OMAHA WWTP – LAND DISCHARGE CONSENT & BENEFICIAL RE-USE OUTCOMES

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ABSTRACT

This project involved the replacement of the previous resource consents for the Omaha Wastewater Treatment Plant ("**Omaha WWTP**") treated wastewater discharges. The Omaha WWTP is located ~70km north of Auckland on Jones Road, Omaha Flats. It treats wastewater from Omaha, Point Wells and Matakana. Treated wastewater is discharged to land at forestry blocks within the Omaha WWTP site itself, and to the Omaha Beach Golf Course ("**OBGC**"). There is no direct discharge to water but the irrigation areas border the Whangateau Harbour which contains substantial ecologically significant areas. At the OBGC, treated wastewater is used to irrigate fairways, tees and fringes primarily during summer-autumn, via subsurface drip irrigation. The irrigation is of great benefit to the OBGC, reducing their freshwater and fertiliser usage. Watercare work in tandem with the needs of the OBGC, to keep the irrigation supply available to provide summer irrigation. A multi-disciplinary team was brought together by Watercare to assess the existing and future environmental impacts from the discharges, and the capacity of the land application sites to accommodate additional volume to meet projected growth. Central to the replacement of the resource consents was the formation of the Omaha WWTP Consultative Group. The extensive engagement included their participation in scoping an investigation plan for the project, consideration of the results of these investigations and discussions of how subsequent stages of the investigation should proceed. Technical experts presented the results of their work to the Omaha WWTP Consultative Group, who were able to discuss the findings directly with the experts. The technical work and consultation process took nearly three years and resulted in widespread community support for a formerly contentious discharge. Replacement consents were recently granted for the Omaha WWTP with 35 year durations and no capital upgrade requirements.

KEYWORDS

Hydrogeology, Land Discharge, Resource Consent, Consultation, Wastewater, Modelling

NOMENCLATURE

Omaha WWTP = Omaha Waste Water Treatment Plant | OBGC = Omaha Beach Golf Club INC. | JRS = Jones Road Site | OCG = Omaha Consultative Group | OFQA = Omaha Flats Quaternary Aquifer | MSQA = Mangatawhiri Spit Quaternary Aquifer | WGA = Waitemata Group Aquifer | OTSWR = Omaha Taniko Scientific Wetland Reserve

PRESENTER PROFILE

Mr Andre Stuart – Wastewater Planning Manager at Watercare Services Limited. Andre led the infrastructure planning input and stakeholder consultation from project inception to consent delivery.

Mr. Aslan Perwick – Groundwater Services Leader at Pattle Delamore Partners Ltd. Aslan led the technical aspects of the groundwater investigations and technical effects assessment.

Mr. Nicholas Woodley – Senior Project Planner at Whakatāne District Council, formerly Senior Consultant at Mitchell Daysh Limited and prior to that Senior Planner at Watercare Services Limited. Nicholas was the planner and project manager for the project.

Mr Tanvir Bhamji – Senior Project Planner at Watercare Services Limited. Tanvir led the project post-lodgement of application with Auckland Council.

1 INTRODUCTION

The Omaha WWTP is located at Omaha Flats, approximately 70 km north of Auckland CBD. The plant treats wastewater from the townships of Omaha, Point Wells and Matakana. The plant has been in operation since 1982; undergoing expansions in 2000 and 2004, due to the residential development on the southern portion of Mangatawhiri Spit (Omaha Beach). While the plant was originally established to service Omaha, Point Wells was connected in 2008 and Matakana in 2012. This project involved the replacement of the previous resource consents for the Omaha WWTP treated wastewater discharges, which expired in 2015.

Due to predicted changes in the population serviced by the Omaha WWTP, wastewater inflows are expected to rise during the proposed consent term. This paper outlines the approach taken to obtain new resource consents for the Omaha WWTP, including the consultation process that was used and the technical investigations and assessments supporting the application. Location of the Omaha WWTP, irrigation blocks and other key features are presented Figure 1 below.

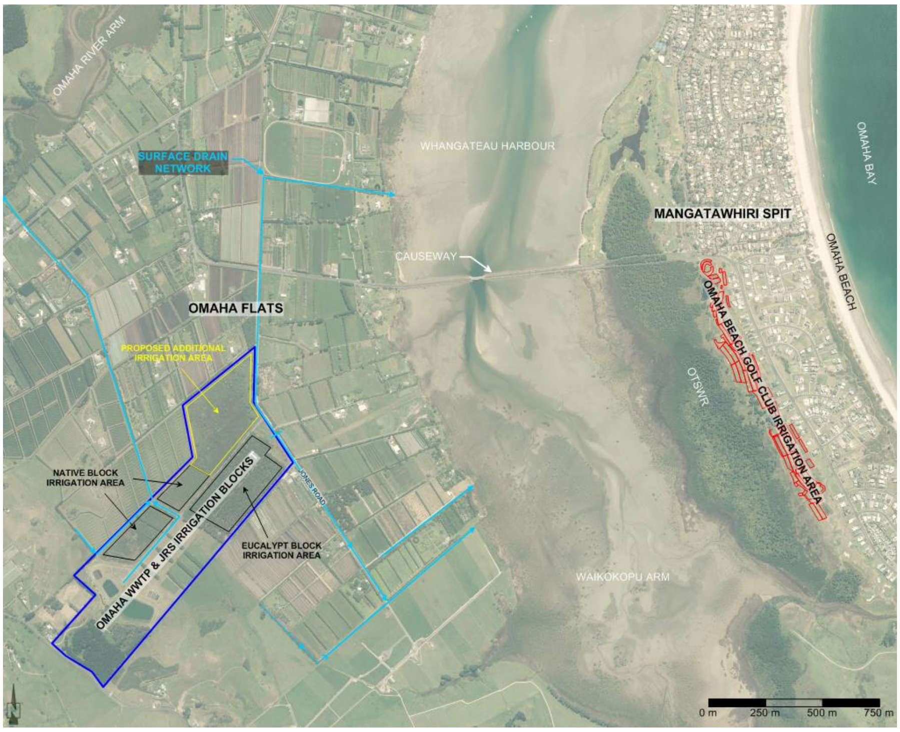


Figure 1: Site Location Plan

2 THE OMAHA WASTEWATER TREATMENT PLANT

2.1 POPULATION SERVED

The Omaha WWTP is unique among Watercare's wastewater treatment plants in that there are more individual connections, at 1,490, than there are people in terms of the estimated permanent population, which is approximately 750 people. The Omaha urban area contains the majority of the wastewater connections to the Omaha WWTP, at approximately 75%. Many of these are holiday homes and are not permanently occupied. As a consequence, peak wastewater flows correlate with holiday periods, particular over the late December/January period.

The area is growing, with the permanent population projected to grow to around 4,000 by 2050 with an estimated 2,240 individual connections. Growth is expected to occur through a combination of new developments and changing occupancy rates. For example, while new developments in Omaha may be restricted by the current zoning of residential land, annual wastewater volumes will increase over time as average occupancy rates increase. As described in Section 6, the irrigation capacity is assessed at 300,000 m^3/year. The total volume of wastewater generated is likely to exceed 300,000 m^3/year within 15-20 years, up from around 157,000 m^3/year currently. Therefore an additional wastewater solution will eventually be required.

2.2 TREATMENT SYSTEM

The Omaha WWTP is a relatively sophisticated plant for its size. Wastewater treatment comprises an aerated lagoon, oxidation pond, storage dam, tertiary filters and UV disinfection. This is shown in Figure 2 below.

