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PATTLE DELAMORE PARTNERS LTD

Tarawera WWTP and Land Disposal System: Concept Design

Rotorua Lakes Council

Tarawera WWTP and Land Disposal System: Concept Design

Prepared for

Rotorua Lakes Council

April 2017

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Limitations:

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1.0 Introduction

Pattle Delamore Partners Ltd (PDP) was engaged by Rotorua Lakes Council (RLC) on 17 November 2016 to develop a concept design of a membrane bioreactor (MBR) based wastewater treatment plant (WWTP) and rapid infiltration based land disposal system (LDS) for the lakeside community of Tarawera.

This WWTP and LDS concept is similar to that proposed at Rotoiti/Rotoma which involves a very high level of treatment (e.g. very good quality effluent) prior to discharge to a trench-based land disposal system.

1.1 Background

Wastewater generated from the lakeside communities of Tarawera is presently treated and disposed of using onsite septic tanks and disposal trenches. To reduce the public health risk and environmental impact associated with the onsite wastewater systems, RLC is investigating options for a reticulated sewerage scheme to service the community.

PDP understands that RLC is presently considering two options for the sewerage scheme which are outlined as follows:

a) Wastewater collection using pressure sewer reticulation and transfer to the Rotorua wastewater reticulation network and Rotorua WWTP and disposal system; and

b) Wastewater collection using pressure sewer reticulation and transfer to a new local WWTP and LDS.

This report has been prepared to assist RLC with the assessment of the above options. PDP understands that this report may be used for consultation with the Tarawera community and with other stakeholders.

It should be noted that presently no site has been identified for the WWTP and LDS. Therefore, this initial desk-top assessment has assumed that a suitable site can be found, and that the site has favourable hydrogeological conditions such that the environmental effects associated with the disposal of the treated effluent will be no more than minor and a long-term resource consent can be obtained.

1.2 Scope of Work

The scope of work in preparing this report is outlined as follows:

- Develop a process train and preliminary sizing of membrane bioreactor (MBR) equipment configured for biological nutrient removal;
- Outline appropriate provisions for odour control and sludge management;

- Develop a conceptual drawing of a possible WWTP and LDS;
- Outline investigations required to confirm site suitability for the LDS; and
- Develop rough-order capital cost estimate for the WWTP and LDS (e.g. in the order of ± 35% accuracy).

The development of a conceptual design and cost estimates for the reticulation component of the Tarawera Sewerage Scheme is outside the scope of this report.

It should be noted that confirming the feasibility of consenting and implementing a WWTP and LDS at Tarawera is outside the scope of this report and will require a suitable site to be found, a comprehensive site investigation programme, stakeholder consultation and a full assessment of environmental effects (AEE).

2.0 Design Requirements

2.1 Area of Benefit and Wastewater Collection

The area of benefit to be serviced by the proposed Tarawera sewerage scheme has been developed by RLC and includes all residential and non-residential properties highlighted in Figure 1.

The proposed wastewater collection system will utilise low pressure sewerage scheme (LPSS) reticulation with low pressure grinder pumps (LPGPs) installed at each property. The LPSS will convey the raw wastewater to the WWTP and LDS. Depending on the elevation and length of pipeline to the selected site for the WWTP and LDS, an additional transfer pump station may also be required.

2.2 Flows

Influent flows to the WWTP have been derived based on the population within the area of benefit which will be serviced by the proposed sewerage scheme.

PDP has utilised 'present' and 'ultimate' household unit equivalent (HUE) figures for the Tarawera area of benefit provided by RLC. The ultimate design horizon is assumed to allow for the full development of some presently unoccupied properties within the area of benefit.

Average and peak occupancy rates provided by RLC have been assumed as follows:

- Annual average: 2.0 persons/HUE.
- Peak summer: 3.8 persons/HUE.

A per person daily flow rate of 220 L/person/d has been assumed together with the above occupancy figures and HUE data to calculate the present and ultimate design average daily flow (ADF) and peak daily flow (PDF) as outlined in Table 1.

