

FUTURE PROOFING NEW ZEALAND – A GUIDE TO KNOWLEDGE SHARING

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ABSTRACT

To progress in the 3 waters space, New Zealand must work together to develop the skillset and knowledge of everyone who resides within it. To aid in this future-proofing need, the Far North District Council (FNDC) have begun to proactively develop internal staff. This is done by developing internal methodologies for technical assessments that are reviewed/improved by experts in the field. The results give FNDC confidence in their technical assessments whilst also improving internal skillsets.

This paper outlines the process undertaken by FNDC to begin developing its internal knowledge of treated wastewater disposal to land. It also discusses the significance land disposal has on the health and wellbeing of our waterways and details the continuing relationship between FNDC and Beca in this space.

This process presents an alternative to the typical service delivery where consultants are used to fill a knowledge gap to ensure the work is fit for purpose. This model means FNDC staff are ultimately able to provide a better service to elected members due to being more invested.

Ongoing relationships will also mean continued shared knowledge in land disposal best practice and offer FNDC support leading into future works.

KEYWORDS

WORKFORCE – CAPABILITY & TRAINING, TE MANA O TE WAI, ENVIRONMENTAL IMPACTS.

PRESENTER PROFILE

Ben Bowden graduated from the University of Canterbury in early 2019 with a Bachelor of Engineering degree in chemical & process engineering. Ben joined the Far North District Council in January of 2020 as a graduate 3 waters planner. Key focuses have been wastewater land disposal, and water/wastewater growth forecasting.

Garrett Hall is a Technical Director with Beca Ltd and holds a BSc in Physical Geography and MSc (Hons) in Environmental Science and Chemistry. He has over 20 years' experience working on a wide range of complex wastewater and water supply projects, both in New Zealand and the United Kingdom.

INTRODUCTION

FNDC holds responsibility for 16 wastewater schemes and eight water supply schemes across the district as shown in Figure 1 below. These schemes all vary considerably in terms of population served, projected population growth, and type/level of treatment. Due to being a tourist destination, several schemes also face a seasonal influx in population which presents a unique set of challenges.

For instance, discharge volume limits for FNDC wastewater treatment plants (WWTP) average dry weather flow ranges from 40 m³/day in Kohukohu to 3100 m³/day in Kaitaia.

