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Central Hawke's Bay District Council
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30 August 2021

Attention: Darren de Klerk

Dear Darren,

Te Paerahi and Pōrangahau WWTP - Outline of Proposed new combined Treatment Plant options P:C.16

1 Background

Central Hawkes Bay District Council (CHBDC) is in the process of preparing applications for new resource consents for the Te Paerahi and Pōrangahau Wastewater Treatment Plants (WWTP) treated wastewater discharges. The wastewater currently undergoes primary treatment in one oxidation pond on each site. Pond effluent is discharged to the Pōrangahau River at Pōrangahau WWTP and irrigated to the sand dunes at Te Paerahi WWTP.

The community has been engaged with to confirm their views on desirable wastewater treatment and discharge method as well as address the concerns or implications on cultural values.

As a result of the community engagement process, the preferred option for long term management of wastewater at Te Paerahi and Pōrangahau is to stop using both existing treatment ponds and relocate Te Paerahi WWTP from a wāhi tapu site. A new wastewater treatment plant at a new location is preferred for wastewater collected at Te Paerahi and Pōrangahau treatment, after which the effluent is discharged to land. This disposal scheme is presented as Scheme 3 in Te Paerahi and Pōrangahau WWTP Options Report, by Beca issued 15 October 2020. The scheme would be implemented in three stages. The new treatment plant would be installed as the core of the third stage (Stage 3) of the upgrading project.

The long-term solutions for both plants are based on the design horizon to year 2057 with a projected population of approximately 837 people for Pōrangahau and 312 permanent residents (up to 624 in peak season) for Te Paerahi.

The purpose of this letter is to provide information to support the long term discharge consent application with outlines of several technological options which could be used for the new treatment plant and could meet the likely needs of the irrigation based effluent discharge system.

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2 New Site

2.1 Site location

A potential site for a new WWTP, treated effluent storage and land irrigation has been identified adjacent to the Hunter road as presented in Figure 1 below. This has been investigated by Lowe Environmental Impact (LEI) for preliminary suitability. A new sewage main to this location would be located along Hunter Road.

Figure 1 – A new WWTP location (aerial picture taken from LEI)

2.2 Site Description

Wastewater from Te Paerahi and Pōrangahau communities will be pumped to a new WWTP which will consist of an inlet works, low input treatment process, treated effluent pump station and treated effluent rising main with offline storage. A very high level, preliminary layout for a new site is presented in Figure 2. The WWTP footprint required will depend on which treatment technology is ultimately selected. Some treatment options such as oxidation ponds would require a bigger footprint (as indicated by the lighter green area) and options such as a tricking filter with clarifier would require a smaller area (as indicated by blue area).

