Porangahau and Te Paerahi Wastewater Upgrade

Land Suitability for Discharge

Prepared for

Central Hawke's Bay District Council

Prepared by

L W E
Environmental
I m p a c t

May 2020

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Central Hawke's Bay District Council

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14. Current Land Use

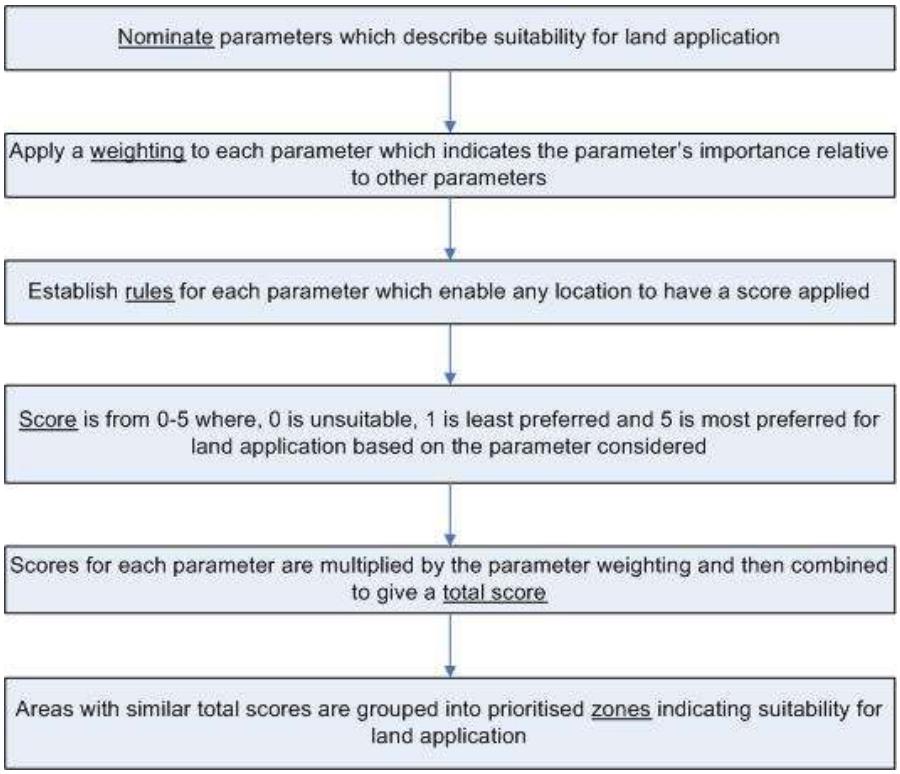
1 EXECUTIVE SUMMARY

Central Hawke's Bay District Council (CHBDC) operate both the Porangahau and Te Paerahi wastewater treatment plants (WWTPs). At present for Porangahau, wastewater is treated through an oxidation pond and discharged to the Porangahau River via a drain which was intended as a wetland. At Te Paerahi, wastewater is treated by an oxidation pond and then disposed to nearby sand dunes via soakage.

CHBDC is currently investigating options for future discharge of wastewater for each of these sites. There are three potential discharge options available; 100% land discharge, 100% river discharge into the Porangahau River and a combination of both a land and river discharge. The Te Paerahi WWTP and discharge into sand dunes is intended to cease operation altogether.

In order to consider the potential for land discharge of both the Porangahau and Te Paerahi wastewater, robust information is required to assess and identify suitable land discharge zones. An evaluation of the suitability of land near the WWTPs to receive wastewater application is needed.

Lowe Environmental Impact Limited (LEI) have been engaged by CHBDC to consider the potential for land based discharges of wastewater for the two communities. This report gives a desktop assessment of the suitability of land within a 10 km radius (Investigation Area) of the Porangahau and Te Paerahi WWTPs for land application of wastewater. A 10 km radius was considered to be the reasonable extent that a land application site could be located from the WWTPs. It is preferred to retain a land application site as close as possible to the treatment plant. However, the benefits in terms of land area needed and possible number of days of discharge for land which is more suitable for land application can warrant additional reticulation length. The process undertaken to determine the suitability of areas around the WWTP to receive treated wastewater is summarised as follows:



The parameters used to assess how suitable a location is for receiving wastewater application include:

- Land use (current capability);
  - Nutrient uptake potential.
- Soil attributes;
  - Slope and stability.
  - Soil drainage and permeability.
  - Depth to restrictive layer for plant root growth or water percolation.
- Hydrological and hydrogeological attributes;
  - Flood return interval and flood risks.
  - Riparian buffer.
  - Coastal hazards.
- Cultural/historic;
  - Wāhi tapu sites.

Maps developed using information from GIS databases show the suitability and limitations for each above parameter with respect to land application are given in Appendix A.

When the wastewater application suitability parameters are considered and grouped together, Zones are created in order of preference. The Zones are labelled A to E, where Zone A has no significant limitations for land application of wastewater and Zone E indicates severe limitations for land application of wastewater. A summary of the Zones within the 10 km of the WWTPs are given in the following table. This summary includes the removal of riparian buffers. Other aspects such as wāhi tapu sites or buffers from property boundaries for example would reduce these values further but should be considered on a site by site basis.

Zone	Description and Design Considerations	Area (ha)	% Investigation Area
A	**Well Suited** Requires smaller land area, as more water can be applied to a given area High value and/or short rotation crops Non-deficit irrigation – nil or limited storage required Greater number of irrigable days High rate of nutrient removal Routine cultivation and harvest, with short withholding periods.	792	3
B	**Moderately Well Suited** High value and/or short rotation crops Non-deficit irrigation or partial deficit irrigation Can irrigate in shoulder seasons (April, May, September, October) for drier than average years – some storage likely to be required Moderately high rate of nutrient removal Short withholding period for grazing or cultivation and harvest	1,316	6
C	**Minor Limitations** Pasture or restricted range of annual crops Predominantly deficit irrigation, requiring large storage or combined water discharge Larger land area requirement Withholding period prior to grazing or cultivation and harvest is extended	18,340	79

Zone	Description and Design Considerations	Area (ha)	% Investigation Area
D	**Significant Limitations** Plantation forestry, pasture, shallow rooting crops Deficit irrigation over summer months, requiring larger storage/combined water discharge Low nutrient loading Limitation to cultivation and harvest Extended withholding period for stock trafficking	2,806	12
E	**Severe Limitations** Requires largest land area Conservation plantings Low deficit irrigation for short season, requiring larger storage/combined water discharge No cultivation, infrequent harvest.	0	0
N/A	**Town, River and Lakes**	32	0.1
N/A	**Riparian Buffers – Excluded from area totals**	1,755	7
Total	**Land within a 10 km radius of the Porangahau and Te Paerahi WWTPs excluding riparian buffers**	25,009	100

The areas categorised as Zones A and B should be the priorities for further consideration for land application of wastewater. An area of 2,108 ha, representing 9% of the Investigation Area, is well suited or moderately well suited to receive irrigation. However, because Zones A and B occupy a comparatively small part of the investigation area and comprise of smaller land parcels and may be located further from the WWTPs, the use of Zone C, and in some cases Zone D land can be considered in further evaluations. Due to having to overcome limitations, a larger land area would be needed for discharge of Porangahau and Te Paerahi wastewater to Zone C or D land compared to Zone A or B land.

