Wellington Water

PORIRUA WWTP – DISCHARGE OF WASTEWATER

Resource Consent Application & Assessment of Environmental Effects

April 2020

Our water, our future.

Document Control

Document Information

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Document Sign-Off

Name	Role	Sign-off Date
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Paul Gardiner	Approver	6 April 2020

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Form 9

Application for Resource Consent

To: Greater Wellington Regional Council
PO Box 11646
Wellington 6142
Attention: Manager Consents

From: Porirua City Council
PO Box 50218
Porirua 5240

1. Porirua City Council applies for the following type of resource consent:
   - Coastal permit

2. The activity to which the application relates [proposed activity] is as follows:

   The discharge of treated and partially treated wastewater from Porirua's wastewater treatment plant, which is currently authorised by resource consent WGN980083 [33805]

3. The site at which the proposed activity is to occur is:

   - *At Rukutane Point through an existing outfall at or about map reference NZTM 1,753,097 X; 5,447,922 Y.*

4. Names and addresses of landowners / occupiers (other than the applicant) of land to which the application relates to:

   N/A

5. The other activities that are part of the proposal to which the application relates are:

   The operation of a wastewater treatment plant, the occupation of the coastal marine area by the existing outfall and the discharge to air from the Porirua wastewater treatment plant.

6. The following additional resource consent are needed for the proposal to this application relates

   A resource consent application associated with discharge to air (odour) from the Porirua wastewater treatment plant was lodged with GWRC at the end of February 2020.

7. I attach an assessment of the proposed activity's effect on the environment that—

   (a) includes the information required by clause 6 of Schedule 4 of the Resource Management Act 1991; and

   (b) addresses the matters specified in clause 7 of Schedule 4 of the Resource Management Act 1991; and

   (c) includes such detail as corresponds with the scale and significance of the effects that the activity may have on the environment.

8 I attach an assessment of the proposed activity against the matters set out in Part 2 of the Resource Management Act 1991.

9 I attach an assessment of the proposed activity against any relevant provisions of a document referred to in section 104(1)(b) of the Resource Management Act 1991, including the information required by clause 2(2) of Schedule 4 of that Act.

10 The value of the investment of the existing consent holder is $56,427,742 (replacement cost for the WWTP).

11 N/A

12 N/A

13 N/A.

14 Wellington Water attaches the following further information required to be included in this application:

- Certificate of title for the WWTP site
- GWRC s124 memo
- Numerous technical appendices

Signed.. Date..................... 3/04/20

(Signature of person authorised to sign on behalf of the applicant)

David Down
Manager, Water and Waste
Porirua City Council

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1 Introduction

Porirua City Council (PCC) is applying to replace the existing coastal permit for the discharge of treated wastewater from the Porirua Wastewater Treatment Plant (WWTP) to coastal waters off Rukutane Point. The existing resource consent took effect on 6 July 2000 (WGN980083 [33805]) and expires on the 6th of July 2020.

1.1 History of the Porirua WWTP

Wastewater from the Porirua Basin (Porirua City and the northern suburbs of Wellington City) has been discharged at Rukutane Point since 1951 when an outfall, adjacent to the existing one, was constructed by the Ministry of Works to serve the Government housing development in Porirua. The discharge was untreated.

In response to the resulting contamination of Titahi Bay, numerous investigations and water right applications were made for treatment options and alternative discharge points over a 26-year period from the 1960s to the 1980s. For various reasons, these proposals were not proceeded with.

In the mid-1980's, the opportunity arose for Porirua City Council to purchase a section of Pikarere Farm as a WWTP site. This opportunity was taken, and after a 3-year construction period the existing Plant was officially opened in September 1989. As it was clear that any application for a new water right to discharge wastewater from a location closer to the treatment plant would be opposed and appealed, it was decided to retain the Rukutane Point outfall some 700 metres to the north-east of the WWTP.

When the WWTP opened in 1989, the discharge of treated wastewater at Rukutane Point operated under Water Right 84/8 granted in accordance with the Water and Soil Conservation Act 1967.

As this Water Right expired, an application for a Coastal Permit under the Resource Management Act (RMA) was lodged. This Coastal Permit was granted in July 2000 and is the existing resource consent under which the discharge of treated wastewater from Rukutane Point currently operates. Alterations were made to the conditions of the existing consent in 2005 (Conditions 15 & 16 relating to monitoring of faecal coliforms) and in 2015 (Condition 6A relating to reviewing the consent under s128 of the Resource Management Act).

Since the WWTP opened in 1989 it has undergone various upgrades. The most recent upgrades, since the commencement of the current consent, are outlined in Section 2.4 of this application.

1.2 The Porirua wastewater system

The WWTP and the associated discharge off Rukutane Point form part of the wider Porirua wastewater system. The wastewater system is shown diagrammatically in Figure 1-1. The ownership of this system is split into three elements:

- that part of the wastewater network owned solely by Wellington City Council (shown in purple in Figure 1-1)
- that part of the wastewater network owned solely by Porirua City Council (shown in yellow in Figure 1-1)
- that part of the wastewater network and the WWTP owned jointly by Porirua City Council and Wellington City Council (shown in red in Figure 1-1).

Figure 1-1:Overview of the Porirua wastewater system

In addition to the WWTP, the key component of the wastewater system is the wastewater network. This network includes a series of pipes and pump stations (PS) which convey wastewater from individual properties to the WWTP. Wastewater from northern Wellington, eastern Porirua and northern Porirua comes together at the Porirua City Centre (PS 20) and is then pumped from the pump station at Tangare Drive (PS 34 on Figure 1-1) via a tunnel to the WWTP. Wastewater from Titahi Bay is conveyed via the Rukutane Point pump station (PS 35 on Figure 1-1) directly to the WWTP. This relatively small portion of Porirua's wastewater does not go via the pump station at Tangare Drive and associated tunnel.

1.2.1 Environmental impacts of the overall wastewater system

The environmental impacts of the WWTP are set out in Section 5 of this application. The Porirua wastewater network and the privately-owned pipes on individual properties also have environmental impacts. These arise from the discharges that occur from time to time from the wastewater network and private pipes to the stormwater system, and streams, the Porirua Harbour and to the open coast (including Titahi Bay). These discharges cause reduced water quality and increased public health risk. The water quality issues in Titahi Bay are discussed in detail in Section 3.3 of this application. The data presented illustrates the impact that discharges from the wastewater network and private pipes can have on receiving water quality.

Discharges from the network arise from both constructed and non-constructed overflow points. The wastewater network has 20 constructed overflows. These typically operate during periods of sustained wet weather when stormwater inflow or groundwater infiltration cause flows in the wastewater network to exceed the capacity of pipes and pump stations. In addition to constructed overflows, there are a number of locations within the network where overflows can occur from manholes.

Options to reduce the frequency and volume of these network overflows, and WWTP options, were originally part of a combined alternatives assessment process. However, for the reasons described in Appendix C, resolution of the network issues was separated from the WWTP alternatives assessment process. Wellington Water and Porirua City Council are currently exploring options to reduce the network overflows as a separate project. The main options currently being considered to do this are:

- inflow and infiltration[1] reduction
- expediting replacement or repair (potentially through lining) of key sections of the public pipe network
- installing storage tanks that will hold a portion of the peak flow during heavy rainfall events and release it back into the pipe network once wastewater flows in the network begin returning to normal.

[1] Inflow and infiltration is the process of water other than wastewater, such as stormwater and groundwater, entering the wastewater system.

In the integrated alternatives assessment described in Appendix C, the option of increasing the peak conveyance capacity of the network to the WWTP was also considered. Modelling estimated that this option could increase peak inflow to the WWTP from the current peak of approximately 1,275 litres per second (L/s) up to 2,900 L/s. Given the implications of this option for inflow to the WWTP, i.e. significantly increasing peak inflow to the WWTP, and also given its cost, this option is not considered to be appropriate. In addition, upgrading the network to convey these peak flows involves complex technical and construction issues for the large pump stations and pipelines.

Wellington Water and Porirua City Council are in the process of confirming investments to improve the wastewater network. A 'global' resource consent application covering the wet weather overflows from the network is expected to be lodged in 2021.

2 Activity Description

2.1 Summary of the proposal

The following sections provide detail on the proposed discharge from the WWTP, and for which resource consent is sought. By way of summary, the proposed discharge will:

- be from the existing outlet at Rukutane Point
- come from the Porirua WWTP, including its proposed upgrade
- involve secondary treated and UV disinfected wastewater
- involve intermittent, partially treated discharges[2] during heavy rain events until capacity upgrades of the treatment plant which are scheduled to be completed by the 30th of June 2023
- have a maximum peak daily discharge volume of 129,600 cubic metres (m^3) per day, which equates to the upgraded WWTP peak capacity of 1,500 L/s operating continuously for 24 hours
- have a maximum average daily discharge volume of 38,016 m^3/day, which equates to the projected average flow of 440 L/s occurring continuously for a 24-hour period. Initial average daily discharge volumes will be significantly lower than this amount, increasing over the proposed 20-year consent duration with population growth.

It is noted that it is proposed to use daily inflow volumes in the consent conditions as a proxy for daily discharge volumes. This is proposed because the measurement of discharge volumes is less reliable than the measurement of inflow. It is noted that given the nature of the Porirua WWTP, inflow and discharge volumes are closely aligned, with only a small volume lost between inflow and discharge through evaporation and no flow buffering within the plant.

2.2 Location of the discharge

This application proposes the continued discharge of treated wastewater from the existing shoreline outfall that is located on open, rocky coast at Rukutane Point, 3.5 km southwest of the entrance to Porirua Harbour. Mana Island lies opposite and 3.2 km offshore, while the Titahi Bay Surf Club lies just over 1000 m to the east. The outfall is located 700 m north-east of the Porirua WWTP (Figures 2-1 and 2-2). The discharge occurs from a short outfall, at a height of approximately 0.8 m above mean sea level. The discharge is to intertidal and shallow subtidal rocky reef habitat (Figure 2-3).

The existing outfall and an associated concrete deflection wall (shown on Figure 2-3) is consented to 'occupy and use the coastal marine area' under coastal permit WGN 980083 (03). This coastal permit expires on 28 June 2034.

[2] Partially treated discharges are a mix of fully treated wastewater and wastewater which has bypassed parts of the treatment process (see Section 2.5 for a more detailed description).

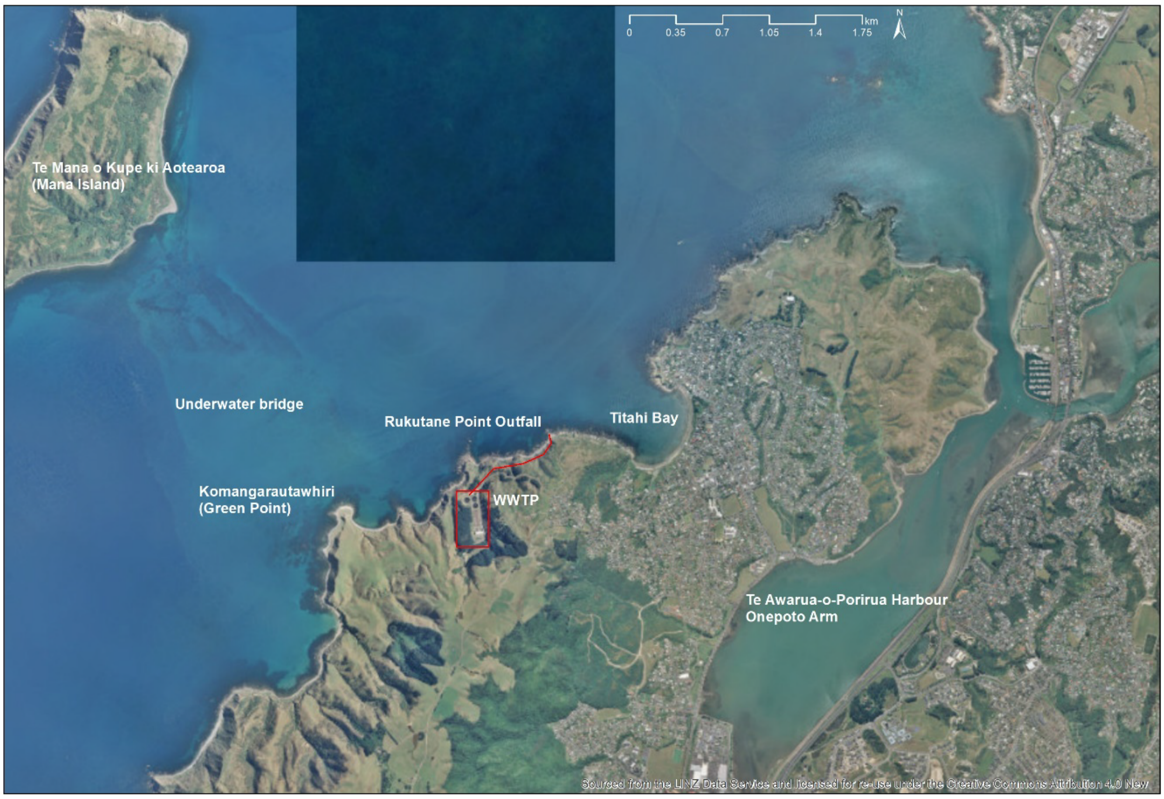


Figure 2-1: Porirua WWTP in relation to Mana Island and Te Awarua-o-Porirua Harbour

Figure 2-2: Porirua WWTP, outfall pipeline and water quality monitoring sites

(See Section 3.3. of the application for an explanation of the bypass monitoring sites.)

