Raglan Wastewater Treatment Plant Stream Recharge Concept

Prepared for Watercare Services Ltd

Prepared by Beca Limited

17 September 2020

Contents

Appendices

Revision History

Revision Nº	Prepared By	Description	Date
1	Claire Scrimgeour/Ari Craven	Draft for Client Review	26/06/2020
2	Claire Scrimgeour/Ari Craven	Final	1/9/2020
3	Claire Scrimgeour/Ari Craven	Updated version following further feedback	17/9/2020

Document Acceptance

Action	Name	Signed	Date
Prepared by	Claire Scrimgeour/Ari Craven		17/9/2020
Reviewed by	John Crawford		17/9/2020
Approved by	Garrett Hall		17/9/2020
on behalf of	Beca Limited		

Executive Summary

The purpose of this report is to identify locations near the Raglan Wastewater Treatment Plant (WWTP) potentially suitable for stream recharge with treated wastewater, to outline the proposed treatment/discharge infrastructure and provide a high level capital cost estimate. This report is a conceptual appraisal of the option. It does not constitute a concept design. This report will inform the short-listed option selection process for Raglan WWTP discharge consent.

The objectives of the stream recharge option are:

- Remove direct discharge to Whaingaroa (Raglan) Harbour
- Provide additional high quality water flow into a local stream to enhance the ecosystem
- Reduce adverse environmental effects from existing rural discharges near the WWTP
- Avoid adverse effects on stream banks and ecosystems
- Provide long-term sustainable wastewater treatment and discharge

Growth is expected to continue in Raglan, due to infill and greenfield residential sites including Rangitahi peninsula and the areas adjacent to the current entry to Raglan. A typical summer season household occupancy has been assumed to develop design flows.

A short list of sites to consider for stream recharge was developed considering:

- Distance from WWTP
- Drainage towards harbour (not sea)
- Potential restoration benefit which could be achieved
- Land ownership and input from landowners where available
- Proximity to houses

The site visits and water quality/ecology assessments confirmed the stream adjacent to the WWTP would be suitable for restoration.

To discharge to a small waterway, a membrane bioreactor (MBR) process with ultraviolet (UV) disinfection and alum dosing has been selected to give a high quality treated wastewater with low nutrient and pathogen concentrations. A flow balancing pond is recommended to store peak inflows during larger rain events. The treated wastewater would discharge to one or more locations adjacent to streams on the WWTP site.

At the edge of the stream, a rock gabion wall or buried rock trench / mini aquifer would distribute the flow along a length of the stream to create a diffuse discharge. The area surrounding the discharge point, the catchment upstream and channel downstream would be planted with native planting. The planting would have several objectives: Improve native plant diversity, improve stream aesthetics, create a cooling ‘canopy’ over the stream, provide a more consistent habitat for fauna, improve stream bank stability.

The biosolids produced by the MBR process would need to be dewatered. One of the current ponds could be used as a monofill for the dewatered biosolids, or any other alternatives that forms part of an agreed biosolids management strategy may be utilised. Further stabilization may be required before re-use options. This option would need to consider the rehabilitation any unused existing ponds at the WWTP. Erosion and stability of the steam banks and the MBR location will also need to be considered. MBR treatment opens up other reuse opportunities for the treated wastewater, for instance summer irrigation schedules for plantings.

The capital cost estimate for the MBR Stream Recharge option is $24.4 million. A conceptual design of the preferred option will need to be undertaken to confirm the estimated capital and operating costs. This cost estimate has an estimation accuracy range of -30% / +50% of which is standard at Conceptual Appraisal stage.

1 Introduction

The Raglan WWTP is owned by Waikato District Council (WDC) and operated by Watercare Services Limited. To support the resource consent process for the treated wastewater discharge from the Raglan WWTP a list of potential treatment/discharge options was developed (Beca Limited, 2019). During engagement with stakeholders a stream recharge option was proposed by the community and Iwi for further investigation.

