Kaipara District Council

# MANGAWHAI COMMUNITY WASTEWATER TREATMENT PLANT: EFFLUENT REUSE

## DISCUSSION DOCUMENT: GOLF COURSE IRRIGATION

Water Quality Standards and NZ Practice

16 DECEMBER 2020

CONFIDENTIAL

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# MANGAWHAI WWTP: EFFLUENT REUSE
# WATER QUALITY STANDARDS AND NZ PRACTICE

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# EXECUTIVE SUMMARY

This report has been written by WSP NZ Ltd to provide support for discussion regarding the opportunity for effluent reuse in Mangawhai as a suitable long term strategy for effluent disposal.

Within this report the key questions are addressed.

- Is the effluent reuse a viable option for KDC?
- Is effluent reuse Safe from a public health risk?
- What quality standard is required?
- Are there any environmental impacts of reuse?
- Is there any community or Iwi concerns around disposal of treated effluent close to the harbour?
- What are the potential solutions?

Consideration has been given to New Zealand Public Health for the irrigation of wastewater effluent, World Health Organisation, Australian National reuse standards and Environment Protection Authority (EPCA) Victoria State reuse standards.

It has been identified that the CWWTP can provide a minimum of 400 $m^3$/d for reuse based on historic data and additional volumes will become available as the catchment population grows.

The effluent quality at the Mangawhai CWWTP is suitable for effluent reuse in a restricted manner. Restrictions may include time between irrigation and access to wetted areas, distances from boundaries and weather conditions.

Few Golf courses in New Zealand are currently irrigated by treated effluent, and of the three identified, only 1, Puanui, Coromandel, is irrigated by surface sprayers with limited time usage and restrictions on access by users. Kinloch and Omaha have subsurface irrigation and can take effluent under all conditions at any time of day. Effluent quality is a lower standard than for surface irrigation.

To meet Class A (EPA Victorian Standard), which is suitable for unrestricted domestic, commercial and agricultural use, additional treatment will be required to lower suspended solids and reduce the risk from viruses on the public.  This additional treatment is not required to produce Class C (EPA Victorian Standard) that can be applied to the Mangawhai Golf course with restrictions.

This document forms the basis for discussion between Kaipara District Council, Mangawhai Golf Course and local iwi to develop a strategy for implementation of this outcome.

Further discussion will be required on

- Cultural benefits and concerns
- Funding

Additional investigations will be required before irrigation can commence in support of a resource consent application. This will include assessing irrigation capacity, nutrient loading, flow paths, and the potential impact on the natural wetland on site.

# 1 PROJECT BACKGROUND

The Mangawhai Community Wastewater Treatment Plant (CWWTP) is expected by 2043 to be treating the wastewater from approximately 6,000 connections, a population of approximately 15,000 people. This is three times the current flow which will result in a daily average flow of around 1,800 $m^3$/d. Summer peak population will be greater, with flows of 2,500 $m^3$/d or more in peak dry conditions expected.

The current disposal route for treated effluent is through the irrigation system at the Browns Road site, with 65.5 ha available for irrigation. This irrigation system will be limited in capacity at approximately 3,000 connections, estimated to be reached at or near 2028. This means that to accommodate future growth alternative discharge locations or approaches are required.

The 2020 summer was a long hot period that demonstrated that there is an interest within the community to reuse water for various uses. These uses include irrigation of the golf course, parks, recreational areas and for farm usage or as a purple pipe to the community, reducing the need for potable water.

This document provides the background information for discussion between KDC and the Mangawhai Golf Club (MGC) with a view to wastewater effluent reuse on the MGC course adjacent to the CWWTP.

It is understood that Council is looking at high level recommendation based on previous investigation and new information in order to respond to the following questions

- · Is the effluent reuse a viable option for KDC?
- · Is effluent reuse Safe from a public health risk?
- · What quality standard is required?
- · Are there any environmental impacts of reuse?
- · Is there any community or Iwi concerns around disposal of treated effluent close to the harbour?
- · What are the potential solutions?

# 2 PREVIOUS INVESTIGATIONS

The following reports were provided to WSP, listed below:

| TITLE AND AUTHOR | DATE |
|---|---|
| Mangawhai Treated Effluent Disposal assessment of Land Disposal Options, URS New Zealand Limited | March 2006 |
| Mangawhai EcoCare Project – Assessments of Environmental Effects, Earth Tech Engineering Pty LTd | August 2006 |
| Mangawhai EcoCare Project – Assessment of Treatment & Disposal Options Earth Tech Engineering Pty Ltd | March 2007 |
| Kaipara District Council, Mangawhai EcoCare Project Environmental Management Plan – Lincoln Downs Amended Final Report, RMCG Consultants, Bendigo (Victoria) | April 2010 |
| Mangawhai Wastewater Scheme, Potential Effluent Disposal Options, Harrison Grierson | September 2014 |
| Transfer of Resource Consent from Water Infrastructure Group Pty Ltd to Trility Water Pty Ltd | June 2015 |
| MCWWS Community Advisory Panel Final Report, Kaipara District Council | July 2015 |
| Biodiversity Report – Mangawhai Golf Course Wetland, Northland Regional Council | October 2018 |
| Irrigation with Treated Wastewater – Parkland | August 2020 |

Part of above studies looked at possible disposal options for the treated wastewater from the Mangawhai CWWTP. The previous investigations included land disposal options which considered farm irrigation options similar to the current Lincoln Downs Farm and golf course irrigation options. The earlier investigations, like the 2006 studies looked at using 100% of the treated effluent on the Mangawhai Golf Course (MGC)

There were two different reports written in 2006, the report by URS found the MGC the most preferred location of five effluent disposal options considered. The reason presented were:

- Disposal at MGC would be viewed favourably by regulators, Tangata Whenua and the community
- Discharge would be localised and could be engineered for controlled discharge
- The proposal would utilise all the available mechanisms for upgrading of the wastewater prior to discharge from the site i.e. plant uptake, groundwater dilution and wetland polishing.