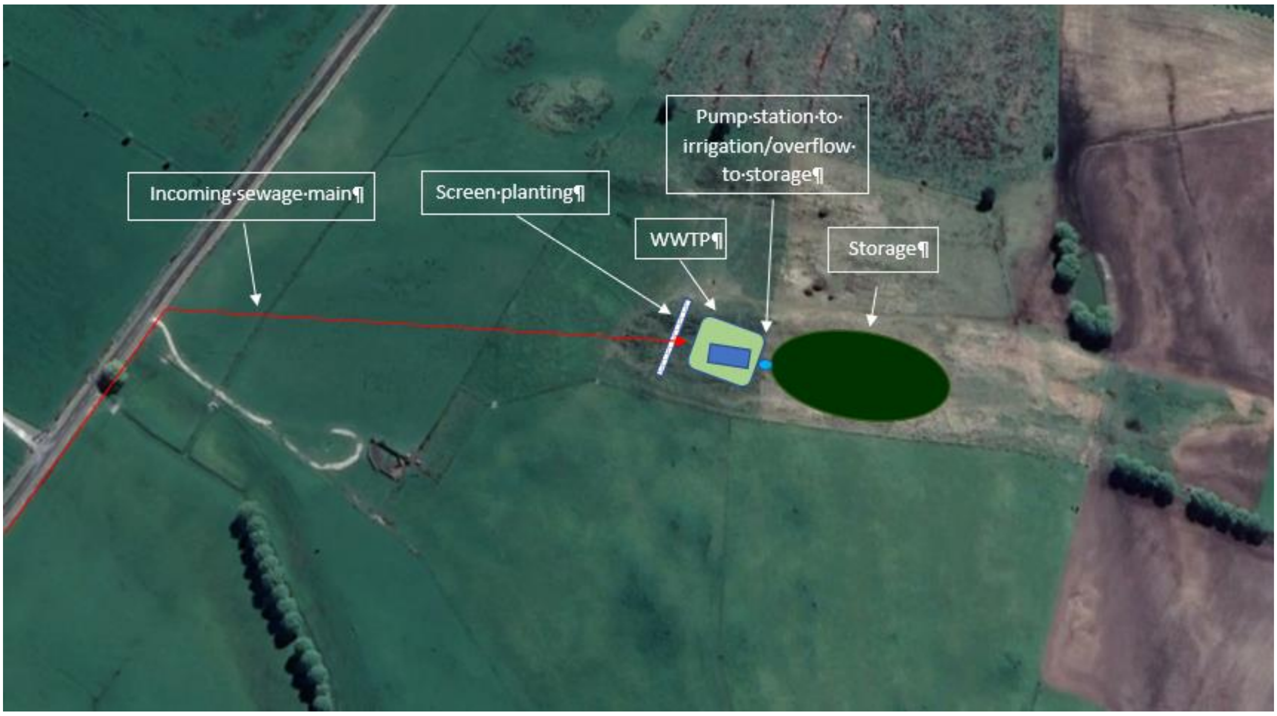

Figure 2 – Indicative locations for new WWTP and treated effluent storage pond

3 Basis of design

3.1 Future Use

In the future (Stage 3) all sewage collected in Te Paerahi and Pōrangahau will be treated in a new WWTP and the existing Te Paerahi and Pōrangahau ponds will be decommissioned (at Stage 3).

The communities are relatively isolated from the main CHB centres, and it will take operators and critical trades (IT, Mechanical, electrical) a significant amount of time to reach the site after a failure or critical alarm. Therefore, a robust, low technology, low operational input treatment process is considered an appropriate form of treatment solution for the Stage 3 upgrade. Obviously, the treatment system will need to be such that it can consistently and reliably deliver the standard of effluent ultimately required by new consents obtained for the scheme.

Following the implementation of Stage 3, untreated wastewater from Te Paerahi and Pōrangahau would be conveyed to a new combined WWTP. Treated effluent from the combined WWTP would be conveyed for irrigation. Intermediate buffer storage would be provided to help match effluent production to soil moisture, and precipitation conditions and farm management requirements. During periods when the soil is saturated and irrigation is not possible and storage is full, treated effluent would be conveyed to a high-rate land disposal system located on another part of the farm that has higher permeability soils.

The projected design average daily flow to the plant is 567 m^3/d at year 2057.

The requirements for the new WWTP design on a new site are as follows:

3.2 Population Projection

3.2.1 Previous Population Projections

Central Hawke's Bay District Council has previously commissioned Beca to prepare an option report for Te Paerahi and Pōrangahau[1] WWTPs. This report included a basis of design for projected wastewater influent flows and loads through to the year 2048. Population projections developed by Economic Solutions Ltd, Napier in a report titled Central Hawke's Bay District Long Term Planning – Demographic and Economic Growth Projections 2018 – 2048 (dated 28 August 2017) were provided by the Council for developing the basis of design.

The population living in Te Paerahi was not considered as part of the population projection assessment. The population of Te Paerahi connected to the WWTP was therefore assumed to be 312, based on an Assessment of Environmental Effects report prepared by Opus in 2007[2]. The options report assumed that Te Paerahi would have negligible population change over the design horizon. Te Paerahi is largely a holiday destination so the design basis assumed the population connected to the WWTP doubles during the summer months (624 people).

3.2.2 Revised Population Projection

The Pōrangahau and Te Paerahi population projections have been revised in June 2021 for an updated basis of design. The population of Pōrangahau in 2057 (design horizon), was linearly extrapolated based on the 'High' growth population data. The June 2021 projection expected the population to increase from 210 to 837 inhabitants between 2020 and 2057.

The previous assumptions regarding the population of Te Paerahi have been retained. This means that the township population is assumed to remain at 312, with a seasonal population peaking factor of 2 during the summer months. The population is also assumed to remain constant through to 2057.

