/Splitt and remainder of Peacocke)	126	310	Ultimately decrease in storage volume or complete elimination of Darjon Park storage. Ultimately relieves capacity in the Far Eastern Interceptor (FEI) for the development in Northern areas of the City	
Lorne PS	68	181	Reduced flows to the Western Interceptor (WI). Will have a positive impact on the Upper WI solution.	Lorne pump capacity increase as per MP still required.
Normandy PS	13	56	Reduced flows to the WI and to Lorne PS.	Normandy pump capacity increase as per MP still required.

Notes:

1. WWMP Version 3 model outputs used.
2. 1 in 2-year overflow event
3. AWWF is an average for 3 days of the simulation (from 25/04/2011 to 28/04/2011)

Recommended approach

In the short term diverting Peacocke and Fitroy / Te Anau and Splitt south via N4/N12 pump stations is recommended (to be confirmed once preferred WWTP site is selected). Once this area is diverted, maximising the use of the Peacocke rising mains is recommended by diverting south as much as feasible of the Hillcrest / Riverlea area in the vicinity of Clyde Street. Diverting more of the upper Western catchment is difficult due to limited service corridors but this could be considered as part of the optioneering for Lorne and Normandy pump station upgrades / storage to address capacity issues.

Longer term there are opportunities to use the redundant Peacocke mains between Clyde and Snells to divert other catchments north. Diverting south areas in the CBD (potentially Hillsborough) and upper Western catchment (potentially in conjunction with southern links) via new rising mains may provide additional capacity to service infill growth in these areas and address network issues.

Overall, the assumed level of diversion (15%, 61,400PE) proposed to the southern WWTP for option 2A is considered appropriate to use for the short list assessment. The design and timing of the N12 pump station and N4-N12 transfer main in Peacocke would be critical to the feasibility of sending flows south. The potential impacts of the diversions on the Hamilton network and Pukete WWTP capacity also need to be investigated further as part of the northern detailed business case. The conveyance cost estimates outlined in the short list report have allowed for pump stations at Peacocke N12 and Clyde Street and modifications to Peacocke N4 pump station.

3 Treatment Shortlist Option Development

3.1 Methodology

Using recommendations from the treatment standards memo[5], all plants on the shortlist were categorised as either small, medium or large based on their design horizon population equivalent (PE). This allowed them to be allocated a set of treatment processes they would be sized for 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.

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

Size	Population Step (PE)	Flow Step (m^3/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	Reactor Membrane separation UV	Screw Press Dewatering
Large	40,000 – 150,000	8,000 – 30,000	Primary Treatment Reactor Membrane separation UV Centrate Treatment	Digester Centrifuge Dewatering
	150,000 +	30,000 +	Primary Treatment Reactor Membrane separation UV Centrate Treatment	Digester Centrifuge Dewatering Advanced Solids Destruction

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

3.2 Process Element Descriptions

The wastewater treatment process elements the Southern Metro options incorporate include the following:

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
- 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
- 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 of cloth pile filters could be employed as the primary clarification devices up front of the MBR and the digesters.

MBR

A new MBR facility, comprising:

- Activated sludge reactors (ASRs) configured for nitrogen and phosphorus removal
- Blowers and diffused aeration system, including internal recycle
- Ultrafiltration membrane separation using submerged hollow fibre membranes
- Permeate pumps for managing effluent flows through and downstream of the membranes
- A clean in place (CIP) systems required for the membranes
- Return activated sludge (RAS) and waste activated sludge (WAS) pumping
- Alum dosing for phosphorus removal where necessary (the reactors/membrane tanks are set up as 5 stage Bardenpho (or similar) for biological phosphorus removal)

UV

A tertiary UV disinfection system comprising:

- Either an in-channel lamp bank or in-pipe pressurized UV disinfection system

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 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.

3.3 Option 2A: Southern WWTP Description

Option description

The Southern sub-regional WWTP is designed to treat an average daily flow in 2061 of ~25,000 m^3/d. To achieve this level of treatment the following plant features are proposed:

- Inlet works
- Primary Sedimentation

- Digestion
- Centrifugal dewatering
- Centrate Treatment
- MBR
- UV treatment.
- Discharge to River

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

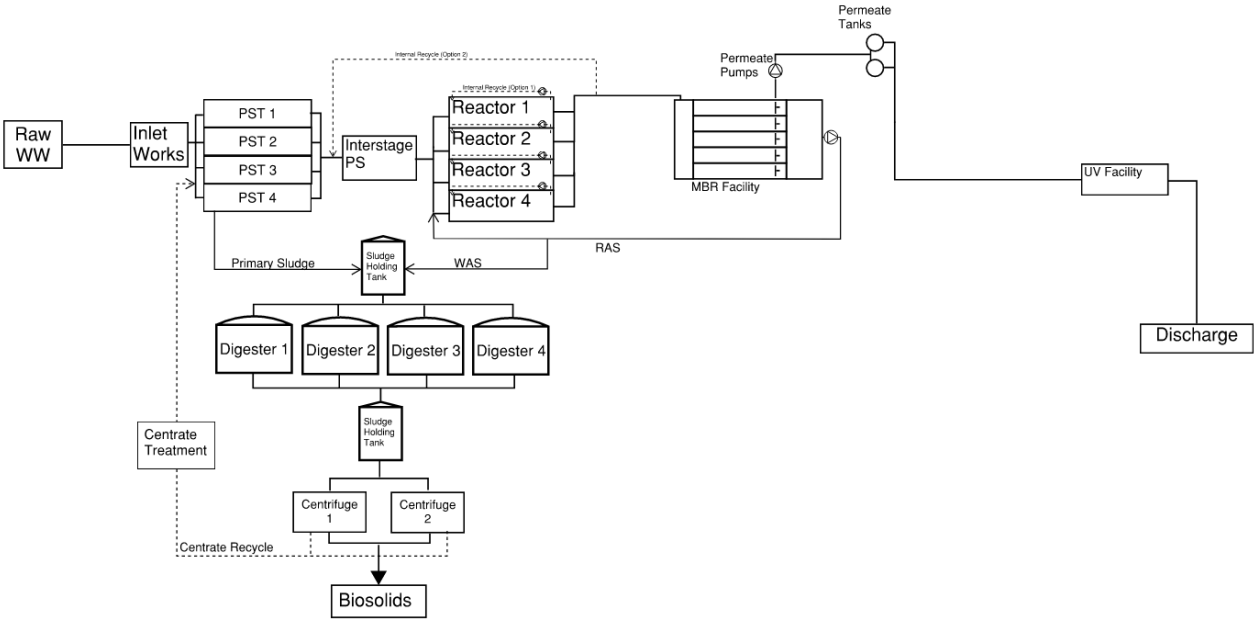

Figure 3-1 Option 2A Southern WWTP PFD

Layout

The plant is expected to require an approx. 5 ha footprint with a potential layout illustrated below. This does not include buffer areas for the WWTP. It is recommended that a site of minimum 15 ha is acquired. In addition to this an area of approx. 200m around the site may need to have some restrictions to use.