The purpose of this report is to identify locations near the WWTP potentially suitable for stream recharge with treated wastewater, to outline the proposed treatment/discharge infrastructure and provide a high level capital cost estimate. This report will inform the short-listed option selection process.

The objectives of the stream recharge option are:

- Remove direct discharge to Whaingaroa (Raglan) Harbour
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- Avoid any adverse effects on stream banks and ecosystems
- Provide for long-term sustainable wastewater treatment and discharge

2 Wastewater Flows

Growth is expected to continue in Raglan, due to infill and greenfield residential sites including Rangitahi peninsula and the areas adjacent to the current entry to Raglan. Population projections are based on NIDEA medium household growth forecasts rebased from the 2018 Census[1]. An estimate of expected connected population and design wastewater inflows are provided in Table 1 below. These are based on average occupancy during the summer season (estimated at 2.7 people for each connected property) rather than usual resident population recorded at the census date.

Household forecasts are well within the available capacity of current and future residential areas included in the Waikato 2070 Growth and Economic Development Strategy (Waikato District Council, 2020). There is currently little commercial and industrial wastewater production in Raglan and this is not expected to increase. Further growth sensitivity analysis is recommended for the preferred option.

Table 1 - Projected Wastewater Flows

Date	Population	Average Daily Inflow (m^3/day)	Peak Wet Weather Inflow (m^3/day)
2018	4,428	1,079	2,949
2020	4,847	1,163	3,175
2025	5,895	1,372	3,741
2030	6,942	1,582	4,307
2050	8,465	1,886	5,129
2055	8,821	1,957	5,321

[1] Information provided by Mark Davey, Waikato District Council

3 Site Visits

A short list of sites to consider for stream recharge was developed considering:

- Distance from WWTP
- Drainage towards harbour (not sea)
- Potential restoration benefit which could be achieved
- Land ownership and input from landowners where available
- Proximity to houses

A site visit was then undertaken on 27 May 2020 to view potential sites where there were opportunities for environmental enhancement. A second site visit was undertaken on 22 June 2020 to inspect an additional site to the south west of the current WWTP facility. Sites visited are shown in Figure 1.

