# LAND TREATMENT OPTIMISATION - A COLLABORATIVE JOURNEY

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**ABSTRACT**

The Ōtaki Wastewater Treatment Plant (WWTP) was granted a new, non-notified Resource Consent in 2016 for the discharge of treated effluent to land. The consent required KCDC to engage a specialist to undertake an optimisation study of the Land Disposal Treatment Area (LDTA), in partnership with Ngā Hapū o Ōtaki (NHoŌ), to investigate options to optimise the distribution and infiltrative capacity of the area. This condition was incorporated to collaboratively address operational concerns raised by NHoŌ prior to the consent being renewed.

The liquid treatment process at Ōtaki incorporates preliminary screening, an aerated lagoon, a clarifier, and oxidation lagoons. The secondary treated wastewater is then discharged to 10.9 hectares of land for rapid infiltration via a perforated pipe system, comprising 18 parallel pipes. In 1995, the area had been upgraded from a border dyke system, to a rapid infiltration disposal system with plantings of harakeke. Maintenance was carried out by operators but eventually was limited by the lack of access through the immense vegetative growth (harakeke, grass, weeds, blackberry).

The LDTA lies next to the Ōtaki River, which recharges the aquifer under the LDTA and flows towards the coast. The community's water supply bore is located 550m down gradient from the closest point of the disposal area. There is also a kai gathering area nearby. Investigations determined there was a less than minor effect on the environment from the disposal activity, at the buffer zone boundary. However, these factors, along with the state of the LDTA in terms of maintainability, drove the inclusion of an optimisation study in the consent conditions.

KCDC, NHoŌ and Cardno worked collaboratively in all aspects of the study, including site testing, concept options development, and the final decisions for the future of the LDTA. Workshops were undertaken to share ideas and work together towards the best outcome for the LDTA. This proved an effective and beneficial approach, introducing alternative perspectives and problem solving strategies that resulted in the best overall outcome for the LDTA, as well as providing an opportunity to strengthen relationships between council, iwi and the consultant. Moving forward, NHoŌ will continue to be involved in monitoring of the performance of the LDTA throughout the term of the consent.

The outcomes from the study will be discussed in this paper, which include use of managed pasture, manuka boundary planting and the future installation of automated valves to control discharge volumes. The final outcome from the collaborative approach between iwi, council and the consultant saw an overall cost effective and culturally acceptable solution.

**KEYWORDS**

**Land disposal, optimisation, consultation, cost effective, collaborative, manuka**

**PRESENTER PROFILE**

Amy is a Senior Process Engineer who specialises in wastewater process engineering. She has designed and commissioned a wide range of facilities, from simple lagoon systems to complex nutrient removal plants with membranes as well as sludge handling processes. She has worked on wastewater projects in Australia, New Zealand and the Philippines.

Martyn Cole is the Water & Wastewater Asset Manager at Kāpiti Coast District Council. He took a lead role in the Ōtaki Consent and Optimisation Study, providing the necessary support to the project from a council and community engagement perspective.

Caleb Royal is the representative from Ngā Hapū o Ōtaki who has been involved in developing the resource consent application and Optimisation Study. He is a passionate member of the Ōtaki community, with a keen interest in the health of the environment.

# 1 INTRODUCTION

The Ōtaki Wastewater Treatment Plant (WWTP) disposes of up to 2820$m^3$/d of treated effluent to a 10.9 hectare of land adjacent to the plant. The resource consent for the disposal activity was renewed in October 2016 following a period of optimization works leading up to the resource consent renewal investigative studies and application. Instead of the new resource consent specifying particular works be carried out during the term of the consent, a collaborative study was required, between the incumbent specialist consultant, the council and iwi. The purpose of the study was to determine the best strategy for continued ongoing ease of operation and improvement of the disposal system, while also addressing operational concerns raised by iwi during the consent application phase.

## 1.1 THE WASTEWATER TREATMENT PLANT PROCESS

The Ōtaki WWTP itself consists of screening, a 2000$m^3$ aerated lagoon to remove soluble COD, a clarifier, followed by polishing in two secondary oxidation lagoons (4 hectares in total), and disposal to land. Sludge from the clarifier is thickened on site and trucked to the nearby Paraparaumu WWTP for further processing. A storm flow buffering lagoon stores secondary lagoon treated effluent as required to manage discharge volumes within the consent disposal volume for up to 1 in 20 year storm events.