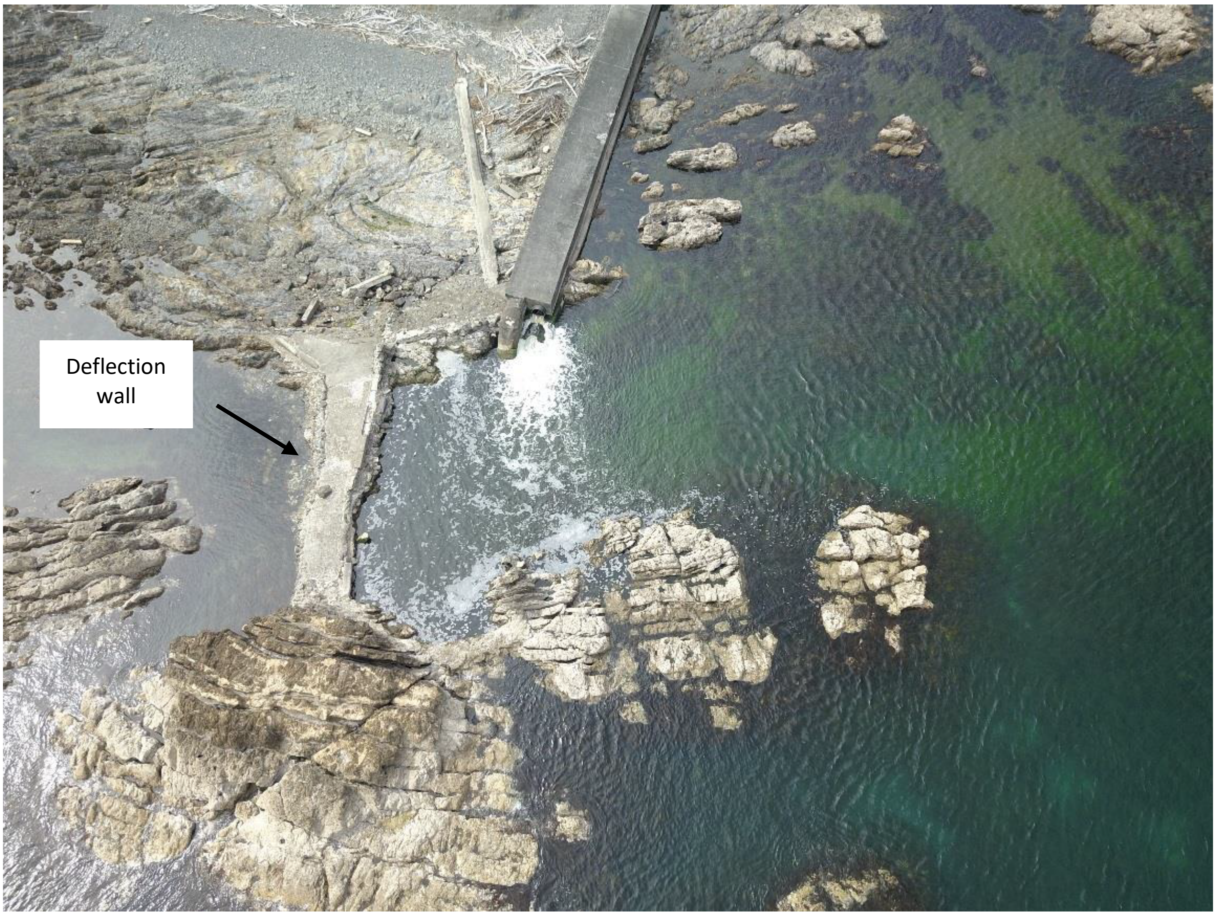


Figure 2-3: Aerial view of the wastewater outfall at Rukutane Point (from Cawthron 2018)

2.3 Description of Porirua WWTP processes

The treated wastewater discharged at Rukutane Point comes from the Porirua WWTP.

The WWTP treats wastewater collected from Porirua City and the northern catchments of Wellington City. The WWTP provides preliminary treatment (screening of incoming solids greater than 2mm), secondary treatment (removal of organic pollutants and separation of sludge from clear wastewater), and tertiary treatment (UV disinfection of micro-organisms) as shown in Figure 2-4.

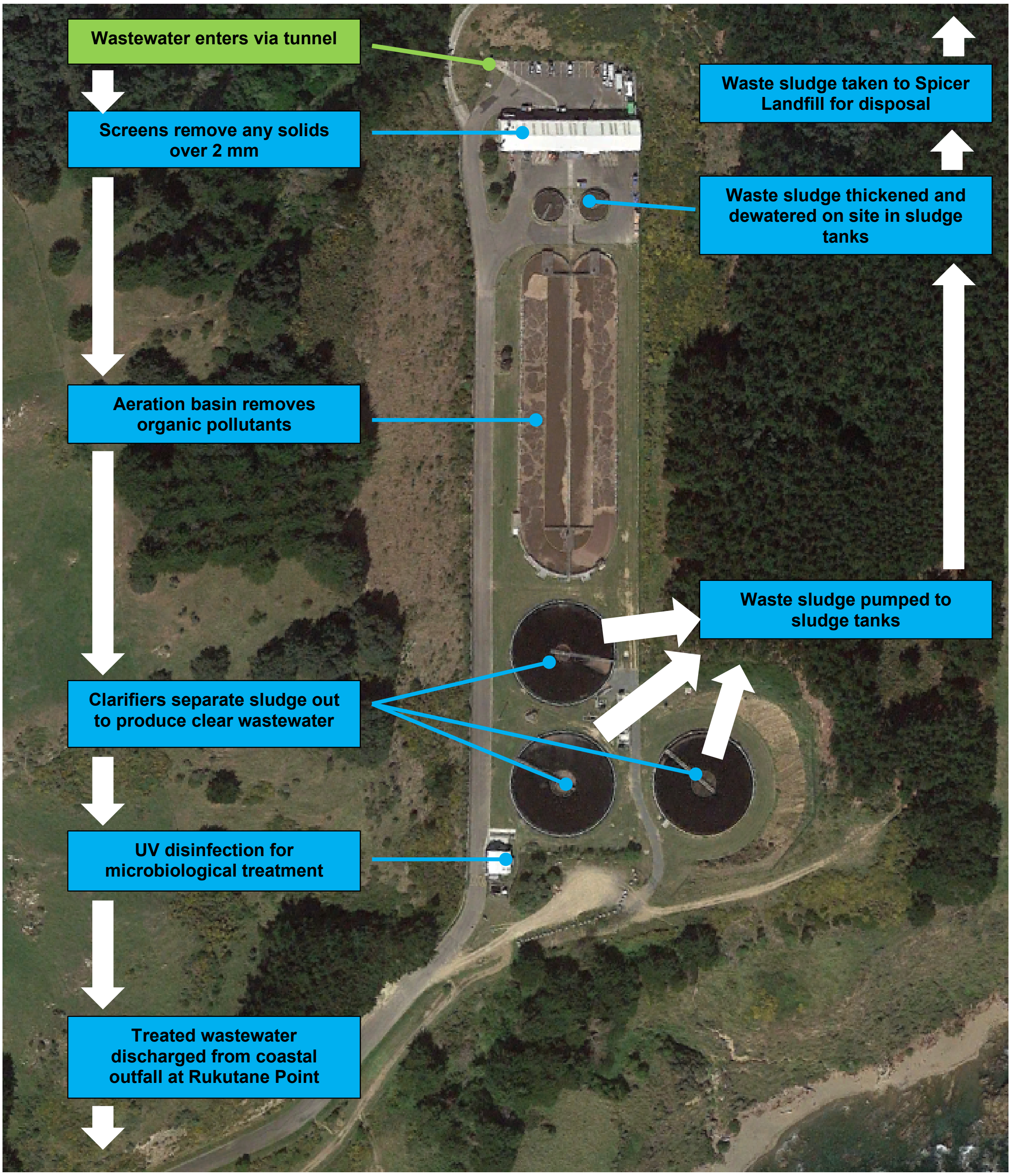


Figure 2-4: Porirua WWTP process diagram

The role of the secondary treatment components at the WWTP is to reduce solids and organic material. However, these processes also facilitate the removal of a portion of the microbiological load that is associated with the solids removal. These contaminants (protozoa, bacteria and viruses) are then removed with the sludge from the plant.

Secondary treatment is by an activated sludge process whereby a portion of the settled sludge from the clarifier tanks is returned to the aeration basin to maintain the biomass of microorganisms which consume the incoming wastewater as "food". The returned sludge is termed the Return Activated Sludge (RAS). A portion of this sludge is removed from the process (the Waste Activated Sludge (WAS)). Air (oxygen) is introduced to maintain the correct conditions for the microorganisms to break down organic material and to convert ammonia to nitrites and nitrates. The Porirua WWTP aeration tank is configured in a single "carousel style" with the two outer lanes being the aerated zones and the two inner lanes anoxic with no introduced oxygen (where nitrates are converted to nitrogen gas).

The mixture of wastewater and biological solids (Mixed Liquor) from the aeration basin is discharged to the three 40m diameter clarifiers where the solids are separated from the wastewater. The wastewater passes over the weirs of the clarifiers to the UV disinfection plant. The solids settle to the bottom of the clarifier tank and are removed and discharged as RAS and WAS. Scum and oils and grease that floats on the surface of the clarifier is collected with the skimmer and removed from the discharged wastewater.

The secondary treatment processes at the WWTP provide a relatively clear wastewater, which is an important requirement for good UV performance. The effective transmission of UV light through the wastewater ensures that an appropriate dose of UV light is delivered to target microorganisms and that the "shielding" effects from other suspended particles are minimised. Total suspended solids (TSS) can also absorb UV radiation reducing the effectiveness of the disinfection process. A TSS concentration of less than 30 g/m^3 with a UV transmissivity greater than 60% (i.e. unfiltered secondary wastewater) are considered good target parameters for UV systems at WWTPs. As shown in Section 2.7, the Porirua WWTP has historically achieved high levels of TSS removal, allowing very effective disinfection most of the time.

UV disinfection systems use light at a wavelength close to the adsorption peak for nucleic acid[3] (i.e., 254nm) to inactivate microorganisms by altering their genetic code to prevent reproduction. UV is an effective disinfectant of bacteria and protozoa, and partially effective for viruses with a relatively short "contact" time (approximately 20-30 seconds). UV also has the advantage of not forming any chemical byproducts or toxic residuals (as is the case with other disinfection methods such as chlorine).

The existing TAK UV disinfection system at the Porirua WWTP, consisting of two banks of submerged horizontal lamps, was installed in 2003. The process guarantee provided by the equipment suppliers (Wedeco), was achievement of a treated wastewater faecal coliform concentration of 1000 organisms/100mLs (90-day geometric mean). Wedeco has indicated

[3] Nucleic acid is the name for DNA and RNA which carry the genetic blueprint for the cell.

that the validated dose[4] for the target organism is 11.45mJ/cm^2 for the wastewater meeting the design TSS and UV Transmittance (UVT) parameters.

Secondary treated and UV irradiated wastewater is discharged via the shoreline outfall at Rukutane Point.

The book value replacement cost of the WWTP is $57M.

2.4 WWTP upgrades during current consent period

The Porirua WWTP has been progressively upgraded since the current consent was granted in July 2000, to maintain and improve treated wastewater discharge quality and capacity. Key upgrades are summarised in Table 2-1.

Table 2-1: Summary of Porirua WWTP upgrades since year 2000

Upgrade Project	Date Completed	Description
UV disinfection	2003	Installation of a UV disinfection plant with a capacity of 928 L/s.
Milliscreens	2006	Replacement of the four rotating drum milliscreens with a change to the aperture to 2mm to provide screening of the raw wastewater. This provided operational benefits to reduce screen cleaning requirements and reduce over-wash of wastewater into the screenings conveyor.
Screenings conveyors and press	2006	Installation of new screenings conveyors and press to improve the reliability of the system and to reduce the water content of screenings discharged to landfill.
Centrifuges	2006	Installation of two sludge dewatering centrifuges to replace the original belt presses. The centrifuges have improved reliability and resulted in a drier sludge cake and hence less volume to be transported and landfilled.
Main Switch Board (MSB)	2012	The MSB was upgraded to provide updated equipment and improved reliability.
Aeration blowers	2013	Installation of three direct drive aeration blowers to increase the aeration capacity and allow for population growth. The project included the installation of additional aeration basin diffusers to improve the removal efficiency of organic and ammonia loads.
Clarifier	2013	Construction of a third 40m diameter secondary clarifier and new outlet weirs from the aeration basin. This increased the total hydraulic capacity of the aeration basin outlet weir and three clarifiers to 1500 L/s and resulted in an improved discharge quality by reducing solids carryover in the wastewater discharge during high flows.

[4] Reduction equivalent dose (or RED) where all water passing through the UV system receives the prescribed UV dose. The dose (i.e., the product of the average UV intensity within the channel multiplied by the contact time of wastewater passing through) is typically given in millijoules (i.e., energy) per square centimetre (mJ/cm^2).