The ETE Disposal Options Report, which followed a couple of months after the URS report, concluded that 100% disposal of the treated wastewater to MGC is not a suitable option as MGC showed no interest at that time in the use of treated effluent other than for their summer irrigation shortfall. The ETE report also found that the modified high rate irrigation preferred by the URS repot was dependent on relatively unproven technology. The ETE report's preferred option was the soil deficit effluent irrigation option at Lincoln Downs (farmland).

The 2014 report by Harrison Grierson revisited potential effluent disposal options. The reported evaluated many options, several which included the MGC. At the time of the 2014 study MGC was not able to irrigate effluent on the golf course, even though effluent uptake of ~900 $m^3$/d was estimated for the summer months. The MGC option evaluated in this report was aimed at developing a small constructed wetland on the golf course, which would discharge to the natural wetland. The study pointed out that MGC is located on very permeable sandy soil, and any excess effluent will flow into the groundwater, and ultimately end up in the upper Mangawhai estuary. The report however also stated that the environmental effects of discharging to the MGC may be lower than that indicated in the 2006 URS report.

Since the time of writing these reports, the situation has changed, the current disposal field is close to reaching its capacity and additional disposal options are required, MGC are interested in the effluent (not only for summer deficit), and an engineered irrigation system meeting the specific design and likely consent requirements can be designed if sufficient treated water buffer capacity is included in the design. The likely water quality requirements are discussed further in Section 3, although a full assessment of the environmental effects would still be required, to ensure the risks are fully understood and addressed either through the treatment process or additional risk management practises.

# 3 EFFLUENT QUALITY STANDARDS

## 3.1 NEW ZEALAND EFFLUENT REUSE STANDARDS

There is currently little guidance in New Zealand for the beneficial reuse of treated wastewater effluent for non-potable municipal use e.g. irrigation of parks and sports fields. The Ministry of Health (MoH) plays no regulatory role in this process, and guidance in similar New Zealand examples have been taken from international sources.

The only standard available in NZ is the 1992 Department of Health microbial guidelines for the irrigation of sewage effluent (Department of Public Health, 1992) see Table 1.

The New Zealand Guidelines for Utilisation of Sewage Effluent Land (New Zealand Land Treatment Collective, 2000) refer to the 1992 Department of Health microbial guidelines and the WHO guidelines when irrigating with sewage effluent.

Table 1 Recommended microbiological guidelines and other control measures for the irrigation of sewage effluent

| LAND APPLICATION OPTION | TYPICAL QUALITY | TYPICAL TREATMENT REQUIREMENTS COMMENTS |
|---|---|---|
| Category I<br>Irrigation of salad crops, fruit and other crops for human consumption, which may be eaten unpeeled and uncooked | <10 faecal coliforms per 100 ml | Treatment by "conventional" biological oxidation or equivalent with tertiary disinfection. No harvesting of crops when wet with irrigated water. |
| Category II<br>Irrigation of public amenities, for examples sports fields, public parks, golf courses, playgrounds. Irrigation of crops for human consumption which will be peeled or cooked before being eaten, orchards where dropped fruit is not harvested, industrial and non-edible crops | <200 faecal coliforms per 100 ml | No public access while land is being irrigated. Treatment by "conventional" biological oxidation or equivalent with tertiary disinfection. |

| | | |
|---|---|---|
| | <1,000 faecal coliforms per 100 ml | Grass surface of sprayed area must be allowed to dry out thoroughly after irrigation (48 hours or longer as necessary) before public allowed. Treatment by "conventional" biological oxidation or equivalent with tertiary disinfection. |
| | No quality restrictions<br>(public amenities only) | Subsurface irrigation system which prevents sewage effluent reaching the ground surface. Treatment by "conventional" biological oxidation or equivalent. |
| Category III<br>Irrigation of fodder crops and pasture | <10,000 faecal coliforms per 100 ml | Treatment by "conventional" biological oxidation or equivalent. Pastures to be free from ponding before crop growing permitted. No harvesting or grazing for 48 hours or while |

| | | |
|---|---|---|
| | | wet with irrigated water. Warning signs around irrigated area |
| Category IV<br>Irrigation of forest and treelots, public gardens, brush and scrublands | No quality restrictions | Treatment by "conventional" biological oxidation or equivalent. No public access for 48 hours after irrigation. Warning signs around irrigated area. |

As can be seen in this guidance, Category II is broad and covers a number of different standards and as such may be misinterpreted.

## 3.2 INTERNATIONAL EFFLUENT REUSE STANDARDS

There are a number of international standards and guidelines on the reuse of treated wastewater. The following guidelines were briefly reviewed:

- World Health Organisation (WHO)
- United States of Environmental Protection Agency (US EPA)
- Israel
- European Union

Most of the international standards and guidelines applies mainly to agricultural irrigation but can be applied to other municipal and domestic reuse applications  The WHO recommended microbiological quality guidelines for wastewater use in agriculture- is ≤ 1,000 E.coli for plants and gardens and a more stringent ≤ 200 E.coli for sports fields and grassed areas where the public may come in direct contact. Intestinal nematodes should be no greater than ≤ 1 (arithmetic mean no. of eggs per litre).

The Australian standard (discussed in more detail below) reflect good international practise and has been considered the most applicable as specific reference is made in these guidelines to urban non-potable use (e.g. municipal use such as sports grounds and golf course irrigation).

The Australian guidelines (discussed in more detail below) reflect good international practise in-line with the WHO guidelines and has been considered the most applicable for this particular evaluation as specific reference is made in these guidelines to urban non-potable use (e.g. municipal use such as sports grounds and golf course irrigation).