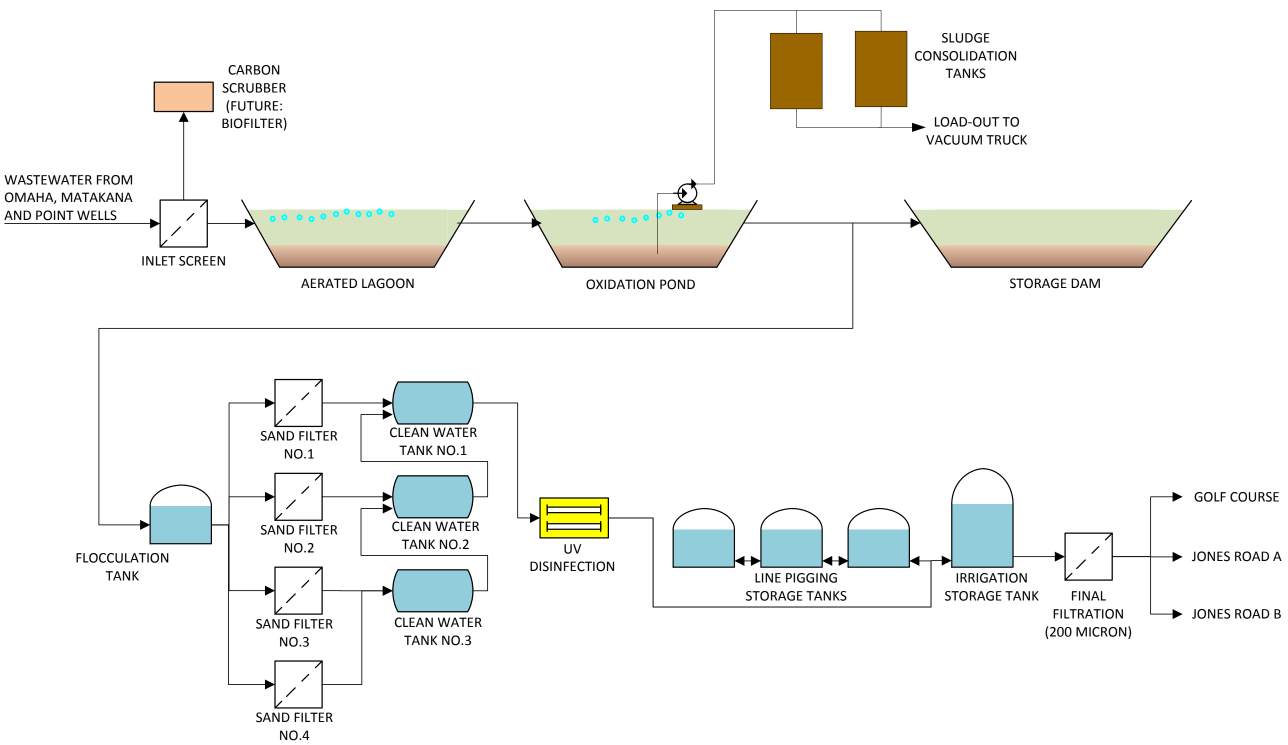


Figure 2: Omaha WWTP Treatment System Diagram

Technical descriptions on each treatment stage are available in the AEE (Watercare Services Ltd, 2016)

2.3 IRRIGATION AREAS

Treated wastewater is disposed to land at the Omaha WWTP itself (being the Jones Road Site, or "**JRS**") and at the Omaha Beach Golf Club Inc. ("**OBGC**") site.

2.3.1 JONES ROAD SITE – IRRIGATION AREA

Irrigation at the JRS is by surface and subsurface drip irrigation. The discharges are limited to no closer than 5 m of a property boundary or within 15 m of any drain. Actual irrigated area for JRS is;

- 7.6 ha of eucalypts ("**JRS Eucalypt**"); and
- 5.5 ha of natives ("**JRS Native**").

Typically about two-thirds of discharge to the JRS is irrigated to the JRS Eucalypt block and one-third to the JRS Native block, although there is some variation. These sites are the preferential irrigation blocks over winter, although during wet conditions flows will be irrigated to the OBGC as described below.

2.3.2 OMAHA BEACH GOLF COURSE – IRRIGATION AREA

Treated wastewater from Omaha WWTP is piped across the Broadlands Drive Causeway to the southern half of the OBGC on the Mangatawhiri Spit. Treated wastewater is irrigated via a network of subsurface drip-fields. Due to sculpting of the OBGC, the depth of irrigation lines can vary and may be less than 15 cm or up to ~50 cm deep in some places. The irrigation blocks fall into two main areas; 5.7 ha of fairways, plus some tees, green fringes, and rough within the OBGC Fairways block; and 0.6 ha of dunes within the OBGC Dunes block.

Typically most of the wastewater treated at the Omaha WWTP during summer is irrigated to the OBGC Fairways. Whilst the OBGC Fairways are currently the preferential irrigation site over summer, flows to these blocks are not expected to increase over time as they are already receiving the volume needed to assist in maintaining the fairways in prime condition during the summer.

The OBGC Dunes have very high infiltration capacities and are generally used over winter or if conditions are such that other irrigation blocks are unavailable. Whilst they may not currently be used as frequently as the OBGC Fairways or JRS irrigation blocks, the OBGC Dunes are crucial to the irrigation system in that they provide a "back-up", in particular by allowing discharges even during very wet winters.

2.4 DISCHARGE QUALITY & QUANTITY

2.4.1 SUMMARY OF DISCHARGE QUANTITY

Although the previous consents authorised a combined total discharge of 390,000 m^3/year, the actual annual discharge was significantly lower than this, at just over 157,000 m^3. However annual discharge volumes, while variable with climatic conditions, are slowly increasing over time. During the winter period the average daily discharge is around 325 m^3/day while over summer the average daily discharge is approximately 530 m^3/day. The peak daily discharge can be considerably higher than this, at around 800 to 900 m^3 per day over the Christmas period.

The irrigation system is controlled manually by Watercare site operators; distributing flows to JRS or OBGC dependent on daily site conditions, rainfall outlook, and to meet other operational constraints/requirements. Distribution between the volume discharged to the JRS blocks vs the OBGC blocks varies year-to-year, but on average approximately 55% goes to the JRS blocks and 45% to the OBGC. During summer most of the treated wastewater is discharged to the OBGC, while in winter more typically goes to the JRS. In wet weather when ground conditions do not favour irrigation, treated wastewater can either be stored in the Omaha WWTP storage dam or discharged to the OBGC Dune blocks.

2.4.2 SUMMARY OF EXISTING DISCHARGE QUALITY

The quality of treated wastewater discharged from the Omaha WWTP is measured fortnightly. Recent annual discharge quality trends are described below in Table 1:

Table 1: Annual Discharge Quality Summary for between 2013 & 2015

Parameter	Unit	Mean	95th %ile	Previous Consent Limit
pH	-	7.3 to 7.9	7.8 to 8.3	None
DO	mg/L	7.3 to 9.1	8.6 to 8.8	None
F. Coliforms	cfu/100 mL	2.5 to 7.2	6.6 to 39.8	500
Total Suspended Solids	mg/L	8.1 to 8.4	11.0 to 15.8	20
CBOD5	mg/L	2.4 to 3.9	5.9 to 7.8	30
Ammoniacal Nitrogen	mg/L	8.4 to 19.3	24.5 to 34.5	None
Nitrate Nitrogen	mg/L	3.9 to 6.5	6.9 to 14.4	None

3 PHYSICAL SETTING

3.1 THE WHANGATEAU HARBOUR

The irrigation sites for treated wastewater from the Omaha WWTP lie within the lower catchments of the Whangateau Harbour. The Whangateau Harbour is a sandspit estuary, which drains into the northern end of Omaha Bay in the outer Hauraki Gulf. The estuary and barrier spit geomorphology is similar to that of many on the NE coast of the North Island i.e. Whangamata, Mangawhai. The Whangateau Harbour is largely infilled, with extensive intertidal sandflats that are drained by relatively simple channels running up the main body of the estuary and Omaha River.