Table 1 provides the June 2021 revised population projections from 2020 to 2057.

Table 1. Population Projection for Pōrangahau and Te Paerahi (June 2021)

Area	Current (2020)	Future (2057)
Pōrangahau	210	837
Te Paerahi	312	312
Te Paerahi (Summer)	624	624
Average Total Population	**522**	**1149**
Peak Total Population	**834**	**1461**

[1] P:C.10 Te Paerahi and Pōrangahau Options Report (Beca, March 2020)

[2] Pōrangahau Beach (Te Paerahi) Wastewater Treatment and Disposal Resource Consent Application (*Opus International Consultants Limited*, May 2007)

3.3 Flows

At the current Pōrangahau and Te Paerahi WWTPs, only the effluent (outflow) flow can be monitored. In February 2021, Beca assessed the per capita wastewater flows for 2019 to Pōrangahau and Te Paerahi based on the pond discharge flows from 2008 – 2020. These flows have been revised, the following outlines the updated method and assumptions for Pōrangahau and Te Paerahi.

3.3.1 Pōrangahau

- The current average daily flow (ADF) was estimated based on actual outflow data, adding evaporation losses, adding seepage losses and subtracting direct rainfall on the pond.
- The current average dry weather flow (ADWF) was estimated based on actual outflow data, adding evaporation losses, adding seepage losses, and assumed 0mm for rainfall.
- The following assumptions were made:
- Evaporation occurs for 3 months of the year, at 4.87 mm/d based on the daily evaporation for Januarys between 2014 – 2020 (climate data from Dannevirke)
- Seepage occurs at a constant rate of 3 mm/d, assuming a 300 mm thick clay liner
- The pond area is 0.3 hectares
- Average rainfall is 994 mm/year, based on the rainfall data over 2008 – 2020

The future ADF was estimated based on the projected population, to get future ADWF and an assumed future ADF/AWDF factor

Table 2 Wastewater flows from Pōrangahau

		Current outflow	Current inflow	Future inflow
Population		**210**		**837**
Dry Weather Flow (ADWF)	**m^3/d**	**51 (estimated as the 15th percentile of outflows)**	**63**	**252**
Average Daily Flow (ADF)	**m^3/d**	**146**	**151**	**481**
L/capita per day	**L/capita/day**		**301**	
ADF/ADWF factor (I&I factor)			**2.4**	**1.9***

* Assumed a 20% reduction in inflow and infiltration due to new, replaced or upgraded network. This is slightly conservative as the majority of the network will be connected to new builds, therefore networks will have much lower I&I. Also, it would be expected that gross 'inflow' to the system, such as direct connection of down pipes will be removed.

The current (based on 2008-2020 data) peak wet weather factor is 29 [3](PWWF/ADWF). This is too high to reasonably be applied to estimate the future PWWF because:

a. the future network will have new and upgraded sections and

[3] Using peak wet weather data January 2017-June 2021, the peaking factor is 12.8 for Pōrangahau, and 5.9 for Te Paerahi (Te Paerahi and Pōrangahau II Management Plan, currently in draft)

b. as above, it would be expected that, at least, gross infiltration will have been dealt with through exclusion, repairs, and renewals.

The future PWWF was determined by:

- New Reticulation (future ADWF – current ADWF) multiplied by 5 peaking factor plus the Existing ADF plus existing reticulation (Existing PWWF – Existing ADF) multiplied by 80%.
- Peaking factor: the 5 factor is based off new reticulation (NZS4404: Land Development and Subdivision Code). This assumes all new houses and stormwater drainage
- 80% is based on an assumption that the existing I & I can be reduced by 20%

3.3.2 Te Paerahi

Similarly, the current ADF from Te Paerahi was estimated based on the measured current average daily outflow, evaporation losses, seepage losses and rainfall accumulation. As discussed, the population in Te Paerahi is assumed to remain unchanged through to the design horizon (2057), therefore the only change to the future ADF is based on the future ADF/ADWF factor (2.2, I&I reduction of 20%). Due to the reduction in this factor, the expected future ADF is less than the current ADF (i.e. the wet weather component of the ADF is reduced).