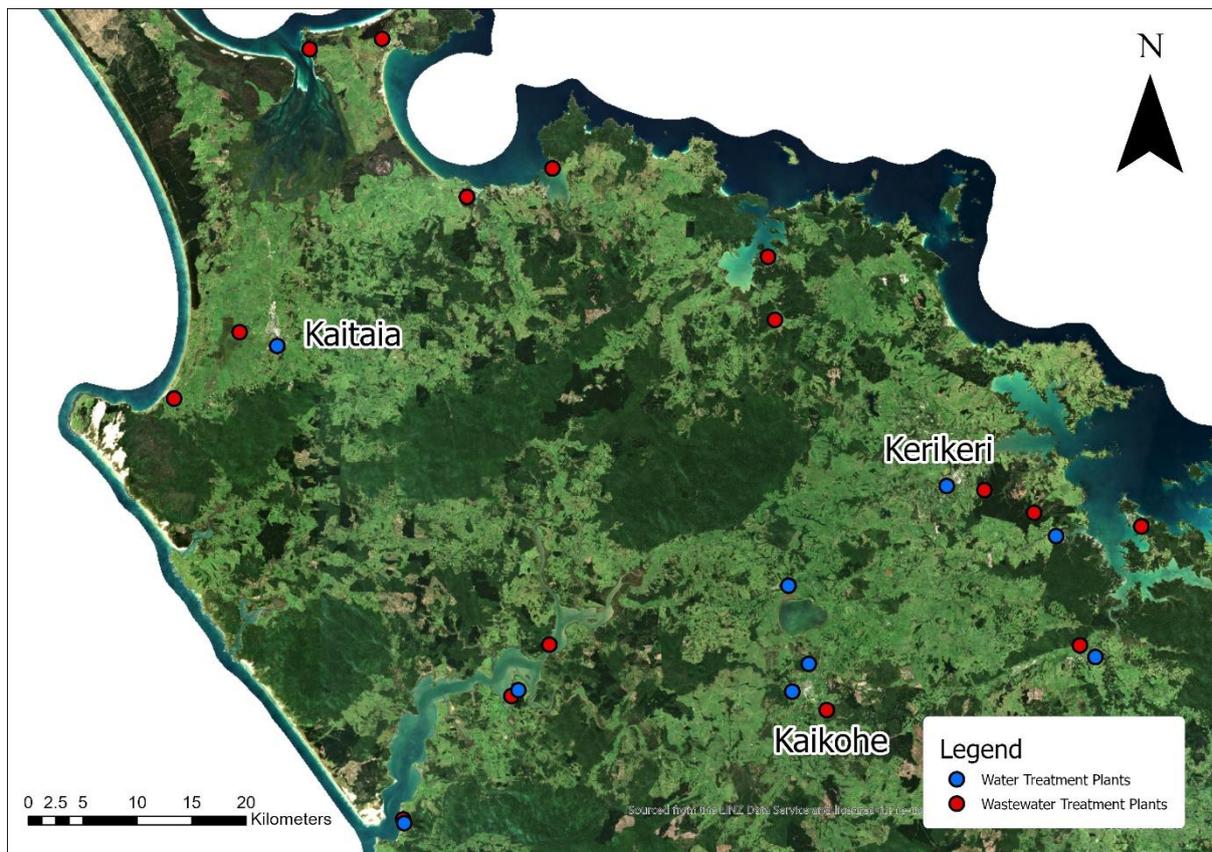


Figure 1: FNDC Treatment Plants

A single WWTP is used for each of the 16 schemes across the Far North District. Of these, 12 use a pond-based treatment process which vary in size, age, number, and challenges faced. For example, anaerobic ponds and constructed wetlands are common but not universal across the district.

The remaining four are mechanical treatment plants which vary in type. The newest is a Sequencing Batch Reactor (SBR) based in Kerikeri that was commissioned in 2020.

Of the 16 WWTP's, only three are currently consented to discharge to land/ground; these are based in Russell, Whatuwhiwhi, and Rangiputa. In Russell and Rangiputa

this is achieved through disposal bores while Whatuwhiwhi discharges directly to marshland. The remaining 13 are currently consented to discharge to nearby surface water with nine passing through a constructed wetland first.

There are nine water treatment plants across the district serving the eight schemes. Two exist as part of the Kaikohe water supply where one draws from surface water and the other draws from groundwater using bores. The remaining schemes each have a single plant associated with them.

To successfully provide waters services across the district, FNDC identified a need to develop a consistent methodology to be applied across these services. This is expected to reduce or eliminate the ad hoc development which have been the basis of previous practice. The methodology will need to be flexible enough to withstand the variances as noted above and have professional backing which holds up to questioning.

As a result of this, a methodology for identifying land suitable for disposal of treated wastewater has been developed by FNDC. Beca was then brought on to review the methodology as a form of professional backing.

IMPORTANCE OF LOCAL CAPABILITY & TRAINING

Having 16 wastewater and eight water schemes throughout the Far North District, a large amount of the same work is done for each of them. In the past this has taken place in a reactive manner where numerous consultants have been used to develop the work in response to critical deadlines. The issue with this method is the variability in approach to the problem.

Using the example project of assessing sites for suitability in disposing wastewater to land: certain sites may not be considered by one consultant where another consultants method would do so. To counteract this issue an internal methodology was developed as a trial to plot out an appropriate process for its development. In this case the methodology was created inhouse before being reviewed externally.

Time is a serious constraint when approaching an internal methodology in this manner. FNDC have since brought on Morphem Environmental (Morphum) to develop a separate methodology which forecasts the growth of our water and wastewater schemes.

In this case, the consultants will oversee developing the methodology and applying it to a trial scheme. The methodology can then be reviewed and implemented across the district by staff with the support of Morphem. This alternative approach holds the advantage of saving time for council staff. It is considered more suitable in the event there is no internal knowledge to help develop the methodology in the first place.

For both cases it is important that the methodology be flexible enough to withstand the different circumstances faced by the variable schemes. The continued support from the consultants means that should these differences cause issue, there is professional help to deal with them. As this occurs, FNDC staff also gain the benefit of learning how to approach certain issues and can replicate them in the future.

It also means that staff are involved throughout the project rather than simply outsourcing the project to a consultant who won't be involved past completion. Upskilling staff in this manner improves investment through increasing their involvement and understanding of the project requirements and outcomes. This allows for council staff to present recommended options to council with greater confidence.

By having an internal methodology that anyone within council can utilize, it ensures any staff turnover does not result in lost knowledge. It also offers the opportunity to all staff within council to upskill should they want to. Creating this opportunity is key to seeing an increase in the knowledge base of New Zealand as a whole and FNDC wishes to do this with its staff where possible.