### *3.2.1*

### *3.2.1 WATER QUALITY AUSTRALIA GUIDELINES*

The National Water Quality Management Strategy (NWQMS) National Guidelines for Water Recycling: Managing Health and Environmental Risks — is an authoritative reference for the supply, use and regulation of recycled water schemes in Australia.

Table 2 2 includes a range of water uses, indicative treatment processes, on-site preventative measures and water quality objectives that support the fit-for-purpose approach adopted in these guidelines. The table indicates how treatment processes can be used alone or in combination with on-site preventative measures to meet health-based targets. (Environment Protection and Heritage Council, the National Health and Medical Research Council and the Natural Resource Management Ministerial Council, 2006)

Table 2 Treatment processes and on-site controls for designated uses of recycled water from treated sewage

| INDICATIVE TREATMENT PROCESS | ON-STIE PREVENTATIVE MEASURES | WATER QUALITY OBJECTIVES[1] |
|---|---|---|
| **Municipal uses – open spaces, sports grounds, golf courses, dust suppression, etc or unrestricted access and application** | | |
| Advanced treatment required, for example:<br>• Secondary, coagulation, filtration and disinfection<br>• Secondary, membrane filtration, UV light | No specific measures | • To be determined on case-by-case basis depending on technologies<br>• Could include turbidity criteria for filtration, disinfectant Ct or dose (UV)<br>• *E. coli* <1 cfu/100 ml |
| **Municipal uses – with restricted access and application** | | |
| Secondary treatment with disinfection | Restrict public access during irrigation **and one** of the following:<br>• No access after irrigation, until dry (1 – 4 hours)<br>• Minimum 25 – 30 m buffer to nearest point of public access<br>• Spray drift control, for example, through low-throw sprinklers (180o inward throw), vegetation screening, or anemometer switching | • BOD < 20 mg/l[2]<br>• SS < 30 mg/l<br>• Disinfectant residual (e.g. minimum chlorine residual) or UV dose<br>• *E. coli* <100 cfu/100 ml |
| **Municipal use, with enhanced restrictions on access and application** | | |
| • Secondary treatment with >25 days lagoon detention or primary treatment with >50 days lagoon detention<br>• Secondary treatment | Restrict public access during irrigation **and combinations** of:<br>• No access after irrigation, until dry (1 – 4 hours)<br>• Minimum 25 – 30 m buffer to nearest point of public access<br>• Spray drift control, for example, through low-throw sprinklers | • BOD < 20 mg/l<br>• SS < 30 mg/l<br>• *E. coli* <1,000 cfu/100 ml (disinfection may be required to achieve this concentration) |

[1] Water quality objectives represent medians for numbers of *E. coli* and means for other parameters.

[2] BOD and SS are an indication of secondary treatment effectiveness.

### 3.2.2 ENVIRONMENT PROTECTION AUTHORTIY VICTORIA GUIDELINES

The *Guidelines for Environmental Management – Use of Reclaimed Water (2003)* from the Environment Protection Authority Victoria, Australia explain that the required level of treatment and water quality objectives vary depending on the nature of the end-use scheme. The guidelines outline four classes (A – D) of reclaimed water that represent the minimum standards for biological treatment and pathogen reduction for defined categories of use (see Table 3). The required level of treatment increases with potential for higher exposure levels, reflecting the risks associated with uses. It should be noted that in addition to minimum levels of treatment, a specific reclaimed water use may also be subject to site management controls to ensure protection of public health, agriculture and the environment.

Class A, B and C reclaimed water are acceptable for non-potable urban use. The potential level of exposure to reclaimed water determines the class suitable for both urban and municipal reuse schemes. The potential level of exposure is influenced by several factors including:

— distance from residential or public access areas,

— use of signage and/or fencing to restrict site access,

— irrigation method used, and/or

— use of restricted watering times (e.g. night-time watering).

Only Class A reclaimed water may be used for residential or municipal reuse schemes where there is a high exposure potential to humans due to limited controls on public access. Class B and C reclaimed water may be used for municipal schemes provided public access to irrigated areas can be controlled e.g. restricted water times, fencing and/or restricted access periods to ensure areas are dry before access by humans.

The type of irrigation can also influence the class of reclaimed water used, the extent of public access control required, and the design of the runoff control required. The reclaimed water quality limits required for municipal irrigation are based on spray irrigation.

Table 3 Classes of reclaimed water and corresponding standards for biological treatment and pathogen reduction.

| CLASS | WATER QUALITY OBJECTIVES – MEDIANS UNLESS SPECIFIED | TREATMENT PROCESSES | RANGE OF USES – USES INCLUDE ALL LOWER CLASS USES |
|---|---|---|---|
| A | Indicative objectives:<br>• <10 E. coli cfu/100ml<br>• Turbidity < 2 NTU<br>• <10 mg/l BOD<br>• <5 mg/l SS<br>• pH 6 – 9<br>• 1 mg/l Cl2 residual (or equivalent disinfection) | Tertiary and pathogen reduction with sufficient log reductions to achieve:<br><10 E. coli cfu/100ml<br><1 helminth per litre<br><protozoa per 50 litres<br><1 virus per 50 litres | Urban (non-potable) with uncontrolled public access<br>Agricultural: e.g. human food crops consumed raw<br>Industrial: open systems with worker exposure potential |
| B | • <100 E. coli cfu/100ml | Secondary and pathogen (including helminth | Agricultural: e.g. dairy cattle grazing |

| | | | |
|---|---|---|---|
| | • <20 mg/l BOD<br>• <30 mg/l SS<br>• pH 6 – 9 | reduction for cattle grazing) reduction | Industrial: e.g. washdown water |
| C | • <1,000 E. coli cfu/100ml<br>• <20 mg/l BOD<br>• <30 mg/l SS<br>• pH 6 – 9 | Secondary and pathogen reduction (including helminth reduction for cattle grazing use schemes) | Urban (non-potable) with controlled public access<br>Agricultural: e.g. human food crops cooked/processed, grazing/fodder for livestock<br>Industrial: systems with no potential worker exposure |
| D | • <10,000 E. coli cfu/100ml<br>• <20 mg/l BOD<br>• <30 mg/l SS<br>• pH 6 – 9 | Secondary | Agricultural: non-food crops including instant turf, woodlots, flowers |