Because additional development area is not envisaged, and it is expected that CHBDC will undertake an I&I reduction [4]programme it will be noted that the future peak weather flow is projected to be less than the current peak wet weather flow. The reduction is reliant on an effective I&I reduction programme.

3.3.3 Pōrangahau and Te Paerahi Summary

Table 3 outlines the current and estimated future wastewater flows for Pōrangahau and Te Paerahi communities.

Table 3. Wastewater Inflows from Pōrangahau and Te Paerahi

		Pōrangahau		Te Paerahi Average		Te Paerahi Summer Peak	
		Current	**Future**	**Current**	**Future**	**Current**	**Future**
Population	People	210	837	312	312	624	624
Average Dry Flow per capita	l/p/d	301	301	144	144	144	144
Dry Weather Flow (ADWF)	m^3/d	63[5]	252	45	45	90	90

[4] Te Paerahi and Porangahau II Management Plan, June 2021

[5] $63m^3/d$ approximates inflow by taking the $51m^3/d$ outflow, adds allowances for pond seepage and evaporation and removes direct rainfall on the ponds

Average Daily Flow (ADF)[6]	m^3/d	151	481	130	99	260	197[7]

3.3.4 Combined flow

The new WWTP inflow will be a combined flow from Pōrangahau and Te Paerahi. The combined flows for average and peak seasons in 2020 (current) and 2057 (future) are outlined inTable 4 The WWTP design average daily flow is 581 m^3/d.

Table 4. Combined inflows to the new WWTP

		Current Flow 2020		Future Flow 2057	
Parameter	**Units**	**Average**	**Summer Peak**	**Average**	**Summer Peak**
Total Population	**People**	**522**	**834**	**1149**	**1461**
ADF/ADWF Factor	**-**	**2.4**	**2.4**	**1.9**	**1.9**
Dry Weather Flow (ADWF)	**m^3/d**	**95**	**153**	**297**	**342**
Average Daily Flow (ADF)	**m^3/d**	**281**	**411**	**567**	**653**

3.4 Loads

To remain consistent with the approach used in the options report, a typical per capita wastewater load was assumed for Pōrangahau and Te Paerahi, due to the limited influent sampling information available. The loads presented in Table 5 were determined by applying typical loads per capita to the June 2021 population projection for Pōrangahau and Te Paerahi. The combined loads can be seen in Table 5. The peak loads depend on the population in Pōrangahau and Te Paerahi during the summer months, when the population in Te Paerahi is assumed to be doubled.

Table 5.Wastewater Loads from Pōrangahau and Te Paerahi

	Typical [8]	Pōrangahau		Te Paerahi Average	Te Paerahi Summer Peak
	Load per capita (g/p/d)	**Current Load (kg/d)**	**Future Load (kg/d)**	**Load (kg/d)**	**Load (kg/d)**
Population	-	210	837	312	624
COD	193	40.5	161.5	60.2	20.4
Unfiltered $cBOD_5$	76	16	63.6	23.7	47.4
TSS	74	15.5	61.9	23.1	46.2

[6] Based on an inflow and infiltration factor of 2.7 currently and 2.2 in the future (20% reduction in inflow and infiltration)

[7] Less than 260 because it is assumed that I&I to existing reticulation will be reduced

[8] Metcalf & Eddy Wastewater Engineering Treatment and Resource Recovery 5th Edition Table 3-18

TKN	13.2	2.8	11.0	4.1	8.2
Ammonia	7.7	1.6	6.4	2.4	4.8
TP	2.1	0.4	1.8	0.7	1.3

Table 6. Combined Projected Wastewater Loads

	Current load 2020		Future Load 2057	
	Load (kg/d)	**Summer Peak load (kg/d)**	**Load (kg/d)**	**Summer Peak load (kg/d)**
Population (people)	522	834	1149	1461
COD	101	161	222	282
Unfiltered $cBOD_5$	40	63	87.3	111
TSS	39	62	85.0	108
TKN	7	11	15	19
Ammonia	4	6	9	11
TP	1.1	1.8	2.4	3.1

3.5 Effluent quality requirements for land application

Treated effluent will be irrigated to farmland most of the time. When conditions will not allow for irrigation, effluent will be stored in a pond and when the storage is full, the effluent will be applied to a rapid infiltration basin therefore very high-quality effluent is not required for this disposal scheme. Indicative expected effluent quality requirements for land application are outlined in Table 7. Note that the parameters are not yet determined and not absolutely critical for land irrigation scheme.