The original land disposal area was constructed in 1978 as a 10.9 hectare grazed border dyke irrigation system. Over time, the border dyke system suffered from soil compaction, blockage and overland flow short-circuiting.

In 1996, the border dyke was converted into a ‘wetland’ disposal area. Grazing was discontinued and a series of 18 perforated pipes running 200m in length replaced the border dyke headworks distribution system. There is a 50-metre-wide buffer strip between the end of the disposal strips and the western boundary of the disposal area. The land was planted with some harakeke upon advice received at the time.

The resource consent for this disposal activity expired in 2015. KCDC undertook a range of projects and investigations leading up to preparing a new resource consent application. The end result was that KCDC was granted a new non-notified resource consent for the activity in 2016.

This paper discusses the resource consent application and subsequent collaborative study between the council, iwi and specialist consultant; the study culminated in an agreed

upgrade plan for the disposal area which improves operability and maintainability for operators, while also addressing concerns raised by iwi during the study.

Photograph 1-6 show the treatment process and 'wetland' disposal area.

*Photograph 1-6: Top Left: Aerated Lagoon; Top Right: Clarifier and Sludge Storage Tank; Middle Left: Secondary Lagoons; Middle Right: Disposal Pipes in Wetland; Bottom Left: Cleared Wetland Area; Bottom Right: Overgrown Wetland Area*






# 2 ASSESSMENT OF ENVIRONMENTAL EFFECTS

The following sections define the assessments and work undertaken to prepare the resource consent application.

## 2.1 TREATED EFFLUENT QUALITY

Treated effluent applied to the 'wetland' from the secondary lagoons is summarized in Table 1 for the period 2005 to 2015. These sampling results are prior to lagoon desludging, and show that the lagoons perform consistently and reasonably well for this system even when relatively full of sludge.

*Table 1: Treated Effluent Quality (2005 – 2015)*

| Parameter | Units | No. of Samples | 50%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|
| BOD | mg/l | 484 | 16 | 31 | 37 |
| TSS | mg/l | 485 | 29 | 64 | 77 |
| $NH_3$-N | mg/l | 121 | 22 | 32 | 45 |
| $NO_3$-N | mg/l | 121 | 0.2 | 0.6 | 1.2 |
| DRP | mg/l | 121 | 6.0 | 8.3 | 11.6 |
| TP | mg/l | 119 | 6.9 | 9.4 | 15.1 |
| Faecal coliforms | cfu/100ml | 121 | 14,000 | 84,000 | 130,000 |

## 2.2 OPERATION OF DISPOSAL ACTIVITY

Treated effluent is disposed to land on a 10.9 hectare wetland treatment and disposal area. The area was originally a border dyke disposal area for the oxidation lagoon effluent but was developed into a 'wetland treatment and disposal area' as part of the 1995 plant upgrade; the naming of this area was defined in the previous resource consent application.

The 'wetland treatment and disposal area' is divided into six zones. Each zone is around 260 m long x 70 m wide and contains three 125mm diameter longitudinal distribution pipes running to within 50 metres from the end of the zone. Each distribution pipe is located on top of a raised bund. The distribution pipes are drilled with 10mm diameter holes along their length. Zones are selected for use by manually opening valves at the head of the distribution pipes. Effluent is applied to one zone at a time, and the zone is manually changed on Mondays, Wednesdays and Fridays, so that each zone receives effluent for 2-3 days, and is then allowed to rest for 11-12 days. This is typical of a rapid infiltration system. The irrigation pump currently operates for 68% of the time typically, turning on for 13 minutes and off for six minutes, due to the presence of the lagoon outlet weirs, which hydraulically separate the lagoons from the irrigation wet well. The zones therefore never become totally flooded during an application period, although there are some isolated areas of flooding due to soil blinding.