Upgrade Project	Date Completed	Description
RAS & WAS pumps	2015	Installation of new Return Activated Sludge (RAS) and Waste Activated Sludge (WAS) pumps. The RAS pump upgrade included individual pumps on each clarifier and allowed better control over sludge blanket depths in the clarifiers and hence less risk of solids carryover to the discharged wastewater.
Aeration feed pipe hydraulic upgrade	2016	Upgrade of the feed pipe to the aeration basin with the removal of the 450 mm flowmeter and replacing with a straight section of 600mm pipe and installation of a 900 mm flowmeter upstream. This has increased the hydraulic capacity of flows to the aeration basin from 740 L/s to in excess of 1000 L/s and reduced the number of bypasses of screened wastewater around the aeration basin.
Emergency generator	2017	The emergency generator was upgraded with a greater capacity to supply the equipment load to the main building and to provide improved reliability. A new 15,000 litre above ground diesel storage tank was also installed. The UV building is on a separate main switch board and could be supplied with a mobile emergency generator.
Diffuser upgrade	2017 – 2019	Over a three-year period, the diffuser grids in the aeration basin were modified to enable them to be removed and reinstalled safely and quickly for maintenance purposes. In addition to this, the layout of the diffuser grids was optimised to provide for additional diffusers in the first aeration zone where the air demand is the greatest. This improves the treatment performance.
Screenings press	2017	Installation of a new screenings press to provide dewatering and compaction of the screenings prior to landfilling.
Aeration blowers	2019	Installation of three new high-speed turbo blowers to provide greater aeration air capacity and improved reliability.
UV Disinfection	2019 - ongoing	Supply of UV disinfection equipment to increase the capacity of the disinfection plant to in excess of 1500 L/s. The project is ongoing with the next phase being the award of the contract for the construction of a UV channel, electrical upgrades and installation of the equipment. As well as increasing the plant's capacity for UV treatment, this upgrade will reduce maintenance requirements, improve reliability and improve the standard of disinfection.

2.5 WWTP hydraulic capacity and bypasses

Throughout the duration of the current resource consent the full treatment capacity of the WWTP has been less than the volume of inflow to the plant during heavy wet weather events. Despite the upgrades listed in Table 2-1, the capacity of the WWTP to fully treat wastewater remains less than the volume of inflow to the WWTP during peak wet weather events. There have been capacity upgrades of key pumping stations in the network during the current consent period to reduce wet weather overflows to Te Awarua-o-Porirua.

At these times, the volume of wastewater exceeding the plant capacity (volumes greater than 1,040 L/s) bypasses the secondary treatment process (aeration basin and clarifiers). This wastewater is screened and then combined with the secondary treated wastewater prior to UV disinfection. However, as the UV disinfection facility currently has a capacity of 928 L/s, combined secondary/bypass flows in excess of this flow bypass UV treatment. The combined wastewater flow is discharged via the Rukutane Point shoreline outfall. Wastewater flow frequency distributions shown in Figure 2-5 indicate that in years 2016, 2017, 2018 and 2019, WWTP inflows greater than 1000 L/s occurred for one percent of the time, or approximately 90 hours per year. The frequency, duration and volume of WWTP bypasses over the period from January 2011 to end of December 2019 is summarised in Table 2-2.

The average number of bypass events over that period is nearly 15 per year, peaking at 24 in 2015 but reducing to 11 in 2019, partly as a result of the upgrade to the aeration feed pipe. These events occurred most often in the winter months from May to September and are mostly associated with heavy rainfall in the catchment.

The average duration over the 2011 – 2019 period was 12 hours per event or 172 hours per year, which is just under 2% of the time. The annual average bypass volume was 37,600 m^3 per year, which is just under 0.5% of the total volume treated.The largest bypass volume occur in the winter months between May and September. The annual duration and volume of bypasses recorded in 2019 was significantly lower than the average for the period at 65 hours and 9,060m^3 respectively.

Regression analysis shows that annual rainfall has no correlation with the number of bypass events (R^2 <0.04) and a weak correlation with annual bypass volume (R^2 <0.3). For example, the highest annual rainfall occurred in 2018 which had a less than average number of bypass events but greater than average bypass hours and volume.

Table 2-2: Frequency, duration and volume of WWTP bypass discharges

Year	Rainfall at Tawa Pool (mm)	Number of bypass events	Annual duration of bypass events (hours)	Annual bypass volume (m^3)
2011	1199	14	119	21,279
2012	945	7	83	18,133
2013	1277	15	242	71,287
2014	1014	17	162	31,622
2015	1054	24	299	54,472
2016	1306	21	183	27,419
2017	1147	12	192	38,501
2018	1388	13	200	66,733
2019	1094	11	65	9,060
Average	1158	14.9	172	37,600

As part of this application, capacity improvements are proposed and are scheduled for completion by the end of June 2023. These will allow full secondary treatment and UV disinfection of all inflows to the WWTP (Section 2.7.4 describes the proposed upgrades).

Prior to the completion of these upgrades, bypasses will continue to occur during peak wet weather events. This application seeks to consent the discharge of partially treated wastewater, as a result of these bypasses, during this interim period.

It is noted that peak wet weather flows (PWWFs) are, by definition, extreme events. A frequency distribution analysis of wastewater flows for the years 2016 to 2019 is provided in Figure 2-5 (PCC data at 1-hour intervals, 2016-2020). Flows exceeded 1000 L/s for less than 1% of the time and exceeded 1200L/s less than 0.1% of the time (<9 hours per year), indicating that peak flows are rare short-term events.

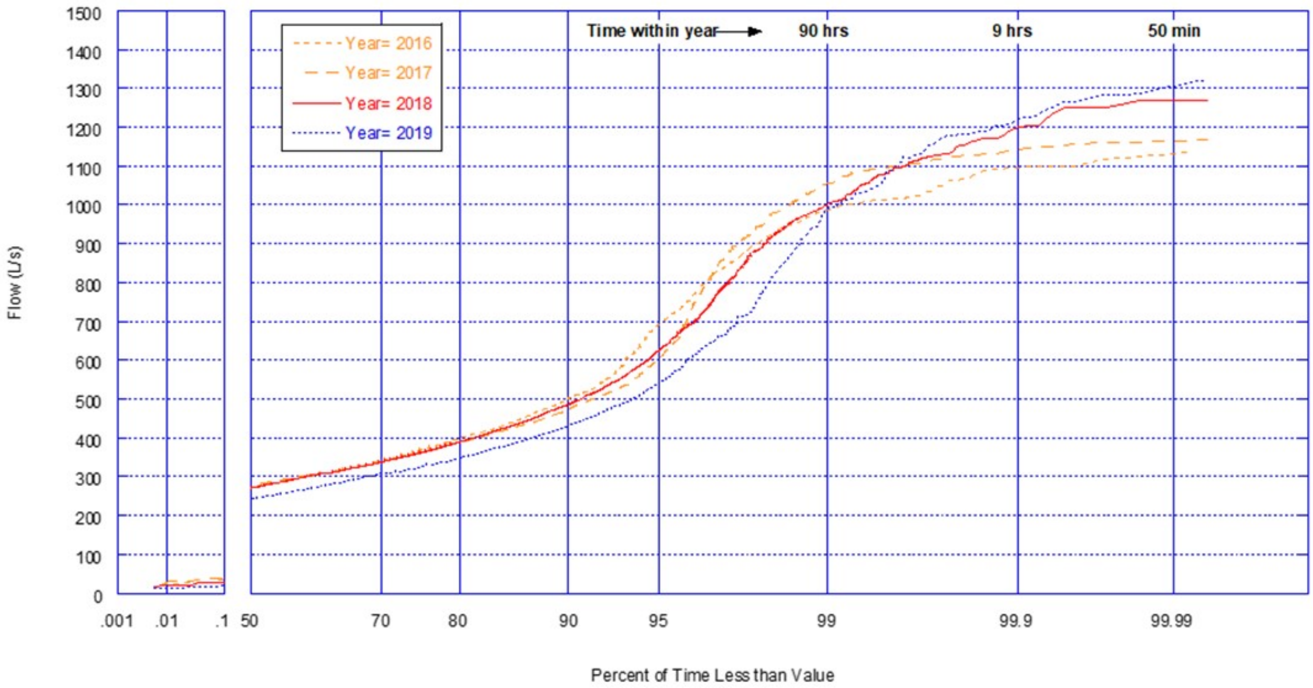


Figure 2-5: Frequency distribution of wastewater flows for years 2016 to 2019

2.6 Population and wastewater flows

Through this application, PCC is seeking resource consent for a period of 20 years. Over this time, wastewater flow to the WWTP will increase as a result of projected population growth in the catchment.

Appendix D sets out the population growth that both Porirua City and Wellington City Councils have projected for the catchment of the WWTP. It then estimates the resulting increase in WWTP inflow over the proposed 20-year consent period. The estimates of future WWTP inflows are calculated by dividing the current total average inflow to the WWTP by the current population, to obtain a per capita figure. The future average inflow has been determined by multiplying the per capita figure by the projected future population within the catchment of the WWTP. This is a conservatively high figure as ongoing efforts to reduce water use and wastewater volumes are expected to reduce the long-term per capita demand, however the exact reductions are uncertain.

Table 2-3 summarises the estimates in Appendix D. The table shows that the population contributing to the WWTP in year 2018 was approximately 84,800 residents, who generated an average wastewater flow of 306 L/s. The 2043 population, which allows for a 20-year resource consent term, is estimated at 121,000, and the predicted average wastewater flow is 440 L/s. The peak wet weather flow (PWWF) is limited by capacity constraints in the wastewater network, which is currently unable to deliver more than 1,300 L/s to the WWTP. It is anticipated that improvements to the wastewater network over the proposed consent duration will result in a peak flow of 1500 L/s being able to reach the WWTP.

Table 2-3: Population and wastewater flows predictions

Metric	Unit	Year 2018	Year 2043
Population	residents	84,000	121,000
Average daily flow (ADF)	m^3/day	26,438	38,016
Instantaneous ADF	L/s	306	440
Instantaneous PWWF	L/s	1,275	1,500

Based on the above flow numbers, this application is seeking resource consent to discharge up to:

- Average (mean) discharge flow of 38,016 m^3/day (up from 24,000 under the current consent)
- Peak discharge flow of 129,600 m^3/day (up from 92,800 under the current consent).

However, it is not anticipated that the average discharge flow will be reached until the end of the proposed 20-year resource consent period, if population growth occurs as predicted (and may not be reached at all, if population growth is less than currently anticipated, or if wastewater per capita declines through water conservation activities or other measures).

2.7 Characterisation of the wastewater discharge

2.7.1 Existing wastewater quality

Summary Total BOD_5, TSS and Faecal coliform results for Porirua WWTP treated wastewater, from daily samples collected during the 36 months from 1 July 2016 to 1 July 2019, are presented in Table 2-4. The results show that the treatment process has provided very effective reduction of BOD_5, TSS and faecal bacteria.

[5] Biochemical oxygen demand

Table 2-4: Summary BOD_5, TSS and Faecal coliform results for quality of Porirua WWTP treated wastewater (PCC daily samples July 2016 to July 2019)

Variable	unit	N.	Min	Geometric mean	90-Percentile	Max	Existing consent limits	
							Geometric mean	90%ile
Total BOD_5	g/m³	1125	<6	7	13	345	30	75
TSS	g/m³	1125	<6	9	19	1200	30	75
Faecal coliforms	per 100ml	807	2	50	804	59,200	1000	2000

Note: *Compliance with consent limits is assessed monthly

Table 2-5 provides summary statistics for limited monitoring of nutrients in the treated wastewater in both the summer and winter periods. Nitrogen concentrations vary seasonally, being present at substantially higher concentrations in the winter compared with the summer because the nitrogen removal process works more effectively in warmer conditions. Concentrations of ammonia are relatively low in both summer and winter as the treatment process converts ammonia to nitrite and nitrate. Both nitrogen and phosphorus are predominantly present in the dissolved form.

Table 2-5: Summary statistics for nitrogen and phosphorus in Porirua WWTP

Variable	Unit	Summer (12 composite samples)*			Winter (24 grab samples)**		
		Median	90-percentile	Max	Median	90-percentile	Max
Nitrite-N	g/m³	0.015	0.03	0.04	1.92	2.01	2.04
Nitrate-N	g/m³	0.53	1.48	2.95	3.64	4.1	4.59
Ammonia-N	g/m³	0.05	0.24	0.57	2.86	3.26	3.41
DIN	g/m³	0.56	1.64	3.03	7.8	9.27	9.45
TN	g/m³	1.25	2.31	3.38	not tested	not tested	not tested
DRP	g/m³	1.62	3.79	4.22	2.26	2.62	2.65
TP	g/m³	1.85	3.85	4.42	not tested	not tested	not tested

Notes: *Summer monitoring is based on 12 daily 24 hour composite samples collected from 17th to 28th February 2018, inclusive.