## 3.3 NEW ZEALAND REFERENCE GOLF COURSES

The following six New Zealand golf courses were contacted as references where treated wastewater/stormwater has been utilised or investigated for irrigating. Relevant feedback received from the courses is summarised in Table 4 and is discussed in more detail below. A full summary table is also included as Appendix A.

— Omaha Beach Golf Course, Auckland

— Kinloch Golf Course, Taupo

— Puanui Golf Course, Coromandel

— Remuera Golf Course, Auckland

— Miramar Golf Course, wellington

— Chisholm Links, Dunedin

### *3.3.1 COURSES CURRENTLY IRRIGATING TREATED WASTEWATER*

Of the six golf courses contacted, three currently have systems in place which utilise treated wastewater for irrigating. These are Omaha Beach Golf Course, Kinloch Golf Course and Pauanui Golf Course.

Omaha Beach Golf Course, in the Auckland Region, has been irrigating treated wastewater from the Omaha wastewater treatment plant since 2002. The irrigation system in place is a subsurface system (which discharges continuously, below the field surface). The total irrigated area is 25-30 ha and the system capacity is 700 $m^3$/day, however, typical summer flows are more in the range 450-500 $m^3$. Omaha wastewater treatment plant (WWTP) holds consent from Auckland Council for the discharge of treated wastewater to Omaha Beach Golf Course, and this was renewed in 2017. Consent conditions include weekly samples and effluent quality requirements as summarised in Table 4.

Kinloch Public Golf Course in Taupo uses a similar subsurface irrigation system commissioned to accommodate planned capacity upgrades at the Kinloch WWTP (Taupo District Council, 2018). The system comprises an irrigation pumping station, filter station, transmission mains and laterals to 15 irrigation areas. The capacity of the system is 730 $m^3$/day and estimated average summer flow is 580 $m^3$/day for an irrigated area of 5.6ha. The quality of the wastewater to be discharged at Kinloch is summarised in Table 4.

Both Omaha and Kinloch manage flows with buffer storage systems. Omaha Golf Course has lake storage at the golf course, while Kinloch WWTP had a large balance tank installed in 2019 as part of the capacity upgrades. Both courses also take additional volumes as required, which are discharged to wetlands/dunes at Omaha, and rapid infiltration trenches at Kinloch.

Local council bodies contributed most of the capital for both the Omaha and Kinloch systems. The Kinloch course was purchased by Taupo District Council for the purpose of wastewater disposal and they are investing $2.2 million capital in the new disposal system (Taupo District Council, 2018). The Omaha Beach Course is not council-owned, but it is estimated the council has contributed over $1 million capital for the system. They are also committed to maintaining the system with inspections, acid flushes and a yearly maintenance program.

For Kinloch and Omaha, the subsurface type system is important for overcoming many of the issues associated with the use of treated wastewater such as odour and surface runoff. Users of the course are also at little risk of coming into direct contact with the wastewater, so signage is not required except for around the storage lake at Omaha.

Another New Zealand golf course which irrigates treated wastewater is a small 9-hole course run by Pauanui Sports & Recreation Club on the Coromandel Peninsula. The wastewater is discharged to 1 ha of greens and tees with a typical discharge rate of 80 m3/day. During Summer months the fairways are also irrigated as required and maximum total flows can reach around 140m3/day. Unlike Omaha and Kinloch, the irrigation system discharges above ground via a sprinkler system. Consent conditions for Pauanui such as quality requirements are still to be obtained from TCDC, however it is expected they will be more stringent than required for subsurface systems. Furthermore, the sprinklers at Pauanui are restricted to operating between the hours of 8 pm and 6 am, and signage is required around the course to warn users of the potential health risks.

The Pauanui Course has two storage tanks on site to balance flows but does not discharge any effluent to bush or surrounding areas. However, adjacent green spaces including a park and airfield also take a portion of the effluent from the Tairua-Pauanui WWTP.

### *3.3.2 OTHER NEW ZEALAND COURSES*

Other New Zealand courses investigated include Remuera Golf Course in Auckland, Miramar Golf Course in Wellington, and Chisholm Links in Otago.

Remuera Golf Course irrigates stormwater from a neighbouring development area, through a hybrid subsurface/sprinkler system. Ponds on the course are used for storage and balancing flows. Resource consent was required from Auckland Council with consent conditions including regular sampling and water quality requirements (with a different set of testing parameters for stormwater). Remuera has observed issues with field health over time arising from unfavourable nutrient and pH levels.

Miramar Golf Course irrigated treated wastewater from the Moa Point WWTP for number of years. Flows were discharged above ground through a sprinkler system and lake storage was used to balance flows. The Moa Point connection is no longer used at Miramar due to ongoing issues arising

from high salt levels. It is believed this was due to the downstream pump station's proximity to sea level and was causing problems with turf health and clogging of filters. Reports of odour complaints were also investigated at Miramar and properties close to the Moa Point WWTP.