Given that the Tarawera LPSS will be pressurised from the on-property LPGPs all the way to the WWTP (potentially with an additional pump station on-route depending on the location of the WWTP), stormwater inflow and groundwater infiltration (I&I) into the network will be minor compared with a conventional gravity reticulation system. For the purpose of this report a peak wet weather flow (PWWF) factor of 1.2 has been applied to the PDF (e.g. peak day summer flow) to allow for potential I&I upstream of on-property gully traps, pipework and LPGPs.

SOURCE:
1. AERIAL IMAGERY FLOWN 2010/2011 SOURCED FROM THE LINZ DATA SERVICE HTTPS://DATA.LINZ.GOVT.NZ/LAYER/1760-BAY-OF-PLENTY-025M-RURAL-AERIAL-PHOTOS-2011-2012/ AND LICENCED FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 3.0 NEW ZEALAND LICENCE.
2. INFORMATION PROVIDED BY ROTORUA LAKES DISTRICT COUNCIL, RECEIVED 21/11/16.
3. CADASTRAL/TOPOGRAPHICAL INFORMATION AND INSET DERIVED FROM LINZ DATA.

FIGURE 1 : AREA OF BENEFIT

SCALE: 1:30,000 (A3)

0 0.25 0.5 1
KILOMETRES

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Table 1: Influent Flows

Design Horizon	HUE[1]	ADF[2]	PDF[3]	PWWF[4]
		m^3/d	m^3/d	m^3/d
Present (2016)	421	185	352	422
Ultimate	544	239	455	546

Notes:

1. *Household unit equivalent data provided by RLC.*
2. *Average daily flows (ADF) have been derived using an occupancy of 2.0 persons/HUE and a per person flow rate of 220 L/p/d.*
3. *Peak daily flows (PDF) have been derived using an occupancy of 3.8 persons/HUE and a per person flow rate of 220 L/p/d.*
4. *A peak wet weather flow factor of 1.2 has been applied to the PDF to arrive at the PWWF.*

2.3 Influent Characteristics

Design influent contaminant concentrations and loads arriving at the WWTP are outlined in Table 2. These concentrations are consistent with medium to strong concentrations presented in the wastewater design text Metcalf and Eddy (2003)[1].

Table 2: Influent Loads

Parameter[1]	Concentration	Average Daily Load for Ultimate Design Horizon	Peak Daily Load for Ultimate Design Horizon
	(g/m^3)	kg/d	kg/d
$cBOD_5$	235	56	107
TSS	294	70	134
TN	75	18	34
TP	15	3.6	6.8

Notes:

1. *$cBOD_5$ = Carbonaceous Biochemical Oxygen Demand, TSS = Total Suspended Solids, TN = Total Nitrogen, TP = Total phosphorus.*
2. *Ultimate average daily and peak daily loads have been calculated based on the assumed influent concentrations and the assumed ADF and PDF as outlined in Table 1.*

PDP understands that influent concentrations from residential and non-residential properties are being monitored as part of the Biolytix trial presently being undertaken by RLC at Rotoiti. PDP recommends that the above influent

[1] Metcalf & Eddy, G. T. (2003). Wastewater Engineering, Treatment and Reuse, Fourth Edition. McGraw Hill Education.

concentrations and loads are confirmed once data is available from the Biolytix trial.

2.4 Effluent Characteristics

In the brief for this project RLC prescribed that influent to the WWTP is to be treated using membrane bioreactor (MBR) technology prior to disposal to land using a rapid infiltration method.

RLC has indicated that the target effluent quality for the WWTP is the same very high quality effluent (e.g. well treated) as proposed for the Rotoiti/Rotoma WWTP. The target contaminant removal rates, effluent concentrations and ultimate average annual effluent loads are outlined in Table 3.

As for the proposed Rotoiti/Rotoma WWTP, supplementary carbon dosing will be required to reliably achieve the low target nitrogen concentration of 5 g/m^3 and alum dosing will be required to achieve the low target total phosphorus concentration of 2 g/m^3.