**Winter monitoring is based on grab samples collected at 2-hourly interval over 48 hours, from 30 May to 1 June 2018

Results of quarterly monitoring for metals and volatile organic compounds (with existing consent limits and ANZG 2018 guidelines shown) are summarised in Table 2-6 and Table 2-7. These results show relatively low metal concentrations in the treated wastewater, fully meeting consent limits and mostly meeting relevant ANZG (2018)[6] receiving water quality guidelines without any dilution in receiving waters (except for zinc which marginally exceeded the default guideline value[7]). All volatile organic compounds tested were present at low concentrations, with only one constituent (Toluene) measured above the method detection limit, and no exceedances of the DGV recorded.

[6] Australian & New Zealand Guidelines for Fresh & Marine Water Quality (ANZG 2018)

[7] Default Guideline Value (DFG) is a guideline value recommended for generic application to all Australian and New Zealand fresh or marine water bodies in the absence of a more specific guideline value (for example site specific) in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

Table 2-6: Summary results for metals and other constituents in Porirua WWTP treated wastewater from quarterly and miscellaneous 24-hour composite samples, June 2017 to December, 2019

Variable	unit	N	Median	90-percentile	Max	Existing consent limits in condition 11(c)	ANZG (2018) DGVs[8]
TSS	g/m^3	15	<6	14.8	47	-	-
Dissolved O_2	g/m^3	10	7.95	9.08	9.8	-	-
Total BOD_5	g/m^3	10	3	9	9	-	-
Arsenic - total	g/m^3	14	<0.002	<0.002	0.002	0.5	-
Arsenic - dissolved	g/m^3	5	<0.001	0.002	0.002	-	ID
Cyanide	g/m^3	10	<0.005	0.005	0.005	0.1	-
Cadmium - total	g/m^3	10	<0.001	<0.001	<0.001	0.05	-
Chromium - total	g/m^3	9	0.002	0.002	0.004	0.2	-
Chromium - dissolved	g/m^3	10	<0.001	<0.001	<0.001	-	0.0044
Copper - total	g/m^3	15	0.002	0.002	0.004	-	-
Copper - dissolved	g/m^3	4	0.0008	0.0009	0.0009	-	0.0013
Lead - total	g/m^3	10	0.002	0.002	0.002	0.5	-
Lead - dissolved	g/m^3	10	<0.0005	<0.0005	<0.005	-	0.0044
Mercury - total	g/m^3	10	<0.0010	<0.001	<0.001	0.002	-
Mercury - dissolved	g/m^3	10	<0.0005	<0.0005	<0.0005	-	0.0001
Nickel - total	g/m^3	5	0.001	0.002	0.002	0.05	-
Nickel - dissolved	g/m^3	4	0.00065	0.0007	0.0007	-	0.007
Zinc - total	g/m^3	15	0.022	0.0406	0.091	2.0	-
Zinc - dissolved	g/m^3	4	0.0175	0.0201	0.021	-	0.015

ID = insufficient data

Table 2-7: Summary results for volatile organic compounds in Porirua WWTP treated wastewater from quarterly 24-hour composite samples, June 2017 to December, 2019

Variable	unit	N	Median	Max	ANZG (2018) DGVs
1,2,4-Trimethylbenzene	g/m^3	10	<0.0005	<0.0005	ID
1,3,5-Trimethylbenzene	g/m^3	10	<0.0005	<0.0005	ID
Benzene	g/m^3	10	<0.0005	<0.0005	0.700

[8] Default Guideline Levels for slightly to moderately disturbed systems

Variable	unit	N	Median	Max	ANZG (2018) DGVs
Ethylbenzene	g/m^3	1	<0.0005	<0.0005	0.080
Isopropylbenzene	g/m^3	10	<0.0005	<0.0005	0.030
m-Xylene	g/m^3	1	<0.0005	<0.0005	0.075
Naphthalene	g/m^3	10	<0.0005	<0.0005	0.070
n-Butylbenezene	g/m^3	10	<0.0005	<0.0005	ID
n-Propylbenzene	g/m^3	10	<0.0005	<0.0005	ID
o-Xylene	g/m^3	10	<0.0005	<0.0005	ID
p-Isopropyltoluene	g/m^3	10	<0.0005	<0.0005	ID
p-Xylene	g/m^3	1	<0.0005	<0.0005	ID
sec-Butylbenzene	g/m^3	10	<0.0005	<0.0005	ID
Styrene	g/m^3	10	<0.0005	<0.0005	0.250
tert-Butylbenzene	g/m^3	10	<0.0005	<0.0005	ID
Toluene	g/m^3	10	<0.0005	0.0018	0.180
Total p,m Xylene, Ethylbenzene	g/m^3	10	<0.0015	<0.0015	ID
1,1,1,2-Tetrachloroethane	g/m^3	10	<0.0005	<0.0005	ID
1,1,1-Trichloroethane	g/m^3	10	<0.0005	<0.0005	0.270
1,1,2,2-Tetrachloroethane	g/m^3	10	<0.0005	<0.0005	ID
1,1,2-Trichloroethane	g/m^3	10	<0.0005	<0.0005	1.900
1,1-Dichloroethane	g/m^3	10	<0.0005	<0.0005	ID
1,1-Dichloroethene	g/m^3	10	<0.0005	<0.0005	ID
1,1-Dichloropropene	g/m^3	10	<0.0005	<0.0005	0.500
1,2,3-Trichloropropane	g/m^3	10	<0.0005	<0.0005	ID
1,2-Dibromo-3-chloropropane	g/m^3	10	<0.002	<0.002	ID
1,2-Dibromoethane	g/m^3	10	<0.0002	<0.0002	ID
1,2-Dichloroethane	g/m^3	10	<0.0005	<0.0005	1.900
1,2-Dichloropropane	g/m^3	10	<0.0005	<0.0005	0.900
1,3-Dichloropropane	g/m^3	10	<0.0005	<0.0005	1.100
2,2-Dichloropropane	g/m^3	10	<0.0005	<0.0005	ID
Allyl chloride	g/m^3	10	<0.0005	<0.0005	ID
Bromochloromethane	g/m^3	10	<0.0012	<0.0012	ID
Bromomethane	g/m^3	10	<0.001	<0.001	ID
Carbon tetrachloride	g/m^3	10	<0.0005	<0.0005	0.240
Chloroethane	g/m^3	10	<0.001	<0.001	ID
Chloromethane	g/m^3	10	<0.006	<0.006	ID
cis-1,2-Dichloroethene	g/m^3	10	<0.0005	<0.0005	ID
cis-1,3-Dichloropropene	g/m^3	10	<0.0005	<0.0005	ID
Dibromomethane	g/m^3	10	<0.0005	<0.0005	ID
Dichlorodifluoromethane	g/m^3	10	<0.001	<0.001	ID
Dichloromethane	g/m^3	10	<0.005	<0.005	4.000
Hexachlorobutadiene	g/m^3	10	<0.0002	<0.0002	ID
Tetrachloroethene	g/m^3	10	<0.0005	<0.0005	0.400

Variable	unit	N	Median	Max	ANZG (2018) DGVs
trans-1,2-Dichloroethene	g/m^3	10	<0.0005	<0.0005	ID
trans-1,3-Dichloropropene	g/m^3	10	<0.0005	<0.0005	ID
Trichloroethene	g/m^3	10	<0.0005	<0.0005	ID
Trichlorofluoromethane	g/m^3	10	<0.0005	<0.0005	ID
Vinyl Chloride	g/m^3	10	<0.0005	<0.0005	ID
1,2,3-Trichlorobenzene	g/m^3	10	<0.0005	<0.0005	ID
1,2,4-Trichlorobenzene	g/m^3	10	<0.0005	<0.0005	0.020
1,2-Dichlorobenzene	g/m^3	10	<0.0005	<0.0005	ID
1,3-Dichlorobenzene	g/m^3	10	<0.0005	<0.0005	ID
1,4-Dichlorobenzene	g/m^3	10	<0.0005	<0.0005	ID
2-Chlorotoluene	g/m^3	10	<0.0005	<0.0005	ID
4-Chlorotoluene	g/m^3	10	<0.0005	<0.0005	ID
Bromobenzene	g/m^3	10	<0.0005	<0.0005	ID
Chlorobenzene	g/m^3	10	<0.0005	<0.0005	ID
1,3,5-Trichlorobenzene	g/m^3	9	<0.0005	<0.0005	0.008
4-Methyl-2-Pentanone	g/m^3	6	<0.0005	<0.0005	ID
Carbon disulphide	g/m^3	6	<0.0005	<0.0005	ID
Bromodichloromethane	g/m^3	10	< 0.0005	< 0.0005	ID
Bromoform	g/m^3	10	< 0.0005	< 0.0005	ID
Chloroform	g/m^3	10	< 0.0005	< 0.0005	0.370
Dibromochloromethane	g/m^3	10	< 0.0005	< 0.0005	ID

Table 2-8 presents the results of treated wastewater faecal coliform monitoring over a longer timeframe, indicating that faecal coliform concentrations were relatively high from years 2011 to 2013 but and generally much lower from 2014 to 2018. The low faecal coliform median values compared to the relatively high mean values indicates that the microbiological quality of the treated wastewater is highly skewed[9], which is consistent with the effective removal of faecal bacteria under most conditions, and occasional bypass discharges causing poor removal of faecal bacteria for short periods.

Table 2-8: Summary results for Porirua WWTP treated wastewater faecal coliform concentrations (cfu/100ml) by year (PCC daily samples)

Year	N. samples	Minimum	Median	Mean	Maximum
2011	360	4	271	5,062	470,000
2012	366	4	564	25,099	3,000,000
2013	365	2	160	11,089	843,636
2014	365	4	65	4,846	296,000
2015	311	4	60	2,945	196,000

[9] Generally low with occasional very high value

2016	262	4	70	1,637	59,200
2017	260	4	16	718	47,000
2018	263	4	36	347	15,000
2019	129	4	120	890	27,700
2011 - 2019	2681	2	116	6,924	3,000,000

A limited three sample virus monitoring programme (Norovirus GI and II, Enterovirus and Adenovirus) was conducted in September 2019 under normal flow conditions. The results presented in Table 2-9 show that for those three samples, the WWTP achieved between 1 and 4 log_{10} reduction (between 10-fold and 10,000-fold) of the target viruses. This is within the range reported previously for other WWTPs in New Zealand (McBride G. , 2017). Note that the method for analysis for this virus monitoring programme (qPCR) does not distinguish between viable and non-viable cells so the treated wastewater samples are expected to over-state the concentrations of 'live' viruses.

Table 2-9: Porirua WWTP untreated and treated wastewater virus monitoring results

Sampling date	Virus type	Untreated wastewater (genome copies/L)	Treated wastewater (genome copies/L)	Log_{10} reduction
9 Sept 2019	Norovirus genotype I	4.8×10^5	1.7×10^4	1
	Norovirus genotype II	1.0×10^7	5.6×10^4	2-3
	Enterovirus	8.4×10^4	1.0×10^2	2-3
	Adenovirus	3.3×10^5	5.7×10^4	1
16th Sept 2019	Norovirus genotype I	8.2×10^4	6.1×10^3	1
	Norovirus genotype II	4.9×10^6	6.3×10^4	2
	Enterovirus	5.2×10^4	5.0×10^1	3
	Adenovirus	2.3×10^5	3.6×10^4	1
23rd Sept 2019	Norovirus genotype I	8.3×10^4	6.7×10^2	2
	Norovirus genotype II	4.7×10^6	3.8×10^3	3
	Enterovirus	1.5×10^5	5.0×10^1	3-4
	Adenovirus	1.0×10^6	1.5×10^4	2

2.7.2 Emerging organic contaminants

Northcott Research Consultants Limited (NRC Ltd) was engaged by Wellington Water to analyse residues of emerging organic contaminants (EOCs) and the toxicity of wastewater from the Porirua WWTP. Sample methods and results are described in full in Appendix E, and summarised below.

EOCs include a vast number of chemicals used in industrial and domestic cleaning products, paints, inks and surface treatments, kitchen and laundry detergents, personal care products, cosmetics, pharmaceuticals and medicines. Products and medicines containing EOCs are used daily by the human population and enter domestic wastewater from bathing, laundry and toileting activities. Treated urban wastewater is one of the major sources of EOCs to the environment in New Zealand. EOC monitoring was conducted to better understand the level of risk associated with the Porirua WWTP treated wastewater discharge to coastal waters.

Three 24-hour composite paired samples of untreated and treated wastewater from the Porirua WWTP were provided for the analysis of EOCs by staff of Veolia Water who operate the WWTP on behalf of Wellington Water. A total of eighty-five individual EOCs representing nine different classes of EOCs were recommended for analysis. These included:

- Alkylphosphate flame retardants (11 compounds)
- Industrial alkylphenols (7 compounds)
- Insect repellents (3 compounds)
- Nitro- and polycyclic musk fragrances (11 compounds)
- Paraben preservatives (11 compounds)
- Pharmaceuticals (10 compounds)
- Phenolic antimicrobials (8 compounds)
- Phthalate esters and plasticisers (13 compounds)
- Steroid hormones (11 compounds)

Of the eighty-five EOCs tested, between 42 and 45 were detected in the influent and between 38 and 39 were detected in the treated wastewater over the three sampling occasions. Northcott (2019) described the profile and relative concentration of EOCs in the Porirua WWTP samples as “being similar to that observed in influent and treated wastewater from other wastewater treatment plants in New Zealand”.