It is up to us to challenge ourselves to learn a new skill, field, or even just get involved in a project of interest to get experience. Success is what you make of it and we should all strive for what we view that to be.

LAND DISPOSAL OPTIONS ASSESSMENT

INITIAL INVESTIGATIONS

A new policy in the Proposed Regional Plan for Northland states that applications for discharges of municipal wastewater to water will generally not be granted unless a discharge to land has been considered and found to not be economically or practicably viable. This process began early in 2020 as part of the renewal for the Kaikohe and Kaitaia WWTP resource consents which will be lodged in August 2021.

Analysing past reports on land disposal prepared by various consultants for FNDC helped develop a knowledge base and initial methodology. Identifying the best reasoning between the various reports allowed for a best practice approach that was as inclusive as possible. The view is that only sites which are completely unviable are not included in further assessment.

To achieve this, a desktop analysis was developed to identify practicably viable land disposal and then rank those options based on suitability. Using Geographical Information Systems (GIS) the following criteria was applied to develop an initial exclusion zone:

- 20m proximity from all lakes and rivers.
- 20m proximity from all land not designated rural production, general coastal or minerals.
- Total area for land designated as minerals.
- Total area for flood susceptible land.
- Total area for 50-year coastal flooding and erosion predictions.
- Slope > 12°.
- Soil drainage classes 0 – 1.

These criteria were developed based on established best practice and considering previous similar studies in the Far North. For the purposes of this report, Kaitaia will be used as a case study to illustrate how the methodology has been applied. Figure 2 shows the implementation of the above criteria as an exclusion zone within Kaitaia's 10km area of interest (AOI). All land within this zone is considered practicably unviable for land disposal.