To accommodate a projected average discharge volume from each or both of the WWTP of ~182 m^3/day from Porangahau and ~156 m^3/day from Te Paerahi (Beca, 2020), this investigation has determined that the approximate land areas which are required are:

Zone	Average daily depth of Irrigation	Land Treatment Area Required (ha)	Rapid Infiltration Area Required (ha)
A	5 mm (Rapid Infiltration 200 mm)	6.8	0.2
B	0.8 – 1.2 mm	42.3 – 28.2	-
C	0.5 – 0.8 mm	67.6 – 42.3	-
D	0.3 – 0.5 mm	112.7 – 67.6	-
E	0 mm	-	-

These areas are the theoretical allowance and do not include buffer areas, which may be needed for land in proximity to riparian areas that are not included in the mapping, buildings, dwellings, wāhi tapu and property boundaries. For Zones B, C and D a deferred (Zone B) or non-deficit (Zone C or D) discharge would likely be required. This means that the discharge would not occur on every day of the year but may be 'concentrated' into a limited number of days throughout the year (Zone B) or to the summer (Zone C and D) and shoulder seasons (Zone C).

These areas have been identified by a desktop assessment and the acceptance and feasibility of acquiring or using the land needs to be determined. Also, care is needed to ensure the land areas identified do not have management and current use limitations that would render land

application inappropriate or unsuitable on these areas (public access, high value crops, industry limitations, etc).

Should land application be considered further, the first step would be to investigate the following areas in further detail, specifically:

- Zone A and B land north-northeast of Porangahau and Te Paerahi on the northern side of the Porangahau River mouth, adjacent to the coastline, may warrant further investigation due to this region being the closest Zone A and B land to the two treatment plants. Accessibility (third party owned land) and continuity of land parcels in these areas would be a significant limitation.
- Zone C land occupying the rolling hills surrounding much of the land around the Porangahau and Te Paerahi townships. These areas should be considered for a lower rate irrigation system, if Zone A or B classed land is not suitable. These areas are extensive and occupy the majority of the Investigation Area meaning locating land of a suitable size and distance from the treatment plants, as well as of the correct characteristics, should not be too much of an issue.
- Flat Zone D land surrounding the Porangahau township and Porangahau River. This land could be considered for low rate irrigation during the summer months if land of more suitable status is not available. This land would be beneficial due to its minimal slope status and proximity to each of the treatment plants, however depth to the restrictive layer and the permeability and drainage status of the soils occupying the Porangahau floodplain would need to be investigated. A significant storage facility or an alternative wet season discharge would be needed.

The use of a continuous (or at least adjacent) block of land would be more efficient than several smaller blocks. Figure 2, Appendix A identifies property parcels >20ha, these are generally outside of the towns but are favourable as they cover areas of flat land.

As mentioned previously, this assessment is to consider the 'potential' for land application. This doesn't imply the land is available, and in fact there has been no approach to property owners to ascertain their interest in receiving wastewater for irrigation.

If land application is investigated further the following should be considered:

- Is there reasonable access to preferential Zone A or B land;
- Storage requirements or alternative discharge options for Zone C or D land;
- Alternative wet season discharge options for Zone C and D land;
- Property ownership, including how many owners occur within a continuous block of land large enough for the wastewater flow from the WWTP (0.2 ha to 112.7 ha; dependent on irrigation method and zone to be applied);
- Depth to groundwater and groundwater movement/contours;
- Land management (crop sensitivity, erosion risk, flat land hydrogeology);
- Routes and costs for reticulation requirements (distance and elevation); and
- Special use locations (archaeological, historic, water take, native forest, recreational etc.).

2 INTRODUCTION

2.1 Purpose

The purpose of this report is to assess the suitability of land within the vicinity of the Porangahau and Te Paerahi (CHB) WWTPs to receive wastewater for long term irrigation (or disposal).

2.2 Background

Central Hawke's Bay District Council is looking at modifications to wastewater facilities and discharges at their Porangahau and Te Paerahi wastewater treatment plants. At present for Porangahau, wastewater is treated through an oxidation pond and discharged to the Porangahau River via a drain which was intended as a wetland. At Te Paerahi, wastewater is treated by an oxidation pond and then disposed to nearby sand dunes via soakage.

Community engagement has established that it is desired that operation of the Te Paerahi wastewater plant ceases altogether due to the land where wastewater is currently being applied is of cultural significance to local iwi who are the land owners of the discharge area. The community has also signalled a strong preference to avoid any direct discharge into the Porangahau River.

Alternative options for the management of wastewater for both Porangahau and especially Te Paerahi need to be developed. There are three realistic options to be considered; 100% river discharge into the Porangahau River, 100% land discharge at an appropriate location within close proximity to the Porangahau and Te Paerahi townships, and finally a combination of both a river or high rate discharge and land discharge.

In order for CHBDC to agree on a best practicable option, land discharge as an alternative to the current river discharge, needs to be analysed and evaluated to determine whether this will be a credible solution.

2.3 Scope

This document is intended to be a preliminary desktop assessment considering the suitability of land that could potentially be used for the discharge of wastewater from the CHB WWTPs.

The report is **not** intended to provide any recommendation of a favoured option, but to provide a factual basis upon which CHBDC may select favoured options for further consideration.

This investigation is to identify if land is potentially suitable for land treatment, prior to further investigation. Prior to final selection, areas identified as suitable in this report should be considered in terms of their current and future management suitability, and subject to a site investigation to verify if their characteristics are suitable for a land application system[1].

[1] No consideration has been given to land availability, and no field investigations to verify the accuracy of the mapped information have been undertaken.

3 LAND SUITABILITY FOR LAND TREATMENT OF WASTEWATER

3.1 General

Land application of wastewater can be regarded as an alternative to current discharge practices at both Porangahau and Te Paerahi. Land can be used as a form of treatment, thereby meaning that minimal or no additional wastewater treatment is needed prior to its application to land. Wastewater can be beneficially applied to land to assist production, providing nutrients alongside water, supplementing fertiliser application and irrigation. Alternatively, a high rate discharge to a smaller area of land can be used where the focus is wastewater disposal, rather than beneficial use. It is considered appropriate to base the land treatment assessment on current wastewater characteristics. Characteristics considered in the design of a land treatment system include:

- Wastewater characteristics (flow, population growth and wastewater quality);
- Climate and receiving environment; and
- Land management and operational considerations.

This report focusses on the land resource and land management. Other characteristics are considered following the identification of suitable land.

3.2 Investigation Area

Land within a 10 km radius of the CHB WWTPs has been assessed and is referred to as the Investigation Area (Figure 1, Appendix A). The characteristics of land in this Investigation Area are variable, and can be broadly described as having the following landforms:

- Hills – being land with a slope >16° predominantly located to the north-northwest and southwest of Porangahau, as well as to the south of Te Paerahi along the coastline. These soils are predominantly derived from both soft mudstone and sandstones, which vary in location throughout the Investigation Area due to numerous faultlines running parallel to the coast (GNS Science, n.d.; Landcare Research, 2020). These faultlines subsequently act as boundaries between parent materials. The predominant age of parent material underlying these hills is of Late Cretaceous/ Paleogene-Neogene origin (GNS Science, n.d.). Soils appear to be relatively moderately well drained on hill crests, turning imperfectly drained on slopes. The predominant land use within the investigation area is sheep and beef farming.