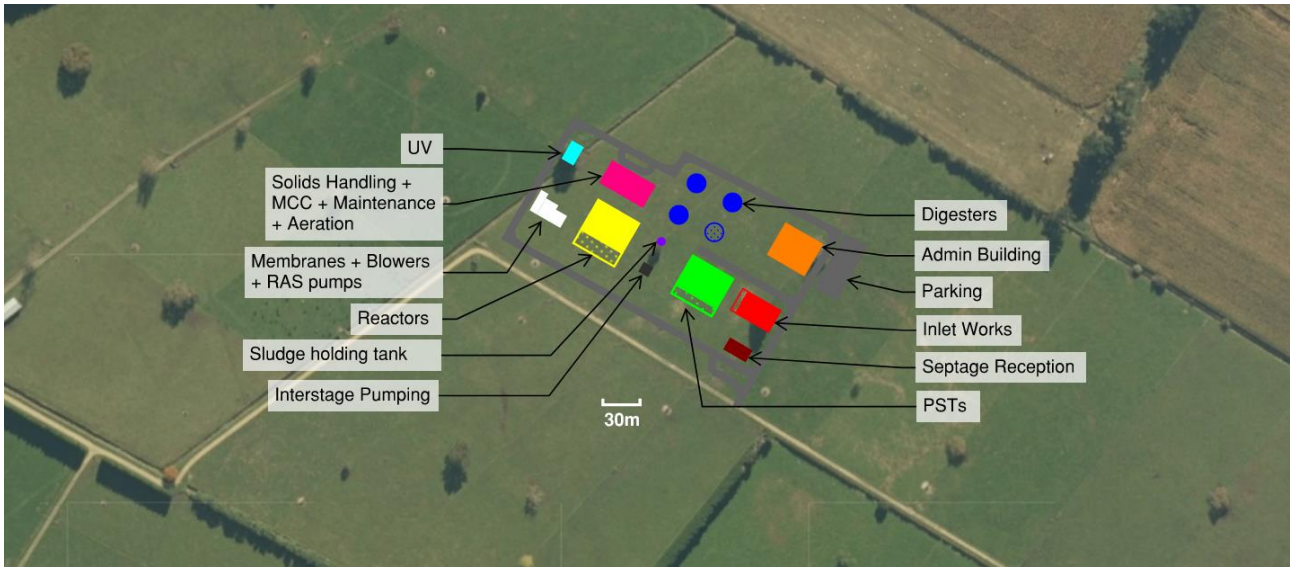

Figure 3-2 Option 2A Southern WWTP Example Layout

Staging

In order to determine process unit sizing and staging, a Site Buildout sizing spreadsheet was used to analyse the process units required and time intervals that might be required. In addition to the Site Buildout spreadsheet, a steady state activated sludge model (based on the ATV [6]standard guidelines) and sizing spreadsheet 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:

Table 3-2 Option 2A Southern WWTP Base Staging

Asset	Size	2031	2041	2051	2061
Flow	m^3/d	15,575	19,525	23,381	24,791
Screening trains	500L/s	2	2	3	3
Grit Removal					
PSTs	$180m^2$	3	3	4	4
Reactors	$2000m^3$	3	4	5	5
Membrane Trains	200L/s	4	5	6	6
Digesters	$1,500m^3$	3	4	4	4
Dewatering	$20m^3/hr$	2	2	2	2
Biosolids @ 26%DS	m^3/d	15	16	17	17
Energy use	Million KWh/year	3.5	4.5	5.4	5.7

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

Installation of the PSTs and Digesters could be delayed to 2051 however additional secondary reactor capacity would need to be installed (estimated at approximately 5 reactors). It may be possible to design reactors that could be converted to PSTs later. If PSTs/Digesters were delayed, operating costs in the intervening years would increase as energy is not recovered and biosolids volumes for disposal are higher.

A lower TN concentration target would reduce reactor sizing and energy requirements – this impact is outlined below in Table 3-3. This analysis also shows the potential impact on required reactor size of removing the primary treatment/digesters (increasing the load to the reactors).

Table 3-3 Option 2A Reactor Volume Sensitivity

Option 2A Southern WWTP		2031	2041	2051	2061
PST, TN 4mg/L (Base)	Reactor vol at 6,600mg/L MLSS (m^3)	6,719	8,219	9,692	10,208
PST, TN 7.5mg/L	Reactor vol at 6,600mg/L MLSS (m^3)	5,621	6,878	8,043	8,460
No PST, TN 7.5mg/L	Reactor vol at 6,600mg/L MLSS (m^3)	8,058	9,764	11,690	12,400

Delaying the introduction of Ohaupo and Matangi would have minimal impact on treatment process capacity required as the flows from those communities are such a small component of the total flows.

Delaying the introduction of South Hamilton flows (if practical from a conveyance perspective) could reduce the number of reactors, membrane trains and digesters required to be built at the start. However, some components such as civil works, transfer pipes and buildings are generally built to ultimate sizing at the start at a new site with more limited potential to stage due to the major interventions required on large hydraulic items.

Significant wet industry flows have been allowed for at the airport industrial area (1,750 m^3/day by 2061). If wet industry was to not locate at this area or more wet industry arrived than allowed for, process capacity could be delayed or bought forward to match requirements.

The ultimate flows to the 2A southern sub-regional WWTP could be up to 30,000 m^3/day based on the current growth assumptions. The 5ha footprint proposed is likely to be suitable for these flows but the site master plan should identify reserve areas for additional screens, PSTs, reactors, digesters and buffers and therefore a total site area of approximately 15ha.

Issues and Risks

A new site 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 is advisable to mitigate potential odour and noise issues. Process equipment can be added over time as flows increase due to residential and industrial growth.

While a new site can be selected with more favourable ground conditions, some ground improvements are likely to be required.

Larger WWTPs provide more redundancy with their processes and equipment.

Option 2A, with its longer and larger conveyance mains than option 4A, presents a greater resilience risk in the face of major seismic activity in the area. However, with modern PE piping systems and adoption of the lessons learned following the Christchurch earthquakes, these risks can be significantly mitigated.

The larger 2A facility provides the greatest opportunity for adoption and implementation of sustainable engineering and management practices and the consequent gains in terms of operational cost savings and reductions in Greenhouse gas emissions associated with the plants.

3.4 Option 4A: Standalone 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
- Digestion
- Centrifugal dewatering
- Centrate treatment
- MBR
- UV treatment.
- Discharge to river