Northcott (2019) assessed the risk of twenty-three EOCs measured in the Porirua treated wastewater for which ‘Predicted No Effect Concentration’ (PNEC) values are available, and found that most of these EOCs present either no risk or a low level of risk to aquatic organisms exposed to undiluted treated wastewater from the Porirua WWTP.

However, the concentration of three contaminants: bisphenol-A, 17β-estradiol, and estrone, exceeded their respective PNEC values by 1 to 2 orders of magnitude, representing a moderate risk to aquatic organisms exposed to the undiluted treated wastewater. Based on these results, the author concluded that a minimum 36 -fold dilution of the Porirua WWTP treated wastewater discharge, as it mixes with the receiving waters, would reduce the concentration of these chemicals sufficiently to present no risk to marine biota (Table 2-10 and Appendix E).

Table 2-10: Risk characterisation for EOCs detected in Porirua WWTP treated wastewater (after Northcott 2019)

Emerging Organic Chemical	Porirua WWTP treated wastewater concentration range (ng/L)	Predicted No Effect Concentration (ng/L)	Dilution required for no risk to aquatic organism (x-fold)
Industrial alkylphenols			
Technical nonylphenol	179-371	330	0
Alkylphosphate Flame Retardants			
TnBP	195-302	660,000	0
TiBP	161-182	150,000	0
TBEP	1316-5710	1,300	0
TCEP	452-526	460,000	0
TCPP	3678-4038	160,000	0
TDCP	491-602	1,300	0
TPP	34.9-60.6	740	0
Phenolic Antimicrobials			
Triclosan	115-122	100	0
Polycyclic musks			
Galaxolide	5510-6160	68,000	0
Tonalide	123-137	3,500	0
Pharmaceuticals			
Carbamazepine	451-536	9000	0
Diclofenac	657-913	9800	0
Ibuprofen	30.7-62.0	13875	0
Naproxen	10.3-182	14,199	0
Salicylic acid	15.2-36.3	118,700	0
Plasticisers			
Bisphenol-A	127-247	60	4
Benzyl butyl phthalate	12.7-17.8	51,000	0
Di-n-butyl phthalate	66.4-318	10,000	0
Diethyl phthalate	112-140	940,000	0
Dimethyl phthalate	8.99-226	3,251,000	0
Estrogenic steroid hormones			
17β-estradiol	7.96-49.8	2.0	25
Estrone	51.5-214	6.0	36

[A]N.D = not detected; [B]NA = not available

Analyte key:

TnBP = Tributyl-phosphate
TiBP = Tri-isobutyl-phosphate
TBEP = Tris-(2-butoxyethyl) phosphate
TCEP= Tris(2-chloroethyl) phosphate
TCPP = Tris (1-chloro-2-propyl) phosphate
TDCP = Tris[2-chloro-1-(chloromethyl)ethyl] phosphate
TPP = Triphenylphosphate

2.7.3 Direct toxicity assessment

Toxicity can be measured in terms of the effects of individual constituents in the wastewater by assessment against water quality guidelines, or by Direct Toxicity Assessment which measures the aggregate effect to organisms from all contaminants contained in the treated wastewater (including the EOC's described above). Direct Toxicity Assessment (DTA) of the Porirua WWTP treated wastewater samples was completed by the Cawthron Institute using a species of green algae, a burrowing amphipod and blue mussel embryos, providing a range of taxa representing those found in the marine receiving environment. The test species, their sources, and the test protocols employed for DTA are listed in Table 2-11.

The algal test incorporates several consecutive generations over its 96-hour duration and therefore provides an indication of potential chronic (long-term) toxicity. The blue mussel assay utilises the early life stage embryos and is the most sensitive of the three toxicity assays used in the DTA procedure.

Table 2-11: Species and testing protocols employed for direct toxicity assessment

Description	Algae	Amphipod	Bivalve[A]
Test Standard	ASTM E1218-04 (2012)	ASTM E1192-97 (2014)	ASTM E724-98 (2012)
Test Species	*Dunaliella tertiolecta*	*Paracorophium excavatum*	*Mytilus galloprovincialis*
Source	Laboratory Culture (CS-175)	Delaware Bay	Tennyson Inlet

[A] embryo larval development

The results of the DTA of three samples of Porirua WWTP treated wastewater, obtained over three consecutive weeks, are summarised in Table 2-12, and the full laboratory test report is included in Appendix E. Prior to testing, the treated wastewater samples were adjusted to a specific salinity that is optimal for the three marine test species. The addition of the required volume of standard brine solution dilutes the treated wastewater samples and this salinity adjusted sample becomes the lowest dilution test solution of treated wastewater (highest % treated wastewater composition). This corresponded to 80%, or 81% treated wastewater composition for the algal tests and 84% treated wastewater composition for the amphipod tests.

The usual endpoint for the algal toxicity test is growth inhibition, but a growth stimulation was observed for three tested treated wastewater samples. This effect is typically observed during algal toxicity assessments of treated wastewater and results from the presence of nutrients (phosphate and nitrates) in the sample. Growth inhibition of the algae was not observed for any of the tested Porirua treated wastewater samples, even at the highest test concentrations, corresponding to an treated wastewater composition of 80% and 81%. Similarly, the tested Porirua treated wastewater did not produce a toxic response in the amphipod test that reduced their survival, even at the highest concentration that corresponded to an treated wastewater composition of 84%. The results for algae and amphipod test organisms indicate no risk of toxicity beyond just a few metres of the WWTP outfall, which is consistent with the finding and the results of the Cawthron ecology survey described in Section 3.4.

Table 2-12: Results of Direct Toxicity Assessment as % treated wastewater

	15-October 2019			22-October 2019			30-October 2019		
Parameter	Algae	Amphi-pods	Blue mussel	Algae	Amphi-pods	Blue mussel	Algae	Amphi-pods	Blue mussel
EC_{10}[A] (%) (95%CI)	>81	>84	0.78	>81	>84	1.27	>80	>84	0.38
EC_{50}[B] (%) (95%CI)	>81	>84	1.42	>81	>84	1.49	>80	>84	0.60
NEC[C] (%) (± SE)	n/c[D]	n/c	1.22	n/c[D]	n/c	1.21	n/c	n/c	0.40
NOEC[E] (%)	81	84	0.78	81	84	0.78	80	84	0.39
LOEC[F] (%)	>81	>84	1.56	>81	>84	1.56	>80	>84	0.78
TEC[G] (%)	>81	>84	1.1	>81	>84	1.1	>80	>84	0.55

[A] median effective concentration substance at which 10% of the test population was affected. [B]median effective concentration substance at which 50% of the test population was affected. [C] no effect concentration. [D] not calculated. [E] no observable effect concentration. [F] lowest observable effect concentration. [G] threshold effect concentration, that should not cause any effect of the related measured endpoint.

The blue mussel embryo was by far the most sensitive test organism. The composition of the discharge plume necessary to ensure no toxicity ranged between 0.55 and 1.1% treated wastewater over the three sampling occasions, which corresponds to 91-fold and 182-fold dilution. This result suggests that mussels might not be found in close proximity to the outfall where predicted dilutions are less than 10-fold. However, the little black mussel (*Xenostrobus pulex*), a close relative of the blue mussel, is found in abundance at most intertidal sites near the outfall.

2.7.4 Future treated wastewater quality

The WWTP upgrades that are currently underway will be completed in two stages:

- By the 30th of June 2021, a new Duron UV treatment system will be installed. This upgrade of the UV system will allow disinfection of flows to a capacity of 1,500 L/s. The new Duron UV system will be installed in a below ground concrete channel and will operate in parallel with the existing TAK UV system. While the upgraded plant will have the flexibility to operate in a 50:50 flow split mode, the new DURON system will be used as the duty (i.e. taking most of the flow – 930 L/s). The new DURON system has more modern lamp technology, a more efficient lamp cleaning system, and lower labour requirements for cleaning than the TAK system. The TAK system will only operate when flows in excess of 930L/s are received at the WWTP (currently <3% of the time). The system specification is based on achieving at treated wastewater concentration of the target indicator bacteria (enterococci) of 1000 organisms/100 mL (95%ile).
- By the 30th of June 2023, upgrade piping from milliscreens to aeration basin, to increase the flow capacity from 1,000 L/s to 1,500 L/s. This would either be a below ground pipe, or an above ground concrete channel and concrete chamber at the WWTP building.

After completion of these WWTP upgrades, all wastewater discharged from the WWTP will be fully treated, delivering a better-quality treated wastewater than is achieved at present, especially during periods of peak flow. Predictions of the level of removal of viruses by secondary treatment and UV disinfection is summarised in Table 2-13 (See Appendix N).

Table 2-13: Predicted log removals of norovirus, enterovirus and adenovirus in Porirua WWTP during normal and wet weather flows post 2022 (Loughran, Jenner and Haverland 2020)

	Norovirus	Enterovirus	Adenovirus
Secondary Treatment	2.1	3.2	2.7
UV disinfection at 306 L/s & 440 L/s	4.9 & 3.8	4.9 & 3.8	1.2 & 0.8
Combined secondary and UV at 306 L/s & 440 L/s	>5.0	>7.0	>3.0
UV disinfection at 1500 L/s	1.9	1.9	0.2
Combined secondary and UV at 1500 L/s	>4.0	>5.0	>2.5

Population growth projected by both Porirua City and Wellington City Councils is expected to gradually increase average daily wastewater flows and contaminant loads. The treatment process modelling predicts that, if population growth occurs as projected, then over the proposed 20-year resource consent duration without any further process improvements to the WWTP, final discharge concentrations of total suspended solids, BOD, ammonia nitrogen and total nitrogen will gradually increase. No process improvements to the WWTP are proposed at this time. However, the need for future improvements will be reassessed as part of the monitor, review and respond mitigation approach described in Section 5.13 of this application. The modelled treated wastewater concentrations for 2018 and 2043 are set out in Table 2-14.

Table 2-14: Modelled treated wastewater quality for 2018 and 2043

Parameter	Units	2018				2043			
		Summer		Winter		Summer		Winter	
		Median	90%ile	Median	90%ile	Median	90%ile	Median	90%ile
Flow	m^3/d	26,500	31,800	26,500	31,800	38,200	45,800	38,200	45,800
BOD	mg/L	3.9	4.9	5.15	6.5	6.1	7.8	9.2	15.7
TSS	mg/L	15	18.7	15	18.7	21	24.5	21	24.5
Ammonia	mg/L	1.1	1.7	2.7	6.5	2.75	4.8	13.45	25.8
TN	mg/L	3.1	4.1	6.1	8.7	5.2	7.6	15.7	28.3
TP	mg/L	2.5	2.63	2.5	2.63	2.6	2.67	2.6	2.67

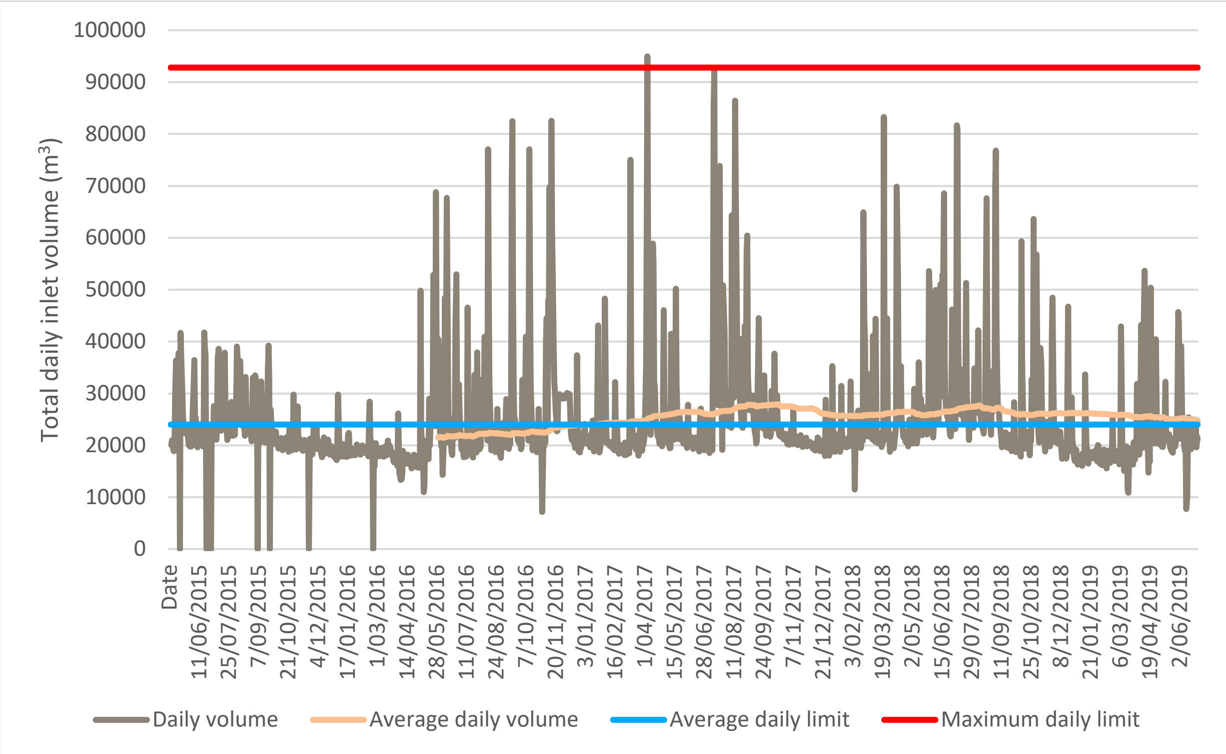
The modelling is not able to predict future EOC concentrations in the treated wastewater, but it is anticipated that a reduction in solids retention time could result in less effective removal of EOCs by WWTP processes, and hence higher EOC concentrations in the final discharge by year 2043.