- Alluvial Flats – are the flat areas predominantly surrounding the Porangahau township to the east between Porangahau and Te Paerahi along Beach Road on either side of the Porangahau River. These soils of Holocene age, derived from alluvium, characterised as having a silty to sandy texture and are typically imperfectly to poorly drained (GNS Science, n.d.; Landcare Research, 2020). They are typically moderate to deep soils with a variation in stoniness between moderately stony and stoneless. Similarly to the rolling hill topography, the predominant land use of these flats is sheep are beef farming.

- Coastal Dunes – are described as of unconsolidated sand origin residing within the direct vicinity of the coastline and subject to regular coastal processes. These coastal dunes are located predominantly surrounding, at both a north and south direction, the Porangahau River mouth. Specifically, coastal dunes extend as far south as the Te Paerahi township and underlie the majority of the township itself. North of Te Paerahi, these dunes extend as far inland as Hunter Road and run parallel to the coastline. They are of Holocene age and their predominant land use appears to be sheep and beef farming.

3.3 Resource Review

This section of the report provides an initial desktop investigation into the characteristics of rainfall, groundwater, geology and soil within the 10 km radius Investigation Area of the CHB WWTPs. The review is to inform this land suitability assessment, and a more detailed account will be prepared if needed to support a land treatment option.

3.3.1 Rainfall and Potential Evapotranspiration (PET)

To analyse rainfall and potential evapotranspiration within the study site, one climate station was assessed, named the Porangahau Climate Station, located approximately 13 km north of the Porangahau township along Bush Road. This site was chosen to give the best representation of rainfall and potential evapotranspiration statistics over a 10 year period for rainfall and 8 year period for PET, within relatively close proximity to the proposed Investigation Area. From the table below, February recorded the least average amount of rainfall at 51 mm with July recording the most at 107 mm. Average yearly rainfall over this 10 year period was 912 mm per year.

For PET, highest average evapotranspiration occurred during the month of January at 139 mm with the lowest being within the month of June at 27 mm. The average yearly PET between this 8 year time period was 909 mm per year. Table 3.1 gives a summary of average rainfall volumes and PET for these respective time periods.

Table 3.1 Rainfall and PET Data for the Investigation Area

Month	Rainfall (mm)	PET (Preistley Taylor)
Jan	66	139
Feb	51	109
Mar	89	78
Apr	108	53
May	61	41
Jun	91	27
Jul	107	32
Aug	78	41
Sep	87	63
Oct	66	92
Nov	57	110
Dec	52	124
Annual Average	**912**	**909**
Station Name	Porangahau Climate Station	
Period	2010 - 2020	2011 - 2019

3.3.2 Geology and Soils

With the 697 km^2 catchment originating within the Ruahine Ranges, the Porangahau River meanders 35 km eastwards over Cretaceous/Paleogene-Neogene aged deposits running in a southwest-northeast direction, entering into the Pacific Ocean approximately five kilometres north of Te Paerahi (LAWA, n.d.; GNS Science).

Soils occupying higher elevations within the Porangahau catchment are typically silty loam in texture with an imperfectly to moderately well drained status (Landcare Research, 2020). These soils are derived from a combination of sandstones and mudstones, varying between moderately stony and stoneless. These silty loam soils turn more of a sandy loam as they reduce in slope and elevation and become within closer vicinity to the coastline where they begin to experience

coastal influences alongside already extensive fluvial processes (Landcare Research, 2020). These sandy loam soils are characteristic of those on the alluvial plain of the Porangahau River surrounding the Porangahau community.

The underlying sandstone and mudstone geology within the Investigation Area is the product of erosional and depositional processes on a million year timescale. These landforms have subsequently been reshaped by fluvial, coastal and tectonic processes to form the soils noted surrounding Porangahau and Te Paerahi (Hayward, Grenfell, Sabaa & Clark, 2012).

3.4 Land Application Area for Assessment Purposes

The land area required for wastewater application from the Porangahau and Te Paerahi WWTPs is dependent on the design of the land discharge system, alternative seasonal discharges and the amount of storage available. This report considers the application to land of wastewater from both WWTPs.

The land area required for full time land treatment varies from 0.2 ha to 112.7 ha, including buffer areas (Table 3.2). The wide range of variation is due to the consideration of different discharge regimes under different soil and land use scenarios when considering all water being applied to land. The regimes represent a range of hydraulic loading for each scenario i.e. varying depth (mm) of irrigation per year. An area of ~0.2 ha is needed for rapid infiltration (land disposal) options.

Appendix A, Figure 2 shows land parcels in the Investigation Area >20ha in area. Further work would be needed to determine which parcels are in the same ownership so that the size of contiguous land areas can be identified.

The future projected average wastewater discharge from each of the treatment plants are as follows (Beca, 2020):

- Porangahau – 182 m^3/d and m^3/yr
- Te Paerahi – 156 m^3/d and m^3/yr

To accommodate year round discharge of the average combined discharge of ~338 m^3/day of wastewater (includes Porangahau and Te Paerahi WWTPs), the approximate land areas required are given in Table 3.2. These areas however, do not include storage of wastewater in the event that discharge to surface waterways was to stop completely and land application would be a full time process i.e. additional land for storage may be required.

Table 3.2: Approximate Land Area Requirements

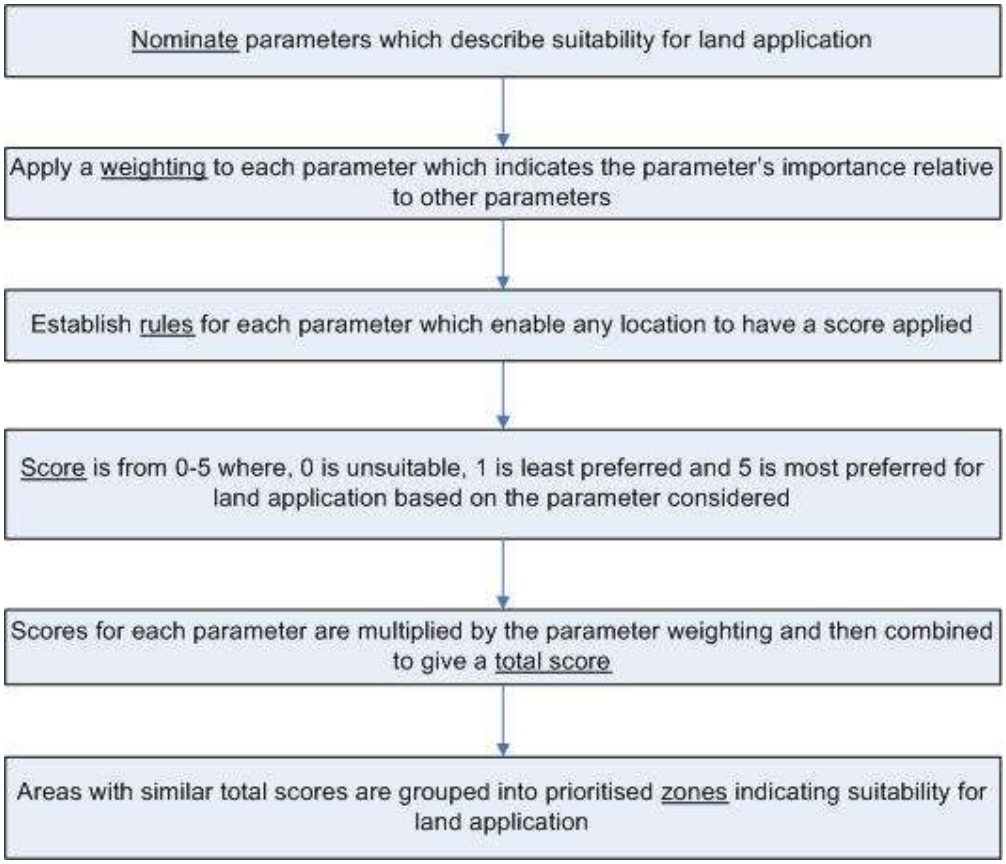
Zone	Depth of Irrigation	Land Treatment Area Required (ha)	Rapid Infiltration Area Required (ha)
A	5 mm (Rapid Infiltration 200 mm)	6.8	0.2
B	0.8 – 1.2 mm	42.3 – 28.2	-
C	0.5 – 0.8 mm	67.6 – 42.3	-
D	0.3 – 0.5 mm	112.7 – 67.6	-
E*	0 mm	-	-