Table 7 Expected effluent quality

Effluent Parameter	Median value
Biochemical Oxygen Demand, mg/l	**20**
Total Nitrogen, mg/l	**20**
Total suspended solids, mg/l	**20**
E.Coli cfu/100ml	**Median 500 (tbc)**

4 Treatment Examples

The communities are relatively isolated, and it will take a significant time for operators and critical trades, such as mechanical and electrical services to reach the site. Therefore, the suitable technology for a new WWTP should be selected considering the following:

- The operator will not be on site daily
- Proximity of operator's commute to the plant and the time it will take to reach side after a failure or critical alarm has been raised,
- Ability to get more specialist trades to the site within a reasonable time,

- How often a new plant will require routine contractor services such as screenings and solids removal from site
- Robustness of the process performance and response to seasonal changes in flow and/or load and unusual situations such as short term power loss.
- How long it will take to service mechanical and electrical parts and what will be a stand down period for the treatment process because of it.

A new combined treatment plant is proposed that services both communities. The treatment plant will discharge to land through irrigation, therefore effluent quality standards are not as stringent as may be expected for discharging directly to surface water. This especially applies to nutrients in the effluent as they can be of benefit (more so in the form of ammonia-N rather than nitrate-N) to the farming operations.

Four examples of potentially feasible treatment technology are considered below which could meet the required effluent quality using a low energy and operational input technology. These options do not generally require daily operational attendance on site or high maintenance.

4.1 Pond based treatment

A pond-based treatment system is simple, low energy technology and allows the buffering of flows and loads through the retention in the pond. Oxidation ponds are natural treatment systems that change over time depending on the incoming load and environmental factors (temperature, sunlight, humidity and wind). The quality of pond-treated wastewater is subject to natural variation and cannot always be controlled to meet consent limits. While oxidation ponds can perform well, they commonly suffer from variable discharge quality including high or variable TSS, variable BOD, variable pathogen and indicator species, and limited nitrogen and phosphorus removal. Ammonia oxidation or uptake and consequently total nitrogen removal is, in most cases (but not all), poor. This is not such a bad thing where the final effluent is being irrigated to a crop. However, winter leaching of nutrients is not desirable if it can be avoided. This can occur due to higher hydraulic loading rates and naturally wetter soil during winter.

A new oxidation pond could be constructed to provide future treatment. Based on the current average BOD load and pond loading rate of 84 kg/BOD/ha/d a pond size of approximately 4,700 m^2 is required for current flows. An additional area of approximately 5,700 m^2 would be required by 2057, making a total approximate area of 10,400 m^2 required in the future. Some improvements would be required such as additional aeration, filtration for TSS reduction, and UV disinfection, to meet treated effluent quality required for farmland irrigation. Therefore, the system would consist as a minimum of inlet works, flow monitoring, pond system with supplementary aeration, tertiary filtration and disinfection such as UV.

An influent screening facility would be installed to minimise the amount of nuisance, gross solids material that can get through to subsequent pumping and other tertiary process facilities.

The pond would be divided into at least three cells to facilitate optimum retention time and therefore treatment. A third cell could be configured to provide some buffer storage and future treatment as required. Some surface aeration is likely to be installed in at least the first pond to provide supplementary oxygen to quickly oxidise soluble BOD that cannot be accommodated by the natural aspiration capacity. This provides a better chance of achieving nitrogen removal further through the process.

A tertiary filtration system would normally be employed to remove solids and larger algal masses before the effluent undergoes UV disinfection. Disc filters containing a physical barrier such as a customised cloth or a mesh installed on a number of discs, which filter the flows could be used. Algae clogging of these filters can be a problem, so unit sizing and nominal pore / exclusion sizing needs to be adequately considered at design to allow for algae peaks.