Table 3: Target Effluent Quality

Parameter[1]	Removal Target	Effluent	
		Median Concentration[2]	Annual Load
	%	g/m^3	kg/yr
$cBOD_5$	n/a	5.0	440
TSS	n/a	2.0	170
TN	93	5.0	440
TP	87	2.0	170

Notes:

1. *$cBOD_5$ = Carbonaceous Biochemical Oxygen Demand, TSS= Total Suspended Solids, TN=Total Nitrogen, TP=Total phosphorus.*
2. *It is assumed that supplementary carbon dosing will be required to achieve the target effluent TN concentration and alum dosing will be required to achieve the target effluent TP concentration.*

2.5 Land Disposal System

For the purpose of this report PDP has assumed that the disposal system will accommodate the hydraulic requirements only and not provide ‘land treatment’ of the effluent (i.e. no additional nitrogen uptake by vegetation will occur within the disposal site).

This type of system is commonly referred to as a rapid infiltration system (RIS), whereby rapid disposal of effluent is achieved in a small footprint.

2.6 Additional Design Requirements

The following additional design requirements have been taken into account when developing the concept for the WWTP and LDS:

1. ***Odour:*** provision has been made for collection and treatment of objectionable odour generated from odorous areas of the WWTP.

2. ***Visual Impact:*** the design will minimise the visual impact of the WWTP and LDS.

3. ***Noise***: the design will minimise noise and comply with relevant acoustic standards for the site (to be confirmed).

4. ***Operation and Maintenance:*** while an MBR WWTP with chemical dosing is an advanced system which will require operator input and on-going maintenance, the design will minimise operator input and maintenance requirements where possible.

3.0 Wastewater Treatment Plant

Based on PDP's experience at other sites in New Zealand, an appropriately designed MBR based WWTP as outlined in the following sections of this report is expected to achieve the target effluent quality criteria outlined in Table 3. Detailed process design has not been undertaken at this stage but this will need to be undertaken as part of the concept/preliminary design development to confirm that the effluent quality is suitable for discharge into the receiving environment and can be suitably achieved.

3.1 Infrastructure Items

Infrastructure items which will be included in the WWTP are outlined as follows:

- Fine screening and grit removal unit (1/0.5 mm aperture), such as a packaged Johnson Screen package (as installed at Maketu);
- A 4-stage Bardenpho biological nutrient removal (BNR) secondary wastewater treatment process, including primary anoxic tank, aeration tank, secondary anoxic tank and MBR tank;
- Supplementary carbon dosing (acetic acid or ethanol) for enhanced biological nitrogen removal and alum dosing for chemical removal of phosphorus;
- Supplementary alkalinity dosing (to maintain adequate pH for biological removal of nitrogen;
- Permeate storage tank, including permeate pumps and land disposal pumps (in the event that gravity discharge to the LDS is not possible);
- Emergency storage tank, including pumps;
- Membrane cleaning system (including chemical storage);
- Control building including motor control centre (MCC), air blowers and chemical storage (in separate rooms);
- Secondary solids dewatering system (including polymer dosing), such as small screw press unit; and
- Foul air collection and treatment unit.

An indicative process flow diagram showing the arrangement of the process units is shown in Figure 2.

A more simple 3-tank Modified Ludzack Ettinger (MLE) BNR configuration could be adopted as an alternative to the 4-tank Bardenpho configuration, however, the 4-tank system is the preferred option to reliably achieve the low effluent nutrient concentrations outlined in Table 3 while minimising chemical dosing requirements.