*dependent on area. Generally, no irrigation would occur, but there could be exceptions for low rate irrigation, in particular, areas of flat land that may be restricted by a clay pan or gravel beds may be suitable for low rate irrigation.

4 LAND APPLICATION ASSESSMENT METHODOLOGY

4.1 Process Overview

The process undertaken to determine the ability of areas near the CHB WWTPs to receive wastewater is outlined as follows:



4.2 Parameters

There are a wide range of parameters which influence the ability of an area of land receive applied wastewater. The selection and interpretation of parameters for assessment may vary from area to area due to location specific challenges or advantages. For instance, where an investigation is near to the coast, consideration of coastal erosion may be important while this would not be considered for an inland investigation area.

The relative importance of the parameters varies and may be subjective. However, there is a need to consider the collective suitability of a particular site or area based on the merits of several parameters. This can be achieved using a weighted scoring system whereby each parameter is given a percentage (the weighting), which indicates its importance relative to other parameters. The weighting of each parameter should be informed by the values that the stakeholders hold for the project and investigation area. For this report, each parameter is given equal weighting.

A range of parameters can be considered within the Investigation Area as listed below.

- Land use;
    - Nutrient uptake potential.
    - Climate
- Soil attributes;
    - Slope and stability.
    - Soil drainage and permeability.
    - Depth to restrictive layer (DSLO).
- Hydrological and hydrogeological attributes;
    - Flood return interval and flood risks.
    - Riparian buffers.
    - Coastal hazards.
- Cultural/historic
    - Wāhi tapu sites

Explanation of the parameters, their relevance to the investigation, and their scoring are given in Section 5. At this stage, in depth investigations of non-technical aspects such as social and cultural consideration have not been incorporated into the assessment.

As part of a more detailed examination, which should include some field investigation, the following parameters should also be considered:

- Property ownership and residential housing;
- Land management (crop sensitivity, industry limitations);
- Reticulation requirements (distance and elevation);
- Land area available;
- Coastal hazards; and
- Special use locations and values (cultural sites, archaeological, historic, water take, native forest, recreational etc.).

Following the addition of these parameters, it is considered appropriate for the Stakeholder Group to score and weight the necessary range of assessment criteria. However, the analysis required to complete these layers is substantial and it is considered that these parameters should be examined following initial identification of preferred areas.

4.3 Development of Land Application Suitability Zones

When the scores from individual parameters for an individual point on a map are combined, they provide a total that can be compared with totals of parameters from different locations. This allows the summation of the parameters to be compared across the Investigation Area. To make the comparison easier, the combined totals can be grouped. These groupings are referred to as Land Application Suitability Zones. Five Zone groupings have been used and are given in Table 4.1, which summarises the implications of the Zones for land application system design.

Table 4.1: Land Application Suitability Zones

Zone	Suitable for
A	**Well Suited** Requires smaller land area High value and/or short rotation crops Non-deficit irrigation – nil or limited storage required Greater number of irrigable days High rate of nutrient removal Routine cultivation and harvest, with short withholding periods.
B	**Moderately Well Suited**

	High value and/or short rotation crops Non-deficit irrigation or partial deficit irrigation Can irrigate in shoulder seasons (April, May, September, October) for drier than average years – some storage likely to be required Moderately high rate of nutrient removal Short withholding period for grazing or cultivation and harvest
C	**Minor Limitations** Pasture or restricted range of annual crops Predominantly deficit irrigation, requiring large storage or combined water discharge Larger land area requirement Withholding period prior to grazing or cultivation and harvest is extended
D	**Significant Limitations** Plantation forestry, pasture, shallow rooting crops Deficit irrigation over summer months, requiring larger storage/combined water discharge Low nutrient loading Limitation to cultivation and harvest Extended withholding period for stock trafficking
E	**Severe Limitations** Requires largest land area Conservation plantings Low deficit irrigation for short season, requiring larger storage/combined water discharge No cultivation, infrequent harvest.

4.4 Using GIS and Aggregation of Parameter Rating Results

A GIS based approach has been used to develop the land application suitability zones, effectively resulting from an aggregation of the induvial parameter scores. In GIS terms this is known as combining layers.

A score has been developed for each parameter for every point on a map in the Investigation Area. This allows a graduated map to be produced which shows how the individual parameter score varies over an area, and essentially creates the data for a single parameter layer (as represented by an individual GIS layer). The maps for each parameter are presented in Appendix A, Figures 3 to 12.

This GIS approach allows the individual parameter maps to be aggregated to produce a map which shows the summation of the combined parameters for any point within the investigation area.

Rather than a graduated scale of totals from the sum of the parameters being shown on a map, the totals can be grouped into Zones, as discussed above. The combined Zone map, indicating greatest to least preference for land application, is shown in Appendix A, Figure 13.

This process means that a transition between any one individual parameter score (layer) will not be shown, and instead boundaries will be the Zones; being as mentioned above an aggregation and grouping of the sum of scores of all parameters being considered.

5 PARAMETER ASSESSMENT

5.1 General

The parameters listed in Section 4 are described below and the method for rating them in the Investigation Areas surrounding the WWTPs are given.

Information for each parameter is available from a number of accessible national resource databases. The data is made available as GIS information. The map scale of the data is given for each parameter and should be regarded to be accurate to this scale. A higher degree of variation can be expected at field scale, however it is the purpose of this report to determine whether land application is broadly feasible within the Investigation Area.

5.2 Land Use Attributes

The land use capability (LUC) of each site along with the current land use, indicates the potential for nutrient removal from the site. For the purpose of this report, nutrient uptake was based on LUC class as described in Section 5.2.1. This is an assessment of the land's capability for use, with consideration of its physical limitations and versatility for sustained production. LUC was determined from the national database of physical land resource information compiled by Landcare Research.