The area was planted with some flax (harakeke) in 1995, and the flax plants were still thriving at the time of the resource consent application; however, over the years the area has also become overgrown with a variety of grasses and weeds, including blackberry. Maintenance of the wetland treatment and disposal area is currently undertaken by the operators, and there is variability in terms of the level of maintenance occurring across the entire area. Some of the bunds supporting the distribution pipes are kept clear using a combination of trimmers and spraying. Others have been left to grow wild.

Table 2 summarises the 'wetland' disposal area operating parameters, as assessed on an engineering basis.

*Table 2: Wetland Disposal Area Operational Parameters – 2005-2015 and 2015 (End of 20 year Proposed Consent Term)*

| | Units | 2005-2015 | 2035 |
|---|---|---|---|
| Disposal area | Hectares | 10.9 | 10.9 |
| Number of zones | | 6 | 6 |
| Annual hydraulic loading rate | m/year | 6.5 | 7.1 |
| Average daily hydraulic loading rate | mm/day | 18 | 19 |
| Maximum monthly hydraulic loading rate | mm/day | 26 | 26 |
| Average daily application depth | mm | 105 | 115 |
| Maximum daily application depth | mm | 155 | 155 |
| Application period | days | 2-3 | 2 |
| Drying period | days | 11-12 | 12 |

The consent application, along with previous studies, had identified the following operational and maintenance issues with the 'wetland' disposal area:

- The area is overgrown with weeds and in need of a clearance to allow improved and ongoing ease of maintenance for operators.
- The current distribution system is sub-optimal in terms of distribution uniformity, due to the growth in the zones, resulting in some blockages. Ongoing use of the 'wetland', without proper maintenance, has led to overuse in the front end of the zones, and therefore some ponding.
- The instantaneous and daily application rate was not managed effectively.

## 2.3 ENVIRONMENTAL STUDY

Groundwater dispersion modelling was carried out by Pattle Delamore Partners (PDP).

### 2.3.1 EFFECTS ON GROUNDWATER - SUMMARY

The water quality within the shallow aquifer within approximately 1 km down gradient of the disposal area is modified by the treated effluent plume; however the background water quality of the shallow aquifer in this area is already unsuitable for drinking water due to existing land use within the area. Also, there are no private drinking water bores down gradient of the disposal site due to the fact that this area is serviced by the Ōtaki water reticulation network.

The deeper aquifer that is used for drinking water supply purposes is separated from the shallow aquifer by approximately 10 metres of lower permeability sediments. This lower permeability layer does allow some leakage from the overlying shallow aquifer. However there is no evidence of contamination of the Rangiuru Rd or Tasman Rd bores (Ōtaki's public supply bores), which draw from the lower aquifer. This is backed up by conservative contaminant transport models which predict no significant impact from the discharge at these distances and depths.

Overall, the PDP groundwater study indicated that there are no observable effects on the public drinking water supply bores (which abstract from the second, deeper aquifer) as a

result of the Ōtaki effluent disposal area, and that the disposal activity has a less than minor effect on the environment.

### 2.3.2 EFFECTS ON SURFACE WATER – SUMMARY

The nearest surface water body to the disposal area is the Ōtaki River, which is located immediately south of the disposal area.