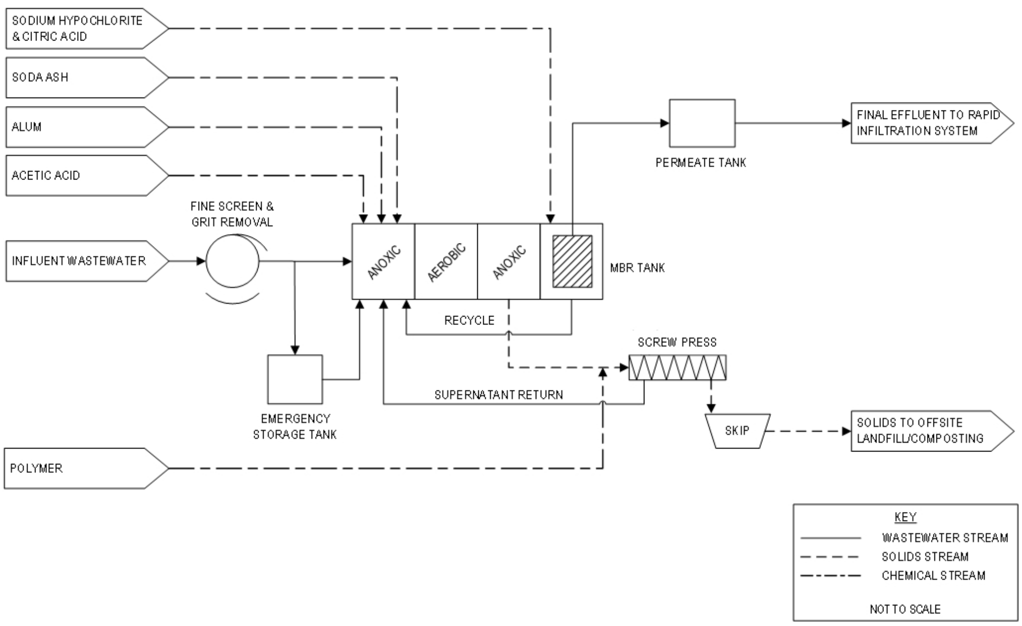

Figure 2: Indicative Process Flow Diagram

3.2 Indicative Process Tank Sizing

Indicative sizing of the key process tanks has been undertaken by applying conservative hydraulic retention times as summarised in Table 4. Detailed process design will be required to confirm tank sizing. For this concept design a maximum tank height of 4.5 m has been assumed.

Table 4: Indicative Process Tank Sizing

Tank	HRT[1]	Volume[2]	Plan Area[3]
	(h)	(m^3)	(m^2)
Stage1: Primary Anoxic Zone	3	57	13
Stage 2: Aeration Zone	3	57	13
Stage 3: Secondary Anoxic Zone	3	57	13
Stage 4: MBR Tank	1.5	28	11
Total	**10.5**	**199**	**44**

Notes:

1. *Hydraulic retention times utilised for tank sizing are based on the PDF.*
2. *Tank volumes have been estimated based on design influent flows and typical hydraulic retention times.*
3. *Plan areas have assumed tank depths of 4.5 m apart from the membrane tank which is assumed to be 2.5 m.*

3.3 Membrane Selection

Selection of membrane equipment has not been undertaken at this conceptual stage. However, there are a number of suppliers in New Zealand who can offer suitable equipment, with the membrane equipment package typically including the fine screen unit, membrane cassettes, manifolds, permeate pumps, membrane cleaning equipment and air scour system. A typical arrangement of membrane equipment for an MBR WWTP is shown in Figure 3.

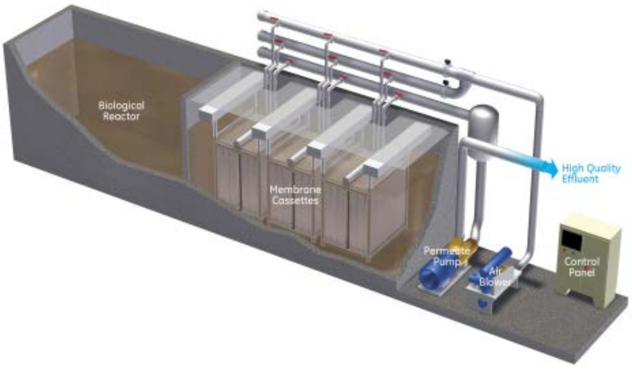

Figure 3: Membrane Equipment Arrangement[2]

3.4 Peak Flow Management

An appropriately designed pressure sewer reticulation system will convey lower peak flows to the WWTP compared with a conventional gravity reticulation system due to minimal wet-weather inflows and infiltration and due to the provision of storage at each property. Therefore, PDP has assumed that influent balancing will not be required and membrane sizing has been based on the PWWF. However, we have assumed that an emergency storage tank will be included to provide 24-hour ADF storage upstream of the process tanks to provide for temporary emergency storage of raw wastewater for maintenance and/or in the event of mechanical breakdown.

3.5 Solids Management

Screenings separated at the inlet works to the WWTP would be stored in a wheelie bin or skip and periodically transported offsite for disposal to landfill or composting/vermicomposting.