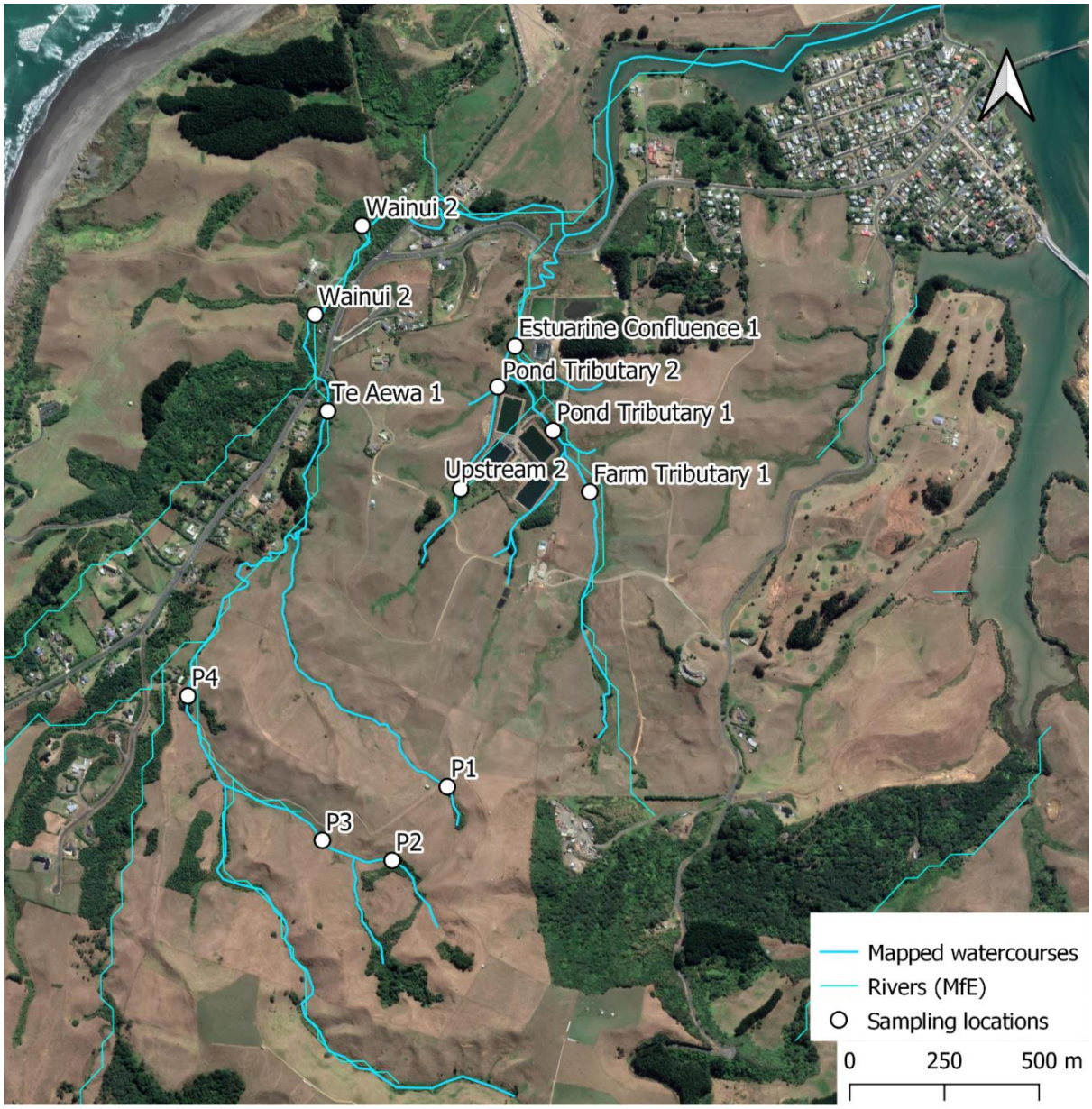

Figure 1 – Potential Sites

Ecological and water quality aspects of the different sites are described in the report Ecological and Water Quality Impact Assessment – Raglan wastewater discharge options (Beca Limited, 2020)

Observations on the identified watercourses based on the site inspection are:

- The main Wainui Stream already has a significant riparian corridor in the areas inspected (refer Appendix A). Revegetation (riparian planting) of the smaller tributaries draining into the Wainui Stream was also observed. While this stream may be suitable to discharge to from a stream stability perspective, there are minimal opportunities to enhance the existing watercourse.
- Farm Tributary 1 is the largest watercourse which passes through the WWTP site, originating near the Xtreme Zero Waste site approximately 800m upstream of the WWTP. The local landholder has undertaken significant watercourse revegetation & fencing works upstream of the WWTP. As with the Wainui Stream, limited opportunities for enhancement exist on this stream.
- The farm tributary enters the WWTP site along the south eastern boundary where it meets the western tributary just downstream of the buffer ponds. The waterways through the WWTP are reasonably well vegetated, particularly in the area between the upper and lower buffer ponds.
- Downstream of the estuarine confluence, the channel becomes more incised with less riparian vegetation (still well-grassed). This channel discharges into tidal estuarine wetland upstream of Wainui Road. Adjacent to the lower buffer pond, low-flow channel banks approach vertical, however limited evidence of slumping or erosion were observed.
- Immediately to the west of the WWTP, a small gully system discharges into Pond Tributary 2. This system was observed to be in a degraded state, with negligible riparian vegetation and no exclusion fencing for stock. Existing gullies in this system are of relatively mild grade and may be a suitable candidate for enhancement works.
- Several minor gullies discharging to the WWTP from the east may also be candidates for restoration works, however given the size these are likely to have limited capacity to discharge flows to.
- The gully system to the south west inspected on the second round of site visits shows similar hydrology to those upstream of the WWTP site. The stream channel is fairly incised (although appears stable). Natural springs (rain fed) are evident at the head of each gully. Riparian planting was observed along much of the stream, although enhancement opportunities were observed where riparian planting had not been completed.