The potential adverse environmental effects on aquatic life of these predicted changes in treated wastewater quality are addressed in Section 5.8. The assessment has assumed, as a starting point or 'worst case' assessment, that there are no further improvements to the WWTP over the proposed 20 year of the consent. In reality, WWL would continuously monitor and review the performance of the WWTP to maintain an appropriate treated wastewater quality. However, this assumption has been made for the purposes of the effects assessment because, at this time, it is not clear what future improvements may be required and so WWL is not in a position to volunteer any specific conditions with regard to future upgrades (beyond the monitor, review and respond mitigation approach which is discussed in Section 5.13).

2.8 Compliance with existing consent conditions

2.8.1 Wastewater discharge flow

The existing discharge consent permits an average discharge flow of 24,000 m^3 per day and a peak discharge of 92,800 m^3 per day. Figure 2-6 presents the total daily inflow of wastewater to the WWTP from June 2015 to June 2019, as well as the running average daily flow calculated over a period of 12 months. The graph shows that the average (mean) inflow per day (and, consequently/presumably, the average discharge) exceeded the average daily flow consent limit at the beginning of 2017 and has remained above the consent limit since that time[10]. The daily maximum inflow has exceeded the consent limit only once, in April 2017.



[10] Calculated as a running average from daily measurements over the previous 12 months

Figure 2-6: Daily inlet volume and running average daily volume compared with consent limits

2.8.2 Wastewater quality standards

Condition 11 states that, from 2003 onwards (i.e. after the UV treatment was installed), the following treated wastewater standards shall apply:

(a) Based on daily 24-hour flow proportioned composite sampling, with a running geometric mean and 90 percentile calculated each day using 90 consecutive daily test results, the effluent shall meet the following standard:

i. Biochemical Oxygen Demand: Geometric mean of 90-day consecutive BOD_5 values shall not exceed 30 g/m^3 and no more than 10% of 90 consecutive daily values shall exceed 75 g/m^3.

ii. Suspended solids: Geometric mean of 90 consecutive daily suspended solids values shall not exceed 30 g/m^3 and no more than 10% of 90 consecutive daily values shall exceed 75 g/m^3.

(b) Based in no fewer than 20 representative grab samples per month the effluent shall not exceed the following standard:

i. Faecal coliform bacteria: Geometric mean 1000 per 100 millilitres and no more than 10% of monthly samples shall exceed 2000 per 100 millilitres.

(c) Based on no fewer than one flow proportioned 24-hour composite samples collected in a normal Monday to Friday on quarterly basis concentrations of metals and other specified compounds shall not exceed the following limits:

Arsenic	*0.5 g/m^3*
Cadmium as the element	*0.05 g/m^3*
Chromium	*0.2 g/m^3*
Copper as the element	*0.8 g/m^3*
Nickel as the element	*0.05 g/m^3*
Lead as the element	*0.5 g/m^3*
Zinc as the element	*2.0 g/m^3*
Mercury as the element	*0.002 g/m^3*
Phenol	*0.2 g/m^3*
Cyanide as CN	*0.1 g/m^3*
Chlorinated hydrocarbons	*0.01 g/m^3*

The treated wastewater BOD_5 running geometric mean and running 90th percentile values calculated from 90 consecutive daily samples from January 2011 to July 2019 are summarised in Figures 2-7 and 2-8, respectively. The graphs show that BOD_5 has consistently complied with the geometric mean standard and has complied with the 90th percentile standard since the beginning of 2012.

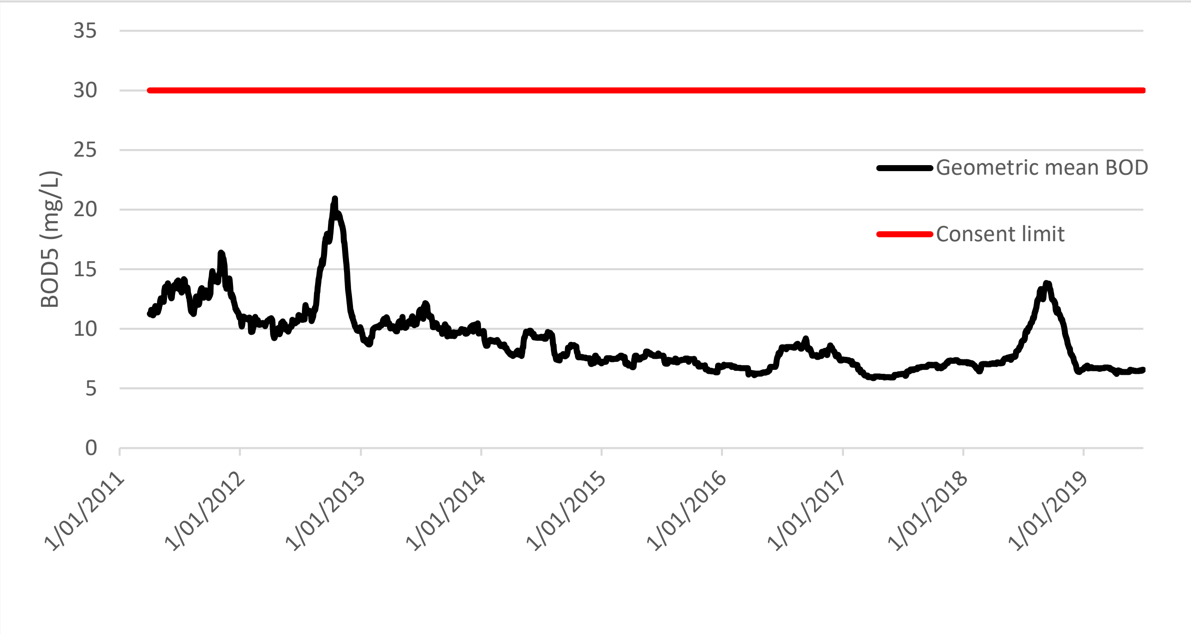


Figure 2-7: Treated wastewater BOD_5 running geometric mean compared with consent limit (January 2011 - July 2019)

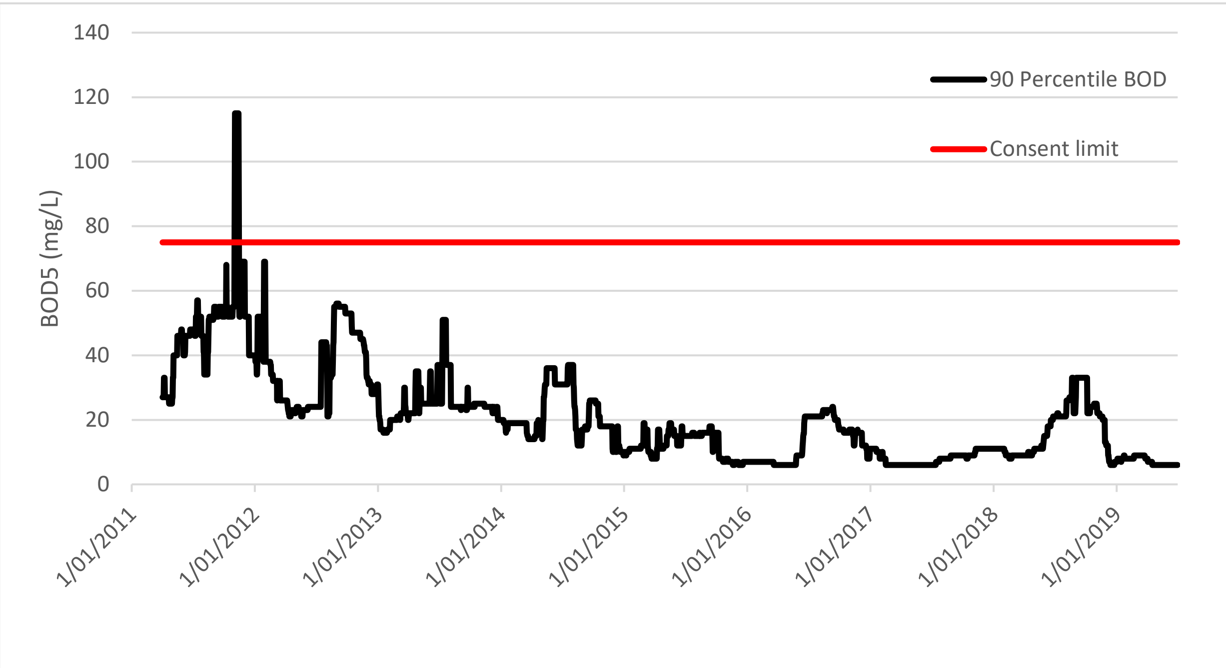


Figure 2-8: Treated wastewater BOD_5 running 90^{th} percentile compared with consent limit (January 2011 – July 2019)

The treated wastewater suspended solids running geometric mean and running 90^{th} percentile values calculated from 90 consecutive daily samples from January 2011 to July 2019 are summarised in Figures 2-9 and 2-10, respectively. The graphs show that the suspended solids content has consistently complied with the geometric mean standard and has complied with the 90-percentile standard since mid-2014.

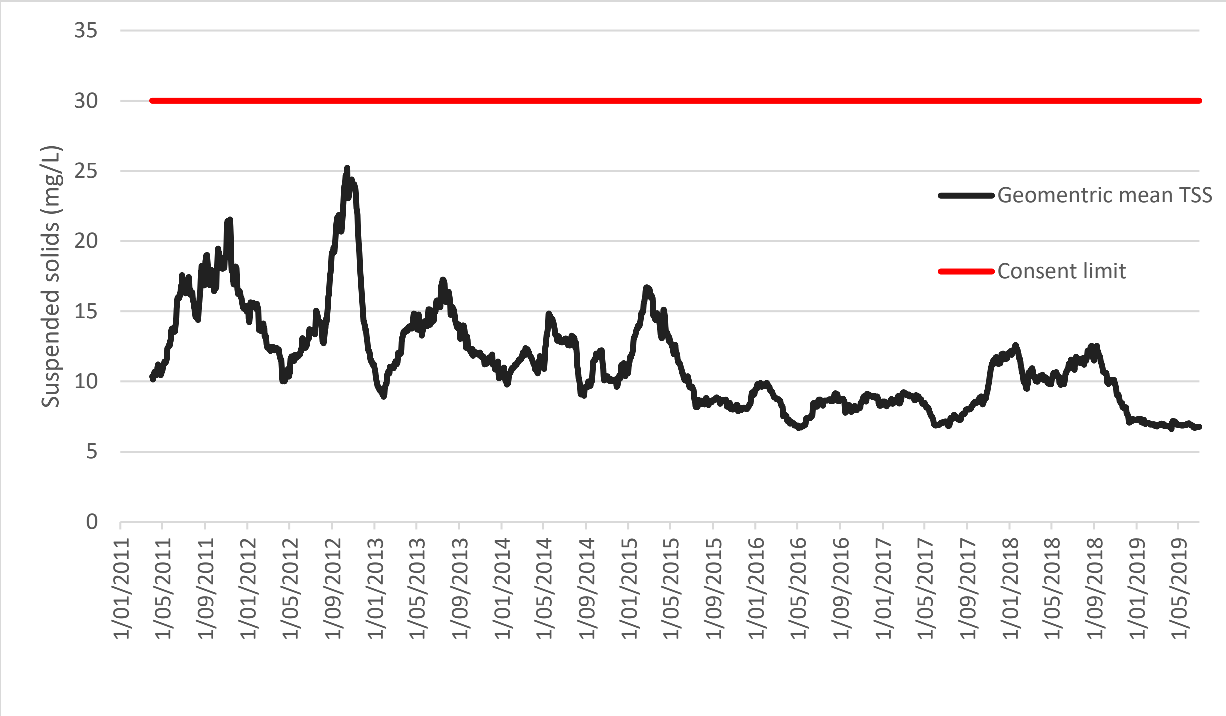


Figure 2-9: Treated wastewater suspended solids running geometric mean compared with consent limit (January 2011 – July 2019)