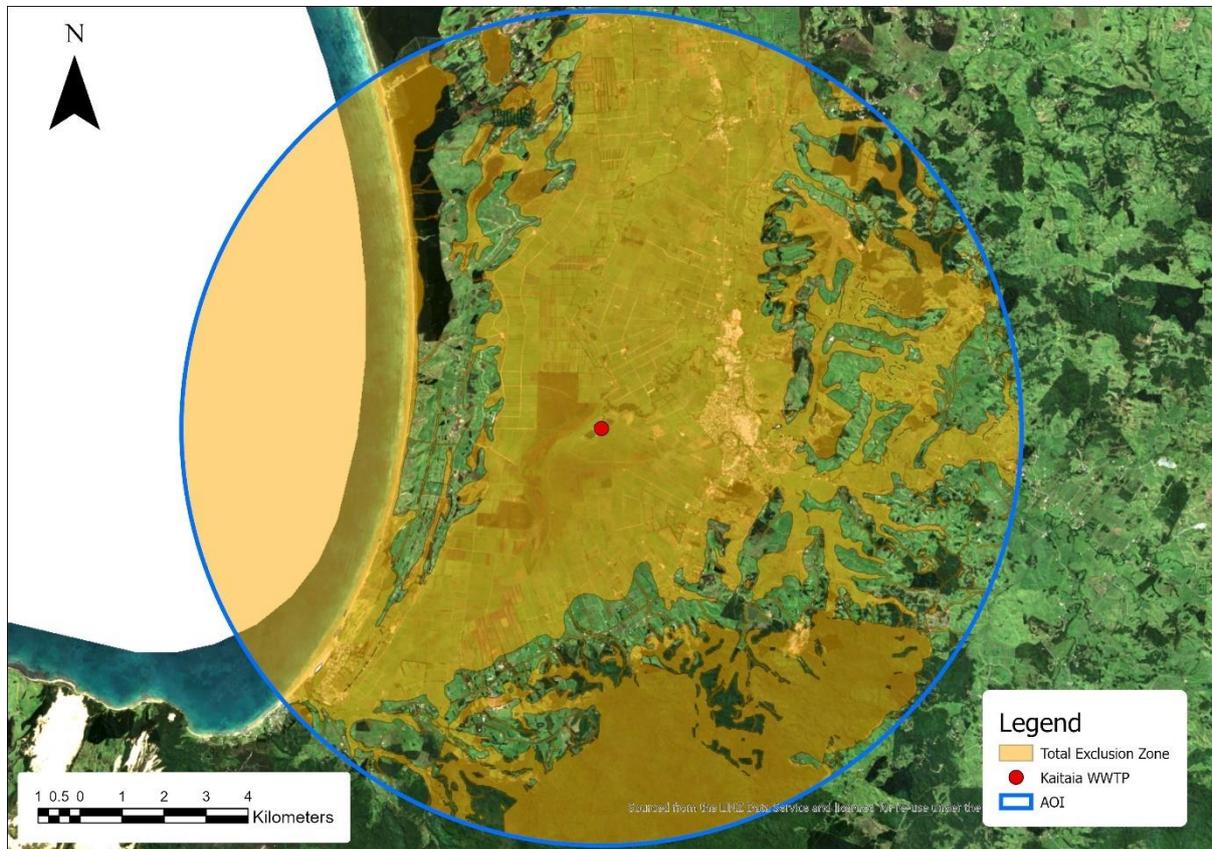


Figure 2: Kaitaia Land Disposal Exclusion Zone

Most land found in the Kaitaia AOI is included in the exclusion zone. This is largely due to the central portion being susceptible to flooding through the Awanui River. Due to it being flood prone, the land also consists of low drainage alluvial soils which have been eroded and reshaped by water.

Ahipara, Awanui, and Kaitaia townships have also been excluded due to the many zones associated with the areas (e.g. residential, commercial). Finally, the

southern portion of the exclusion zone is excluded due to the land being above 12° in slope.

Of the remaining 'available' land, the western side close to the sea was noted as the most likely area for land disposal due to the higher drainage sandy soils. To confirm this, initial calculations were done to estimate the land area requirement.

Based on previous work such as Bryce and Cussins (2019), the calculation is for slow rate irrigation as a method of disposal as it best suits the soils found in the Far North District. It uses an estimated soil permeability, design safety factor, rainfall, and evapotranspiration. A 25% buffer is then applied to account for future growth and the potential of a storage pond for wet winter months. The 25% buffer was retracted down from an original 50% as used by Daniel (2020) due to the greater land area requirements.

This calculation was achieved at four different drainage levels present in the soils being investigated (drainage level 2 – 5). Higher drainage class soils allow for a greater permeability and therefore require a lower amount of land. The calculated area requirements were then used to assess the remaining available area for land disposal.

Parcelled land was joined based on owner/s and proximity to each other before being excluded if it did not at least meet half the lowest area requirement. This allows for sites to be considered for partial disposal as a side stream should there not be many sites large enough to take the required flows. Partial disposal would mean that treated wastewater would still be discharged to surface water, however, at a much lower rate.

This resulted in all 67 practicably viable sites being identified as in Figure 3 below. These options could then be assessed against each other to determine the best ones. The top options could then be investigated for economic viability, community approval, owner interest, and design.