Miramar and Remuera Golf Courses were both restricted to irrigating reuse water at night and were required to display signage around the course. Miramar was also required to install a weather station on the course to monitor wind levels, and irrigation was paused when wind conditions were too strong. It is believed both Remuera and Miramar Golf Clubs paid capital for the setup of their reuse systems and pipework, however both had water rights agreements with their respective council body.

Chisholm Links Golf Course in Otago commissioned a feasibility study into the use of recycled wastewater for irrigation in 2018. The study concluded that the Tahuna WWTP, which was to supply the wastewater, did not achieve the anticipated quality requirements to discharge to land. This judgement was based on the EPA Victorian Standards, and the quality requirements outlined in the resource consent for wastewater use at Omaha Beach Golf Course (Table 4). An option to improve the effluent quality was the addition of a membrane filtration plant (MFP) at the end of Tahuna treatment process, at a rough cost of $700,000. Dunedin City Council showed interest in owning and operating an MFP and would consider contributing to the capital expenditure required. However, the project has not since progressed.

Table 4. Summary of New Zealand Reference Golf Courses

| | | REMUERA GOLF COURSE | OMAHA BEACH GOLF COURSE | PAUANUI GOLF COURSE | KINLOCH GOLF COURSE | MIRMAR GOLF COURSE | CHISHOLM LINKS |
|---|---|---|---|---|---|---|---|
| System Type | | Subsurface, sprinklers (Stormwater) | Subsurface drip | Sprinkler | Subsurface drip | Sprinklers (System no longer active) | N/A (System not installed) |
| Irrigated Area | | 15 ha | 25-30 ha | 1-4 ha | 5.6 ha[3] | 32 ha | Unknown |
| Volumes | | Typically: 775 $m^3$/day (Summer)<br>Annual Mean: 289 $m^3$/day (2020) | Max/Capacity: 700 $m^3$/day<br>Typically: 450-500$m^3$/day (Summer) | Max ~ 140 $m^3$/day<br>Typically: 80 $m^3$/day | Max/Capacity: 730 $m^3$/day<br>Typically: 578 $m^3$/day<br>Annual average: 356 $m^3$/day | Typically: 800 $m^3$/day (Summer) | Ideal Max (Summer): 400$m^3$/day<br>Ideal (May-Oct): 182 $m^3$/day |
| Effluent Quality | BOD | - | Median Limit: N/a<br>92nd %ile Limit: 30 mg/L | | Average: 14.7 mg/L<br>Median: 5 mg/L<br>95th %ile: 10.6 mg/L | (Not restricted) | (Unknown) |
| | TSS | - | (Not restricted) | | Average: 38 mg/L<br>Median: 10 mg/L<br>95th %ile: 47 mg/L | Mean: 20 mg/L<br>Limit: 30 mg/L | (Unknown) |
| | NH3 | 0.2 mg/L | Median Limit: 20 mg/L<br>92nd %ile Limit: 35 mg/L | | - | (Not restricted) | (Unknown) |
| | TN | - | Median Limit: No Limit<br>92nd %ile Limit: No Limit | | Average: 7 mg/L<br>Median: 3 mg/L<br>95th %ile: 20 mg/L | (Not restricted) | Average (measured 2016-17): 28.4 g/$m^3$ |
| | TP | - | (Not restricted) | | Average: 4.7 mg/L<br>Median: 4.2 mg/L<br>95th %ile: 6.4 mg/L | (Not restricted) | Average (measured 2016-17): 3.5 g/$m^3$ |
| | E coli | >150 CFU/100mL | Median Limit: <2 CFU/100mL<br>92nd %ile Limit: 250 CFU/100mL | | Average: 1.7 x $10^4$ mg/L<br>Median: 6.6 x $10^3$ mg/L<br>95th %ile: 7.3 x $10^4$ mg/L | (Not restricted) | (Unknown) |
| | Other | - | - | | - | Faecal coliforms:<br>Mean[4]:10 CFU/100 mL<br>Max[5]: 50 CFU/100 mL | pH (Average 2016-17): 7.5<br>Sodium (Average 2016-17): 110 mg/L |
| Financial Arrangement | | GC paid capital for system. Arrangement with council for water rights. | Council contributed to capital and committed to system maintenance. | | Council funded (public golf course) | GC paid capital for system. Arrangement with council for water rights. | Council indicated receptiveness to contribute capital. Project did not progress |

[3] Area queried (based on discussions with golf course)

[4] Based on one grab sample taken per day, the mean lowest six of the seven consecutive samples

[5] Based on one grab sample taken per day, max concentration shall not exceed

## 3.4 OTHER SIMILAR NEW ZEALAND EXAMPLES

### *3.4.1 GISBORNE DISTRICT COUNCIL*

Gisborne District Council (GDC) has in recent years been looking at options for alternative uses of treated municipal wastewater. A 2015 study looked at number of alternative uses (Palmer, Murray, 2015), including treated wastewater for irrigation. Guidelines for water quality referred to in this study are the same guidelines discussed and proposed in this document and include:

- New Zealand Guidelines for Utilisation of Sewage Effluent on Land (New Zealand Land Treatment Collective, 2000).
- National Guidelines for Water Recycling: Managing Health and Environmental Risks (Environment Protection and Heritage Council, the National Health and Medical Research Council and the Natural Resource Management Ministerial Council, 2006), and
- WHO Safe Use of Wastewater, Excreta and Greywater (WHO, 2006)

### *3.4.2 WHANGAREI DISTRICT COUNCIL*

Whangarei District Council (WDC) has two consents to discharge treated wastewater to land and coastal marine area. The first consent, granted in 2019, allows discharge to land and coastal marine area, and the following relevant conditions were noted (Northland Regional Council, 2019):