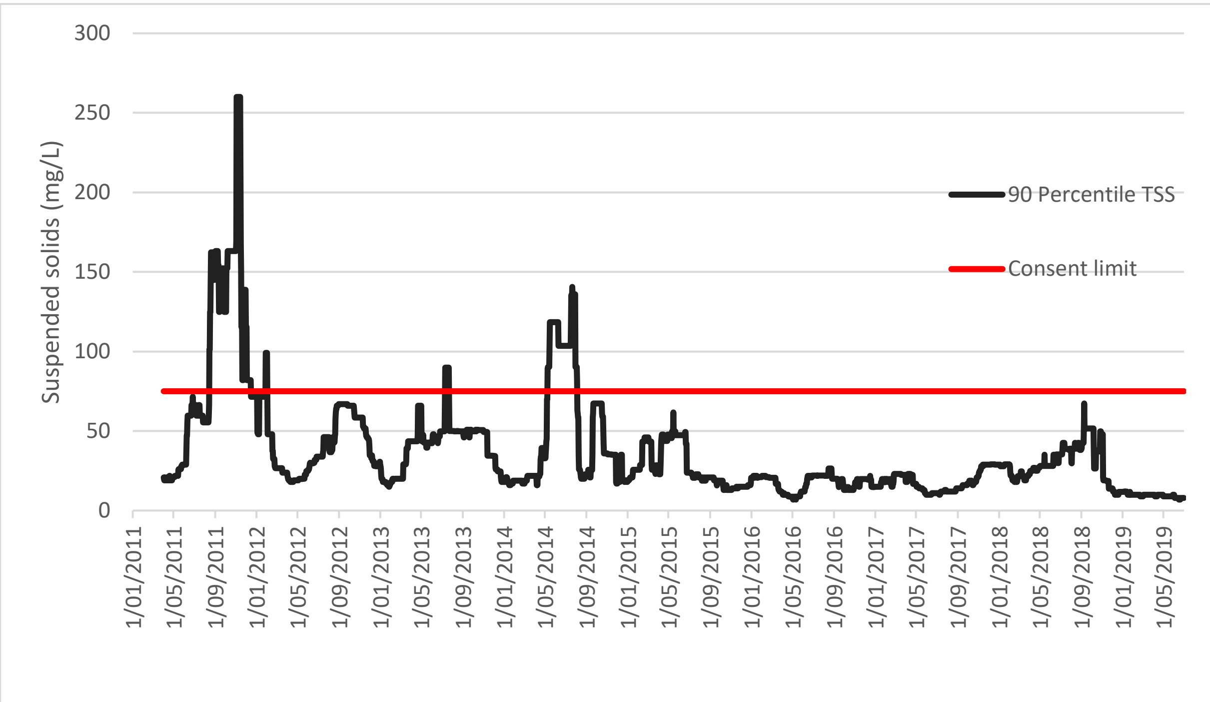


Figure 2-10: Treated wastewater suspended solids 90th percentile compared with consent limit (January 2011 – July 2019)

The treated wastewater faecal coliform running geometric mean and running 90th percentile values calculated from 20 representative grab samples per month, from January 2011 to July 2019 are summarised in Figures 2-11 and 2-12, respectively. The graphs show that the geometric mean standard has been largely complied with since the beginning of 2012 while the 90-percentile standard has been frequently exceeded throughout the assessment period. The rate of compliance has improved since 2014, after construction of a third clarifier which results in lower treated wastewater solids performance during wet weather and hence improved disinfection.

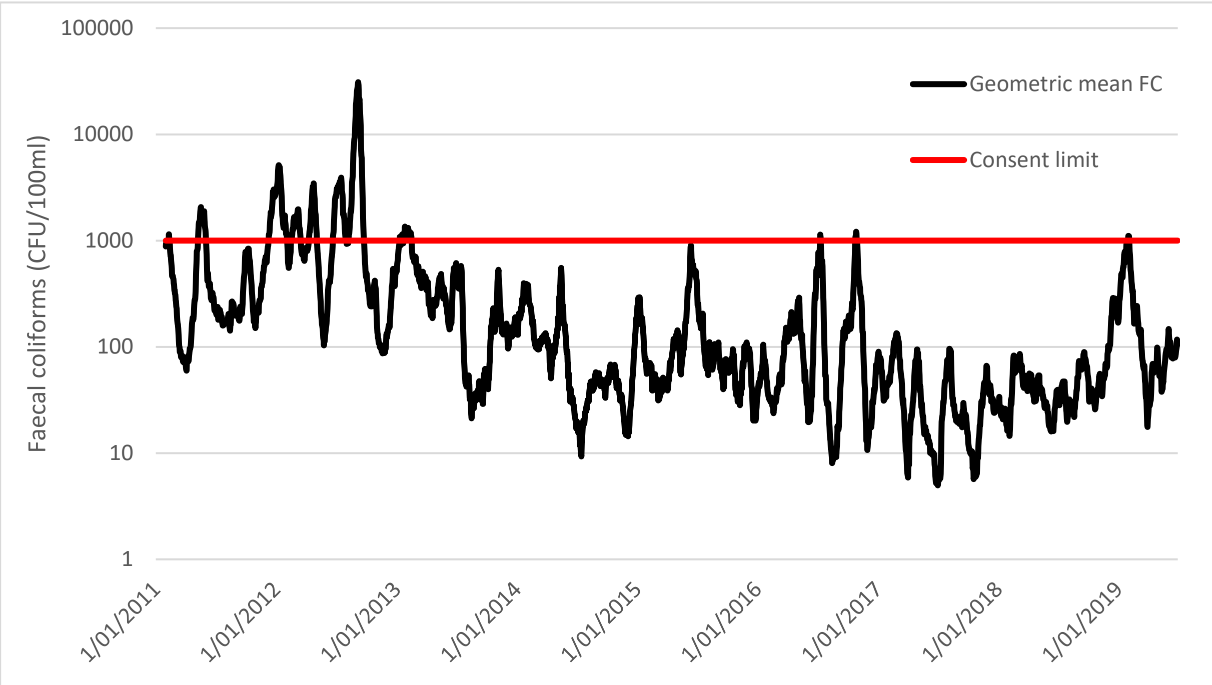


Figure 2-11: Treated wastewater faecal coliforms running geometric mean compared with consent limit (January 2011 – July 2019)

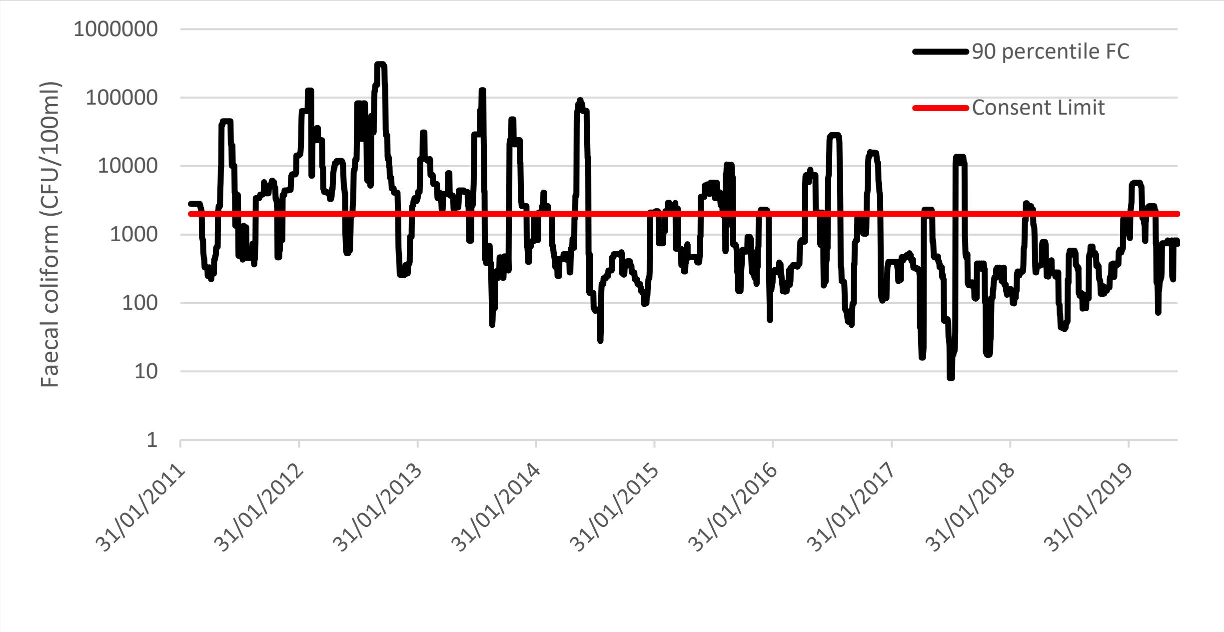


Figure 2-12: Treated wastewater faecal coliform 90th percentile compared with consent limit (January 2011- July 2019)

The permitted maximum concentration of metals and other contaminants in the treated wastewater specified by Condition 11(c) have been consistently complied with, as shown in Table 2-6.

2.8.3 Compliance summary

Table 2-15 provides a summary of compliance with Condition 11 of consent WGN980083 [24384]. It is acknowledged that the degree of compliance has historically been poor in relation to both the quantity and quality of wastewater discharged. While the average quality of the discharge has been mostly compliant, the 90-percentile values have not, which is a reflection of the deterioration that occurs during sustained wet weather when the hydraulic capacity of the plant is exceeded and a proportion of the flow bypasses part of the treatment process.

Nevertheless, the quality of the discharge has improved considerably in recent years and is set to improve further after June 2023 when the increased capacity will allow full treatment all flows received at the WWTP.

Table 2-15: Summary of compliance with consent discharge standards

Consent Condition	Variable	Compliance Assessment	
Activity description	Discharge flow rate	Average daily flow: non-compliant	✕
		Maximum flow: exceeded once in April 2017	✕
11(a)(i)	BOD	Geometric mean: full compliance	✓
		90-percentile: complied with since January 2012	✓

Consent Condition	Variable	Compliance Assessment	
11(a)(ii)	Suspended solids	Geometric mean: full compliance	✓
		90-percentile: complied with since January 2014	✓
11(b)(i)	Faecal coliforms	Geometric mean: substantially complied with	✓
		90-percentile: non-compliant	✗
11(c)	Metals	Full compliance	✓

3 The Receiving Environment

As noted in Section 2, the proposed discharge of treated wastewater from the existing shoreline outfall is to rocky coastal habitat at Rukutane Point, located approximately 1000m south west of the Titahi Bay Surf Club. Dispersion modelling shows that the discharge plume, at very dilute levels, will potentially affect an area of coastal water extending southwest as far as Green Point and northwest as far as the northern end of Whitireia Peninsula. No observable effect on water quality or marine ecology is likely beyond that area[11].

This section of the application describes the receiving environment including the social and cultural values associated with it.

3.1 Physical character and values of the coastline

An assessment of the distribution of and risks to coastal habitats in the Greater Wellington Region identified the southwest coast, the general receiving environment for the WWTP discharge, as an area of "*exposed, rugged coastline backed by hard rock and primarily grassland catchments*" (Robertson & Stevens, 2007). The authors observed that, south of Porirua Harbour "*greywacke uplands extend to the edge of the coastal margin and consequently the shoreline is exposed and dominated by steep cliffs, hard rocky shores and steep gravel beaches*".

Porirua's open coast includes a large area of exposed, rocky shore and shallow subtidal reef habitat with high biodiversity of animals and plants. Morrisey, et al (2019) (Appendix F) found marine habitats in the area to be of moderate to high ecological value, and generally in good condition, consistent with the non-intensive use of land in the contributing catchment. A submerged isthmus known as 'The Bridge' is located 500 m to the west of the outfall. The Bridge is an area of shallow rock, covered in places by patches of small stones, which extends between the mainland and Mana Island. The Bridge is designated as an area of important conservation value in the Greater Wellington Regional Council's Regional Coastal Plan (RCP) for its marine flora and fauna of national significance and as a significant geological feature in the Proposed Natural Resources Plan (PNRP) (see Figure 3-2 and Table 3-1). The location of the former Korohiwa whaling station sits directly below the WWTP and adjoining the Bridge (see Figure 3-1 and Table 3-1).

The stretch of rocky coast from Rukutane Point to the Titahi Bay beach is recognised as a regionally significant geological feature in the PNRP, containing interbedded greywacke and argillite Flysch sequence (see Figure 3-2 and Table 3-1). Stevens & Robertson (2006) described the coastal habitat of Titahi Bay as a relatively sheltered, crescent shaped beach consisting mainly of sand but with cobbles at its midpoint and rock headland at either end.

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[11] Dispersion modelling indicates that the discharge plume could theoretically extend to the north as far as the entrance to Porirua Harbour but at that point minimum dilutions would exceed 1000-fold (Streamlined 2019).

The margins of the beach include relatively steep dunes with marram grass and flax and there is an artificial seawall at the southern end.

Whitireia Peninsula, north-west of Titahi Bay, forms the western side of the entrance to Porirua Harbour. The Peninsula in recognised as a site with significant mana whenua values. It is an important archaeological site including a pā, terraces and middens which represent Māori occupation dating up until about the 1840s. Much of the area is now included in Whitireia Park and co-managed by GWRC and Ngāti Toa.