The sites selected for the concept development and high-level cost estimate were Pond Tributary 1 and 2. These sites were selected due to their proximity to the WWTP and potential for further stream enhancement.

4 Concept Outline

To discharge to a small waterway, a MBR process with UV disinfection and alum dosing has been selected to give a high quality treated wastewater with low nutrient and pathogen concentrations. The expected 90th percentile treated wastewater quality is outlined in Table 2.

Table 2 - Expected Treated Wastewater Quality (90th percentile)

Suspended solids (TSS)	Biochemical oxygen demand ($cBOD_5$)	Ammoniacal nitrogen (NH_4-N)	Total nitrogen (TN)	Total phosphorus (TP)	E Coli	Virus
<5 mg/L	<5 mg/L	<1 mg/L	<8 mg/L	<1 mg/L	<10 cfu/100ml	4 log removal

The proposed layout is shown in Figure 2.

Figure 2 - Proposed MBR and discharge layout

A new inlet works with two stage screening and grit removal would be required to protect the membranes from larger and more abrasive solids. The MBR reactor would have a volume of approximately 1,150m^3 and could be located within the area where the anaerobic ponds are currently located.

MBRs are not inherently good at 'turning up' to process much higher than normal flows. They are reasonably 'linear' in their flow processing capability. To avoid having to size the MBR for peak flows, one of the existing ponds would be reused as a wet weather buffer pond and the MBR sizing limited to 3,000 m^3/day. The wastewater would need to be pumped back to the MBR after the storm event. Alum dosing will be required to meet the TP requirement. Following the MBR and UV processes, the treated wastewater would gravity discharge via some form of rock structure to the stream which runs through the WWTP site.

At the edge of the stream, a rock gabion wall or buried rock trench / mini aquifer could be constructed to distribute the flow along a length of the stream to create a diffuse discharge in a manner that may be more culturally acceptable. The area surrounding the discharge point would be planted with native planting and potentially the other catchments upstream of the WWTP (not in WDC ownership) which drain to the same stream could also be planted. There are opportunities for local stakeholders to be involved in the design of the discharge structure and planting. The biosolids produced by the MBR process would need to be dewatered and managed in accordance with an approved biosolids strategy.

Raw wastewater balancing during and immediately following storm conditions has been allowed for but no allowance has been made for storage of treated wastewater. The treated wastewater would be suitable for and could be made available for a variety of non-potable reuse options. Some storage would be required and appropriate high pressure pumps for delivery to the required location.

A planting concept is provided in Figure 3. The small blue area in the gully would ideally be planted with wetland species. The darker green area would be planted with riparian vegetation and the light green area would be infill planted with enrichment species to complement the existing planted vegetation. The planting would have several objectives: Improve native plant diversity, improve stream aesthetics, create a cooling 'canopy' over the stream, provide a more consistent habitat for fauna, improve stream bank stability. These planting concepts should be developed in consultation with local landowners and interested parties, including hapū. Extension of planting into catchments upstream of the WWTP site, to the west and east could be explored.