- Irrigation of nursery plants via reticulated irrigation system,
- 100 $m^3$/d not exceeding 10L/$m^2$/hr,
- Volume irrigated must be monitored,
- E. coli <100 MPN/100 ml,
- Plant to be irrigated located on areas where an underground drainage system has been installed that discharges into an irrigation recycle sump,
- Recycle sump recycles to irrigation system or discharge into the WDCs stormwater connection.,

The second consent, granted in 2020, allows discharge to land, and the following relevant conditions were noted (Northland Regional Council, 2020):

- Irrigation of garden beds, trees and sports fields with treated wastewater.
- Emergency conditions only, Northland Regional Council needs to be advised 24 hours before commencement
- Only exercised during periods of water restrictions
- All wastewater shall receive tertiary treatment (UV) and additional chlorination
- Faecal coliforms in treated wastewater <1,000 CFU/100 ml
- Irrigation of closed sports fields only for the purpose of re-establishing vegetation
- Public shall be restricted from sport fields during irrigation activities and fields shall remain closed, with prominent signage
- Treated wastewater to sport fields have well defined exclusion/buffer zones.

— No irrigation during rain events

— No spray drift from irrigation beyond consent holder's property

— Expires February 2023

The 2020 consent followed the guidelines provided by the WHO, which has a recommended microbiological quality guidelines for wastewater use in agriculture- where treated water should be ≤ 1,000 *E.coli* for plants and gardens and a more stringent ≤ 200 *E.coli* for sports fields and grassed areas where the public may come in direct contact. Intestinal nematodes should be no greater than ≤ 1 (arithmetic mean no. of eggs per litre). In addition to this, WDC have added chlorination at a disinfection rate of 40 ml of 12.5% Sodium Hypochlorite per 1,000 litres to further disinfect the treated wastewater prior to use. Only treated wastewater after the final UV treatment process is re-used and no wastewater that may have bypassed any part of the wastewater treatment plant may be re-used.

### *3.4.3 MARLBOROUGH DISTRICT COUNCIL*

Marlborough District Council (MDC) have a number of feasibility studies currently underway looking at options to re-use treated effluent from several its wastewater treatment plants.

— Seddon Sewage Treatment Plant (STP)

  Feasibility studies are underway to evaluate the use of treated effluent form the Seddon STP for irrigation of the Awatare Golf Course.

— Blenheim Sewage Treatment Plants (STP)

  Feasibility studies have been initiated to evaluate the use of treated effluent from the Blenheim STP for viticulture (vineyard irrigation)

At this early stage, MDC have been following the EPA Victorian Guidelines (Section 3.2.2) to determine impact on treatment processes required.

# 4 MANGAWHAI EFFLUENT

## 4.1 EFFLUENT QUALITY

An estimate of future effluent quality to 2028 loading and flows will be made to determine the likely treatment upgrades required to meet the reuse standards. To make this assessment it will be necessary to review the flow and effluent and influent and operational management on site tests data for the last 2 years. This will determine the expected range for each effluent parameter and an estimate of future performance. Of concern is the impact of flows bypassing the sand filters, that will be assessed by mass balance and site data.

Table 5. Mangawhai CWWTP treated effluent quality 2018-2020

| Parameter mg/l | TDS | TSS | TN | TP | CBOD | E Coli n/100ml |
|---|---|---|---|---|---|---|
| Average | 471 | 7 | 15 | 8 | 4 | 1 |
| Median | 457 | 4 | 13 | 7.5 | 3 | 1 |
| Maximum | 678 | 31 | 34 | 16.2 | 15 | 20 |
| 90%ile | 613 | 17 | 21 | 12 | 6.1 | 1 |

A high standard is achieved reliably at the plant. This meets Category I standards defined in NZ guidelines, class C Victorian and may achieve unrestricted quality to Australian Standards.

A higher effluent quality can be achieved by reduction in the suspended solids concentration. Normally the effluent is achieving Class A, but due to the capacity of sand filters, periodically the effluent bypasses the tertiary polish and results may be elevated. Additional solids removal treatment will be required for Class A. Additionally, the use of UV and chlorination will achieve additional viral removal and surety of microbial quality for unrestricted use.

This enhanced level for unrestricted use will be suitable for a purple pipe domestic reuse system.

## 4.2 MANGWHAI WWTP IRRIGATION VOLUMES

It is estimated from the spatial plan of 2020 that the population of Mangawhai will treble by 2043. This will see an increase in volume of wastewater as the population increases.

Current daily flow data since November 2018 is shown in the graph below.

It is known from flow records that the area has wet years and dry years. 2020 has been an exceptional dry year and this, with low water table and little rainfall has provided information on the minimum expected flow through the treatment plant.

Covid lockdowns have been seen to have an impact on the flow patterns seen at the CWWTP.

Notably that during lockdown, for the same period as 2018, the flow decreases by over 100 m3/d. Peak population is seen at New Year, with flows of over 1200m3/d, but this is short duration.

In this data period there have been no significant rainfall events. When heavy rains occur, there is often surface flow and ingress from the catchment that elevates flow for a few hours. Currently the

maximum flow through the treatment plant is restricted to 70 l/s, but long term this may increase to over 200 l/s.  The irrigation system will not be required to take all flows.