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

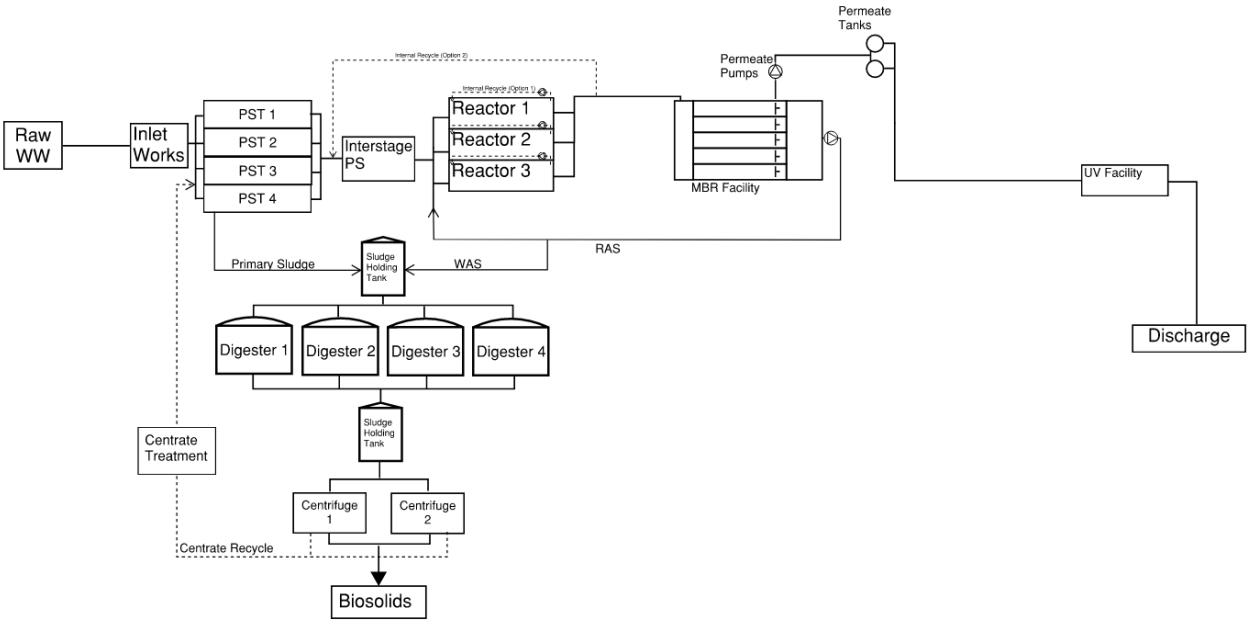

Figure 3-3 Option 4A Standalone Cambridge WWTP PFD

Layout

The plant is expected to require an approx. 3 ha footprint. The site could be located in the area 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.

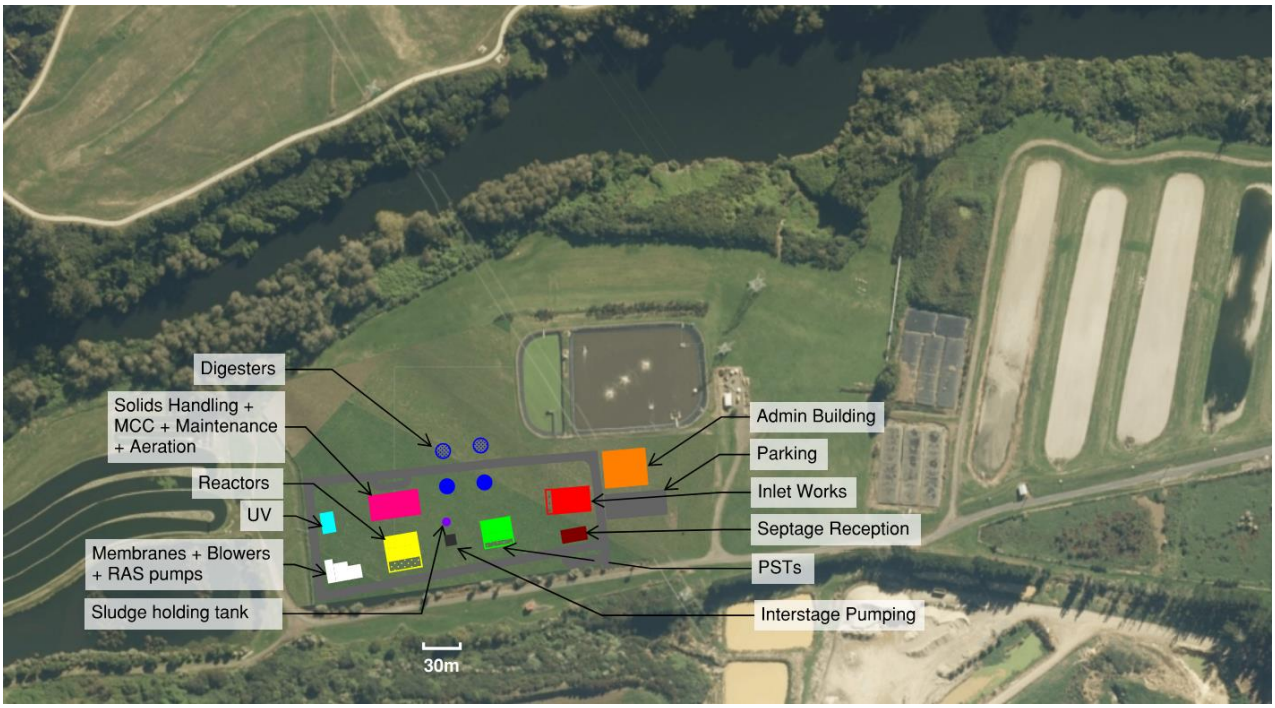

Figure 3-4 Option 4A Cambridge WWTP Example Layout

Staging

To determine process unit sizing and staging, a Site Buildout sizing spreadsheet was used to analyse the process units required and time intervals they might be required. In addition to the Site Buildout spreadsheet, an a steady state activated sludge model (based on the ATV [7]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 3-4:

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

Table 3-4 Option 4A Cambridge WWTP Base Staging

Asset	Size	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	600m³	3	3	4	4
Dewatering	10m³/hr	2	2	2	2
Biosolids @ 26%DS	m³/d	5.6	5.8	6	6.1
Energy Use	Million KWh/year	1.5	1.7	2.0	2.1

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.

A lower TN concentration target would reduce reactor sizing and energy requirements. Table 3-5 outlines potential reactor size requirements for changing the target treated wastewater quality from 4mg/L TN to 7.5mg/L or removing the primary treatment (increasing the load to the reactors).

Table 3-5 Option 4A Cambridge reactor volume sensitivity

Option 4A Cambridge WWTP		2031	2041	2051	2061
PST, TN 4mg/L (Base)	Reactor vol at 6,600mg/L MLSS (m³)	2,766	3,102	3,454	3,626
PST, TN 7.5mg/L	Reactor vol at 6,600mg/L MLSS (m³)	2,311	2,593	2,882	3,023
No PST, TN 7.5mg/L	Reactor vol at 6,600mg/L MLSS (m³)	4,201	4,698	5,208	5,448

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.

The ultimate flows to the 4A Cambridge WWTP could be up to 11,500 m^3/day based on the current growth assumptions. The 3ha footprint proposed is likely to be suitable for these flows but the site master plan should identify reserve areas for additional screens, PSTs, reactors, digesters and buffers. The site may need to expand into the adjacent quarry site to minimise geotechnical concerns and to minimise process disruptions in the existing treatment plant while the new facilities are constructed.

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.

3.5 Option 4A: Southern Sub-regional Plant

Option description

For the Southern WWTP sub-regional plant to treat an average daily flow in 2061 of ~3,900 m^3/d the following plant features are proposed:

- Inlet Works
- Screw Press dewatering
- MBR
- UV treatment
- Discharge to river and potentially discharge to land within a larger, future proofed site.

The process flow diagram (PFD) is shown in Figure 3-5.