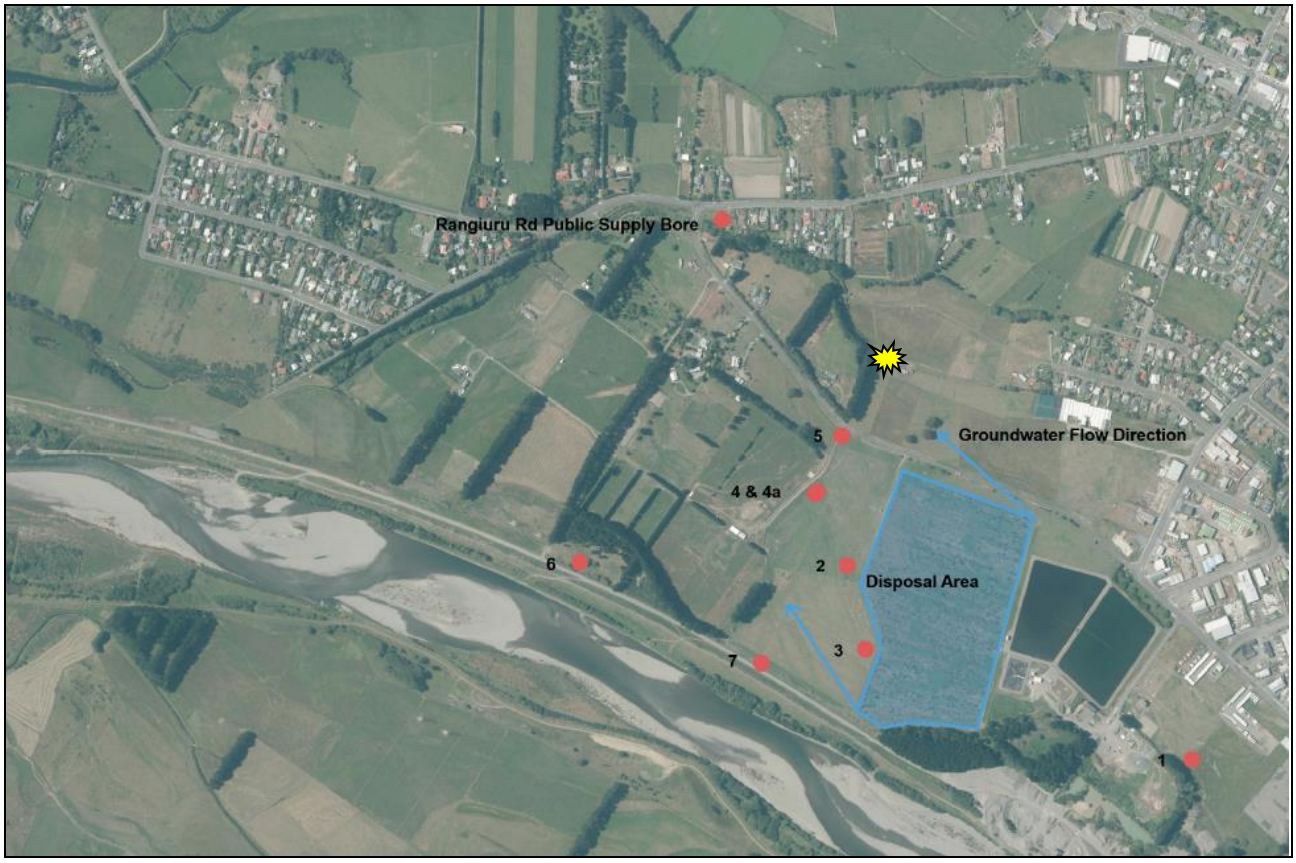
Groundwater within the shallow aquifer is recharged principally from leakage from the Ōtaki River and a downwards gradient exists between the river and adjacent shallow groundwater next to the disposal area. This downwards gradient is therefore expected to limit groundwater flow to the river from adjacent groundwater. Groundwater quality data from the two monitoring bores adjacent to the river also show low contaminant concentrations which suggest that they represent seepage from the river rather than contamination from the disposal fields.

Bunding around the disposal area contains the discharge to within the site boundaries, preventing surface runoff leaving the site.

Ngā Hapū o Ōtaki identified a small artesian spring which emerges just north of the disposal field. It flows along a small waterway towards the rear of the Rangiuru Road water treatment plant and out towards the sea. There was no information available on the ultimate source of this artesian spring. As the spring is artesian, it would indicate that it is not linked to the shallow groundwater aquifer which is unconfined. In agreement with Ngā Hapū o Ōtaki it was included in the monitoring schedule for the groundwater bores, in the resource consent conditions. Thus the spring source quality can be studied over time and KCDC can understand whether it is linked to the disposal field or not and appropriate measures undertaken.

Figure 1 shows the disposal area, monitoring bores, and surface water locations.

*Figure 1: Groundwater Flow, Monitoring Bores and Public Water Supply Bore*



## 2.4 MITIGATION MEASURES

In the last five years, KCDC programmed a wide range of upgrade works as part of their plan to continually improve the performance of the WWTP and disposal area. These projects were developed in Cardno's 2012 Capacity Study and Master Plan for the WWTP, and planned or implemented in consideration with the resource consent renewal process.