UV disinfection could be applied to all examples outlined in this section. Effective UV disinfection relies on light being able to pass through the water to reach and deactivate the microorganisms. There are two main obstacles to the passage of the light through wastewater - light being absorbed by dissolved contaminants, and light being obstructed by TSS. A pond based system tends to produce relatively high TSS concentration in the effluent, therefore tertiary filtration is essential for a UV installation at a pond based plant.

4.2 Biological Trickling Filter and Secondary Clarification

Biological Trickling Filter (BTF) is a low energy wastewater treatment technology where screened raw wastewater is spread over stone or plastic media where biomass grows as a biofilm, containing organisms that consume various components of the waste. Traditionally the effluent, after passing through the trickling filter, is passed through a clarifier to help remove residual solids and biomass that sloughs off the media on which it grows. By including a clarifier, this BTF configuration is a very different concept than those used at Hastings, Napier and Gisborne. A new BTF could be constructed on a new site to provide treatment to meet farmland-based irrigation requirements. This site would require all traditional additional elements such as inlet screening, secondary clarification and disinfection.

An influent screening facility would be required to screen wastewater prior to treatment in the BTF.

BTFs are not traditionally used for nutrient removal (mainly for BOD removal), but can be used to achieve biological nitrification if lightly loaded or used in a two stage configuration. Nitrogen removal effectiveness can then be adjusted using recycles of effluent and blending with raw wastewater or via a small side stream anoxic process. Nitrification process can be heavily reduced during colder winter temperatures.

A BFT design could be used to meet the required future effluent quality. One BTF of approximately 15m diameter[9] and media specific surface area of 150 m^2/m^3 would be required to at least partially nitrify current loads. A second BTF of the same diameter could be implemented when appropriate to cater for and nitrify projected 2057 future loads. Applying low loading rates, some nitrification of ammonia would occur down low in the filter after the soluble BOD of the raw sewage has been consumed higher up.

Typically recycle pumping is required to maintain wetting of the media and sustain the biomass.

A conventional clarifier of approximately 12 m diameter can be used after the BTF. Secondary clarifiers in general can produce effluent quality good enough for disinfection. However, tertiary treatment (filtration) might be required if the effluent quality is not meeting specific UV requirements, especially during flushing cycles or if the effluent contains floating insect husks or snail shells[10].

UV disinfection would be the same as in the pond-based option.

4.3 Rotating biological contactor or modular disk treatment plant

Rotating biological contactor (RBC) can be configured as a low energy wastewater treatment system and could come in a form of package plant. A dual treatment system such as Masons Aqua BioMax is a combination of RBC technology and cloth media filtration. The package unit utilizes multiple RBC discs that

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[9] Assumes depth of filters are 1 – 2.5 m, based on Metcalf & Eddy Wastewater Treatment 5th Edition Table 9-12

[10] In addition to the biomass, BTFs typically sustain populations of snails and insects that live in the media and graze on the biomass. These can result in shells and insect husks being discharged with the effluent.

are vertically mounted and closely spaced on a steel shaft, providing a large surface area for biofilm growth, where treatment occurs.

An influent screening facility would be installed to minimise the amount of nuisance, gross solids material that can get through to the RBC and other tertiary process facilities.

The discs located in the treatment chamber are 40% submerged and rotate continuously to allow for aeration of the biomass when exposed outside the tank water. Flow would then enter the filter portion of the unit. A cloth media drum filter follows the RBC to collect and remove the biological solids prior to the effluent discharge. This cloth media filter eliminates the need for a secondary clarifier. Therefore, making this technology a compact treatment/clarification unit all in one. The backwash water from the filter is returned to the upstream primary sedimentation basin and the biosolids are typically anaerobically digested in the bottom of the pre-treatment tank. The sludge from the bottom of pre-treatment tank would need to be taken out off site every 3 to 6 months. A solids management strategy would be required as the solids from the bottom of sedimentation tank would be of a different nature than a traditional biosolids.

RBC technology could be used to meet the required future effluent quality parameters for farmland irrigation. Two units of approximately 217 m^3/d each would be required to provide nitrification, BOD and TSS removal for current flows. One more unit could be implemented when appropriate for 2057 future loads. The number of units is indicative and would be determined at a later stage and would assess appropriate level if redundancy.

A cloth media filter is already integrated in RBC system and the filter size can be custom selected, therefore no further solids removal is expected to be required before UV disinfection.