The existing land use within the Investigation Area was determined from the MfE Land Use and Carbon Analysis System (LUCAS) database. The most recent data for land use held by the MfE data service is dated April 2019. Data from LUCAS was used since it is well defined, published, consistently recorded and regularly updated. Land use parameters considered are as follows:

5.2.1 Nutrient Uptake

The versatility of land for productive use (cropping, horticulture, pastoral) is an indicator of a site's ability to remove nutrients applied in wastewater. Sites in the Investigation Area are scored as given in Table 5.1 and based on the land use capability (LUC) at the time.

Table 5.1: Land use capability nutrient removal rating

LUC Class	Rating	Nutrient uptake score
1	high nutrient removal	5
2	high nutrient removal	5
3	moderately high nutrient removal	4
4	moderate nutrient removal	3
5	moderately low nutrient removal	2
6	low nutrient removal	2
7	very low nutrient removal	1
8	N/A	0
Lake	N/A	0
River	N/A	0
Town	N/A	0

The LUC is chosen to represent nutrient uptake potential since the LUC class identifies the land's general versatility for productive use.

5.2.2 Current Land Use

The land cover type and land management practices adopted on any site are another indicator of the site's ability to remove nutrients applied in wastewater. Sites in the Investigation Area have been identified but not scored as LUC class was the most appropriate way to determine nutrient uptake. The approximate areas in each land use are given in Table 5.2. Figure 14, Appendix A represents the current land use within the 10 km buffered region. Current land use data was retrieved using the LUCAS land use map from the Ministry for the Environment.

Table 5.2: Land Use around Porangahau and Te Paerahi

Description	Land Area (ha)	Land Area (% of Total)
Grassland - High producing	15,261	59.5%
Grassland - Low producing	5,975	23.3%
Grassland - With woody biomass	894	3.5%
Natural Forest	1,284	5.0%
Other	290	1.1%
Planted Forest - Pre-1990	369	1.4%
Post 1989 Forest	692	2.7%
Settlements	32	0.1%
Wetland - Open water	365	1.4%
Wetland - Vegetated non forest	501	2.0%
Total land area ha	25,663	**100.0%**

5.3 Soil Attributes

The soil is the primary receiving environment for applied wastewater and is the final treatment process for renovating the wastewater. The capability of the soil to avoid transmittance of wastewater derived contaminants to the wider environment, and effectively recover the nutrient resource within the wastewater for plant and biota use is key to the successful development of a low rate (irrigation) land application scheme. For the purpose of rating the land in the Investigation Area, soil parameters assessed are given below.

It should be noted that a number of the data sets were created in the 1970s and 1980s and so some details may have changed due to drains and other large scale works. Following the prioritisation of land areas, it may be necessary to confirm or review data on-site.

5.3.1 Soil Drainage

The soil's ability to drain is a function of soil texture and soil structure. Data for the Investigation Area comes from the Fundamental Soil Layer (FSL, LRIS portal) and has a scale of 1:50,000. Areas are scored as follows:

- 5 – Well drained;
- 4 – Moderately well drained;
- 3 – Imperfectly drained or excessively drained;
- 2 – Poorly drained; and
- 1 – Very poorly drained.

5.3.2 Depth to Slowly Permeable Horizon

Depth to a slowly permeable horizon describes the minimum and maximum depths (in metres) to a horizon in which the permeability is less than 4 mm/hr (Newsome, Wilde & Willoughby, 2008). DSLO classes are located in the FSL layer of the LRIS portal and are scored as follows:

- 5 – >1.50 m;
- 4 – 1.20 – 1.49 m;
- 3 – 0.90 – 1.19 m
- 2 – 0.60 – 0.89 m;
- 1 – 0.45 – 0.59 m; and
- 0 – <0.44 m.

5.3.3 Soil Slope and Stability

In the absence of suitable flat land, steeper land may be used for wastewater irrigation, but it requires specific design to manage the risk of runoff and soil movement under moist soil conditions. Data for the Investigation Area comes from the Land Resource Inventory (LRI, LRIS portal) and has a scale of 1:50,000. Areas are scored as follows:

- 5 – Slope class A (flat to gently undulating 0 - 3°);
- 4 – Slope class B (undulating, 4 - 7°);
- 3 – Slope class C (rolling, 8 - 15°);
- 2 – Slope class D (strongly rolling 16 - 20°) and E (moderately steep 21 - 25°); and
- 1 – Slope class F (steep 26 - 35°) and G (very steep >35°).

5.4 Hydrological and Hydrogeological Attributes

The prevention of wastewater derived contaminants entering water (surface or ground) is a key environmental objective of a low rate (irrigation) land treatment system design. It is generally of lesser concern in a high rate land disposal system. The main mechanisms for transport to water are drainage to groundwater and direct surface water discharge i.e. by overland flow or flooding. The system should be designed to avoid overland flow and ideally excessive drainage volumes if land disposal is to be avoided. The likelihood of insufficiently treated wastewater entering water is reduced by:

a) Avoidance of sites with a high groundwater table;
b) Avoidance of sites with steep slopes and low permeability soil; and
c) Avoidance of sites with a high risk of flooding.

In addition, the hydraulic properties of the shallow groundwater can influence the impact that the increased drainage volume can have and so must be considered. Land areas have been assessed as follows.

5.4.1 Depth to Groundwater

The ability to treat and disperse applied wastewater is limited by the available unsaturated soil volume, i.e. depth to groundwater. The depth to groundwater is considered to be important in considering the suitability of land for wastewater discharge.

Section 5.3.2 describes the depth to slowly permeable horizon mapping. This is considered to adequately describe the depth to a saturated layer since it includes saturation due to a perched water table where that occurs. As a result, a separate layer for depth to groundwater is considered to be redundant, and inclusion here would be effectively double counting this parameter.

5.4.2 Flood Return Interval

Flooding along the areas adjacent to the Porangahau River poses a risk to land application of wastewater. Flooding of a land application site causes:

- Loss of soluble applied nutrients;
- Potential loss of nutrient laden sediment;
- Damage to crops and soil quality;
- Damage to irrigation infrastructure; and
- Reduction in number of irrigable days.

The areas are scored based on the FSL Flood Return Interval as follows:

- 6 – Nil risk;
- 5 – Slight risk = <1 in 60 y;
- 4 – Moderate risk = 1 in 20 y to 1 in 60 y;
- 3 – Moderately severe risk = 1 in 10 y to 1 in 20 y;
- 2 – Severe risk = 1 in 5 y 1 in 10 y;
- 1 – Very severe risk = >1 in 5 y.

5.4.3 Riparian Buffers

Riparian buffer zones have been identified but are not ranked. Rivers were identified using the Ministry for the Environment – River Environment Classification layer. Setbacks of 20 m were added to each waterway to give an indication of the approximate buffers required within the Investigation Area. These areas are effectively setbacks from waterways where irrigation is not recommended. This reduces the risk of over land flow to surface water. For further investigations, this distance will vary depending on width of the channel, channel shape, capacity of the waterway, topography and soils and natural vegetation already growing alongside the waterway. The Hawke's Bay Regional Resource Management Plan, Chapter 6, states when discharging to land, air, or water with agricultural products or discharging wastewater from a new sewage system, a buffer of 20 m is used as stated in Rule 16 f and 37 e respectively (HBRC, 2015).