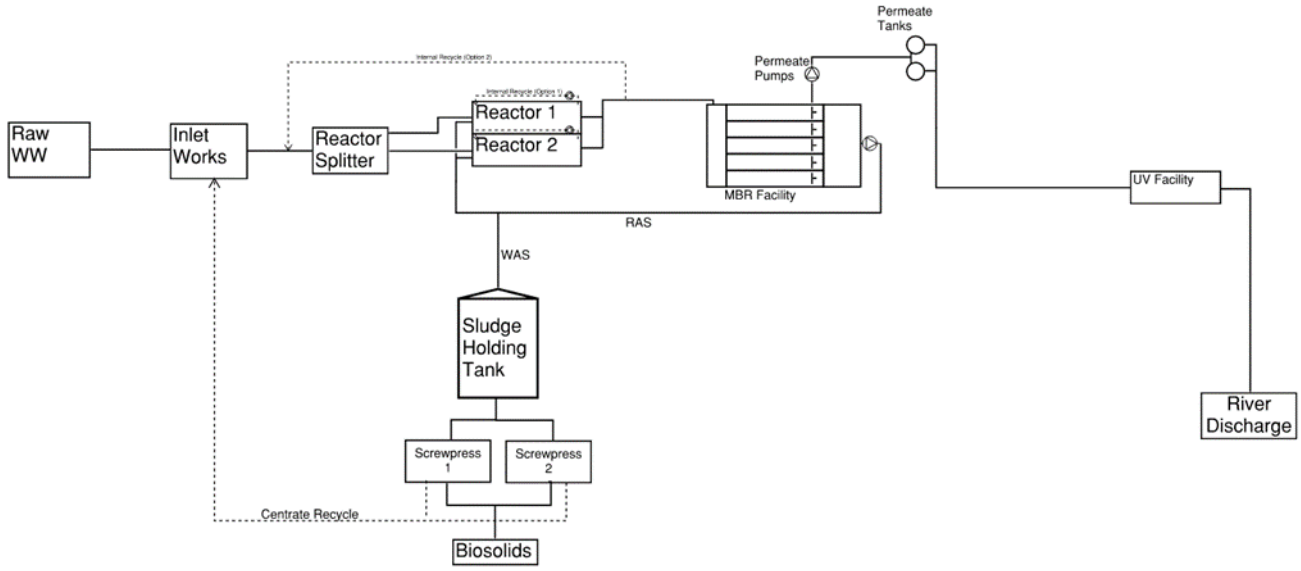

Figure 3-5 Option 4A Southern Sub-regional WWTP PFD

Layout

The plant is expected to require an approx. 3 ha footprint for the 2061 and ultimate development (i.e. most development expected to be complete prior to 2061). This does not include buffer areas for the WWTP. It is recommended that a site of minimum 15 ha is acquired. In addition to this an area of approx. 200m around the site would need to have some restrictions to use.

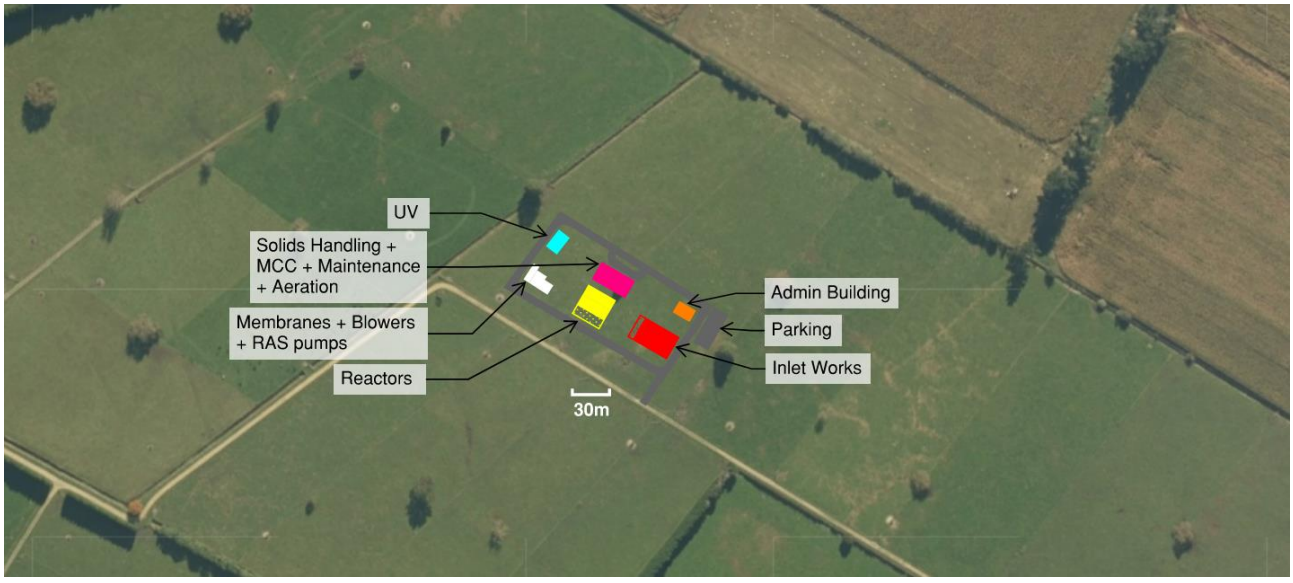

Figure 3-6 Option 4A Southern WWTP Example Layout

Staging

To determine process unit sizing and staging, a Site Buildout sizing spreadsheet was used to analyse the process units required and time intervals they might be required. In addition to the Site Buildout spreadsheet,

an 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 3-6. Further membrane trains could be added in 2041/51 or when wet industry flows required. A minimum of 2 screens and 2 reactors would likely be required at start up to provide a level of operational redundancy.

Table 3-6 Option 4A Southern WWTP Base Staging

	Size/Unit	2031	2041	2051	2061
Flow	m^3/d	1,562	2,707	3,858	3,859
Screens	100L/s	1	2	2	2
Reactors	$800m^3$	1	2	2	2
Membrane Trains	50L/s	2	3	4	4
Biosolids volume @ 26%DS	m^3/d	2	4	6	6
Energy Use	Million KWh/year	0.7	1.2	1.8	1.8

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. 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. A more modular approach could be undertaken with self contained treatment systems added as development occurs. Smaller modular units would be less likely to be cost effective for larger wet industries of uncertain waste volume and composition.

In the short to medium term, a package 'secondary treatment' WWTP with land discharge may be suitable for up to 500 m^3/day, to service light industry in the Airport industrial precinct. A land area of up to 10 ha would be needed for the land discharge along with additional area for buffers. Over this level of flow, package plants are less cost effective and much larger areas of land would be required for discharge of treated wastewater.

A transfer pipeline from the Airport to Cambridge WWTP was considered in the long list options with an estimated cost of $20M (this also included capacity for south Hamilton flows). This option would need a minimum starting flow to avoid excessively long retention times in the conveyance pipe and resulting septicity. A smaller pipeline could be used if wet industry was not serviced.

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 a light industrial facilities.

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

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.

3.6 Tauwhare Pa WWTP (Both Options)

Option description

The current WWTP at Tauwhare Pa discharges secondary treated wastewater to land and is generally compliant with consent requirements. The treated wastewater quality required for discharge to land depends on the soil type, climate and intended land use. Soils in the area have reasonable drainage characteristics and there are limited opportunities for discharge to water.