4.4 Fixed growth package plant

A fixed film process package plant is another low energy wastewater treatment technology and has a similar process to the biological trickling filter (BTF) described above. A fixed film system uses media (in this case filter cloth) which supports bacteria growth. The biomass grows on the surface and in the porous structure of the filter. Usually the system consists of a series of septic tanks for primary settling, pre-anoxic tanks, recirculation tanks, packed reactors (containing filter media) treated effluent tanks and UV disinfection if required. The screened and settled wastewater is passed through the last septic tank outlet filter before sprinkled over the filter media whereon grows biomass containing organisms that consume various components of the waste in the same way as the BTF biofilm. The effluent, after passing through the filter, is either discharged to a treated effluent tank or sent back to a recirculation tank for further polishing. The filter media is made of fairly dense filter-like material, therefore the effluent produced by this system is low in TSS and suitable for UV disinfection. No tertiary filtration would typically be required.

A system such as Innoflow Advantex AX100 could potentially used as an option. The system itself is automated and therefore little input from operator would be required. It could provide a stable process and produce good quality effluent for farm irrigation and UV disinfection. Approximately 32 AX100 treatment pod units could be used for current flows which comes with 6 septic tanks (100 m^3 each), 3 pre-anoxic tanks (100 m^3 each), 3 recirculation tanks (100 m^3 each), effluent storage tank of approximately 100 m^3 required for UV operation. While these are multiple units, they do have a small footprint. A second installation of the same quantity and size of treatment pods could be implemented when appropriate for 2057 future loads.

Customization of the above package plant may be available from suppliers to make a package plant of a more appropriate scale by introducing an inlet screen instead of septic tanks, custom sized concrete process tanks with an enclosed filter provided as a kit set.

The above system would require emptying septic tanks on a routine basis. Considering the number of septic tanks included in a standard design for a packaged plant, this would become a labour intensive plant operation, which is not ideal for a new WWTP.

4.5 Expected performance of a new plant

Table 8 outlines what removal is expected / can be achieved by the various technologies described above.

Table 8. Summary table of the expected performance for each technology

Technology/ Effluent quality	BOD	TSS	TN	E. coli
Oxidation Ponds with supplementary aeration and tertiary filters	Good removal	Good removal of incoming TSS, seasonal spikes of TSS related to algal blooms	Seasonal removal, may provide good in summer, poor in winter	Seasonal removal, depending on sunlight, and retention time and number of cells/ponds
Trickling filter and Clarifier	Very good removal can be expected on low rate plants (typical removal 75%)	Very good removal can be achieved using secondary clarification (typically 95%). Assuming clarifier installed	Traditionally poor removal, unless designed lightly loaded or in stages, where nitrification can occur.	UV disinfection will be required
RBC with filter	Very good removal	Very good removal can be achieved using cloth filters (typically 95%).	Good removal if sized appropriately (low loaded) to provide for all year round nitrification. May require supplementary carbon to denitrify due to the up front septic tanks.	UV disinfection will be required
Fixed film process package plant	Very good removal	Traditionally good, can be achieved very good with effluent filtration	Can be good, but requires specific design and may require supplementary carbon to denitrify due to the up front septic tanks.	UV disinfection will be required

5 Next Steps

Several low impact treatment options are available to provide a robust and reliant wastewater treatment, requiring low levels of operational input for Pōrangahau and Te Paerahi communities. There are several WWTP configurations that can treat the combined flow from Pōrangahau and Te Paerahi to achieve the required effluent quality for discharging to land via irrigation. Technology examples provided in this memorandum demonstrate that there is a range of treatment options available from pond-based system to a package plant.

Following granting of consent, the next steps required to develop these examples into options concept design would be as follows:

- Short list and select an appropriate technology via an appropriate selection criteria model such as a multi-criteria analysis
- Identify appropriate selection criteria
- Prepare Class 5 cost estimates to assist with selection
- Undertake basic pre-concept designs. The concept would include options for site layout, process sizing and plant footprint
- Provide options summary including pros and cons which would assist to make an informative decision for option selection
- Undertake and summarise the selection process and provide a summary report for adoption of the preferred technology type

Yours, sincerely

John Crawford
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on behalf of

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