5.5 Coastal Hazards

Coastal hazards have been identified but not ranked so do not directly influence the distribution of land suitability zones surrounding Porangahau and Te Paerahi. When mentioning coastal hazards, these particularly relate to sea level rise in response to the effects of climate change facilitating coastal inundation and at an extreme level, the risk of tsunamis. Coastal hazard zones underlined within the Hawke's Bay Regional Coastal Plan, alongside coastal boundaries and tsunami hazard zones have been retrieved from Hawke's Bay Regional Council to provide insight into the potential risks of land within closer proximities to the coastline.

5.6 Sites of Cultural Significance (Wāhi Tapu)

Similarly to coastal hazards, sites of cultural significance are identified surrounding Porangahau and Te Paerahi but are not ranked so too do not influence the distribution of land suitability zones. Great variation occurs between culturally significant sites within a Investigation Area. Culturally important sites vary through what they actually are, why are they significant, their level of importance in comparison to others and to whom they are of high importance. This emphasises the need to correctly identify all culturally significant sites within the Investigation Area to appropriately recognise locations that would unsuitable for land application. Culturally significant

sites have been identified from district planning maps provided by Central Hawke's Bay District Council.

5.7 Summary

The described parameters when combined are considered to give a semi-quantitative assessment of the suitability of an area suitable for land application of wastewater at any point within the Investigation Area.

6 RESULTS OF PARAMETER ASSESSMENT

6.1 General

Assessment of each parameter has been undertaken as described in Section 5. Maps for each parameter and for the aggregated map are provided in Appendix A and the results and trends shown are detailed below.

Figure 1, Appendix A defines the Investigation Area. Orientation to the locations have been made relative to the location of the Porangahau and Te Paerahi WWTPs that are central to the delineated 10 km radius area.

6.2 Nutrient Uptake Potential

Appendix A, Figure 3, gives a map of nutrient uptake potential based on LUC. Land that has a high nutrient removal (bright green – score 4) comprises only 1% of the total area and is found northwest of the Porangahau township near the intersection of Porangahau Road and Old Hill Road adjacent to the Taurekaitai Stream.

Land with a moderately high nutrient removal (green area – score 3) comprises 16% of the investigation area and is found along the alluvial flat areas surrounding the Porangahau River, alongside the Mangareia and Mangamaire Streams to the south-southwest of Porangahau.

Land with minor limitations (brown area – score 2) comprises 3% of the total area. These areas are dotted around the region, north, west and south of Porangahau with none considerably close to the two communities.

Land with low nutrient removal (brown/red area – score 1) comprises 63% of the Investigation Area. These areas are scattered throughout the Investigation Area but are particularly evident along the river systems away from the alluvial plains. Aside from the Porongahau floodplain, this score 1 land surrounds much of the Porangahau township if the zone 3 land wasn't to be utilised for land application. Although these areas do pose major limitations for year round irrigation, deficit and low rate irrigation should be considered.

Low nutrient removal areas (red area – score 0) covers 18% of the total investigation area and are confined to areas of extreme physical limitations or hazards that make it unsuitable for arable, pastoral, or commercial forestry use. Within the investigation area these cover slopes >16° with a high degree of erosion susceptibility. Most of this zone is located either along the coastline to the south, or along the hills to the southwest of Porangahau. Although these areas do pose major limitations for year round irrigation, deficit and low rate irrigation could be a consideration.

6.3 Soil Drainage

Figure 4, Appendix A, gives a map of soil drainage within the Investigation Area. Well drained and moderately well drained (light and dark green – score 4 and 5) land comprises 88% of the Investigation Area. Drainage in these areas is unlikely to be a limiting factor for the application of wastewater. These areas occur predominantly within the hill country of the Investigation Area away from the flat alluvial plains of the Porangahau River.

Areas with imperfectly or excessively drained soil (light brown – score 3) covers 1% of the Investigation Area. This area is approximately 10 km northwest of Porangahau adjacent to the Mangawhero Stream, north of Wilder Road.

Poorly drained areas (red – score 2) cover 11% of the investigation area and are mostly imperfectly to poorly drained sandy loam soils located along the Porangahau River, surrounding much of the Porangahau township. Although these areas are poorly drained, a light application rate of wastewater (0.3 – 0.5 mm/day/annum equivalent) may be beneficial through the summer months.

6.4 Soil Depth to Slowly Permeable Horizon

Figure 5, Appendix A gives a map of soil depth to a slowly permeable horizon. This may be related to the soil drainage, permeability and to the depth available for root exploration or aerobic treatment of applied wastewater. 87% of the Investigation Area has no observed restriction within at least 1.5m from the soil surface. These areas are located throughout the Investigation Area, predominantly on the rolling hills between significant water bodies away from the alluvial plains at all directions surrounding Porangahau.

Areas with lower scores for slowly permeable horizon (<0.89 m) mirror those soil types that have finer particle sizing along the flats surrounding the Porangahau River. Areas where pans are likely to cause restriction may be considered for a low rate, deficit irrigation system. This would avoid any potential overland flow or unnecessary ponding.

6.5 Soil Slope and Stability

Figure 6, Appendix A, gives a map of slope within the Porangahau and Te Paerahi area. Flat to gently undulating land of 0 - 3º (bright green) is predominantly located on the alluvial plain of the Porangahau River and its tributaries. These regions of land account for 13% of the total area and extend from near the Porangahau River mouth, upstream of the Porangahau township to the north-west, alongside on the alluvial flats of the Mangareia and Mangamaire Streams to the south-southwest of Porangahau. Flat land occurs between Porangahau and Te Paerahi which minimises reticulation distances.

Undulating slopes of slope class 4, highlighted in green (4 - 7°), cover only 4% of the Total Investigation Area. These regions are located directly westward of the Porangahau River mouth, as well as on the flats of the Tangaruhe and Mangaorapa Streams near Mangaorapa and Te Uri Roads westward of the Porangahau township.

Rolling hills highlighted in dull green (8 - 15°) account for 3% of the Investigation Area and are located throughout the Investigation Area. Significant areas are located northeast of Porangahau along Hunter Road, between Porangahau and Te Paerahi, with others being south and northwest of the community.

Strongly rolling to steep slopes highlighted in brown (>16º) account for 80% of the Investigation Area and is located throughout. 76% of this is class D land and 4% being class E. This land covers the majority surrounding river systems away from the alluvial flats surrounding Porangahau and Te Paerahi.

The flats within the Investigation Area are likely to withstand higher rates of irrigation, however, these will be dependent on other variables, such as drainage and wetness limitations. If areas of higher slope need to be considered, to avoid potential overland flow and runoff on steeper slopes, a deficit irrigation/ low rate irrigation practice would need to be considered.

6.6 Flood Return Interval

Figure 7, Appendix A, gives a map of the flooding risk in the Investigation Area as indicated by the flood return interval. 86% of the Investigation Area has a "nil" risk, with only 13% having less than a 1 in 60 year flood return. 1% of the Investigation Area has between a 1 in 20 year and 1 in 60 year flood risk. Slight risk regions are located along the Porangahau River and along the Mangareia and Mangamaire Streams surrounding Porangahau. Regions of moderate risk are located northwest of Porangahau, near the intersection of Porangahau Road and Old Hill Road adjacent to the Taurekaitai Stream.