Secondary solids generated in the biological wastewater treatment process will be pumped to a dewatering building where it will be dewatered using a screw press or a similar unit to achieve a dry solids concentration of around 15 to 20% with polymer dosing (to aid flocculation). The supernatant will be returned to Stage 1 of the MBR process stream and the dewatered solids will be stored on-

[2] Source - GE Water and Process Technologies Ltd

site in a skip prior to off-site disposal to landfill or to composting / vermicomposting.

3.6 Odour Management

The WWTP will have several sources of odour which will require careful consideration to ensure there is no odour generated at the site.

Odour will largely be attributed to hydrogen sulphide gas (H_2S) released under anaerobic conditions at the following process areas:

- Influent screening/grit removal unit.
- Emergency storage tank.

Given that the reticulation system is to comprise of a LPSS, the retention time in the network is likely to be significant and high concentrations of H_2S will likely be released at the head of the WWTP (Inlet screen). For this reason, enclosure of the inlet screen inside a building will be required to minimise odour release, with foul air extraction and treatment. Alternatively, appropriately designed covers could be installed to an exterior mounted screen unit for foul air collection.

The concept design has assumed that foul air would be extracted by a fan and duct system for treatment in a bark-bed biofilter or chemical wet-scrubber unit.

3.7 Corrosion Protection

Influent wastewater entering the WWTP is likely to be corrosive due to the relatively long hydraulic retentions times associated with LPSS promoting release of hydrogen sulphide and subsequent formation of sulphuric acid. Therefore, design of all infrastructure including pipes, tanks, pumps and instrumentation will need to consider appropriate corrosion protection.

3.8 Noise Management

Noise will be generated by mechanical equipment at the WWTP site. Sources of noise at the WWTP and controls are outlined as follows:

- ***Blowers:*** house inside a blower room with acoustic silencers on the inlet and specialised building design; and
- ***Fans:*** may likely require acoustic enclosures.

Acoustic assessment of all sources of noise will be required during detailed design to ensure compliance with RLC's noise limits.

3.9 Chemical/HSNO Requirements

Several chemicals will be used at the WWTP. In order of expected use/cost these are: acetic acid or ethanol, alum, caustic, sodium hypochlorite and citric acid.

The concept design has assumed that acetic acid will be used to enhance denitrification. While acetic acid is more expensive than ethanol (which is used at the Rotorua WWTP for enhanced denitrification), health and safety requirements are less stringent for acetic acid than for ethanol. Therefore, given the relatively small quantity of supplementary carbon required at Tarawera, acetic acid is the preferred choice. A number of HSNO controls will be required at the site for the storage and use of these chemicals.

3.10 General Layout and Civil Works

The following general civil works will be required within the WWTP compound:

- Access road suitable for chemical delivery;
- Electricity supply;
- Stormwater management;
- Water supply (roof water collection, tank and pump); and
- Security fence.

A conceptual perspective view of the WWTP described in this report is shown in Figure 4. Note that the size of the equipment shown in Figure 4 is based on the Rotoiti/Rotoma WWTP and equipment will be around 50% smaller for the Tarawera WWTP.