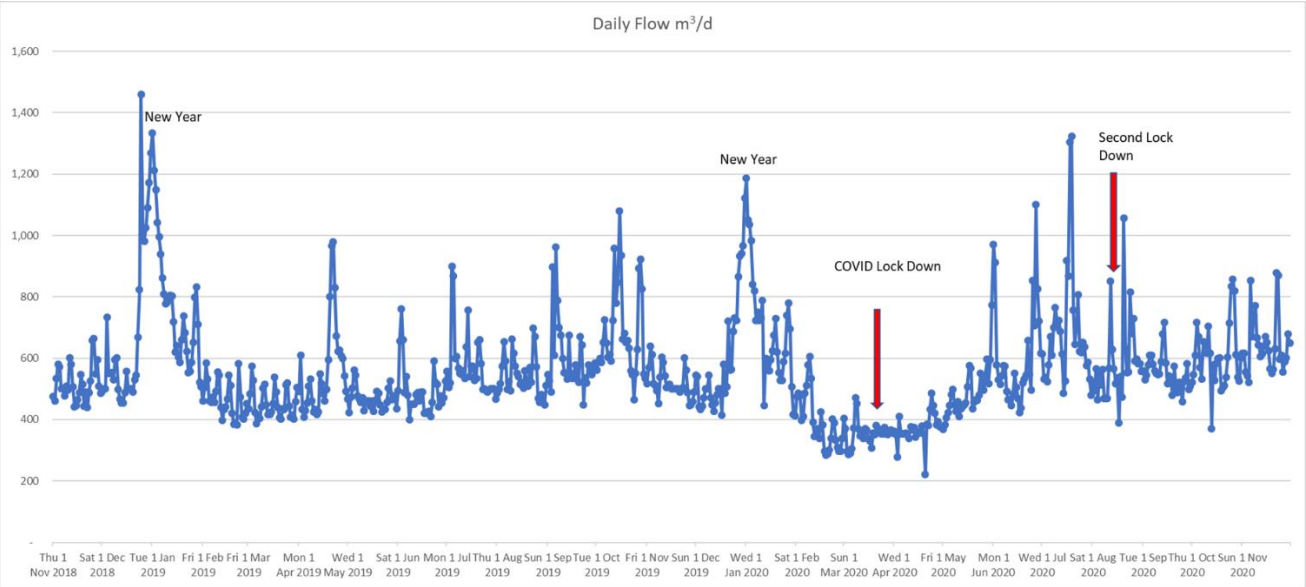


Figure 1 : Mangawhai CWWTP Daily Flows, Nov 2018 – Dec 2020.

# 5 OTHER RISKS

The following additional risks have been identified and should be considered in the development of any effluent re-use strategy with MGC:

- Potable water bores

  The MGC and some of the adjacent properties draws its potable water from boreholes between the 11th and 18th fairways. The surface water level in the bores is at times less than 2.5 – 3 m below ground level. MGC's fertiliser practise has changed in the past due to elevated nitrate levels that were detected in these bores (Donnely, 2013). Any effluent re-use practise should consider any possible impact on the bores or put specific measures in place to avoid impact on these bores.

- Operation and maintenance

  The irrigation system will introduce additional operational and maintenance requirements. In addition to this, with increased or improved irrigation the green space could thrive, and the cost of mowing could increase.

- Nutrient management and the wetland

  The 2018 Biodiversity Report (Griffen, 2018) stated that to maintain the current wetland conditions the amount of nutrients entering the wetland should be limited. The current wetland is low to medium fertility wetland, and nutrients from the treated effluent or recycled effluent should essentially stripped before entering the wetland as any additional nutrients could lead to a complete change in the wetland's natural character.

- Wetland Enhancement and Sustainability

  The wetland on MGC has been identified as significant for Mangawhai and Northland, and there are strategies to enhance and sustain the wetland. Any effluent re-use practise should consider any possible impact on the wetland and the strategies to enhance and sustain it

- Soluble salts

  Most turf grass species will grow in soluble salt levels between 200 – 800 mg/l. Soluble salts levels below 650 mg/l are useful under most turf conditions, while levels above 2,000 mg/l are undesirable and can be quite injurious. The current consent for the Mangawhai CWWTP has total dissolved solids limit of 500 mg/l, levels above 500 mg/l has however been reported at times.