Figure 8, Appendix A also represents the flood risks for a 1 in 100 year flood for the Porangahau River. From this, it is evident as expected, that much of the alluvial floodplain of the Porangahau, extending as far upstream as the confluence with the Mangaorapa Stream, is classed as being a high flood risk during an event of this scale. This includes the majority of the lower lying, flat terrain land surrounding the Porangahau township and extending to Te Paerahi. Regions of lower risk are also mapped with these areas extending approximately 500m away either side from the high risk alluvial plains of the Porangahau.

Irrigation within a severe flooding risk area or greater is not advised. Since the Investigation Area contains a large portion of "nil" risk areas, there should be sufficient areas to choose from where this can be avoided.

6.7 Riparian Buffers

Within the 10 km radius investigation area there is an extensive network of streams which transport surface water to the main rivers.

The more dissected an area is, the more disruption to irrigation infrastructure and the greater the total area needed. No ranking has been applied to this parameter but Figure 9, Appendix A shows the extent of riparian buffer zones within the investigation area. In total, approximately 1,755 ha of land is excluded within the Investigation Area due to riparian buffers. Table 6.1 outlines the extent of these riparian buffers within each zone. Refer to Section 7 for a discussion of the Zones. The largest portion of riparian zones are within Zone C, due to the combination of both steeper topography, alongside this zone being the most dominant within the Investigation Area, thus meaning it is dissected by more streams, increasing the total riparian area.

Table 6.1: Area of riparian zones within each zone of the CHB Investigation Area

Zone	Riparian Area (ha)	Zone Area (ha)	% of Zone as Riparian
A	83	875	10%
B	82	1,398	6%
C	1,202	19,542	6%
D	356	3,162	11%
Total	**1,755**	**25,009**	**7%**

6.8 Coastal Hazards

Figure 10, Appendix A represents both Coastal Hazard Zones 1 and 3 from the Hawke's Bay Regional Coastal Plan, alongside the Coastal Environment Inland Boundary. There is no land within the Porangahau/Te Paerahi region that falls under the Coastal Hazard Zone 2. This coastal inland boundary encompasses all of the Te Paerahi community and extends as far inland as the intersection of Beach and Hunter Roads.

Figure 11, Appendix A represents the tsunami evacuation zones for the Hawke's Bay coastline at Porangahau and Te Paerahi. Regions under the red tsunami hazard zone include the direct coastline and Porangahau River mouth, as well as the Porangahau River, extending upstream of the Porangahau township. The orange hazard zone is confined to the Te Paerahi township, south of the Te Paerahi WWTP. The region encompassing the yellow hazard boundary extends up to the Porangahau community. The yellow hazard zone is confined to the alluvial flats of the Porangahau River at lower elevations where the slope gradient is minimal.

6.9 Sites of Cultural Significance (Wāhi Tapu)

Figure 12, Appendix A represents sites of cultural significance (wāhi tapu) surrounding Porangahau and Te Paerahi. From this figure, there are a significant number of historic sites of varying importance within 10 km of the WWTPs. Of the listed sites, Pa sites are of substantial importance to local Maori and are some of the most important and sacred sites represented. Eight Pa sites have currently been mapped within the surrounding area, of which four, are located within relatively close proximity to the Porangahau River, indicating a potentially strong connection with the river by Maori. The remaining sites are located off Hunter and Blackhead Roads, alongside one being located approximately 10 km northwest of Porangahau, slightly north of the intersection between Porangahau and Old Hill Roads, adjacent to the Taurekaitai Stream.

Figure 12, Appendix A represents archaeological sites within the Investigation Area known by the district council. It should be noted that there are potentially koiwi sites within the Investigation Area, particularly on the banks of the Porangahau River in its lower reaches, and in dunelands. Site specific consultation with tangata whenua should occur, and any subsurface investigation in these areas should include an accidental discovery protocol.

6.10 Rating Summary

The parameters examined indicate that there are areas likely to be suitable for land treatment of wastewater. Different areas are constrained by different parameters. The relative suitability of areas for wastewater land application can be determined by aggregating the scores for each parameter as discussed in the next Section.

7 SUMMARY OF CAPACITY AND PRIORITY

As described in Section 4.3 above, parameter scores can be combined to create zones representing land suitability within the Investigation Area for land application of wastewater. Figure 13 shows these aggregated zones. Table 7.1 summarises the land area for each zone within the Investigation Area.

Table 7.1: Irrigation Suitability – Central Hawke's Bay Locality

Zone	Suitability	Land Area (ha)	Land Area (% of total)
Zone A	Suitable – negligible limitations	792	3%
Zone B	Moderately Suitable – minor limitations	1,316	6%
Zone C	Marginally Suitable – moderate limitations	18,340	79%
Zone D	Not Suitable – significant limitations	2,806	12%
Lake, River, Town	Not assessed	32	0.1%
Riparian Buffers	Not assessed	1,755	7%*
Total (Excluding Buffers)		**23,254**	**100%**

* Riparian buffers are excluded from all total areas and percentages within the above table. This total value and percentage of the Investigation Area is addition to the values represented within the table. Area associated with riparian buffers can be added to the total land area excluding riparian buffers (23,254 ha) which is 25,009 ha (the total land area within 10 km surrounding the wastewater treatment plants).

Zone A (dark green) class land is scattered throughout the 10 km buffer Investigation Area evident within Figure 13, Appendix A. Within this area, nine individual regions of Zone A status are present with the nearest being northeast of Porangahau and north of Te Paerahi, directly westward of the Porangahau River mouth, residing between Hunter Road and the river's true left. However, the majority of Zone A classed land is located within a northwest direction of Porangahau at approximately 10 km. Zone A classed land is located northwest of the intersection of Porangahau and Old Hill Roads, adjacent to the Taurekaitai Stream. Further Zone A land is located slightly to the southwest of this location, surrounding the Kaiparahoura Stream south of Wilder Road.

Similarly to Zone A land, areas of Zone B classed land (light green) are scattered throughout the Investigation Area occupying approximately 6% of the total land area. With a similar distribution to Zone A, Zone B land is also mostly confined to regions northwest of Porangahau. However, like Zone A, the closest Zone B land is also located at the Porangahau River mouth on the true left between the river and Hunter Road. To the northwest, Zone B land is located near Kaiparahoura Stream south of Wilder Road, as well as regions surrounding and between both the Mangaorapa and Tangaruhe Streams near Te Uri and Mangaorapa Roads.

Zone C land (brown) occupies the majority of the Investigation Area at 79%. This type of land is classified as being marginally suitable for wastewater irrigation. Due to its dominance within the Investigation Area, this zone type surrounds the majority of Porongahau and Te Paerahi.

Specifically, Zone C land is located on the rolling hills between the alluvial plains surrounding and upstream of the Porongahau River and its tributaries. This land could still potentially be workable to enhance summer productivity of north facing hill slopes which are more prone to drying out. Other benefits include the irrigation of pine/eucalypt plantations. A higher cost and management requirement are associated with irrigation of Zone C soils compared to Zone A and B soils.

Areas of Zones D (red) tend to occur in those areas described in Section 6 as having limitations due to shallow depth to a restrictive layer, slow permeability or very steep slopes. Zone D land accounts for 12% of the Investigation Area. The alluvial flats of the Porangahau River directly surrounding the Porangahau township fall within this zone. It is evident that Zone D land closely resembles the DSLO layer, indicating that where the depth to the restrictive layer is shallow, the overall zone class is also low.