Of the upgrades carried out, the following sections outline the improvements that Cardno considered would improve the biological performance of the effluent treatment process, and hence improve the treated effluent quality discharged to the disposal field. However, given the recent (and upcoming) nature of these upgrades, no long term trends were able to be observed in the consent application.

### 2.4.1 STORM FLOW BUFFERING LAGOON

The decommissioned earthen anaerobic digester (EADER) was converted into a storm flow buffering lagoon in 2014. This EADER was originally installed to treat the primary sludge when a meatworks was discharging to the WWTP. Since the meatworks closed down, the EADER had essentially become a large covered sludge settling lagoon with minimal anaerobic activity.

The physical works included cleaning out sludge from the EADER lagoon and installing actuated valves and pipework to automatically divert treated effluent flow into the storm flow buffering lagoon when the secondary lagoons become full and the daily disposal volume is reached. This provides an additional 5,000 $m^3$ of wet weather storage.

This upgrade significantly reduces the risk of exceeding the consent discharge limit of 2,820$m^3$/d to the disposal area. Based on a typical 'wet-month' scenario, in-line with population projections, and the secondary lagoon capacity increase from dredging, the current buffering capacity of the plant is adequate, such that it can operate within the current discharge limit volume over the next twenty years of the consent period.

### 2.4.2 SECONDARY LAGOON DE-SLUDGING

Both of the secondary lagoons were de-sludged over a period of several months, in 2014-2015. In 2010-2011, the surveyed sludge levels in both lagoons had reached half full (approximately 0.75m sludge depth out of a 1.5m deep lagoon). At these levels the hydraulic retention times within the lagoons were at the minimum required to achieve the desired level of disinfection performance. Approximately 700 tonnes of dry solids were removed from both lagoons, leaving a sludge layer of 150-200mm across the bottom of the lagoons.

Desludging was expected to have a significant improvement in disinfection performance once the lagoon 'settled down' due to the increased retention time provided by removing sludge volume from the lagoon. Also during previous periods of wet weather or other turbulent (windy) conditions, operators observed that the sludge layer would become suspended and this would increase the solids concentration in the effluent. This is very unlikely to occur in the future now that the sludge layer is only 150-200mm.

The sludge deposition rate within the secondary lagoons is expected to be significantly slower after this desludging process. There is no record of when sludge was removed from these lagoons previously, but Cardno was anecdotally advised that sludge removal had not occurred as part of the mid 1990's upgrade or since then. Therefore a significant amount of the sludge must be from prior to the clarifier installation. The sludge load to the lagoons has significantly reduced as a result of the upstream primary lagoon and clarifier.

A 150-200mm layer of sludge was left across the bottom of the lagoons to avoid damaging the bases, to provide a seal across the base of the lagoons to protect from leakage and maintain some biological material within the lagoons.

## 2.5 ALTERNATIVES CONSIDERED IN RESOURCE CONSENT APPLICATION

A range of treatment and disposal upgrade alternative options were considered in the resource consent application:

- Nutrient Removal Upgrade
- UV Disinfection Upgrade
- Increase Existing Disposal Area
- Disposal to River
- Disposal to Tasman Sea
- Pump to Paraparaumu WWTP

The assessment of these alternatives identified that the current operation was the most suitable for the application, in line with the findings of the groundwater assessment and bore monitoring results.

## 2.6 WORKING WITH NHOŌ THROUGHOUT THE APPLICATION PROCESS

The Kāpiti Coast District Council is in partnership with Ngā Hapū o Ōtaki, in recognition of their role as kaitiakitanga and rangatiratanga. KCDC recognises that as partners, Ngā Hapū o Ōtaki must be involved in the development of the Ōtaki WWTP resource consent renewal process. This relationship is above the typical requirement for a Cultural Impact Assessment.