The Whangateau Harbour is highly regarded regionally, and in some cases nationally, as one of the highest quality estuaries containing valued kahikatea forest/wetland, mudflats, mangrove forests, tidal channels, intertidal and subtidal habitats for a range of invertebrates, fish and wading and migrating birds. The Harbour is also highly valued regionally for shellfish gathering and as a fish nursery for the wider Hauraki Gulf (AES, 2016). The Mangatawhiri Spit is approximately 4 km long, with land use in the southern 3.4 km mainly consisting of residential development (Omaha), a golf course running down the western-central part of the spit, and a 1.9 km strip of native swamp forest running along the south-western, coastal margin (Omaha Taniko Wetlands Scientific Reserve). Land use on Omaha Flats is dominated by horticulture, with a small area of urban development at Point Wells.

The residents and stakeholders of the Whangateau Harbour are a diverse community with varying interests in, and engagement with, the area. The Whangateau Harbour and surrounding coastal area is included in the Coastal Statutory Acknowledgement Area for Ngāti Manuhiri.

3.2 TOPOGRAPHY

The topography of the Omaha region varies from low-lying (Omaha Flats and Mangatawhiri Spit < 15 mRL), to > 420 mRL on surrounding hill country. Omaha Flats and Mangatawhiri Spit are surrounded in all landward directions by relatively steep hill country; reaching elevations of ~ 60 mRL to 80 mRL to the west through south and >250 mRL north to northwest. Mangatawhiri Spit is exposed to the Outer Hauraki Gulf / Pacific Ocean to the east.

On the JRS, topography is near flat, ranging between ~10 mRL and 6 mRL. Open channel drains which have been excavated into areas of the JRS are approximately 1 m – 1.5 m below the surrounding land surface. The OBGC irrigation areas comprise gentle sloping relief. The OBGC fairways are typically between 4 mRL and 6 mRL, sloping gently to the west. Fairly steep slopes exist from the fairways up the western slope to the relic dunes, where the elevation typically range between 10 mRL to 14 mRL.

3.3 CLIMATE & RAINFALL

The Omaha climate is sub-tropical with warm, humid summers and mild, wet winters. Annual rainfall averages ~1130 mm per year. More rain falls in the winter months, averaging ~730 mm (April to October) than summer months, averaging 380 mm (November to January). Large rainfall events can occur at any time of the year; however the site may be more prone to heavy falls from easterly weather systems than urban Auckland due to greater exposure to the Pacific Ocean and the proximity to the relatively high elevation of the surrounding hill country (Chappell, 2015).

4 CONSENTING APPROACH

4.1 INTRODUCTION

In developing this application, Watercare undertook a collaborative engagement process with the community. This involved the formation of the OCG which brought together a diverse range of stakeholders, through which concerns about the potential adverse effects of the Omaha WWTP treated wastewater discharges were raised, investigated and the results discussed. This engagement played a significant role in shaping this application and will continue for the duration of the consents.

This process was used because Watercare understood that any application to replace the discharges would be contentious. The Omaha WWTP had a mixed perception amongst the wider community. Some groups were supportive of the proposal, who saw the irrigation benefits to the OBGC. Other groups were strongly opposed, particularly following the connection of Matakana, located outside of the Whangateau catchment, in 2012. Previous discussions with those opposed to the Omaha WWTP discharges had not resolved their concerns.

4.2 FORMING THE OCG

The OCG was formed following two local open days run by Watercare in July 2014. A range of individuals and organisations from the Omaha, Point Wells and Matakana communities attended the open days, at which information was presented on the Omaha WWTP, including discharge quality and quantity information, performance against consent conditions and environmental monitoring results. No replacement application for the Omaha WWTP was proposed; instead attendees were invited to share any concerns they may have had regarding the operation of the plant; so that these could be used to inform the development of a replacement application.

The strength of opposition to discharges from the Omaha WWTP was made clear at the open days, particularly from representatives of groups concerned about the environment in and around the Whangateau Harbour. One attendee introduced herself by saying "I'm your worst nightmare!".

Specific concerns raised at the open days included the:

- Effects of the discharge on Whangateau Harbour and the lack of monitoring;

- Geology of the golf course and adjoining wetland is unsuitable for the discharge;
- Absorption capacity of the trees (eucalypts) at Jones Road may be insufficient and they should be replaced;
- Health of the kahikatea Forest and southern part of the Whangateau Harbour;
- Need to monitor hormones and medical residues in discharge;
- Long term effects of the discharge and the effects on the cockle beds in the Whangateau Harbour;
- Ability of the current scheme to cope with the new development occurring in Matakana; and
- Ability of the scheme to cope with changing occupancy at Omaha and completion of new houses within service areas.

The open days confirmed Watercare's expectations that the replacement of Omaha WWTP resource consents was likely to encounter significant opposition, which had the potential to lead into a drawn out litigious process.

However, most attendees indicated that they would like to receive further information and be included in further discussions regarding the replacement of the resource consents. Therefore following the open days, Watercare invited open day attendees, iwi, community groups, neighbours of the Omaha WWTP and residents of Jones Road to form a community consultative group for the replacement of the Omaha WWTP. The OCG was established and a draft Terms of Reference for the OCG was prepared and circulated. The following groups were either represented on the OCG or kept informed of the group's progress:

- Auckland Council
- Department of Conservation
- Forest & Bird (Mid North Branch)
- Mana whenua
- Matakana Community Group
- Omaha Beach Community Inc
- Omaha Beach Golf Club
- Omaha Shorebird Protection Trust Inc
- Point Wells Community & Ratepayers Association
- Residents of the local communities, particularly those in the vicinity of Jones Road
- Watercare
- Whangateau Harbourcare Group Inc
- Whangateau Residents and Ratepayers Association

At the following meeting of the OCG the draft of the Terms of Reference were agreed, and an independent chairperson was confirmed. The agreed objectives of the OCG were to participate and attempt to achieve consensus in respect of:

(a) *The effects of the current and future discharges from the Omaha WWTP on the environment, including but not limited to the Whangateau Harbour;*
(b) *The contributions of factors other than the discharges from the Omaha WWTP that may be affecting the Whangateau Harbour and how these may change over time;*
(c) *Development of resource consent applications by Watercare that will enable the treatment and discharge of wastewater from the Omaha WWTP in an environmentally appropriate manner for a period of up to 35 years; and*

(d) *Identification of other initiatives that may contribute in improving the quality of the Whangateau Harbour, noting that these may not be within the responsibility of Watercare.*

As is apparent from (b)-(d) above, the scope of the Terms of Reference ended up being broader than simple consideration of the effects of the discharge from the Omaha WWTP. A project webpage was created and all minutes, reports and presentations were made publicly available and the webpage was updated throughout the project.