The flats near to the Porangahau River offer a number of advantages for land application including comparatively short reticulation distances, limited pumping requirements (due to comparatively low elevation changes) and ease of irrigation to flat land. However due to high groundwater, these areas are likely to be suited to summer irrigation only. If they are to be further considered then it is likely an alternative discharge will be required for winter and shoulder season flows, or a large storage requirement is expected.

For a high rate disposal system (rapid infiltration), the requirements are for high capacity land to receive wastewater without ponding or run-off, and without risk of contaminating surface water bodies. The areas identified as most suitable for this purpose are within Zone A and potentially the free draining/ rapid permeability areas where sandy gravelly horizons occur. These locations, however, provide some obstacles in relation to the proximity to coastal areas with a high recreation value, and dune lands which have a high density of wāhi tapu whereby buffer zones will need to be established.

8 DESIGN CONSIDERATIONS

8.1 General

This section of this report highlights issues to be addressed in a land discharge option assessment for consent is to be sought.

8.2 Rapid Infiltration Scenarios

Rapid Infiltration (RI) involves setting aside a modest sized area of land (0.2 ha) for effectively the permanent discharge of high rates of wastewater. The intensity of the activity and its effects are likely to be high enough to rule out any use of the land involved for productive use, or any prospect of public access. The designation of an RI facility for wastewater discharge purposes is a potential avenue for CHBDC to consider. The qualities of the soils of the site will not be preserved or protected, and so should be designated in the same manner as must apply to any WWTP.

RI is for wastewater disposal, rather than for any beneficial re-use, but is a potential candidate for BPO consideration because of its small footprint and low cost compared to other potential options. Its environmental constraints will include the following;

- Odours and air discharge will need to be considered in a neighbourhood context, including appropriate designation and/or zoning in the district plan to protect the investment in, and community dependence on, the RI facility from reverse sensitivities (i.e. a new neighbour building a house next to the RI facility then complaining about the smell). There would need to be contingency plans to respond to odour events, and an enforceable consent requirement for there to be no offensive or objectionable odours beyond the property boundary.
- Effects on Groundwater should be expected because of the rapid rate of discharge involved, resulting in a high contaminant loading entering shallow groundwater beneath the discharge area. RI is used internationally in areas where adverse effects on local groundwater quality are considered acceptable. In HBRC's relevant plans, groundwater quality is to be maintained or enhanced where it is used for human consumption or irrigation, but the option is implicitly left open for RI in locations where the groundwater is not used for these purposes.

8.3 Irrigation Scenarios

Irrigation involves applying low rates of wastewater to a comparatively large area of land, to enable the beneficial re-use of the water and nutrients involved. The effects of the activity are able to be managed to be compatible with a range of productive land uses on a sustainable basis. The qualities of the soils of the site will be protected and even enhanced, in the same manner as applies to the use of clean irrigation water and the use of commercial fertilisers.

Irrigation is for beneficial re-use of wastewater, rather than for disposal, and is a potential candidate for BPO consideration. Its environmental constraints will include the following;

- Odours and aerosol discharges arising from sprinkler irrigation will need to be considered in a neighbourhood context. There would need to be contingency plans to respond to odour events, and an enforceable consent requirement for there to be no offensive or objectionable odours or aerosols beyond the property boundary.

- Surface water quality will need to be protected from any surface ponding or run off, but this is standard for all effluent discharges to land and is capable of being met with good design and management.
- Groundwater quality will need to be protected from any over-application of wastewater, but this is capable of being met with good design and management.
- There will be expectations, and maybe even requirements, for the protection of the quality of the receiving soil from the potential adverse effects of the irrigation discharge. Again, this is standard practice with effluent discharges, this is capable of being met with good design and management.
- While all the above environmental considerations relate to measurable performance standards that are capable of being met, the concern will be how the wastewater is to be managed when irrigation is not possible. The two options for this are a wastewater storage facility, and a contingent discharge facility. The alternative of a contingent discharge facility could remove the need for storage, but at the cost of an occasional and recurring discharge to surface water (current practice). Such a continued surface water discharge would need to be discussed with tangata whenua.

9 CONCLUSIONS AND RECOMMENDATIONS

9.1 Assessment Conclusions

In general, there is suitable land available for the establishment of a land application system within the Investigation Area. Although most suited to land application of wastewater, Zone A and B classed land occupies relatively small areas of the Investigation Area (9%) and therefore may be restricted for land treatment due to buffering restrictions for riparian zones, property boundaries and land parcel size, as well as distance from the treatment plants. Zone C and D land is more commonly available and therefore, alongside the more suitable Zone A and B land, should be the priority for any further investigations of land treatment.

9.2 Recommendations

This report presents the outcomes of a preliminary, desktop based, assessment designed to inform an overall assessment of options for CHBDC as part of its decision to upgrade the two WWTPs and discharge systems. Should a land-based application option be considered further, then additional stages would be required to confirm desktop identified characteristics.

This report considers only the technical feasibility of land application in the area. If land application is further pursued, then non-technical considerations such as cultural preference and cost to the community can be included and may alter the relative weighting of the technical attributes. It is recommended that interested stakeholders should be canvassed for views.

If a land application option is to be pursued then, based on the outcomes of this report, it is recommended that the following areas are assessed in further detail:

- Zone A and B land north-northeast of Porangahau and Te Paerahi on the northern side of the Porangahau River mouth, adjacent to the coastline, may warrant further investigation due to this region being the closest Zone A and B land to the two treatment plants. Accessibility (third party owned land) and continuity of land parcels in these areas would be a significant limitation.
- Zone C land occupying the rolling hills surrounding much of the land surrounding the Porangahau and Te Paerahi townships. These areas should be considered for a lower rate irrigation system if Zone A or B classed land is not suitable. These areas are extensive and occupy the majority of the Investigation Area meaning locating land of a suitable size and distance from the treatment plants, as well as of the correct characteristics, should not be too much of an issue.
- Flat Zone D land surrounding the Porangahau township and Porangahau River. This land could be considered for low irrigation application if land of more suitable status is not available. This land would be beneficial due to its minimal slope and proximity to each of the treatment plants, however depth to the restrictive layer and the permeability and drainage status of the soils occupying the Porangahau floodplain are limiting. Summer irrigation ay only be possible in these areas. Additional storage or an alternative, wet-season discharge would be required for Zone D land.

The biggest limitations to land application of CHB municipal wastewater is the amount of Zone A or B land in close proximity to the WWTPs and associated cost of infrastructure that result from larger land areas or longer pipe routes plus the potential storage or alternative discharge that may be required.

If land application is investigated further the following should be considered:

- Preference of Zone A or B land;
- Storage requirements or alternative discharge options for Zone C or D land;
- Alternative wet season discharge options for Zone C and D land;
- Property ownership, including how many owners occur within a continuous block of land large enough for the wastewater flow from the WWTP (0.2 ha to 112.7 ha; dependent on irrigation method and zone to be applied);
- Depth to groundwater and groundwater movement/contours;
- Land management (crop sensitivity, erosion risk, flat land hydrogeology);
- Routes and costs for reticulation requirements (distance and elevation); and
- Special use locations (archaeological, historic, water take, native forest, recreational etc.).

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11 APPENDICES

Appendix A: Figures

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APPENDIX A

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