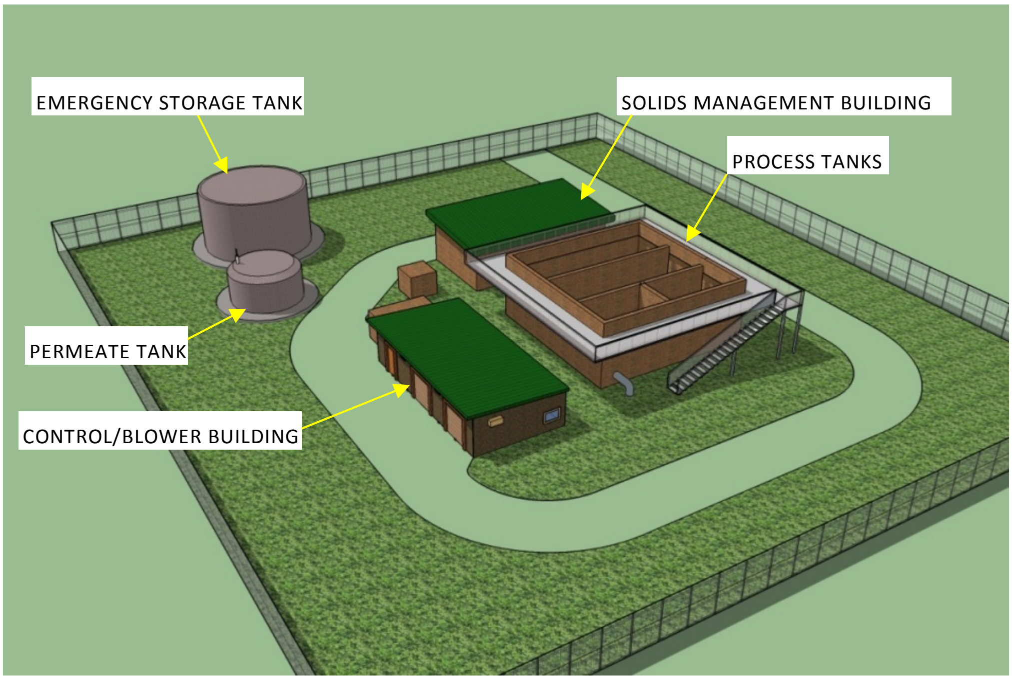

Figure 4: Indicative Perspective View of Tarawera WWTP

4.0 Land Disposal System

RLC has specified a preference for a trench based rapid infiltration land disposal system (LDS) for Tarawera similar to that proposed at Rotoiti/Rotoma.

As no site has been identified at this stage for the LDS, there is no information presently available to confirm the suitability of the site for treated effluent disposal, to assess the environmental effects of this activity and for sizing of the disposal system infrastructure. However, in the interests of providing an indication of size we has assumed some dimensions and this is discussed in Section 4.2.

In the absence of site information, for the purpose of this report we have assumed that a suitable site can be found that satisfies the hydrogeological requirements outlined in the following section.

4.1 Hydrogeological Requirements

The key hydrogeological requirements that determine the feasibility of a rapid infiltration system are:

1. Adequate soil infiltration rate to accommodate the peak design hydraulic loading rate.
2. Avoidance of localised ‘daylighting’ of disposed effluent at the ground surface due to mounding effects or due to interface flow at low permeability layers.
3. Avoidance of adverse localised nutrient loading (e.g. nitrogen and phosphorous) to a sensitive down-gradient surface water body (e.g. stream or near-lake shore effects) due to insufficient dispersion/mixing of the plume as it migrates through the groundwater to the receiving surface water body.

Site investigations will be required to confirm site suitably as discussed in Section 4.3.

4.2 Concept Design

The conceptual design of the LDS is based on the hydraulic load only and little or no nitrogen removal is expected to occur or to be required following disposal given the low nitrogen concentrations in the treated effluent. As well as low nutrient concentration in the treated effluent, there is also low concentration of solids, biochemical oxygen demand (BOD), phosphorus and microbial contaminants, and these concentrations (with the exclusion of nitrogen) will be further removed as the treated effluent passes through the land system.

In the absence of any site information, the following design assumptions have been made to allow indicative sizing of the disposal trenches:

- Ultimate PWWF (design flow): 550 m^3/d;
- Trench width: 2.0 m; and
- Assumed infiltration rate: 1 m/d (site investigations are required to confirm this.

Based on the above assumptions a total trench length of 275 m is required for the ultimate design peak wet-weather flow (+20% contingency). This could potentially consist of 2 No. 165 m long trenches spaced 25 m apart constructed at right angles to the groundwater contour.

4.3 Investigations

Once a potential site (or a number of potential sites) for the WWTP/LDS have been identified, a staged investigation programme will be required to assess the feasibly of the site(s) for treated effluent disposal.

4.3.1 Initial Site Walkover

It is recommended that an initial walkover of the site(s) is undertaken by a suitably qualified hydrogeologist and engineer to provide a preliminary assessment of the suitability of the site for construction of the WWTP and for implementing and consenting the LDS.

The walkover should assess the general topography of the site, geographical features, proximity to streams and/or other surface water, proximity to neighbouring dwellings, ease of constructing the road access. The walkover should also identify any other potential constraints associated with the site.