4.3 UNDERTAKING THE INVESTIGATION WITH THE OMAHA WWTP

Watercare considered that for the engagement process to be successful, members of the OCG would need to be able to express their concerns about the Omaha WWTP and to participate in the investigation itself. Therefore, an early meeting was devoted to providing the OCG members with information and to discuss their concerns, which were recorded and accepted as being definitive.

In combination with a review of the existing state of knowledge, the identified concerns were used to develop a draft investigation plan for assessing the effects of the Omaha WWTP discharge. The draft investigation plan identified the existing knowledge gaps with regards to the effects of the discharge and what work was required to resolve these. The following matters were covered:

- Groundwater flow paths and travel times, including the underlying geology such as lithology, presence and peat layers and saline intrusion
- Contribution of the Omaha WWTP contributed to flooding problems on Omaha Flats;
- Nutrient processes in soils, surface and groundwater and wetlands, effectiveness of the vegetation at nutrient removal, and the fate of nutrient loadings from the treated wastewater discharges
- Microbial contaminants, including the efficacy of the UV treatment and public health risk from the discharges
- Other contaminants, including the risk from emerging contaminants and heavy metals
- Wetlands/Forest, including their existing state and consideration of nutrient inputs and water level changes
- Hydrodynamics of the Whangateau Harbour
- Water quality of surface water, groundwater and the Whangateau Harbour, particularly in the areas where the treated wastewater discharges were expected to emerge
- Benthic habitat, including the past and existing extent of seagrass and mangroves, and how the Omaha WWTP could be contributing to this
- Fish and birds, being their existing states and potential effects from the treated wastewater discharges

A list of matters that did not require technical investigations but were identified as concerns, such as the disposal of private septage, was also created. Watercare agreed to follow up on these matters with third parties, such as Auckland Council.

In summary, the overarching concern involved potential effects on the surrounding environment and the Whangateau Harbour. Interwoven with this concern was a requirement to determine how sustainable the discharges were in terms of both hydraulic and nutrient load. The draft investigation plan was circulated to the OCG for discussion to ensure they were satisfied that all of their concerns were included. Group members requested a peer review of the plan by the regulator. Following receipt of this, the investigation plan was finalised. The investigation plan included the following technical workstreams:

- Water quality - surface, groundwater & harbour (AES, 2016);
- Hydrogeology and groundwater management (PDP, 2016);
- Nutrient transformation (SEL, 2015);
- Microbiology (NIWA, 2016);
- Emerging contaminants (SEL, 2015b);
- Hydrodynamics (AES, 2016);
- Ecology (Wildlands, 2016);
- Agronomy / Land Use (PDP, 2016b)

The investigation plan was divided into three stages. The Stage One investigations involved gathering information on the receiving environment and undertaking preliminary field work. The results of these were presented by the relevant technical experts and discussed at OCG meetings. By having the technical experts present, attendees were able to clarify matters and develop confidence in the information that was being presented to them. Watercare staff were actively facilitating this process and making sure the information presented was clear, concise and comprehensible to the OCG members. This facilitation role was very important given the complexity of the science underpinning much of the investigation. In addition, the involvement of the OCG members also meant that the investigation plan required a greater degree of flexibility to allow changes to subsequent stages through the findings and discussions at the meetings.

The Stage Two investigations involved the collection of additional field data to develop models of the receiving environment, as well as forming methodologies for determining matters such as a risk assessment of emerging contaminants. At this stage of the project, meetings of the OCG were occurring approximately every two months and members were active in discussing the findings and the implications of those findings directly with the technical experts (see Figure 3 below).

Figure 3: Technical experts presenting to the OCG

The Stage Three investigations involved using the information gathered from the earlier stages to model the effects of the discharges of treated wastewater. As the investigations were nearing completion, Watercare started to introduce what the replacement consents for the Omaha WWTP could look like, in terms of the types of conditions usually associated with these types of resource consents.

4.4 AGREEING OUTCOMES

A key concern raised by members of the OCG was the monitoring undertaken in the receiving environments. Watercare constructed 23 monitoring bores during the investigation process and developed an extensive monitoring programme to enable adverse effects in the receiving environment to be measured. Once the sustainable discharge limit for the Omaha WWTP was identified (see Section 6), the basic parameters for the replacement consents were proposed, discussed and agreed. Following this, the draft AEE and a proposed set of consent conditions was circulated. Amendments proposed by Group Members were accepted by Watercare. These amendments included:

(a) Reducing the proposed volume to be discharged annually to the JRS;
(b) A small increase in the number of parameters to be monitored;
(c) Undertaking periodic risk assessments for emerging contaminants; and
(d) Ensuring on-going engagement with the OCG, including with regards to future land use changes at the JRS.

The application was generally supported even before these amendments, but after this there was virtually unanimous support. The application did receive some opposing submissions, however this almost entirely dealt with matters unrelated to the discharge itself. The consents were granted for 35 years after a very short hearing and there were no appeals.

4.5 CONCLUDING COMMENTS ON THE OCG PROCESS

At the start of this project, there was vocal and organised opposition to the replacement of the Omaha WWTP discharge consents. Watercare was careful not to commence the consultation process with a predetermined outcome in mind, and committed to engaging in good faith with the community.

It was important that the concerns expressed through the open days, and then the OCG, were able to be identified, investigated and discussed. Some technical experts presented multiple times over the course the investigations, so that the progress of their work could be discussed and the planned future work amended to incorporate matters raised or concerns expressed. OCG members were able to undertake a site visit with Watercare and some of the technical experts to see the investigation locations, and a site visit to the Omaha WWTP itself was also carried out.

Initially many members of the OCG were openly sceptical of the consultative process, but nonetheless as they saw that their concerns were being addressed, they kept attending. The presence of technical experts, and their independence from Watercare, was very important for conveying information directly and so it was not perceived as biased. Having an independent chair was similarly helpful. However, the active involvement and input from Watercare staff was critical, through explaining matters about how the wastewater system operates, ensuring technical information was sufficiently clear and also through being able to directly contribute to discussions

The consultative process proved very successful, to the extent that groups formerly opposed to the Omaha WWTP discharges submitted in support of the eventual application, including from the person who introduced themselves at the open day as Watercare’s worst nightmare.

A key benefit of this process was that Watercare was able to agree preferred outcomes directly with the community, rather than addressing these matters through a hearing or appeal process.

As a result of the OCG, mana whenua and the community remained informed and directly involved throughout the resource consent application process, and have been educated on the technical operations of the Omaha WWTP.

5 HYDROGEOLOGY

As described earlier, the results of the technical work showed that the discharge from the Omaha WWTP was limited by the volume of treated wastewater able to be applied, rather than the total nutrient load. The results of the hydrogeology investigation also underpinned many of the other investigations, in particular through identifying the:

- ultimate discharge location of the irrigated wastewater;
- subterranean pathways; and
- travel duration.

The remainder of this paper summarises the completed hydrogeological technical works and management of groundwater related effects. While the hydrogeology of the Omaha area was relatively well understood, comprehensive further investigations were undertaken by PDP, as follows:

- Site surveys and field mapping to identify key hydrogeology features;
- Analysis of sediment composition from 14 auger hole samples;
- Approximately 4 km of Ground Penetrating Radar ("GPR") surveys and approximately 3.1 km of Electro-Magnetic ("EM") surveys;
- Construction of 23 additional groundwater monitoring wells (shallow);
- Groundwater level gauging and chemistry sampling;
- Flow gauging and surveying of major drains;
- Shallow geological investigation of the Omaha Taniko Wetland; and
- Testing of soil infiltration capacity and permeability;

These helped informed the hydrogeological understanding, which is described in the below sub-sections.