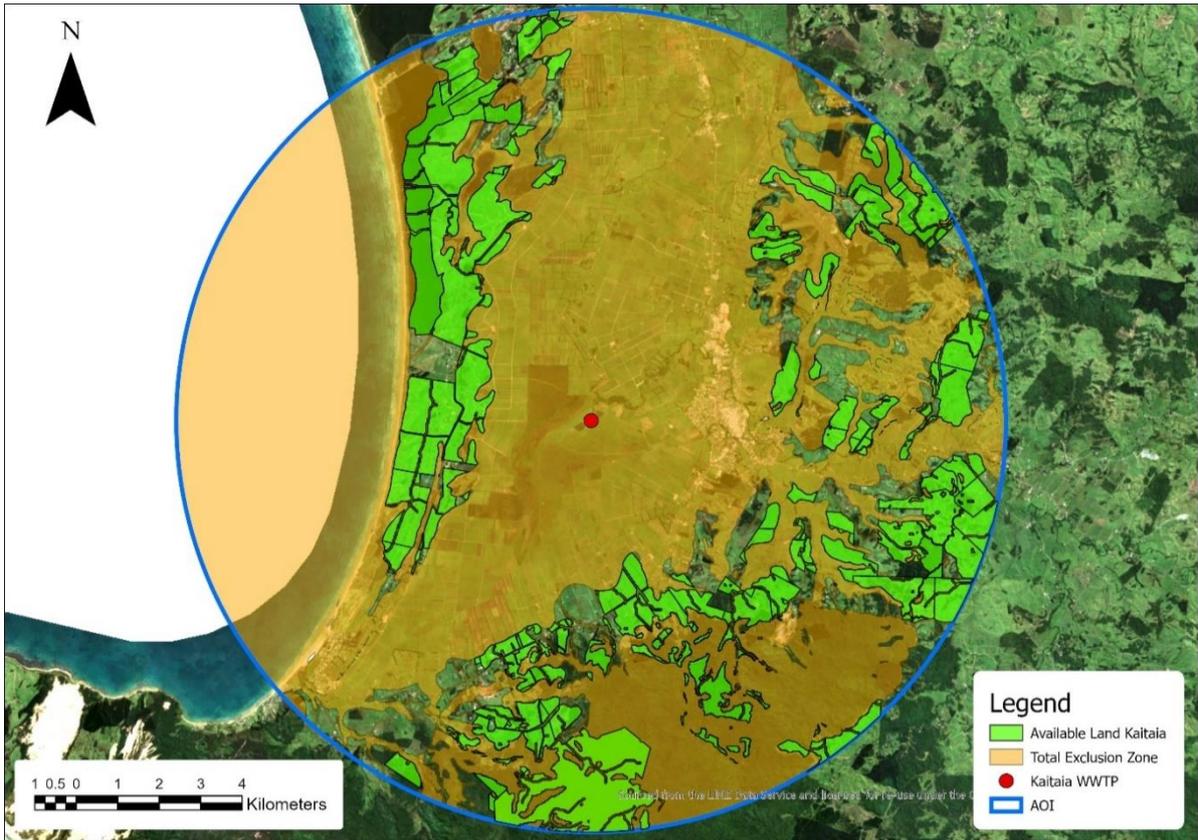


Figure 3: Kaitaia Available Land for Land Disposal

All 67 practicably viable options can be ranked to develop a shortlist of the top ten options. A new set of criteria for land disposal application was weighted as in Table 1 below. These criteria are considered the most important when considering the application of land disposal.

Table 1: Shortlist Criteria and Weighting

Criteria	Weighting
Highest Total Area Available	33.3%
Highest Average Hydraulic Loading Rate	33.3%
Lowest Average Slope	22.2%
Highest Regularity Score	11.1%

Kaitaia WWTP has high outflows which make total area and the hydraulic loading rate the most important attributes. Despite already being used in the exclusion zone for slope above 12°, scoring lowest average slope recognises that flat land is preferable. Finally, a highly regular site is considered more optimal when implementing land disposal at a site. Regularity is found using equation 1 below.

$$\text{Regularity} = \text{Area} / \text{Perimeter}^2 \quad (1)$$

This means that sites which are broken up with slopes above 12°, rivers and other exclusions are scored lower than a regular site with one large piece of land.

Using the criteria listed above the 67 practicably viable sites are ranked in order of suitability for land disposal. The top 10 of which are then taken through a multi-criteria analysis (MCA) which assesses the options against criteria and weightings as in Table 2. These criteria are used to assess possible practical issues and possible community/cultural impacts.

Table 2: Multi Criteria Analysis Criteria and Weighting

Criteria	Weighting
Shortlist ranking	35%
Proximity to cultural sites of significance	25%
Distance to discharge point	20%
Current land use	20%

Cultural sites of significance are identified using Marae locations and New Zealand Archaeological Association (NZAA) sites. Treaty settlement land is also identified to determine partners to approach on the potential for land disposal in the area. It also allows FNDC to assess whether it is unlikely to be a site worth further consideration (e.g. cultural redress land).

Distance to the discharge point is used as a proxy for cost due to the piping being a considerable amount of the overall cost. Land use is determined using aerial photography and comparing it to the land cover database (LCDB). Potential areas of natural significance (SNA) are also mapped which may impact implementation with particular interest in wetlands for the Kaitaia AOI due to the restrictions associated with them.

An example of comparing SNAs and cultural sites of significance is shown in Figure 4 below and following that Figure 5 shows the treaty settlement land in the AOI. It was identified in this process that several of the top options fall under the category of commercial or cultural redress land.

Using this criteria, the top 10 sites are ranked so that the best option is considered first. To present the top considered options to council for a decision, an economic analysis can now be achieved on the top sites to give an indication of cost.