4.3.2 Stage 1 – Hydrogeological Investigation

Assuming that a preferred potential site is identified from the initial site walkover(s), the next stage would include preliminary sub-surface ground investigations.

This investigation would include bore-hole investigations, permeability testing, soil infiltration testing and scala penetrometer testing.

4.3.3 Stage 2 – Hydrogeological Investigation

Assuming favourable findings are obtained from the stage 1 investigation, the next stage would involve drilling and installing a number of groundwater monitoring bores in order to collect soil profile data and baseline groundwater level and groundwater quality information. Groundwater level information will confirm the likely groundwater flow direction, and hence the expected flow path of the contaminant plume through the underlying groundwater from the LDS to the receiving environment.

This investigation would include drilling around 5 or 6 bores, including up-gradient and down-gradient bores, to depths below the minimum summer water table level. If the site was at a high elevation above the level of Lake Tarawera, then the depth of the bores at the LDS site and up-gradient bores may need to be significant (for example the bore depths at the Rotoiti/Rotoma LDS are up to 72 m below ground level). These bores could subsequently be used for permeability testing and ongoing groundwater quality monitor once the LDS is operational.

Based on the findings of the Stage 2 Hydrogeological investigation, groundwater modelling would then need to determine the travel time of the treated effluent through the groundwater, the extent of dilution and the expected impact on the groundwater contaminant concentrations.

4.3.4 Ecological Investigation

Assuming favourable findings are obtained from the stage 2 hydrogeological investigation, an ecological investigation would then be required to collect baseline ecological information. The effect of any predicted change to the groundwater quality on the receiving environment as a result of the disposal activity would also need to be considered as part of the ecological investigation.

4.4 Assessment of Environmental Effects

Once the above investigations have been completed then all the findings would need to be compiled into a complete assessment of environmental effects (AEE) which will form part of the discharge consent application for the WWTP and LDS activity.

5.0 Cost Estimates

PDP has developed 'concept level' estimates of capital expenditure (CAPEX), operating expenditure (OPEX) and 35-year net present value (NPV) estimates for the proposed wastewater treatment and disposal system.

5.1 CAPEX

CAPEX estimates are subject to the following assumptions:

- It is assumed that a reasonably flat graded sit can be found to avoid the need for significant earthworks and retaining;
- Land purchase or leasing costs are excluded;
- Costs for constructing an access road to the site are excluded;
- Costs to establish an electrical supply to the site are excluded;
- A contingency allowance of 30% has been included as this conceptual/pre-feasibility stage;
- A 15% allowance for professional services has been included;
- Costs for site investigations and consenting are included;
- Internal RLC costs are excluded;
- Costs are based on present (2017) costs and exclude escalation; and
- Costs are in NZD and are exclusive of GST.

A summary of the CAPEX estimate is outlined in Table 5 and a breakdown of these cost estimates is included as Appendix A.

Table 5: Capital Estimate

Item	Low	Likely	High
Wastewater Treatment Plant	$4.2M	$5.1M	$6.2M
Land Disposal System	$0.4M	$0.5M	$0.6M
Investigations and Consenting	$0.4M	$0.6M	$1.0M
Total	**$5.0M**	**$6.2M**	**$7.8M**

Notes:

1. *Costs are in NZD and are exclusive of GST.*
2. *No RLC costs have been included in these estimates.*

As a comparison with the CAPEX estimates for the Tarawera WWTP and LDS outlined in Table 5, the CAPEX for the Maketu WWTP and LDS constructed in 2011 to service a similar sized community (541 HUE for Maketu compared with

544 HUE for Tarawera) was around $4.8M excluding GST and excluding investigations and consenting[3]. Note that the Maketu project included a similar type of treatment technology (sequencing batch reactor system) and included contractor operation of the plant for a one year period. Tender prices received for this design-build-operate contract ranged from $4.2M to $8.5M.

5.2 OPEX

OPEX estimates are shown in Table 6 and a breakdown of the cost estimate is included in Appendix A.