5.1.1 OMAHA FLATS GEOLOGY

A sandy peat/organic silt deposit covers essentially the entirety of the JRS and the majority of Omaha Flats area surface soils. The thickness of this organic rich layer varies across the Omaha Flats area from 0 m to ~5 m, potentially deeper in some parts. Some of the area's thickest peat/organic silt is present beneath the JRS, for example 4.8 m at Bore OF7 (near centre of the JRS Eucalypt irrigation area).

5.1.2 MANGATAWHIRI SPIT GEOLOGY

Sand-dominated materials cover the majority of the Mangatawhiri Spit surface soils. On the OBGC irrigation areas, both fairways and dunes, an organic top soil layer typically ~150 mm to 200 mm is present. Beneath this, field investigations undertaken for this application indicate that sandy material dominates.

5.1.3 GROUNDWATER SYSTEMS

For the purposes of their assessment, PDP grouped the groundwater system at Omaha into three separate regimes. These are presented in Table 2.

Table 2: Omaha Groundwater Regimes

Name	Acronym	Encompassing Geological Units & Typical Thickness	Aquifer Type
Omaha Flats Quaternary Aquifer	OFQA	Peat/Org Silt (Tauranga Group): 0-5 m Sands (Kariotahi Group): 20-40 m Marine Silt (Undefined Group): 5-10 m	Unconfined
Mangatawhiri Spit Quaternary Aquifer	MSQA	Beach/dune sands (Modern): 0-10 m Estuarine Silt & Alluvial Sand (Tauranga Group): 0-5 m Sands (Kariotahi Group): 10-50m Marine Silt (Undefined Group): 5-10m	Unconfined
Omaha Waitemata Group Aquifer	WGA	Sandstone and Mudstone (Pakiri Formation) 50- >100 m	Confined

A regional conceptual hydrogeological model is presented in Figure 4. The figure illustrates the key flow paths within the three groundwater systems.

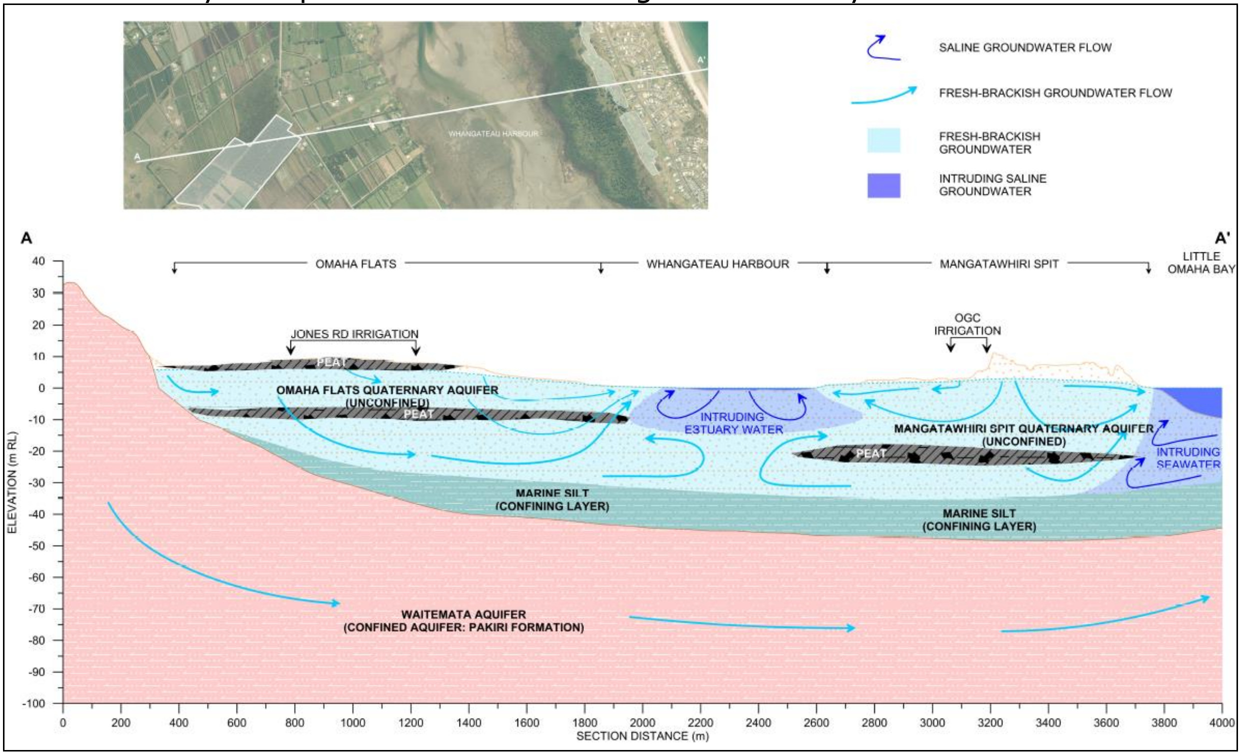


Figure 4: Omaha Regional Conceptual Hydrogeological Model

OFQA – GROUNDWATER HEAD AND FLOW REGIME

The unconsolidated sand units (Kariotahi Group) of the OFQA transmit the largest groundwater flow (flux) to the discharge areas, and are consequently important units within this groundwater regime. This is due to the large thickness and high hydraulic conductivity of the sands compared to the peat/organic silt units.

Assessment of the constructed drains located within the JRS and other areas of the Omaha Flats was also possible by surveying the drain water levels. Drain water levels were very similar to adjacent groundwater levels measured in monitoring wells. This indicates that the drains locally influence the groundwater flow directions within the peat/organic silt (becoming groundwater discharge areas) and draining groundwater off-site through the surface water network (see Figure 1). However, due to the drains' shallow depth, their influence within the OFQA is overall limited.

MSQA – GROUNDWATER HEAD AND FLOW REGIME

Groundwater flows within the MSQA are away from the relic dune ridge; towards the discharge locations of the Waikokopu Arm (to the west) and Omaha Bay (to the east). A groundwater flow divide, in a position relatively close to the topographic divide, is interpreted. The presence of natural saline groundwater intrusion from both the Whangateau Harbour and the Pacific Ocean plays an influential role in the groundwater flow patterns of the Mangatawhiri Spit. The coastal fringes of the MSQA are in direct connection with bodies of saline water. The Omaha Beach interface this presents a classic sandy beach - ocean aquifer set-up. Saline groundwater intrusion is assessed to encroach ~300 m inland.

WGA – GROUNDWATER HEAD AND FLOW REGIME

Flow within the confined Waitemata Aquifer is primarily eastwards beneath the Omaha Flats and Mangatawhiri Spit (Thorley, 2004). The hill country surrounding Omaha Flats provide the primary recharge areas for the rock group. Primary discharge locations are interpreted to be seaward of Omaha Beach at sub-marine outcrops. Slightly artesian pressures (<3 m above ground level) are understood to be present in some of the water supply wells on the Omaha Flats (AC bore data). This indicates upward leakage potential i.e. groundwater flow in the upward direction; from the Pakiri Formation to the overlying OFQA and MSQA when viewed on a regional scale.