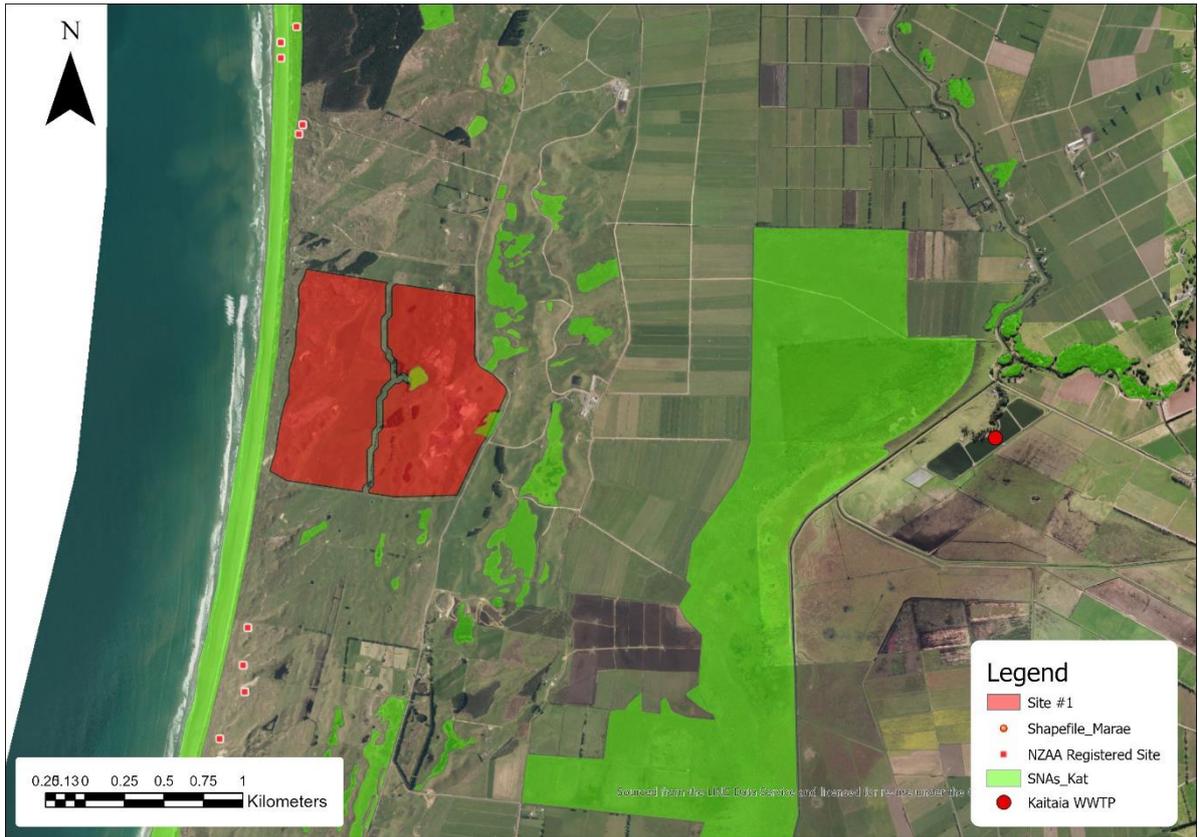


Figure 4: SNA & Cultural Impact Example

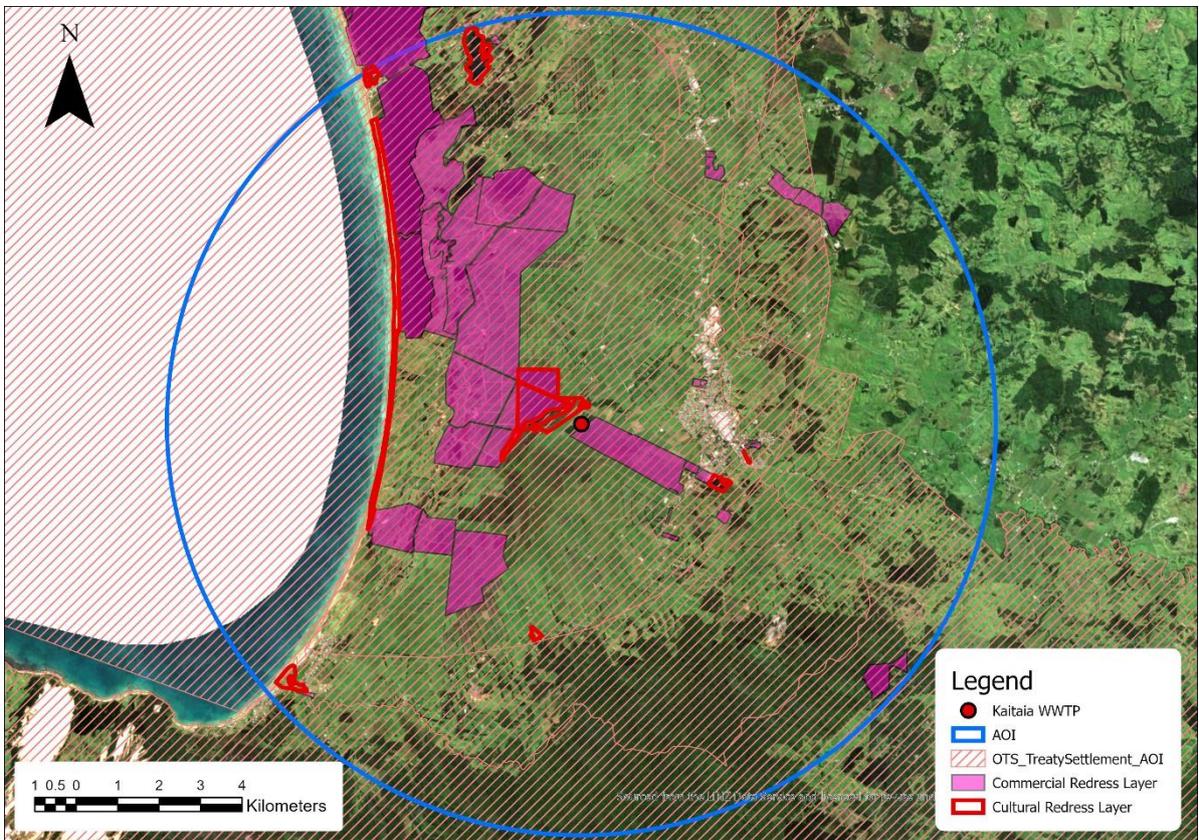


Figure 5: Treaty Settlement Land

This level of information provides the council members with a good base knowledge and involves them early in the process. Following approval from council, engagement with owners, iwi, and the general community will begin the assessment of what the number 1 option might be.

Should none of the options from the top ten be considered viable then the process could be repeated with the next 10 sites identified as practicably viable.

REVIEW PHASE

This methodology was reviewed by Beca so that FNDC had confidence in its approach and could apply it across the district.

An initial review from Beca provided a confidence in the general approach with specific improvements that could be made. Specific improvements included the AOI being increased to a 10km buffer, advice on various disposal options, and advice on being as inclusive as possible when initially considering options. Focus was put on making the exclusion zone as small as possible so that all options could be considered in the next line of criteria. This ensures FNDC does not miss out on any opportunities for land disposal.

This advice was taken onboard and included in the methodology and report to council that would determine if further investigation was advised. The resulting methodology was then signed off by Beca so that FNDC had confidence that it could hold up to scrutiny.

Resource consent renewal for both Hihi and Kaeo are coming up in 2022 and will also need to be assessed for practicality of land disposal. Implementation of the methodology has begun for both AOIs and upon completion will be reviewed by Beca. Both schemes are much smaller than Kaikohe and Kaitaia and present their own unique circumstances. This will make them a good test for the methodology's flexibility.

CONTINUED SUPPORT