There is uncertainty over the timing and flows 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 MBR plant has been sized for comparative purposes. No allowance has been made for discharge to land.

Discharge to land with conventional secondary treatment is likely to have a lower capital and operating cost than an MBR plant.

Tauwhare Pa is 3 km from Matangi. Should Matangi be conveyed to a sub-regional WWTP, it may be feasible to convey Tauwhare Pa wastewater to Matangi and then onto the sub-regional WWTP.

Layout

An MBR plant would have a similar process to the WWTP for the 4A southern WWTP. 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 timing of development at Tauwhare Pa and availability of suitable land.

Issues and Risks

Once a preferred southern option is identified further investigation of Tauwhare Pa options can be undertaken. Soil conditions and environmental effects associated with land discharge will need to be investigated.

3.7 Treatment Cost Estimates

A costing exercise has been completed for the four potential WWTPs that form a part of Option 2A and Option 4A. This exercise uses the costing assumptions from Section 2 and develops the potential costs for each of these plants should they be built to their design flow process unit requirements at 2061. These cost estimates have an estimation accuracy range of -30% / +50% of which is standard at Conceptual Appraisal stage.

3.7.1 Capital Costs

Table 3-7 and Table 3-8 summarises the capital costs for Option 2A and Option 4A respectively. The detail is provided in Appendix A. As outlined in the costing assumptions Council internal costs, procurement and consenting costs are excluded from the cost estimates.

Table 3-7 Option 2A Capital Costs summary

Area	WWTP name	Size of plant	WWTP Capital Cost ($ M) to 2061
Hamilton South	2A Southern Sub-Regional WWTP	Large	$ 169M
Matangi			
Airport			
Ohaupo			
Cambridge & Hautapu			
Te Awamutu & Kihikihi	Te Awamutu	Medium	$ 29M
Tauwhare Pa	Tauwhare Pa	Small	$ 6M
TOTAL			**$ 204M**

Table 3-8 Option 4A Capital Costs summary

Area	WWTP name	Size of plant	WWTP Capital Cost ($ M) to 2061
Matangi	4A Southern Sub-Regional	Medium	$ 54M
Airport			
Ohaupo			
Cambridge & Hautapu	Cambridge	Large	$ 113M
Te Awamutu & Kihikihi	Te Awamutu	Medium	$ 29M
Tauwhare Pa	Tauwhare Pa	Small	$ 6M
TOTAL			**$ 202M**

To compare the capital costs on an equivalent basis, the equivalent cost of the Pukete WWTP capacity consumed by the Hamilton south flows needs to be determined. Based on work undertaken for HCC for the 2021 LTP and Site Buildout reports[9], the expected capital costs for Pukete upgrades was estimated with and without Hamilton South flows. This work assumed Pukete would be converted into an MBR process. This information is indicative only as it is not based on the same level of detail as the southern short list development work. Further options for Pukete WWTP include retaining the existing clarifiers instead of converting to an MBR which would result in a minimum TN concentration of 7.5mg/L. Further investigation on the options for Pukete WWTP staging is expected to be undertaken in the northern detailed business case assessment.

[9] Pukete WWTP Site buildout report, Beca 2021. Pukete WWTP LTP 2021/31 cost estimates report, Beca 2020

Table 3-9 Pukete Capital Costs summary

WWTP name	Size of plant	WWTP Capital Cost to 2061 ($ M)
Pukete 2A upgrades (without Hamilton south, with Te Kowhai and Ngaruawahia)	Large MBR	$ 288M
Pukete 4A (Hamilton only)	Large MBR	$ 304M

3.7.2 Annual Operational Costs

Table 3-10 and Table 3-11 outline the details of the operational costs for each of the options 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 per ML processed due to energy recovery and reduced biosolids volumes for disposal. Assumptions are outlined in Appendix A. 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 3-10 Option 2A Operational Costs summary

WWTP name	**Size of plant**	**WWTP Operational Cost 2031 ($ M)**	**WWTP Operational Cost 2041 ($ M)**	**WWTP Operational Cost 2051 ($ M)**	**WWTP Operational Cost 2061 ($ M)**
Southern Sub-Regional WWTP	Large	$ 3.7M	$ 4.7M	$ 5.6M	$ 6.0M
Te Awamutu	Medium	$ 2.6M	$ 2.8M	$ 3.2M	$ 3.3M
Tauwhare Pa	Small	$ 0.1M	$ 0.1M	$ 0.1M	$ 0.1M

Table 3-11 Option 4A Operational Costs summary

WWTP name	Size of plant	WWTP Operational Cost 2031 ($ M)	WWTP Operational Cost 2041 ($ M)	WWTP Operational Cost 2051 ($ M)	WWTP Operational Cost 2061 ($ M)
Airport Southern Sub-Regional	Medium	$ 0.7M	$ 1.2M	$ 1.8M	$ 1.8M
Cambridge – with PSTs/Digesters	Large	$ 1.6M	$ 1.8M	$ 2.1M	$ 2.2M
Cambridge – without PSTs/Digesters	*Medium*	*$ 3.0M*	*$ 3.5M*	*$ 3.9M*	*$ 4.1M*
Te Awamutu	Medium	$ 2.6M	$ 2.8M	$ 3.2M	$ 3.3M
Tauwhare Pa	Small	$ 0.1M	$ 0.1M	$ 0.1M	$ 0.1M

3.7.3 Staging of Costs

Table 3-12 outlines the indicative base staging for the 2A Sub-Regional and 4A 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). An alternative staging scenario is to delay the installation of PSTs and Digesters to 2051 is also outlined. However, this also defers the onset of operational cost savings (energy purchase and biosolids disposal cost reductions). A cost vs benefit analysis for this deferral has not been undertaken at this time. Staging for the Airport and Tauwhare Pa would depend on development timing and flows being confirmed.

Table 3-12 Indicative Capital Costs Staging

WWTP name	Scenario	WWTP Capital Cost 2031 ($ M)	WWTP Capital Cost 2041 ($ M)	WWTP Capital Cost 2051 ($ M)	WWTP Capital Cost 2061 ($ M)
2A Southern Sub-Regional WWTP	Base Staging	$ 136.7M	$ 16.2M	$ 18.5M	$ 5.2M
	Delay PSTs and digesters to 2051	$ 120.2M		$ 53.8M	
4A Cambridge WWTP	Base Staging	$ 95.2M	$ 3.9M	$ 5.5M	$ 9.8M
	Delay PSTs and digesters to 2051	$ 82.9M		$ 29.7M	

For Option 2A, an alternative staging strategy would be to build capacity for Cambridge (because this is critical) plus the current / near future airport flows (which already require a change of management method) as stage 1. Peacocke and the other Hamilton South precincts would continue north in accordance with

existing practice and as intended by the new Peacocke rising mains. This initial capacity would likely be built as an aerobic, MBR plant only plus inlet works and UV disinfection. The second stage of development would then likely add primary tanks, digestion and side-stream centrate nutrient removal. The timing of this second stage is complex and would likely be linked to network development in Hamilton (particularly Peacocke), capacity burn at Pukete WWTP and or the need to divert the northern (Ngaruawahia, Taupiri and Horotiu) flows and loads south to Pukete WWTP. Subsequent development stages would see existing unit processes augmented as the need arose. This alternative staging option could be developed and costed in more detail at the stage of developing of the northern business case and preferred option.