There are five hapū within the Ōtaki area; Ngati Pare, Ngati Koroki, Ngati Kapu, Ngati Huia ki Katihiku, and MaiŌtaki. Collectively they are represented by Ngā Hapū o Ōtaki (NHoŌ). NHoŌ are the signatories to the memorandum of partnership on behalf of Te Runanga o Raukawa, so NHoŌ deal with issues in their area (the geographical area of our Iwi is too big to deal with consents at the iwi level). Nga Te Runanga o Raukawa has divulged all resource consenting and autonomy issues around the wider Ōtaki area back to the hapū who reside in the geographical area.

Several of the issues raised by NHoŌ during the preparation of the resource consent application, and subsequent year-long approval process were addressed by modifying resource consent conditions. This included a yearly review of the Compliance Report, monitoring of a nearby artesian spring that supports food gathering activities, and reductions on treated effluent limits.

As referenced in Section 2.6.1, a significant change in the resource consent conditions as a result of collaboration with NHoŌ, was the inclusion of a disposal area optimization study. This was raised by the issue of distribution efficacy within the disposal area. This was a turning point in the resource consent application, ultimately allowing the consent to be processed as a non-notified consent.

### 2.6.1 INCLUSION OF A DISPOSAL AREA OPTIMISATION STUDY IN CONSENT CONDITIONS

KCDC allocated a significant budget for an upgrade of the disposal area, in the 2015-2016 financial year. It was intended to be carried out post resource consent application submission and approval. This was originally allocated for specific capital works of installing automated valves on the distribution header, as per the recommendations of the Cardno Wetland Review report (2010). However, during the process of preparing this resource consent application, it became apparent that an overall review of the effluent application system would be beneficial to all parties involved, in line with KCDC's continuous improvement process. Notwithstanding, the status quo operation of the disposal field demonstrated a less than minor effect on the environment.

Automation of the 'wetland' zone selection valves involves the installation of automatic actuated valves on each of the effluent disposal pipes. The improvement works will allow automatic rotation of the zones based on the totalised volume applied. This will ensure that each zone has the same volume of treated effluent and will allow the operational flexibility to move to daily rotation or any operational application strategy that is considered appropriate. At the moment the zones are changed on a two to three day basis, and not on a totalised volume per zone basis.

It was proposed to carry out a study on the disposal area application efficacy (along with the effect this has on the environment, if any), and identify options for optimising the existing land disposal area. For the identified optimisation options, the study was designed to consider the performance, operation and maintenance improvements/requirements, costs, available budget, and possible programme for implementation. This study was proposed to allow KCDC, Greater Wellington Regional COuncil and Ngā Hapū o Ōtaki to make an informed decision on the best way of optimising the existing land disposal area, as agreed during the resource consent application development process with Ngā Hapū o Ōtaki.

A new condition was incorporated into the resource consent to cover this study.

### 2.7 PUBLIC CONSULTATION

KCDC communicated with interested parties, and particular interest groups relevant to the area including neighbours, various environmental groups and Regional Public Health. No neighbours expressed concern or interesting in the activity. Interest from environmental groups was positive, and Regional Public Health supported the activity once the assessment of environmental effects had been provided to them.

### 2.8 NEW RESOURCE CONSENT

The resource consent was submitted in July 2015, followed by 15 months of review and workshops between Cardno/KCDC and GWRC and their specialist advisors.

The 'wetland' disposal area was renamed as the Land Disposal and Treatment Area (LDTA) as a result of this process.

The non-notified resource consent certificate was issued in October 2016, after which implementation of the new monitoring conditions and the Optimisation Study commenced.

## 3 LDTA OPTIMISATION STUDY

The LDTA Optimisation Study is an excellent example of KCDC, NHoŌ and Cardno working together to develop a solution for the area which addressed iwi concerns, in conjunction with developing a sound engineering solution which improved operability and maintainability of the disposal area.

### 3.1 SCOPE OF STUDY

Conditions 3, 4 and 24, as outlined in Ōtaki's 2016 Resource Consent, provided the scope of works for the Optimization Study of the LDTA. It is worth noting that the assessment of environmental effects concluded that there was a less than minor effect on the environment from the discharge activity. These resource consent conditions were therefore not included for the purpose of mitigating effects on the environment from the discharge activity, but rather for the purpose of identifying the potential for optimising the distribution uniformity within the existing disposal area and system to achieve NHoŌ's

objectives, while also improving the operability and maintainability of the area for operators. This approach is in line with KCDC's ongoing improvement strategy.