6 GROUNDWATER ASSESSMENT

The use of two separate 3D numerical groundwater models (MODFLOW) was employed to aid in answering fundamental questions on the hydraulic capacity and potential groundwater related effects of the proposed discharge. An iterative approach to modelling was employed; with the learnings from each iteration fed back into decision making for the next model scenario, and repeated until the assessment objectives were achieved.

6.1 MODELLING OF THE EXISTING LOADINGS

Existing irrigation volumes and spatial distributions were used to test the hydraulic capacity of the current system. The volumes were based on recent data for each irrigation block. The models were 'history-run' with the above irrigation loading trialled on top of the historic climate conditions from 1 April 1969 to 31 December 2014 (~45 year period).

6.1.1 JRS IRRIGATION & GROUNDWATER MODELLING

The long-term application of existing loading rates at the JRS is summarized below:

- Over the majority of the model run time, the existing irrigation loading rates and distributions are sustainable and manageable. The model did not include operational rules in regards to utilizing onsite dam storage or re-distribution during wet period, as occurs in reality, so the predictions were promising given the exclusion of these measures.
- During 'Wet' winter seasons, the hydraulic capacity of both the JRS Eucalypt and JRS Native irrigation blocks is likely to be exceeded for a period of up to 2-3 months. A 'Wet' winter is defined in this study as a season (being 1 April to 31 October) with rainfall depth approximately at a 1 in 6 year return period.

Figure 5 below displays the predicted groundwater level beneath the centre of the JRS Eucalypt irrigation blocks

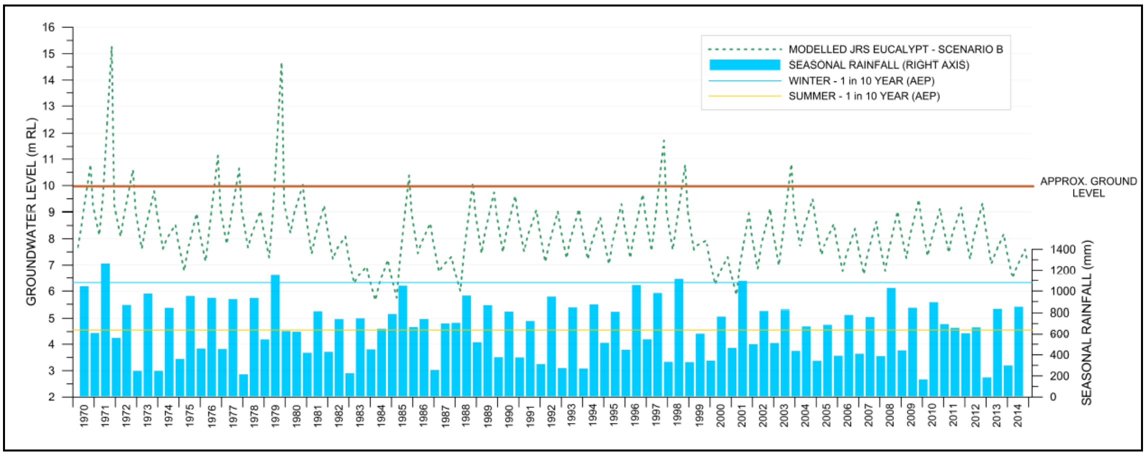


Figure 5: History modelled JRS groundwater levels under existing irrigation loadings

Groundwater flow from beneath the JRS blocks is primarily towards the Waikokopu Arm of the Whangateau Harbour; where discharge into the harbour occurs at low -tide. Particle tracks from the Omaha Flats Groundwater Model (OFGM) are described below and displayed in Figure 6.

- ~90% of irrigation that seeps below the root zone discharges to the Waikokopu Arm. Predicted travel time ranged between ~16 to ~36 years, but typically 19 to 22 years, dependent on where the particle was released; particles further east had the shorter travel times.
- The remaining ~10% essentially accounts for areas within ~50 m of the JRS drains, where groundwater discharge is simulated from the surficial peat unit into the drains, and then flow as surface water to discharge at the Omaha River Arm. Travel time vary between 1 month to ~3 years.

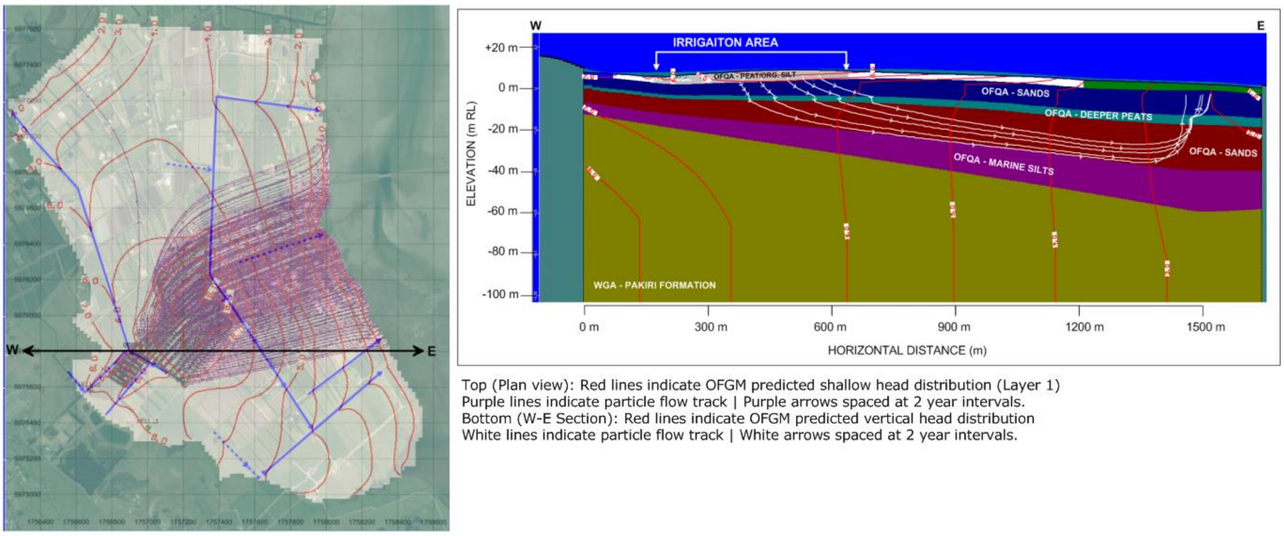
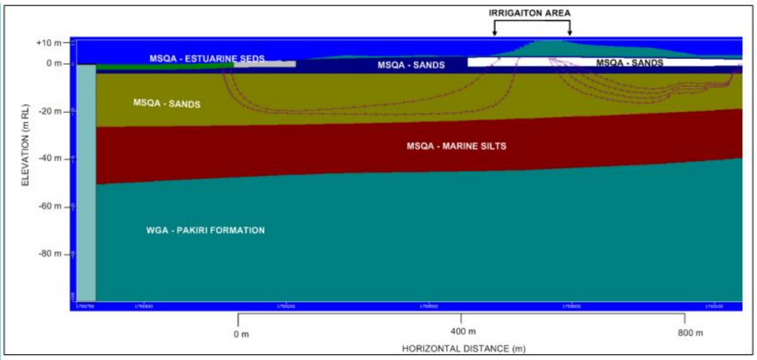


Figure 6: Omaha Flats modelled groundwater pathways

6.1.2 OBGC IRRIGATION & GROUNDWATER MODELLING

The majority of the OBGC irrigation areas have significant hydraulic capacity and existing irrigation rates are comfortably sustainable. During 'Wet' winter seasons, some localised areas of groundwater excess - in the low-lying western areas of the OBGC – will occur. However, almost all of this is caused by natural rainfall input rather than the irrigation input i.e. these wet areas would still be present even if no irrigation occurred to the OBGC, and are only slightly exacerbated by the winter time dune irrigation.