4 Next Steps

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

- For operational costs and energy recovery, benchmarking with existing performance and costs for Pukete and other sites with MBR or biological nutrient removal
- Further investigate capital and operational cost impacts of lower TN target and delaying installation of PSTs and digesters
- Sensitivity analysis for Hamilton flow split, residential and non-residential greenfield growth, connecting small communities (Ohaupo, Matangi, Tamahere hub and Tauwhare Pa), wet industry and infill
- Geotechnical investigations for Cambridge WWTP if 4A is the preferred option
- Review of redundancy requirements for major process units e.g. screens and reactors
- Biosolids reuse and disposal options.

Appendices

Appendix A – Cost Estimates

Waikato Metro DBC Southern Shortlist - Treatment Plants

Comparative Cost Estimate Summary

Ref	Description	Capital cost	
		Most Likely Estimate	P95 Estimate
	Wastewater Treatment Plant Upgrades		
	Option 2A Southern WWTP	$169,098,295	$187,090,664
	Option 4A Southern WWTP	$54,476,479	$61,614,836
	Option 4A Cambridge WWTP	$112,664,171	$124,964,566
	Tauwhare Pa Package WWTP (excludes irrigation)	$5,733,900	$7,207,276
	TOTAL ESTIMATE	**$341,972,845**	**$380,877,341**

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.
0.7 Council internal costs and procurement (included in PWC cost elements)

Project Specific Exclusions

0.7 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.

Waikato Metro DBC Southern Shortlist - Treatment Plants

Comparative Cost Estimate Summary

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.
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 agree
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 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 definitio 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 estima

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.).

Waikato Metro DBC Southern Shortlist - Treatment Plants

Comparative Cost Estimate Summary

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 p 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 accu 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 b

Project	**Metro DBC Southern WWTPs Development**	
Phase	Shortlist Design Development	
Version	2A Southern V1	
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		

Stage

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		

Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.

	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
1	**Siteworks and Civil**										Civil Subtotal	$10,006,123
1.1	Form & Maintain temporary site access for construction purposes.		C		m2	200	400	800	$25	$30	$45	$12,000
1.2	Platform Development	Site stripping & Tree Removal	C	Site not decided, as little as zero and as much as whole site	m2	0	27,500	55,000	$1.50	$3.00	$5.00	$82,500
1.3		Strip contaminated topsoil to landscaping bunds within the site	C		m2	0	27,500	55,000	$5.00	$6.00	$7.00	$165,000
1.4		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

	Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
		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
1.5		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
1.6		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
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	5,020	5,585	4,480	$5.00	$7.00	$9.00	$39,095
1.8		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
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	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

	Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
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
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

	Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
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
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	$38,400	$48,000	$57,600	$144,000
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	$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		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

	Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
4.14	MBR Pretreatment Electrical & Instrumentation	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
	PST Tank Structure	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
		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

	Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
		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
		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

	Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
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
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		Includes: Concrete structure floor slab with reinforcing and allowances for formwork	S	New MBR tank to suit the requirements of the MBR system vendor	m^3	123	144	173	$1,850	$2,000	$2,200	$287,745

	Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	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, 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
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

	Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
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	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	$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
4.42		Controls	I		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	m^3	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	m^3	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

	Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
	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
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
		New meso LP blowers	M	15kW motor	ea	4	6	6	$30,000	$40,000	$50,000	$240,000

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	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
	Digester Mechanical	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 equipm	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
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
		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

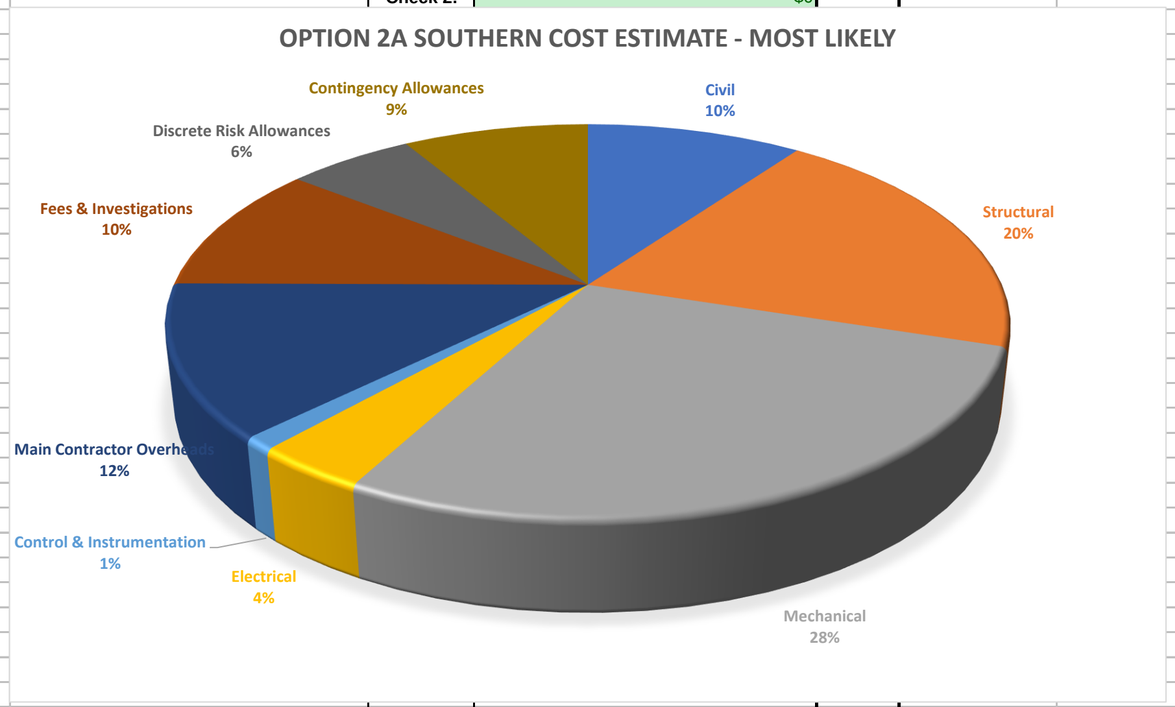
	Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
	Gas Handling	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											
	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

	Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
	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 t	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 Sub	$2,196,000
6.1	Electrical - General	MCC	E	1000kVa.								
6.2		Incomer	E									
6.3		Allowance for Site wide power, Instrument and control cabling, cable support & ducting	E		Sum	1	1	1	$848,000	$1,060,000	$1,378,000	$1,060,000
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
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

	Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
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**

Option 2A Southern Combined WWTP, servicing; Peacockes, Airport, Cambridge, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.