The specific operational issues that required addressing within the LDTA Optimisation Study:

- The area is overgrown with weeds and in need of a clearance to allow improved and ongoing ease of maintenance for operators.
- The current distribution system is sub-optimal in terms of distribution uniformity, due to the growth in the zones, resulting in blockages. Ongoing use of the LDTA, without proper maintenance, has led to overuse in the front end of the zones, and therefore localised ponding.

Figure 2 shows the current layout of the LDTA distribution system.

*Figure 2: Layout of LDTA Distribution System*

## 3.2 WORKSHOPS AND SITE TRIALS

A number of workshops and site trials were held with KCDC, NHoŌ and Cardno representatives as a method of developing the Optimisation Study. These are described in the following sections.

### 3.2.1 WORKSHOP ONE

Workshop One was a chance to 'set the scene' for the Optimisation Study, and tease out what was important to all stakeholders (NHoŌ, KCDC, and Cardno). Outcomes of the first workshop were:

- It was discussed that pasture was the best vegetation for the LDTA going forward, due to ease of ongoing maintenance, and likely compatibility with effective surface distribution.
- The current harakeke or swamp flax would be removed along with the weeds, as it is considered inappropriate in the LDTA by NHoŌ. If practicable, these plants could be reused as boundary planting.
- The state of the LDTA meant it was difficult to observe and quantify distribution uniformity in any trial. Site trials were recommended, with clearing of a zone required before trials could commence.
- A number of Distribution Options (modified or new) were to be investigated including:
    - Automated current system
    - Current system with added laterals
    - Border dyke system
    - Travelling lateral irrigator

### 3.2.2 SITE TRIALS

A number of site trials were carried out in February to April 2017 to investigate distribution improvement options. With surface distribution systems, the key to achieving high distribution efficiencies is to provide high application rates and application depths in order to encourage surface flow across the entire strip. For this type of distribution system, good distribution is achieved by essentially flooding during the application event. Without high flow rates, infiltration occurs before flooding conditions prevail, thus decreasing distribution coverage (USEPA, 2006).

During site trials, close observation of the application events showed that the current instantaneous application rate and pump operating times meant that the current system would never be able to achieve 'perfect' distribution uniformity.

With the Ōtaki LDTA, there was scope to increase the application rate and depth by:

- Reducing the number of pipes used during an application event;
- Increasing the irrigation flowrate; and
- Applying greater application volumes (pumps operating without stopping).

Applying greater application depths not only improves distribution uniformity, but also results in longer return periods, which improves recovery of the soil in the rest phase prior to the next application. Lack of maintenance/remediation of the LDTA also affects the distribution uniformity, as was evident from the site trials that observed pipe blockages and scoured out areas.

From the results of the site trials involving the current distribution method, it is anticipated that the following attributes give the best chance for excellent distribution uniformity:

- Higher instantaneous flow rate, achieved by removing the upfront concrete flow header box structures, which currently limit the pump flow rate and pumping duration at any one time.
- No blockages in pipes, achieved through flushing the system regularly and manually maintaining the weeds around the pipe outlets.

- Graded surface across the width of the strip (no ponding areas) and pasture that is well maintained over the entire area. Land had been cleared for the trial, but not graded.

### 3.2.3 WORKSHOP TWO

Work was done by Cardno, incorporating the results of the site trials, to develop the improvement options. The purpose of workshop two was to discuss the improvement options, both Baseline and Distribution Improvements for the LDTA. Outcomes of the second workshop were:

- It was agreed that the Baseline Improvements were important and achieved KCDC's goal for ongoing improvement. A staged approach would be taken to complete them, beginning with site clearance, land planing (flattening and levelling of land across the strip) and pasture sowing.
- All Distribution Improvement options were discussed in detail. More research was requested by KCDC on behalf of NHoŌ for the proposed concept of 'travelling sprinkler' with drip nozzles.
- It was agreed that an assessment of the initial Baseline Improvements should go ahead once one strip had been planed and grass is established.
- Insufficient time was available to discuss perimeter planting options at the workshop.