From the OBGC irrigation areas, groundwater, after variable residence time in the ground, will discharge as low tide coastal-zone seepage to both Waikokopu Arm (western coastline) and Omaha Bay (eastern coastline). Modelled groundwater travel times from OBGC irrigation blocks are expected at 20 to 40 years for eastward headed particles (Omaha Bay discharging), and 13 to 35 years for westward headed particles (Waikokopu Arm discharging). Average travel times are typically between 30 years and 25 years respectively, for eastwards and westwards discharging flow. However, near the western extremities of the OBGC Fairway blocks, some particles are expected to discharge into spring/stream areas within the Omaha Taniko Wetland Scientific Reserve. Travel times for these particles are expected at typically 1 to 2 years. Figure 7 displays the modelled pathways:



Top (Plan view): Red lines indicate OFGM predicted shallow head distribution (Layer 1).
Purple lines indicate particle flow track | Purple arrows spaced at 2 year intervals.
Bottom (W-E Section): Red lines indicate OFGM predicted vertical head distribution.
White lines indicate particle flow track | White arrows spaced at 2 year intervals.

Figure 7: Mangatawhiri Spit modelled groundwater pathways

6.2 ADDITIONAL LAND AREA & ASSESSED CAPACITY

Additional land, suitable for land application, and increased use of the existing irrigation blocks are required to deal with the projected volume increase. An additional 9.1 ha of potentially suitable land was identified on the existing JRS site, owned by Watercare. This land will be beneficial for irrigation of summertime inflows, and to a lesser extent winter time inflows. Other nearby sites on Omaha Flats were considered and assessed, but the 9.1 ha bock was deemed preferable due to the overall higher topographic elevation, substantial area, and immediate proximity to existing JRS irrigation fields.

Additional suitable land on the OBGC or greater Mangatawhiri Spit was not readily available and deemed less beneficial to the irrigation scheme. This is primarily due to the high infiltration rates at the OBGC (which mean that increased volumes could be applied without the need for increased land area) coupled with need to manage groundwater level rise at the low-lying surface areas on the OBGC playable area. The capacity of the proposed land application system, including the additional ~9.1 ha of Watercare land, has been assessed at 300,000 m^3/year. One of the limiting factors at both the JRS and OBGC irrigation sites is managing onsite and offsite rises in groundwater level elevation.

6.2.1 DISTRIBUTION UNDER THE PROPOSED IRRIGATION SCHEME

The assessments show that land application of the projected treated wastewater volumes are feasible and manageable, provided incorporation of the aforementioned additional ~9.1 ha of JRS land. Increases to the volumes applied to the existing irrigation blocks would also be required and are considered equally feasible and manageable. Table 3 provides a detailed breakdown of the proposed volumes, and the temporal and spatial distribution amongst each irrigation block.

Table 3: Proposed Irrigation – Simulated Irrigation Rates & Distribution

Irrigation Block	Season[1]	Volume (m3)	Block Irrigation Rate (mm/day)	Proportion of Total
JRS Eucalypt	Summer	36,054	3.1	21%
	Winter	27,686	1.7	
JRS Natives	Summer	19,501	3.7	10%
	Winter	9,211	1.2	
JRS Additional	Summer	42,150	3.1	26%
	Winter	35,390	1.8	
OBGC Fairways	Summer	49,100	5.7	16%
	Winter	0	0.0	
OBGC Dunes	Summer	0	0.0	27%
	Winter	80,908	60.6	
Summer Total[2]		146,805	-	49%
Winter Total[3]		153,195	-	51%
Annual Total		300,000	-	100%

Notes: 1. Winter volume presented are for 'Average' rainfall winters only. 2. Includes irrigation of 11,520 m3 from dam storage. 3 Includes dam storage to rise to 11,520 m3

6.2.2 PREDICTED UPTAKE OF THE PROPOSED IRRIGATION

On average, approximately two-thirds of the total water (combined treated wastewater irrigation and incident rainfall) received by the JRS irrigation blocks is taken up by vegetation (via evapotranspiration) growing within the managed irrigation areas. The majority of the remaining one-third migrates to the groundwater system.

On average, approximately 45% of the total water (combined treated wastewater irrigation and incident rainfall) received by the OBGC irrigation blocks is taken up by vegetation (via evapotranspiration) growing within the managed irrigation areas. The majority of the remaining 55% migrates to the groundwater system.

6.2.3 ASSESSMENT OF GROUNDWATER RELATED EFFECTS

MANAGING GROUNDWATER MOUNDING/RISE

During the proposed land application scheme, additional groundwater recharge will occur beneath irrigated areas. This is due to the increased total volume of water – natural rainfall plus Omaha WWTP treated waste water – being applied to the land surface. The additional groundwater recharge will cause a localised rise, or 'mounding', of the groundwater table beneath and proximal to the irrigation areas.

- For the existing 'JRS Native' and 'JRS Eucalypt' irrigation blocks, groundwater rise for above existing levels, is on average typically small i.e. <0.2 m.
- For the 'JRS Additional Native' block, proposed to be added for proposed system, groundwater rise is on average ~1.2 m above existing. The rise is significantly greater as the area is not currently irrigated.
- For the OBGC Fairway and Dune irrigation blocks, groundwater rise for Scenario E (above existing levels), is on average typically small i.e. <0.2 m.

Figure 8 displays the predicted groundwater rise (above existing conditions) for Omaha Flats.

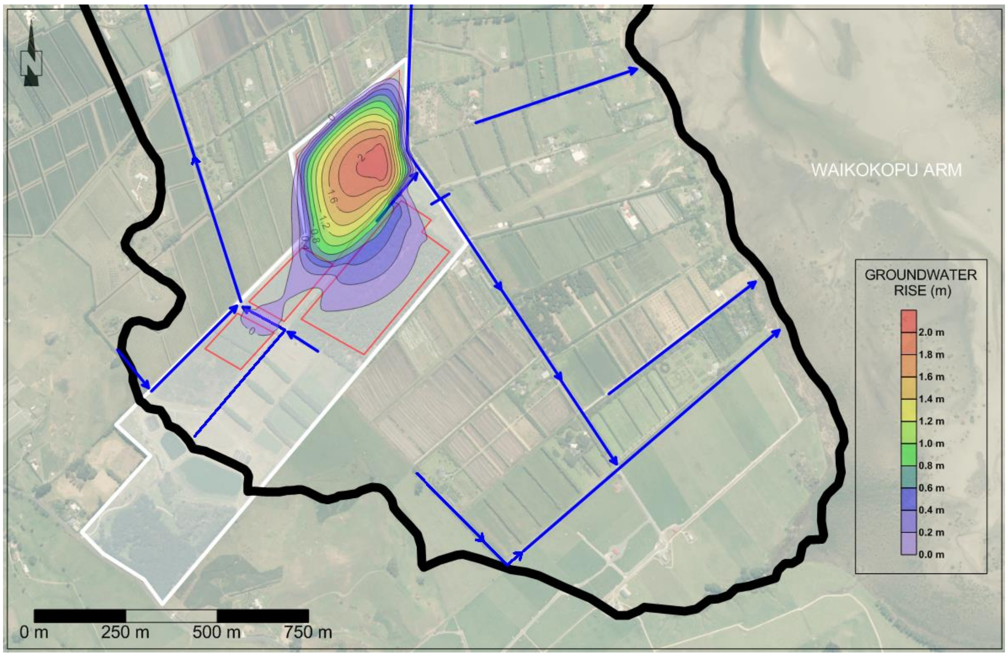


Figure 8 - Omaha Flats: Predicted Groundwater Rise (Annual Average)

(White Shade = WSL owned land | Red outline = approximate extent of irrigation blocks | Blue lines = surface water drains | Black line = model boundary).