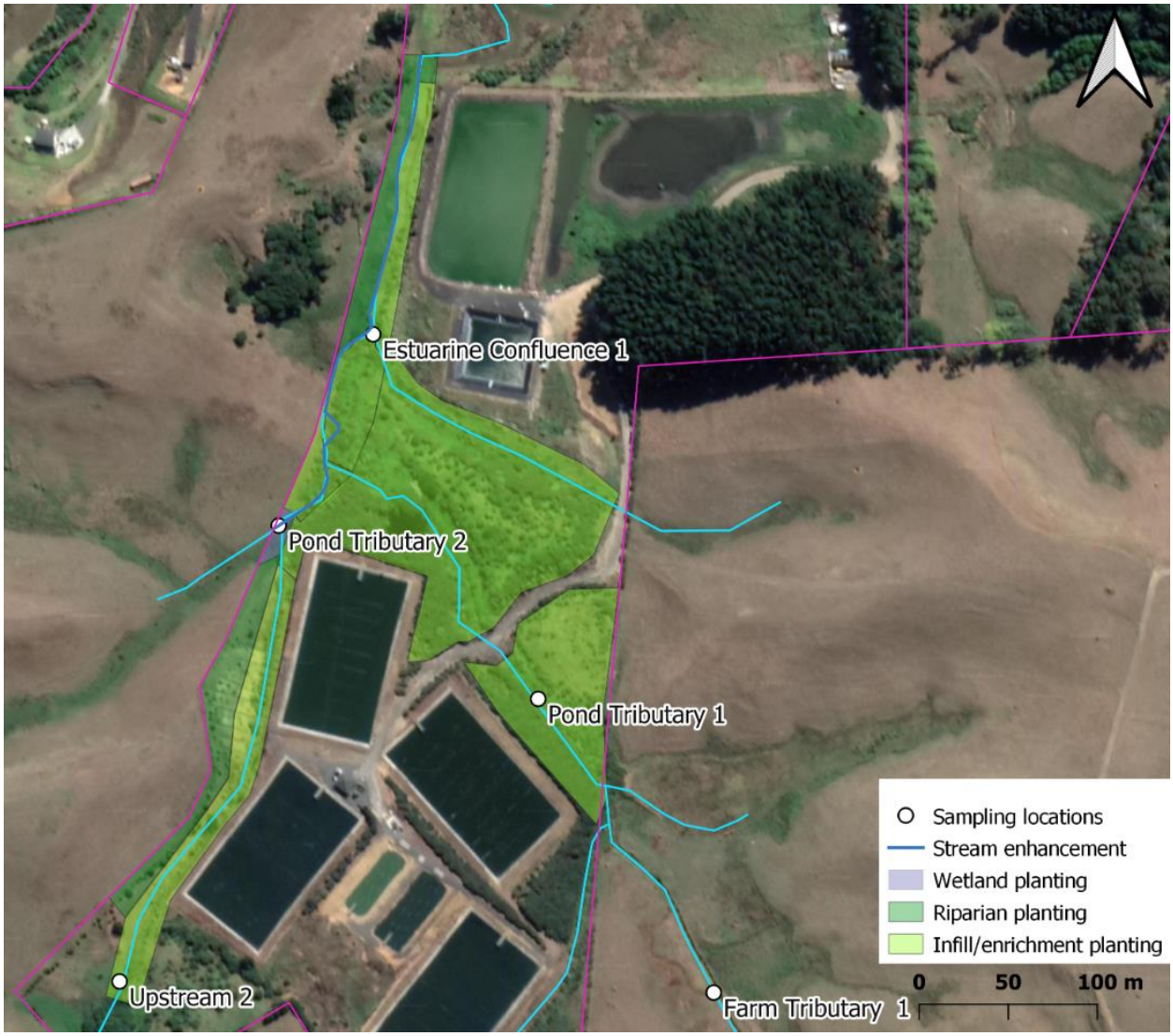

Figure 3 - Example Planting Plan

5 Issues, Opportunities and Risks

A high quality treated wastewater has been selected to minimise potential for adverse effects on the stream and harbour. Potential ecological and water quality effects are covered in a separate report (Beca Limited, 2020).

There could be considerable time and cost associated with decommissioning the current ponds including de-sludging, filling and planting.

An MBR system has high operating costs for energy, chemicals (e.g. for phosphorus removal, membrane cleaning), sludge/biosolids disposal and labour. Given the distance from other WDC WWTPs, biosolids disposal on site or nearby could be considered.

An MBR system has good flexibility to cope with the growth expected and can be expanded. Master planned provisions for expansion and staging options should be considered when the treatment plant is conceptualised.

An MBR combined with UV treatment provides a highly disinfected effluent, with low solids, low nutrients (TP and TN) and high clarity. Therefore, it also opens up opportunities for future beneficial reuse.