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								



Total											
Cumulative Total											

Project	**Metro DBC Southern WWTPs Development**	
Phase	Shortlist Design Development	
Version	4A 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		

Option 4A Cambridge WWTP

	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
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
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

	Option 4A 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.	m^3				$16	$17	$20	$0
		Fill in of ponds	C	assume ponds 2m deep avg Fill with AP65 or similar sourced locally	m^3				$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

	Option 4A 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

	Option 4A 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

	Option 4A Cambridge WWTP											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
		Scum Hopper	S	Allowance for scum hopper concrete works at higher rate than standard floor slab	m^3	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
	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

	Option 4A Cambridge WWTP											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
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
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		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	99	123	148	$750	$1,000	$1,250	$123,200
3.08		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		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		MLSS Line from Reactors to MBR	M	assume 600mm diameter	m	40	47	56	$2,500	$3,000	$4,500	$141,000
3.09		Instrumentation	I		Sum	1	1	1	$96,000	$120,000	$144,000	$120,000
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	$93,600	$117,000	$140,400	$468,000
3.09		Penstocks, valves etc.	M		Sum	4	4	4	$31,200	$39,000	$46,800	$156,000
		Upgrade of the electrical system	E		Sum	4	4	4	$147,000	$163,000	$211,000	$652,000
		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
		Cabling (Power and control incl installation)	E		Sum	4	4	4	$13,000	$15,523	$31,045	$62,091

	Option 4A Cambridge WWTP											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
		Installation labour	E		Sum	4	4	4	$20,000	$23,881	$47,762	$95,524
		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	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 Assume 3 trains, 0.35 thk	m³	53	62	74	$1,850	$2,000	$2,200	$123,319
4.18		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 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

	Option 4A Cambridge WWTP											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
4.33	MBR Tank Mechanical	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
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	m^3	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	m^3	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

	Option 4A Cambridge WWTP											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
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	4 x 600m3 Digesters Structural	11.5m diameter tank - ring beam foundations	S	Site Concrete	m²	415	415	789	$20	$50	$75	$20,774
6.02			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 th	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

	Option 4A Cambridge WWTP											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
6.16	Digester Mechanical	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
6.20		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

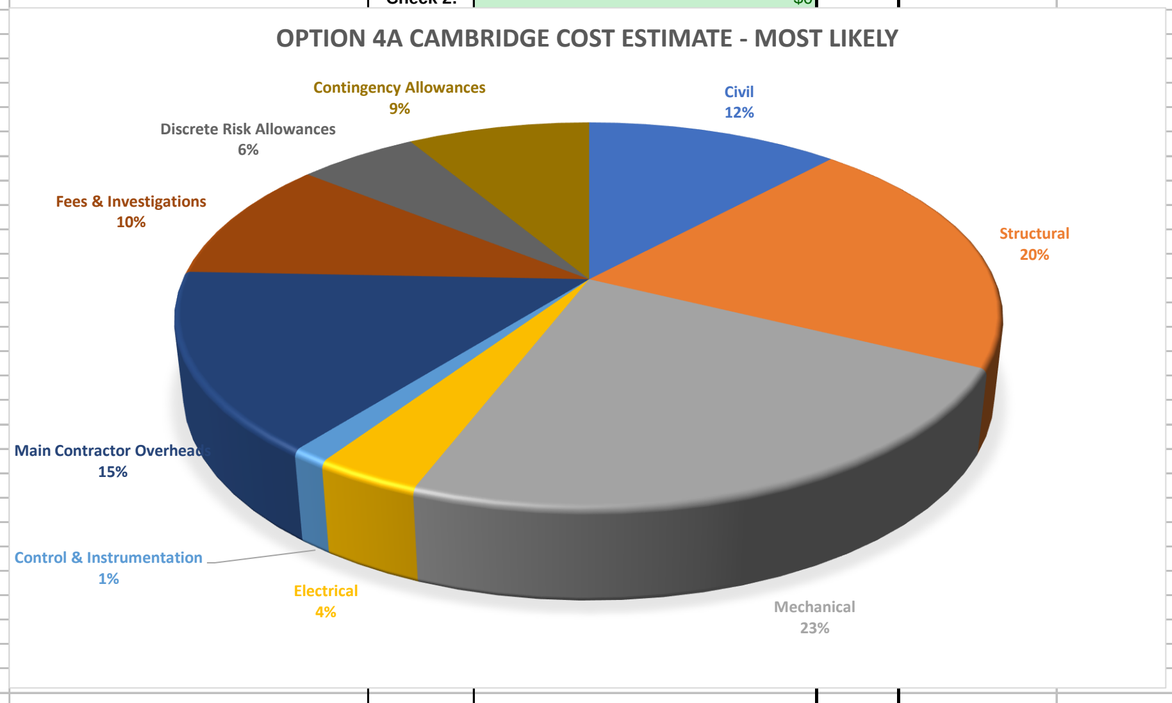
	Option 4A Cambridge WWTP											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
7.02	Dewatering Mechanical	FRP Pumpstation	M	Allowance for FRP Pumpstation	Sum	1	1	1	$180,000	$200,000	$240,000	$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
	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 thi		S		m³	45	50	94	$1,850	$2,000	$2,200	$90,000
	Precast Concrete- for tank											
	Precast Panels -supply and errect (250	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 th	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

	Option 4A Cambridge WWTP											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
6	**Electrical & Control**										Electrical General Subtotal	$1,821,000
6.1	Electrical - General	MCC	E	1000kVa								
6.2		Incomer	E									
6.3		Software	E		Sum	1	1	1	$628,800	$786,000	$1,021,800	$786,000
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
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

	Option 4A Cambridge WWTP											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
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
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**

Option 4A 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								



Total	
Cumulative Total	

Project	**Metro DBC Southern WWTPs Development**	
Phase	Shortlist Design Development	
Version	4A Southern V1	
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		

Option 4A Southern Combined WWTP, servicing; Airport, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.

	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
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
1.3		Strip contaminated topsoil to landscaping bunds within the site	C		m2	0	14,000	28,000	$5.00	$6.00	$7.00	$84,000
1.4		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
1.5		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

	Option 4A Southern Combined WWTP, servicing; Airport, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
1.6		Recompact excavated granular fill	C	Uplift and place from stockpile immediately adjacent excavation	m3	850	935	1,120	$10	$12	$15	$11,220
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	1,700	1,870	2,240	$5.00	$7.00	$9.00	$13,090
1.8		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
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	3,131	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

	Option 4A Southern Combined WWTP, servicing; Airport, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
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
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	MBR Pretreatment Mechanical	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		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

Option 4A Southern Combined WWTP, servicing; Airport, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.