For the OBGC, the predicted groundwater rise for the proposed irrigation volume coupled with 'Wet Winter' conditions is displayed on Figure 9.

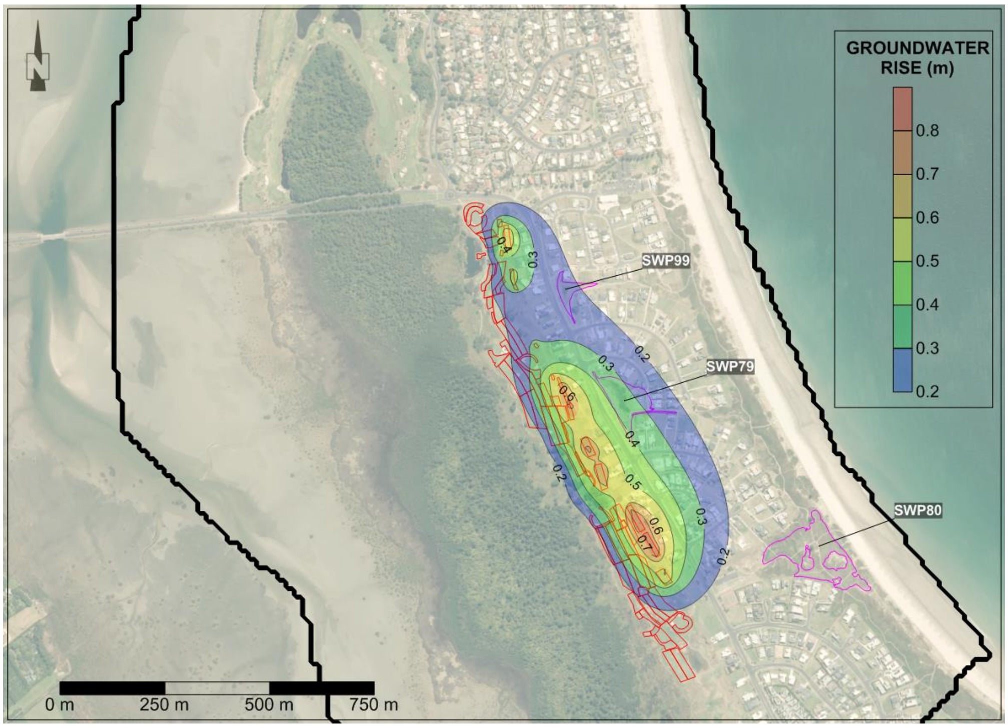


Figure 9 - Mangatawhiri Spit Groundwater Rise During a 'Wet Winter' Event

(Thick black line = model boundary | Red line = OBGC irrigation blocks | Magenta line = AC storm water structures)

A goal of the proposed irrigation scheme is to (as far as practical):

(a) maintain groundwater levels beneath the ground surface of JRS irrigation blocks; and

(b) minimise areas experiencing groundwater levels >3.5 mRL on the OBGC (elevation above which the majority of the OBGC playable area lies).

During winter, to maintain groundwater levels beneath the JRS land surface, the scheme will require managed distribution of irrigation between the JRS irrigation blocks and the OBGC Dune irrigation blocks. Modelling and assessment of a 'Wet Winter' event has shown that when elevated groundwater levels at the JRS become a limiting factor, all winter time irrigation can be distributed to the OBGC Dune blocks. The predicted effects of 100% of winter-time treated wastewater flows (~153,195 m3) being applied to the OBGC Dune irrigation blocks are described below:

(a) Isolated areas of the 'in play' regions, which are above 3.5 mRL will experience saturated ground conditions for ~2 months towards the end of a 'Wet Winter' event.

(b) Average groundwater rise offsite, above that of a 'Wet Winter' under existing conditions, is typically <0.5 m. Groundwater levels beneath the Omaha residential area remain below ground surface, with shallowest groundwater level beneath residential properties at ~1.8 m below ground level.

In practice, the distribution of irrigation will be determined via daily onsite management procedures and decisions to determine which irrigation blocks are used and how much irrigation will be applied. This is the current method of operation between the Omaha WWTP foreman and the OBGC Head Greenkeeper.

In summary, the results of the modelling and assessments identified the magnitude and location of areas more susceptible to groundwater level rise effects under the 'worst-case' scenario, which are the key limitation on discharges from the Omaha WWTP. The overall water and nutrient balances are shown on Figure 10.

Figure 10 – Representative of water and nutrient balance from Omaha WWTP discharges

MANAGING POTENTIAL EFFECTS TO GROUNDWATER USERS

All of the registered groundwater takes proximal to the irrigation areas are from the confined Omaha Waitemata Group Aquifer (WGA). Given the significant depth and confinement of this aquifer, water quality risks from the irrigation activity were deemed very low. However, a 5-year groundwater residence time was agreed with Auckland Council as an appropriate pathogen assessment timeframe – based on work completed by Seitz & et al., (2011). Consent conditions to complete a land owner survey of properties within the predicted 5-year travel time envelop (to check for bores potentially drilled before Auckland Council's official records), and water quality monitoring of these bores and other selected known bores, was agreed prudent. The predicted 5-year travel envelope are presented in Figure 11 and Figure 12.

Figure 11 (Left) - JRS 5-year Average Particle Travel Envelope

(Purple arrows = model particles at 5-years elapsed time | Red lines = approximate extent of JRS irrigation fields | Blue lines = surface water drains | Black lines = land parcel boundaries (LINZ))

Figure 12 (Right) - OBGC 5-year Particle Travel Envelope

(Purple arrows = model particles at 5-year elapsed time | Blue lines = surface water drains | Grey lines = land parcel boundaries (LINZ).

7 CONCLUSIONS

The replacement of the discharge consents for the Omaha WWTP involved nearly three years of intensive engagement with the community. This was in response to considerable community opposition to the activity and was undertaken to avoid an extended hearing and appeal process. The consultative process was not quick and involved discussions that were at times very wide ranging, or highly technical.

Support for the replacement resource consents only occurred slowly over a long period of time, and this was in response to the results of the investigation plan that showed the discharges from the Omaha WWTP were not having adverse effects. However, by the time the application was lodged, it had widespread support amongst the OCG. The resource consents were granted within nine months of lodgement and there were no appeals. While the replacement resource consents have greater monitoring and reporting requirements, no capital upgrades of the treatment plant are required and the consents have a duration of 35 years. The consultative process used has also resulted in a significant “lift” in the reputation of Watercare within the area of the Omaha WWTP.

A wide range of technical investigations were undertaken to support this project. Due to predicted changes in the population serviced by the Omaha WWTP, wastewater inflows are expected to increase significantly. Assessments of the proposed enlarged irrigation scheme calculated an annual hydraulic capacity of around 300,000 m^3.

The Omaha WWTP will continue to meet growth in Omaha, Point Wells and Matakana for the next 15-20 years. Beyond this time it will remain vital to the wastewater servicing for the area, in combination with one or more supplementary options.

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