FNDC has applied the methodology to both the Kaikohe and Kaitaia wastewater schemes and presented the findings to council. Results of the council committee meeting are that further investigation for land disposal in both Kaikohe and Kaitaia is encouraged and supported. FNDC staff have been tasked with getting preliminary designs for preferred sites in both scheme AOIs.

Continued support from Beca has meant that the process of assessing land through to a preliminary design at a preferred site is currently being mapped. FNDC is undertaking engagement with the affected communities in Kaikohe and Kaitaia as per an engagement plan which is part of this process. As we continue down this path, we will be consulting with Beca on lessons learnt from their previous experience across New Zealand so that we get it right.

This has created an ongoing relationship for land disposal inquiries/work between FNDC and Beca which both sides benefit from.

Work has begun in partnership with Beca to develop what the next steps are and how to implement them on the path to achieving a preliminary design. Initial high-level thoughts are the following:

- Community outreach (Engagement plan).
- Concept design to support decision making of a preferred site (including consideration of end-use options for proposed sites).
- Step-by-step guide for agreeing a preferred site with relevant partners and stakeholders (including how to secure the site upon agreement).
- Development of a preliminary design.
- Next steps guide to progress to implementation stage.

Through working with Beca, FNDC intends to set the foundations for how the implementation of land disposal discharge from our wastewater treatment plants should be achieved throughout the district. As seen in other areas of New Zealand, this process typically takes 5 – 7 years to get a working land disposal application in place. Therefore, building relationships with consultants and the community is considered vital to the success of the long-term project.