### 3.2.4 WORKSHOP THREE

Following further work by Cardno to develop the possible Distribution Improvement options, a third and final workshop was held with representatives of KCDC, NHoŌ and Cardno. The purpose of this workshop was to discuss all trials and studies, and to make a recommendation to take to Greater Wellington Regional Council. Outcomes of the third workshop were:

- It was agreed by all parties that the Baseline improvements are necessary for the LDTA.
- It was also agreed by all parties that zone automation (with valving) of the current distribution system is the improvement option of choice (of the four options presented in the Cardno report).
- The order of works would start with implementing the Baseline Improvements and automation of the distribution system, with a view of achieving a vast improvement over the current distribution performance.
- The risk of deterioration around distribution performance over time is acknowledged and to be included in an annual review process with NHoŌ. To manage this:
    - It was decided to investigate scour risk at the discharge points and the potential improvements if this did become an issue with the new application method, and include in the performance review process.
    - Quarterly reviews are to occur with NHoŌ, which are to involve formal site visits, but representatives are also welcome to visit informally at any other time to see how the LDTA is changing, to ensure their presence on the journey to developing these improvements.
- It was decided to replant the harakeke removed from the LDTA along the road side of the LDTA to provide screening, followed by a belt of a mixture of tree species including manuka, akeake and karamu, between the harakeke and the LDTA, but predominately manuka as requested by NHoŌ. This is due to the potential for antibiotic properties of the manuka root system.

- Concepts discussed during Workshop 3 in regards to the perimeter planting are to be implemented in collaboration with help from NHoŌ.
- Weekly observations are to be carried out by operators once system is established, to report on:
    - Distribution uniformity of system.
    - Cut and leave method of pasture management (to observe grass clumping effects and schedule mowing).
    - Overall system performance.
- The implementation process will be carried out over a two-year period in line with KCDC budgetary constraints and a performance review will be carried out after the implementation is completed.

### 3.3 STUDY CONCLUSIONS

The Improvements that will be implemented at the LDTA aim to improve the ease of maintenance and management of the distribution system. Recommendations include the following works:

- Clear and remove all vegetation from the site, including the buffer area between the western end of strips and western boundary of LDTA.
- Grade distribution zones to ensure even flow of treated effluent (not preferential flow and ponding when zones are only roughly cleared).
- Leave pasture to establish on its own following clearance and grading of the land. If this proves to be unsuccessful, sow site with appropriate grass seed in Spring.
- Clean inside of pipes with high pressure cleaning equipment to unblock
- Replant harakeke from the LDTA along the northern boundary of the site if possible, to provide screening.
- Carry out perimeter planting as per agreed planting plan with NHoŌ.
- Remove existing three concrete flow structures to allow double pump operation and re-pipe header pipes.
- Remove weir from oxidation lagoon B outlet to allow hydraulic connection of lagoon B to irrigation wet well and continuous irrigation pump operation.
- Install actuated valves at head of each existing distribution pipe, to allow automation and control of flow to each zone.

Ongoing management of the LDTA is crucial to maintain the distribution uniformity achieved as a result of the improvements. Solutions should be developed as performance issues arise.

## 4 CONCLUSIONS

Although the resource consent application and assessment of environmental effects showed a less than minor effect on the environment from the treated effluent disposal activity, the Cultural Impact Assessment raised several key issues for NHoŌ which required addressing as part of the consent application process. KCDC, NHoŌ and Cardno undertook a collaborative approach taken to develop a set of resource consent conditions (including an Optimisation Study) to address these issues was a key factor in subsequently obtaining a non-notified consent.

The Optimisation Study process developed a strong working relationship between KCDC, NHoŌ and Cardno (as the specialist consultant). The outcome of the Study provides a solution for the Ōtaki WWTP that will be robust and cost effective, while also managing the community's expectations for ongoing improvement and management of risks associated with wastewater disposal.

## ACKNOWLEDGEMENTS

Cardno would like to acknowledge the collaborative relationship between Kāpiti Coast District Council and Ngā Hapū o Ōtaki in working closely and effectively throughout this process to achieve a reasonable and effective solution for the Ōtaki WWTP.

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