# APPENDIX A - REFERENCE GOLF COURSE SUMMARY TABLE

| | | REMUERA | OMAHA | PAUANUI | KINLOCH | MIRAMAR | CHISHOLM LINKS |
|---|---|---|---|---|---|---|---|
| Course information | Location | Auckland | Auckland | Coromandel | Taupo | Wellington | Dunedin |
| | Course contact + role | Spencer (GC Green Keeper)<br>Ph: 095244288 (ext 4)<br>Email:<br>spencerc@remueragolfclub.com | Alan (GC Greens Superintendent)<br>Ph: 021825572 | Garry Smith (GC Manager)<br>Ph: 027 446 8961<br>Eugene (GC Green Keeper)<br>Ph: 0210 241 5733<br>Ian Smith (TCDC)<br>ian.smith@tcdc.govt.nz | Andrew Ellis (Kinloch Village GC)<br>Ph: 027 262 2832<br>Jeremy Laws (Envirowater)<br>Ph: 022 545 0350 | Allan Turvey (GC Greens Superintendent)<br>Ph: 04 388 2077<br>Email: allanturvery5@xtra.co.nz | Wilson James (GC Manager)<br>Ph: 03 455-0715 |
| | Relevant Council organisation | Auckland council | Watercare | Thames-Coromandel District Council | Taupo District Council | Wellington City Council | Dunedin City Council |
| Golf course | Golf course area (ha) | 70 ha | 45 ha | (Unknown) | (Unknown) | (Unknown) | N/A (System not installed) |
| | Area irrigated | 15 ha | 25-30 ha | 1 ha of greens/tees, occasionally fairway | 5.6 ha | 32 ha | Unknown |
| | Volume/day (max/min/typical) | Max: 775 m3/day (Jan monthly AV)<br>Min: 11m3/day (June monthly AV)<br>Mean: 289 m3/day (2020 AV) | Max/Capacity: 700 m3/day<br>More typically: 450-500m3 (Summer) | Consent is for 365 m3/day<br>Max (Summer) actually more like 140 m3/day<br>More typically: 80 m3/day | Consent for 1500 $m^3$/day<br>Max (current): 730 m3/day<br>Summer average: 578 m3/day<br>annual average: 356 m3/day | 800 m3/day target/peak, though often less due to issues with filters clogging | Ideal Max (Summer): 400$m^3$/day<br>Ideal (May-Oct):<br>182 $m^3$/day |
| Irrigation system | Time of use | Sprinklers at night only | Not restricted. | At night only 8pm-6am | Not restricted. | At night only. Had to wait for a period of dryness/no pooling before use | Project not progressed |
| | Any restrictions E.g., fencing/security | Warning signs around ponds | Warning signs around ponds | Signs around course | No | Signage around the lake - weather station for wind. Irrigation had to stop when wind was too high. Limitations regarding discharge in proximity to boundaries also applied. | |
| | Type of system i.e., subsurface, dripper, spray | Subsurface/sprinklers hybrid | Subsurface | Sprinkler system | Subsurface | Overhead system | |
| | Any discharge to bush or other areas when irrigation not needed? | No | Yes, water pumped to wetland and dunes when not required | No, but Kenndedy park and the adjacent Pauanui airfield also take a portion of the effluent. | Water diverted to trenches | No | |
| | Any additional volume taken? | No | Yes | No | Yes | | |
| | Storage/buffer system? | Ponds used for buffer/storage | Ponds used for buffer/storage | Two buffer tanks. | 400 m3 irrigation tank | Lake storage | |
| | Sole source of water? | Yes | (Unknown) | Bore at course also has connection to buffer tanks. Typically, just the WW used at this course (there are two courses at this location). | Yes | No also had 100mm town supply line from irrigation lake | |
| | Water pumped to tanker? | No | No | No | No | No | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | What is the source? | Stormwater from Stonefields development area (piped from across the road) | Omaha WWTP | Tairua-Pauanui WWTP | Kinloch WWTP | Moa Point WWTP | Tahuna WWTP |
| Effluent Quality (tested or consent requirement) | BOD | - | Median Limit: N/a<br>92nd %ile Limit: 30 mg/L | - | Average: 14.7 mg/L<br>Median: 5 mg/L<br>95th %ile: 10.6 mg/L | (Not restricted) | Unknown |
| | TSS | - | (Not restricted) | - | Average: 38 mg/L<br>Median: 10 mg/L<br>95th %ile: 47 mg/L | Mean: 20 mg/L<br>Limit: 30 mg/L | Unknown |
| | NH3 | 0.2 mg/L | Median Limit: 20 mg/L<br>92nd %ile Limit: 35 mg/L | - | - | (Not restricted) | Unknown |
| | TN | - | Median Limit: No Limit<br>92nd %ile Limit: No Limit | - | Average: 7 mg/L<br>Median: 3 mg/L<br>95th %ile: 20 mg/L | (Not restricted) | Average (measured 2016-17): 28.4 g/m$^3$ |
| | TP | - | (Not restricted) | - | Average: 4.7 mg/L<br>Median: 4.2 mg/L<br>95th %ile: 6.4 mg/L | (Not restricted) | Average (measured 2016-17): 3.5 g/m$^3$ |
| | E. coli | >150 CFU/100mL | Median Limit: <2 CFU/100mL<br>92nd %ile Limit: 250 CFU/100mL | - | Average: 1.7 x 10$^4$ mg/L<br>Median: 6.6 x 10$^3$ mg/L<br>95th %ile: 7.3 x 10$^4$ mg/L | (Not restricted) | Unknown |
| | Other | - | - | - | - | Faecal coliforms:<br>Mean*:10 CFU/100 mL<br>Max**: 50 CFU/100 mL | pH (Average 2016-17): 7.5<br>Sodium (Average 2016-17): 110 mg/L |
| Council info | Standards adhered to (E.g., AS) | NZ heathy water standards (though not sure if they will ever achieve them) | (Unknown) | (Unknown) | (Unknown) | | Victorian standards, Omaha consent |
| | Charging method/financial arrangement E.g., capital contribution, cost/m3 | Golf club paid capital. "RGC may take as much as desired subject to Auckland Council's operational and environmental requirements" | Council contributed significantly to capital costs and is committed to maintaining the system with inspections, acid flushes and a yearly maintenance program | Council paid capital for new connection to existing buffer tank and irrigation system. Agreement for GC to pay low rate for reuse water supplied. | Public course owned by the council. | Arrangement to take what they wanted for 20 years. Alan not sure if they paid capital for connection to Moa Point, but paid for all irrigation pipework | Project not progressed |
| | Resource consent required. Can we have a copy of consent | Yes - copy not obtained. | Yes - copy obtained | Yes - copy not obtained. | Yes - copy obtained. | Yes - copy obtained. | |
| Other Notes | | Stormwater reuse (not wastewater). | | 9-hole course. | This system is in commissioning stages now. | The Moa Point connection is no longer used at Miramar due to ongoing issues. PS which pumped the reuse water to Miramar was below sea level resulting in high salt levels. This was causing issues with the grass and filters (clogging) | A feasibility study was conducted for discharge of effluent from the Tahuna WWTP, but the works have not gone ahead. If was found that Tahuna WWTP does not achieve the effluent quality, enough to meet the likely requirements. Examples used were Omaha quality requirements and Victoria standards. |

# LIMITATIONS

This report ('Report') has been prepared by WSP New Zealand Limited ('WSP') exclusively for Kaipara District Council ('Client') in relation to treated effluent reuse, specifically for golf course irrigation, from the Mangawhai Community Wastewater Treatment Plant and in accordance with the Offer of Service dated 5 November 2020, under the Kaipara Professional Service Panel Agreement 2020 ('Agreement'). The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any use or reliance on this Report, in whole or in part, for any purpose other than the Purpose or for any use or reliance on this Report by any third party.

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