This collaborative relationship is key to the continued growth of FNDC staff as land disposal of wastewater becomes more topical in the Far North District. Moving forward then, the partnership between FNDC, consultants, and the community is considered of utmost importance to confidently protecting our waterways and providing safe and cost-effective infrastructure to the Far North.

FNDC would like to encourage councils and other water organisations to take this approach now to future proof New Zealand through the sharing of knowledge. Whilst the 3 waters reform is on the horizon, FNDC has taken the stance that putting this off until then would be detrimental to both staff and district.

ENVIRONMENTAL IMPACTS

Beyond upskilling in land disposal of wastewater, this project has also enlightened staff to other areas of interest such as: what 'Te Mana O Te Wai' means to FNDC, and wastewater end-use products that could mitigate costs of land disposal. It is expected that as the collaboration continues, and more staff are involved, other topics will arise that need to be considered and included in the process.

TE MANA O TE WAI

The health and wellbeing of water and therefore the people/communities it provides for is of vital importance across New Zealand. The importance of safeguarding our waterways is something that cannot be understated but is often neglected due to it being out of sight for the many. Aging infrastructure and has then led to cases such as the Havelock North water contamination in 2016.

The dangers associated with not protecting the health and wellbeing of our waterways are well known. Therefore, a commitment to proactively protecting our waterways in the present and the future should have a high priority. Regardless of new legislation or reform, it is important that this takes place now and then used to support further works/investigations in the future.

To achieve this commitment however, it requires the whole of New Zealand to work together. Of vital importance to protecting the health of our waterways is getting iwi/hapu, community, council, and consultants input and investment in the purpose and outcomes.

A shift in mindset around our conservation and protection of water is necessary. This type of change does not happen quickly and requires strong relationships with a dedicated purpose in mind. As with investigating land disposal options for wastewater, a dedication to building the foundations for this positive change needs to occur over time. Therefore, consistent engagement with key partners and stakeholders throughout project lifetimes is required and needs to start early.

Land disposal of wastewater is generally the preferred option of all communities in the Far North as it prevents disposal into our surface waterways. It is FNDC's job then to seek out how this can be achieved across the district and communicate that with the affected communities. Also important to the success of this project is to make sure that contamination of our waterways won't just be shifting from surface water to groundwater.

It must be ensured throughout the long-term project that all appropriate considerations are made to prevent unforeseen complications. It is FNDC's hope that this work can carry over following the water reform and that the relationships formed throughout the initial engagement are not squandered.

END USE OPTIONS

National and international examples of end use options show a consistent high cost associated with disposing wastewater to land. Unfortunately, these examples have all experienced public hesitancy from the various communities associated with them. This is due to the stigma that surrounds reuse of wastewater.

This has been identified as a significant complication with enacting an end use option to support the development of land disposal. To develop end uses in the Far North, FNDC plans to consult with specialists in the field to assess all potential options that suits the desired location. Engagement with the community will then take place to impart those options and reasoning to the public so that a preferred option can be found.

For now, FNDC is in the early stages of considering all possible options for end use in Kaikohe and Kaitaia as part of the process for attaining a preliminary design. This way FNDC staff can be confident when engaging with the community on the topic to help with public hesitancy.

CONCLUSIONS

The development of an internal methodology for assessing land for disposal of wastewater has been a resounding success. It has allowed FNDC staff to be invested in the project and confidently report on the findings to both council and community. Relationships being built with council, community, and consultants are being bolstered with the sharing of this knowledge and signs are good for them continuing.

FNDC has used the methodology to inform council on the potential for land disposal in Kaikohe and Kaitaia. Approval has been granted to proceed with further investigations up to a preliminary design stage for both schemes. This gives FNDC staff confidence for repeating the process for future schemes as wastewater treatment plant consents come up for renewal.

Continued support from Beca has meant that FNDC can be confident in the work they are producing and have professional advice to lean on should it be required. FNDC staff's investment in land disposal projects has increased which has resulted in further works being achieved in the area than previously. This is key to the future development of protecting our waterways as a district and a country.

It is encouraged that this approach be taken on by other councils without waiting for the outcomes of reform. By developing these relationships now, it will allow a future where the protection of all New Zealand waterways is a top priority for all people that reside within it.

ACKNOWLEDGEMENTS

FNDC – For encouraging this project and providing the opportunity for staff upskilling in the wastewater land disposal field.

Garrett Hall & Beca – For supporting the development of an internal methodology and offering continual support in the field of wastewater land disposal.

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