Some bank stability issues have occurred at the Raglan WWTP in the past so future design work of the MBR and stream discharge structures would need to consider ground stability and erosion potential. In particular, the proximity of the lower pond to the adjacent watercourse currently presents a risk in the existing scenario, and this would be exacerbated if additional flow was discharged to this watercourse. Riparian planting could be commenced early to stabilise the stream banks prior to increasing flows.

6 Cost Estimate

The previous optioneering work (Beca Limited, 2019) established the order of magnitude capital costs of the various options for Raglan WWTP and a capital cost estimate for the stream recharge option has been prepared on the same basis. The capital cost estimate is $24.4 million and more detail is provided in Appendix B.

A conceptual design of the preferred option will need to be prepared to confirm the estimated capital and operating costs.

The accuracy of this Conceptual Appraisal is commensurate with the level of design information available and base assumptions made. 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. This cost estimate has an estimation accuracy range of -30% / +50% of which is standard at Conceptual Appraisal stage.

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

- Major 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, design and specification).
- Consultant fees (Design/Engineering)
- A contingency allowance of 30%

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

- Client management costs
- Consents and easements
- Legal fees
- Land acquisition or leasing costs
- Client insurances
- Escalation after 4th quarter 2019
- Pond de-sludging and site restoration
- Goods and Services Tax

7 References

Beca Limited. (2019). *Raglan WWTP Optioneering - Short List Design and Costing.* Hamilton.

Beca Limited. (2020). *Ecological and Water Quality Impact Assessment – Raglan wastewater discharge options.* Auckland.

Waikato District Council. (2020). *Waikato 2070 - Waikato District Growth and Economic Development Strategy.* Ngaruawahia.

A

Appendix A – Site Photos

Figure 4 – View of Wainui Stream showing riparian coverage of the main steam and tributaries.

Figure 5 – Upper Tributary 1, existing riparian planting.

Figure 6 – Tributary 1 at WWTP site boundary, looking upstream.

Figure 7 – Existing estuarine wetland.

Figure 8 – Western gully system.

Figure 9 – South West Farm

B

Appendix B – Cost Estimate

Project:	**Raglan Waste Water Treatment Plant Optioneering** **Waikato District Council**
Document:	**Conceptual Cost Estimate**
Location	1
Project No:	4286014
Date:	09 June 2020
Author:	Claire Scrimgeour (verified Rob Newman)

Option I: Treatment - MBR Plant
Option I: Disposal - Stream Discharge

Ref	Estimate Detail Item Description	Calculation	Quantity	Unit	Rate	Sub-Total	Total
	Key Metric Data						
	MBR Plant 3MLD (Including new inlet works and UV) **Renew Harbour outfall and Diffuser (as per Option A)**						
1.00	**Reference Documentation:**						
1.01	John Crawford MBR cost curve January 2020						
1.02							
1.0.3							
2.00	**Establishment**						
2.01	Establishment - site set out, service location/relocation, temporary fencing, silt control, site lay down area/facilities, security and plant machinery delivery		1.00	LS	70,000.00	70,000.00	
2.02	Disestablish offsite - remove plant machinery, remove site laydown area/facilities, silt control, temporary fencing and install new fencing.		1.00	LS	30,000.00	30,000.00	
	Sub Total Establishment						**100,000**
3.00	**MBR Plant**						
3.01	MBR Plant (including screening and UV) - Includes design		1.00	LS	17,000,000.00	17,000,000.00	
4.00	**New Discharge section**						
4.01	400NB HDPE SDR20 (assume depth of 0-1.5m)		225.00	m	550.00	123,750.00	
4.02	E/O for all connections and valves		4.00	No.	10,000.00	40,000.00	
5.00	**Diffuser**						
5.01	Supply and install Diffuser complete with all temporary trenching and piling (Assumed Similar design to Picton Outfall)		1.00	LS	260,000.20	260,000.20	
6.00	**Pump station for pumping buffered influent through MBR**						
6.01	3.5kW pumps		2.00	No.	6,000.00	12,000.00	
6.02	Mech + electrical install to last (2men 5days, plant 5days)		1.00	LS	6,000.00	6,000.00	
6.03	3.5kW VSDs		2.00	LS	2,500.00	5,000.00	
6.04	Mini switchboard for motor starters + PLC (assume micrologix)		1.00	LS	25,000.00	25,000.00	
6.05	Pump station slab with shed (total span garage or similar)		1.00	LS	26,250.00	26,250.00	
6.06	Valving and pipework (SS) - 2 x KGVS (150NB), 2 x NRVs, 2 x PRVs		1.00	LS	12,200.00	12,200.00	
6.07	Flowmeter + 2 x PTS, 2 x Pressure switches		1.00	LS	15,000.00	15,000.00	
6.08	160 NB PE100 PN10 (Assume in trench 0-1.5m depth))		13.00	m	400.00	5,200.00	