Table 6: OPEX Estimate

Item	Annual Estimate[1]
Electricity	$19K
Chemical Use	$20K
Solids Disposal	$17K
Operator and Consent Compliance	$63K
Maintenance	$61K
Generator Rental	$10K
Total	**$190K**

Notes:
1. Costs exclude GST.

5.3 NPV

The estimated net present value (NPV) cost for the scheme is $10.0M based on the 'likely' CAPEX of $6.2M, annual OPEX estimate of $190K and a 35-year period and a discount rate of 3.5% which is assumed to be the actual discount rate adjusted for infiltration.

[3] U. Glasner and K. Hill (2012) Maketu/Little Waihi Wastewater Scheme – A Solution is Executed, Western Bay of Plenty D.C., Water NZ Conf.

6.0 Conclusions

PDP has developed a desk-top conceptual design for a wastewater treatment plant (WWTP) and land disposal system (LDS) to service Tarawera utilising membrane bioreactor (MBR) technology and disposal to rapid infiltration trenches.

As no site has been identified at this stage, there is no information presently available to confirm the site suitability for treated effluent disposal. Therefore, PDP has assumed that a suitable site can be found that satisfies certain requirements described in this report. A staged investigation programme is outlined in this report to confirm the feasibility for treated effluent disposal at a given site and to provide sufficient information for a resource consent application.

Excluding costs for land purchase or leasing, and excluding costs to construct an access road and establish an electricity supply to the site, the rough-order estimated CAPEX for the WWTP and LDS is in the range of $5.0M to $7.8M.

The estimated annual operating cost is around $190K. Based on the likely mid-range CAPEX estimate, the 35-year net present value of the facility is $10.0M.

Site investigations and analysis together with consultation is required to confirm the feasibility of constructing the concept design outlined in this report and to obtain sufficient information to prepare a satisfactory AEE to apply for a long term (e.g. 35 years) resource consent term.

Appendix A

Cost Estimates

PRE-DESIGN ESTIMATE

Name: CONCEPT DESIGN OF TARAWERA WWTP AND LDS
Job No. A03101200

CAPEX ESTIMATE

Level of Accuracy: ± 35%

		Low	Likely	High
MBR Wastewater Treatment Plant	Preliminary and General	$ 420,000	$ 540,000	$ 670,000
	Inlet Works and Solids Management	$ 447,000	$ 566,000	$ 705,000
	Reactor Tanks and Aeration Systems	$ 559,000	$ 686,000	$ 805,000
	Membrane Plant	$ 687,000	$ 900,000	$ 1,113,000
	Permeate and Chemical Systems	$ 155,000	$ 210,000	$ 265,000
	Compressed Air Systems	$ 25,000	$ 30,000	$ 35,000
	Odour Management	$ 80,000	$ 120,000	$ 160,000
	General Civil Works	$ 91,000	$ 115,000	$ 138,000
	Electrical and Control	$ 362,600	$ 476,000	$ 591,100
	SUBTOTAL:	**$ 2,827,000**	**$ 3,643,000**	**$ 4,482,000**
Contingency	30%	$ 850,000	$ 1,090,000	$ 1,340,000
Professional Services	15%	$ 420,000	$ 550,000	$ 670,000
	TOTAL - WWTP:	**$ 4,100,000**	**$ 5,280,000**	**$ 6,490,000**
Rapid Infiltration Trench Land Disposal System	Preliminary and General	$ 40,000	$ 50,000	$ 60,000
	Land Disposal System	$ 234,000	$ 305,000	$ 367,000
	SUBTOTAL:	**$ 274,000**	**$ 355,000**	**$ 427,000**
Contingency	30%	$ 80,000	$ 110,000	$ 130,000
Professional Services	15%	$ 40,000	$ 50,000	$ 60,000
	TOTAL - LDS	**$ 400,000**	**$ 500,000**	**$ 600,000**
	Investigations and Consenting	$ 400,000	$ 600,000	$ 1,000,000
	TOTAL PROJECT	**$ 4,900,000**	**$ 6,380,000**	**$ 8,090,000**
Date of Estimate:	2-Dec-16			
Estimate prepared by:	D Garden			
Estimate reviewed by:	Daniel Kuruppu			

Note: these estimates are concept-level only and are exclusive of escalation and GST.