	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
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
4.11		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	MBR Pretreatment Electrical & Instrume	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		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	Reactor Structure	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		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

	Option 4A Southern Combined WWTP, servicing; Airport, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
3.08	Reactor Mech.	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
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

	Option 4A Southern Combined WWTP, servicing; Airport, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
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
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 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 Tank Mechanical	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

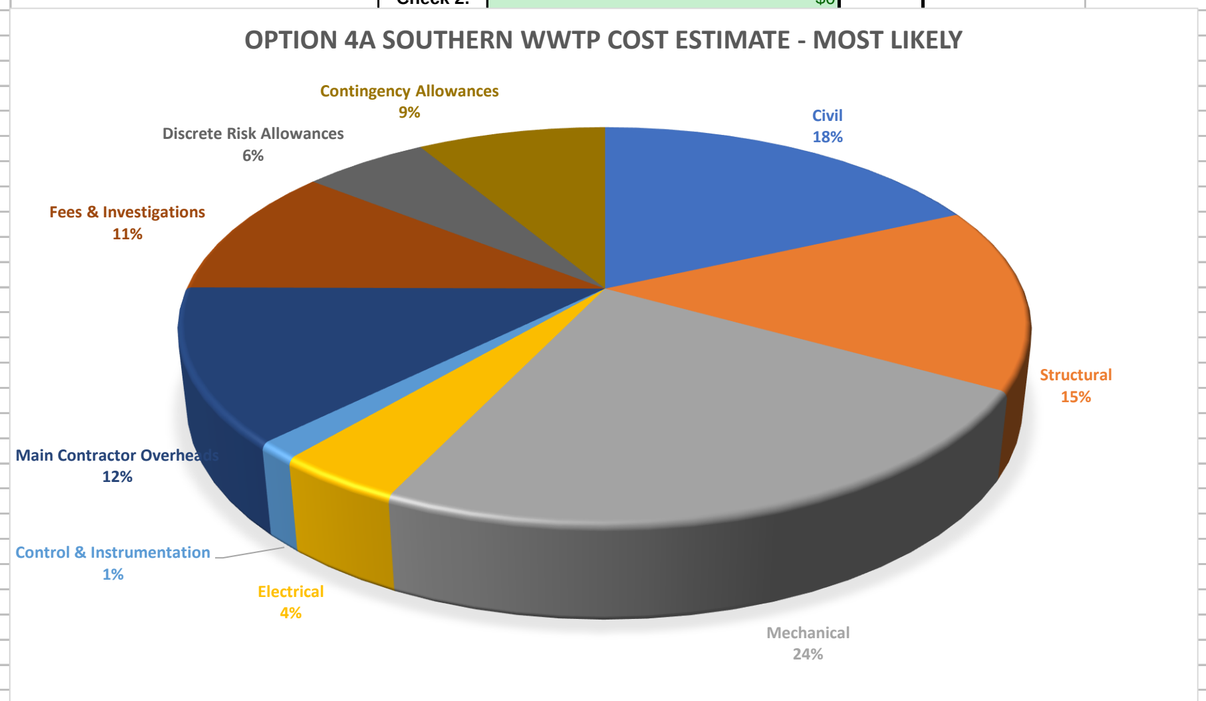
	Option 4A Southern Combined WWTP, servicing; Airport, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
4.39		Stopboards	M	Aluminium stoplogs/boards - nominal 4-5m deep	Sum	1	1	1	$90,000	$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
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 Subt	$1,496,000

	Option 4A Southern Combined WWTP, servicing; Airport, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
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
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

	Option 4A Southern Combined WWTP, servicing; Airport, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.											
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
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
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**

Option 4A Southern Combined WWTP, servicing; Airport, Matangi, Tamahere, Ohaupo. Concept Cost Estimate.

	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%							
		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								
	Total											
	Cumulative Total											



Project	**Metro DBC Southern WWTPs Development**	
Phase	Shortlist Design Development	
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

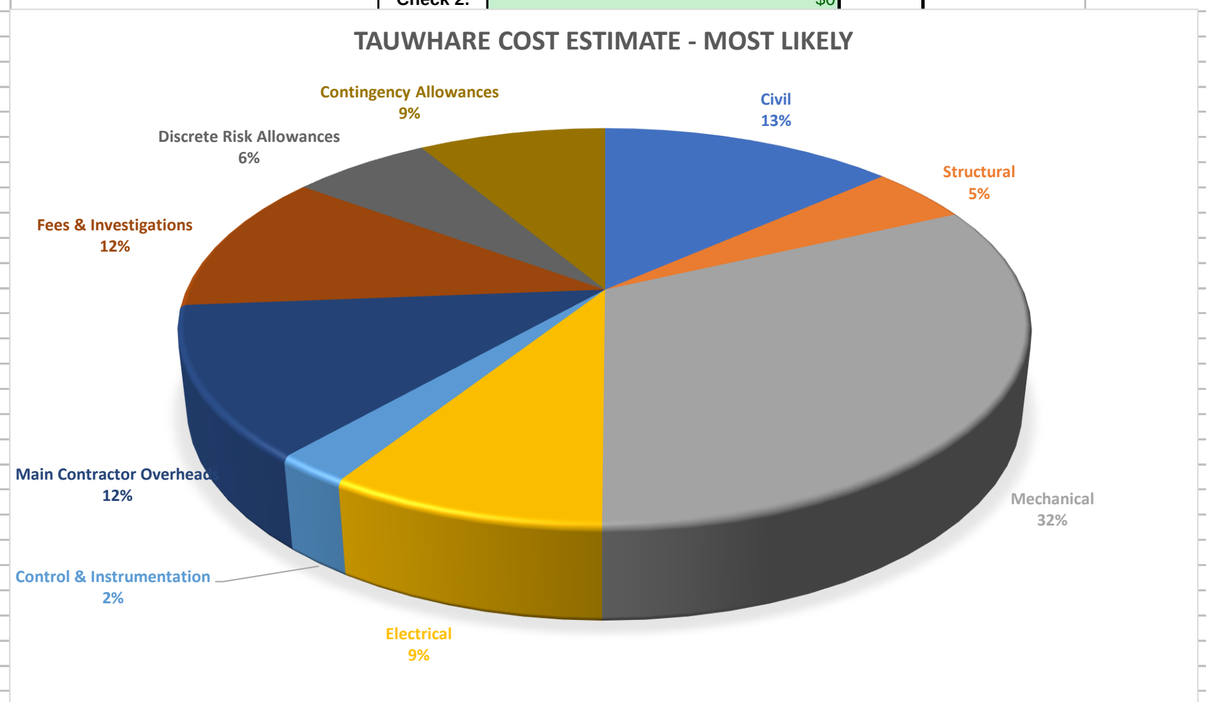
	Plant Area	Description	Type	Size or Capacity	Unit	Quantity			Rate			Most Likely
						Min	ML	Max	Min	ML	Max	
1	**Siteworks and Civil**										Civil Subtotal	$743,679
1.1	Form & Maintain temporary site access for construction purposes.		C		m2	50	100	200	$25	$30	$45	$3,000
1.2	Platform Development	Site 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
1.6		Recompact excavated granular fill	C	Uplift and place from stockpile immediately adjacent excavation	m3	80	85	60	$10	$12	$15	$1,020
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	160	170	120	$5.00	$7.00	$9.00	$1,190
1.8		Spread and roll surplus excavated material somewhere on the wider site <500m.	C		m3	230	255	765	$10	$12	$15	$3,060
1.9	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

	Tauwhare WWTP Package WWTP All options											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
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
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	MBR Package Plant	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		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 Subt	$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

	Tauwhare WWTP Package WWTP All options											
	Plant Area	**Description**	**Type**	**Size or Capacity**	**Unit**	**Quantity**			**Rate**			**Most Likely**
						Min	**ML**	**Max**	**Min**	**ML**	**Max**	
5.7	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
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								



	Total											
	Cumulative Total											

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Rev.No.	Author	Reviewer Name	Signature	Approved for Issue Name	Signature	Date
Draft for client comment	C. McRobie, C. Scrimgeour	J. Crawford		Sioban Hartwell		14 December 2020
Final	C Scrimgeour	J. Crawford		Sioban Hartwell		14 April 2021