8.00	**Effluent gravity stream discharge site 2**						
8.01	300 NB PE100 PN10 (Assume in trench 0-1.5m depth))		150.00	m	800.00	120,000.00	
8.02	Discharge diffuser		1.00	LS	20,000.00	20,000.00	
8.03	Rip-rap/gabion discharge structure		60.00	m3	500.00	30,000.00	
8.04	1050mm Manhole (assume 1m deep)		2.00	No.	7,000.00	14,000.00	
9.00	**Miscellaneous**						
9.01	Vegetation planting		20,000.00	m2	10.00	200,000.00	
9.02	Perimeter fence (stock fencing) + 2 gates		830.00	m	20.00	16,600.00	
10.00	**Testing and Commissioning**						
10.01	Testing and Commissioning		1.00	LS	100,000.00	100,000.00	
11.00	**Traffic Management (outfall only)**						
11.01	Prepare Contractor's Temporary Traffic Management Plan		1.00	LS	1,000.00	1,000.00	
11.02	Implement Traffic Management Plan - local authority		30.00	days	650.00	19,500.00	
11.03	Rounding		1.00	LS			
11.00	**Sub Total Treatment and Disposal**						**18,244,500**
12.00	**Main Contractors Preliminary & General / Off-Site Overheads & Profit**						
12.01	Main Contractors Preliminary & General (Construction Management)	18,244,500.20	1,244,500.20	LS	8.00%	99,560.02	
12.02	Main Contractor Off-Site Overheads & Profit	18,344,060.22	1,344,060.22	LS	8.00%	107,524.82	
12.03	Rounding		1.00	LS	659	659.00	
13.00	**Sub Total Contractors P&G/Oversite Overheads and Profit**						**207,744**
14.00	**Total Physical Works**						**18,552,244**
14.01	**Consultant Fees (Design/Engineering) / Consents (Cost to Complete)**						**223,000**
14.02	Geotechnical Investigation	1.00	1.00	LS	30,000	30,000	
14.03	Further Assessment Work	1.00	1.00	LS	10,000	10,000	
14.04	Investigation Work	1.00	1.00	LS	10,000	10,000	
14.05	Detailed Design (outfall and discharge pipes only as included in MBR)	1.00	1.00	LS	50,000	50,000	
14.06	Procurement &Tender Evaluation	1.00	1.00	LS	50,000	50,000	
14.07	Construction Monitoring & Contract Administration	13.00	15.00	month	3,500	52,500	
14.08	Practical Completion/Producer Statements, etc	1.00	1.00	LS	20,000	20,000	
14.09	Rounding Adjustment	1.00	1.00	LS	500	500	
16.00	**Total Base Estimate**						**18,775,244**
17.00	**Contingency**						**5,633,073**
17.01	Construction Contingency	1.00	18,775,244.03	LS	30.00%	5,632,573.21	
17.02	Rounding Adjustment		1.00	LS	500	500.00	
18.00	**Total Expected Estimate**						**24,400,000**