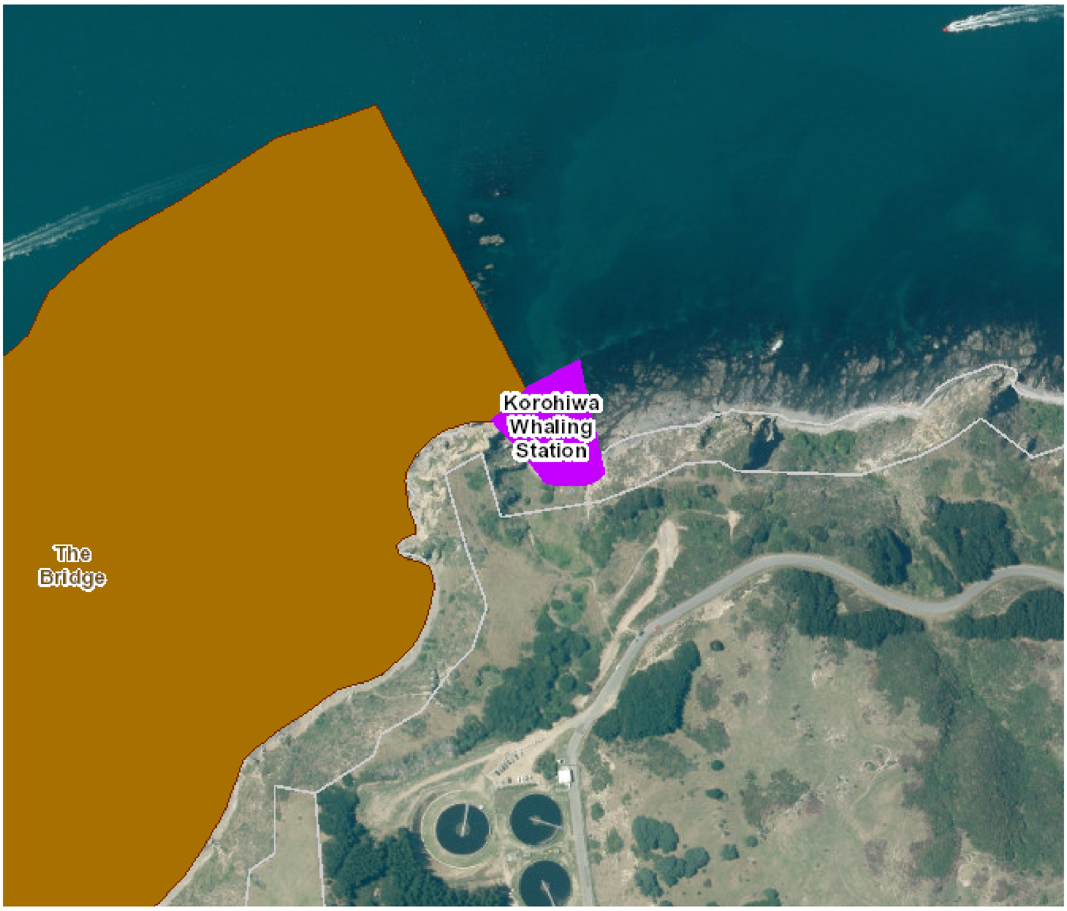

Figure 3-1 - Location of the Korohiwa Whaling Station Scheduled in the PNRP

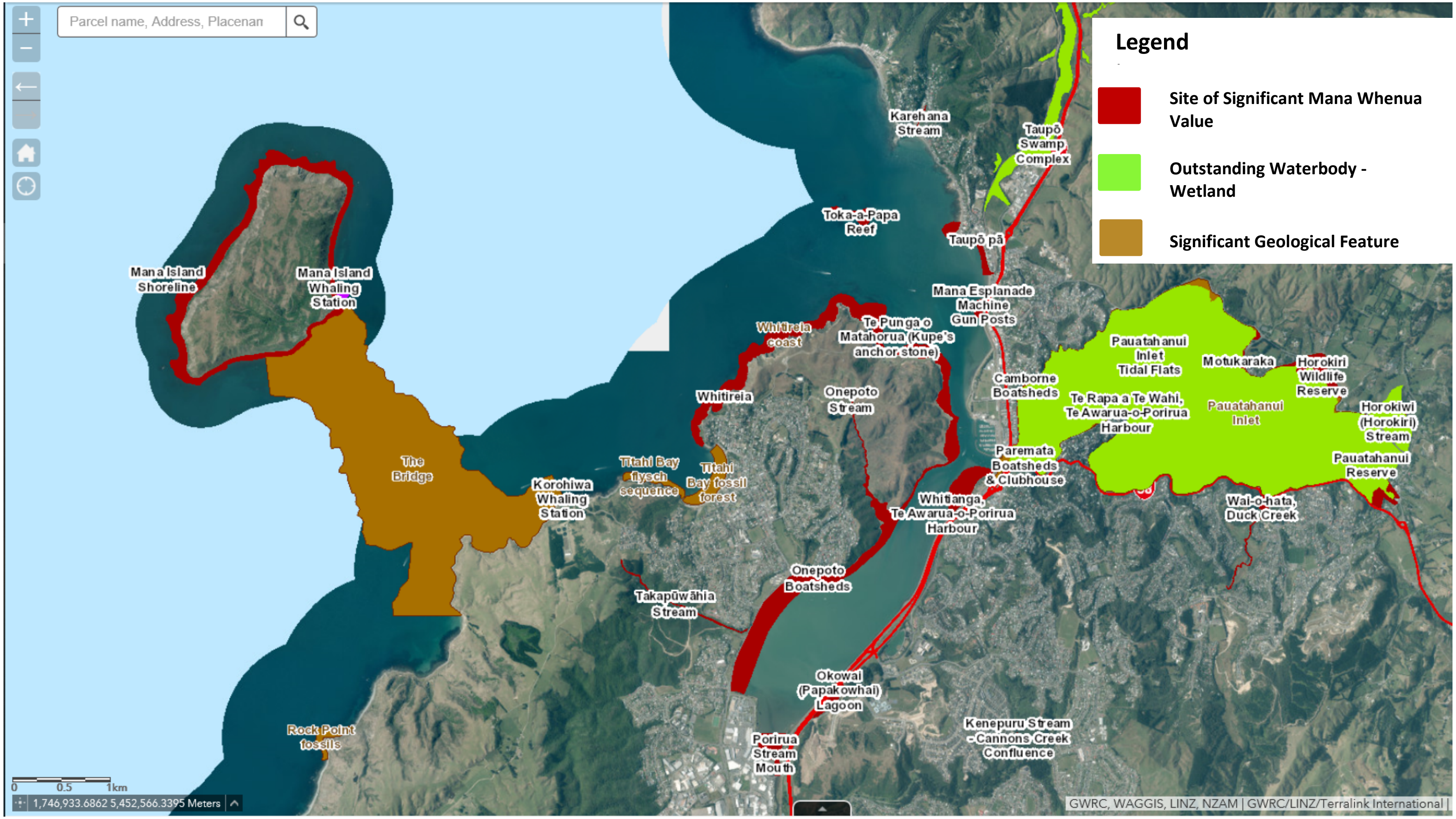

Figure 3-2: Values of the Porirua coastal area and harbour scheduled in the PNRP (see also Table 3-1)

Table 3-1: Values/features of the west coast of Porirua Scheduled in the Proposed Natural Resources Plan

PNRP Schedules	Feature / Location	Values
Schedule B: Ngā Taonga Nui a Kiwa – Ngāti Toa Rangatira	Te Awarua-o-Porirua (Porirua Harbour including contributing streams)	Ngā Mahi a ngā Tūpuna: At Porirua, Ngāti Toa settlements were located exclusively in the coastal area around the harbour and outer catchment. The natural flows and processes of the harbour are a defining feature of traditional life. Te Mahi Kai: The abundance of natural life historically supported by the harbour provided a wealth of kai moana. This is recorded in numerous historical accounts by Ngāti Toa and early foreign visitors. The streams that feed into the harbour also provided a plentiful supply of freshwater fish, forest foods and rongoā. Te Mana o te Tangata: The abundance of kai moana provided by the harbour is renowned by iwi Māori and recorded in legend. In addition to providing sustenance for Ngāti Toa and guests, kai moana gathered from the harbour was an important commodity for trade and gifts. There are numerous accounts and images to support this. Te Manawaroa o te Wai: Despite excessive land reclamations, modification, and environmental damage the harbour continues to support a variety of endemic wildlife; including endangered species. There is vast potential for environmental restoration and this is a primary objective for Ngāti Toa. The only remaining traditional settlements of Ngāti Toa in the Wellington region are located in the coastal area around the harbour at Takapūwāhia and Hongoeka. Environmental issues continue to have a direct and significant impact on successive generations. Te Mana o Te Wai: A defining feature of Ngāti Toa settlement in the Wellington area and integral to Ngāti Toa identity. Wāhi Mahara: Numerous sites in and around the harbour foreshore bear testament to not only the history of Ngāti Toa, but also the formative history of New Zealand.
	Te Moana o Raukawa	Ngā Mahi a ngā Tūpuna: While travelling, Te Rauparaha observed a trading ship passing through Te Moana o Raukawa as he stood at a well-known lookout point in Omere near Cape Terawhiti. The strategic advantages of Te Moana o Raukawa as a major travel and trade route were well noted by those who observed the ship and the layout of the land. When Te Rauparaha returned to Kawhia to find that the on-going conflicts had intensified he commenced a historic campaign to lead

PNRP Schedules	Feature / Location	Values
		Ngāti Toa from Kawhia to settle the land around Te Moana o Raukawa. Te Mahi Kai: The abundance of natural life historically supported by Te Moana o Raukawa provided a wealth of kai moana. This is recorded in numerous historical accounts by Ngāti Toa and early foreign visitors. The passing of the Treaty of Waitangi (Fisheries) Settlement Act 1992 provided iwi with quota shares of which Ngāti Toa gained benefit within the FMA2 (Tepāo Kapo ki Turakirae). Te Mana o Te Tangata: The abundance of kai moana provided by Te Moana o Raukawa is renowned by iwi Māori and recorded in legend. In addition to providing sustenance for Ngāti Toa and guests, kai moana gathered from Te Moana o Raukawa was an important commodity for trade and gifts. There is a shared mana whenua, mana moana area from Turakirae to Pipinui Point with Taranaki Whānui. Te Manawaroa o te Wai: This body of water has extensive pressures placed on it from commercial fisheries, marine transport, as well as stormwater and wastewater discharges form Wellington City and Hutt City. Recreational and commercial fisheries are still sustainable if somewhat diminished. Te Mana o Te Wai: A defining feature of Ngāti Toa settlement in the Wellington area and integral to Ngāti Toa identity. Wāhi Mahara: Numerous sites in and around Te Moana o Raukawa bear testament to not only the history of Ngāti Toa, but also the formative history of New Zealand.
Schedule C3: Sites of significance to Ngāti Toa Rangatira.	Whitireia	papa kāinga, kāinga, pā, mahinga kai, taunga ika, wāhi tapu, urupā, Te Ara o Kupe, tohu whenua, wāhi whakarite, mahinga kai, kai moana, mahinga mataitai, mara kai
Schedule E: Sites with significant historic heritage values.	Korohiwa Whaling Station	Archaeological site
Schedule F2c: Significant	Mana Island foreshore:	Supports the only breeding population of shore plover in the Wellington region, comprising up to 20% of the global population of this species.

PNRP Schedules	Feature / Location	Values
Habitats for indigenous birds in the coastal marine area		Supports little penquins with access to one of less than half a dozen relatively large and secure nesting colonies remaining in the Wellington region. Five threatened or 'at risk' species are known to be regular visitors to this site: shore plover, little penguin, red-billed gull, white fronted tern and pied shag.
	Onepoto Arm, Porirua Harbour	The Onepoto Arm is one of only a handful of relatively large estuaries in the Wellinigton region and is therefore a regionally important stop-off site for several migrant shorebird species such as SI pied oystercatcher and bar tailed godwit. At least nine threatened or 'at risk' species are known to be resident or regular visitors to this site: royal spoonbill, pied shag, black shag, SI pied oystercatcher, variable oystercatcher, bar tailed godwit, pied stilt, banded dotterel, red-billed gull and Caspian tern.
	Pauatahanui Inlet, Porirua Harbour	Pauatahanui Inlet is one of only a handful of relatively large estuaries in the Wellington region and is therefore a regionally important stop-off site for several migrant shorebird species such as SI pied oystercatcher and bar tailed godwit. At least eleven threatened or 'at risk' species are known to be resident or regular visitors to this site: royal spoonbill, pied shag, black shag, little black shag, SI pied oystercatcher, variable oystercatcher, bar tailed godwit, pied stilt, banded dotterel, red-billed gull and Caspian tern.
Schedule F5: Habitats with significant indigenous biodiversity values in the coastal marine area.	Subtidal rocky reefs. Most of the south west coast	Significant indigenous biodiversity
	Giant kelp (*Macrosystis pyrifera*). Patchy distribution	Significant indigenous biodiversity
Schedule J: Significant geological features in coastal marine area.	Mana Bridge, remnant marine terrace drowned in Holocene Postglacial marine transgression.	Regionally significant
	Tītahi Bay Pleistocene aged (last interglacial 120,000-80,000 yr) fossil forest.	Nationally significant
	Whitireia shore platforms; interbedded sandstone and mudstone flysch;	Regionally significant

PNRP Schedules	Feature / Location	Values
	fossil worm tubes (Torlessia mackayi Bather). Whitireia peninsula coast from Titahi Bay to Onehunga Bay.	
	Tītahi Bay Triassic interbedded greywacke and argillite Flysch sequence. Southern side of Titahi Bay from end of boat sheds to point.	Regionally significant

3.2 Hydrodynamics

The Ministry of Works and Development (MWD) conducted an extensive field investigations campaign in the mid seventies (MWD 1975), as part of an option assessment for potential outfall sites along the coast between Porirua Harbour and Pipinui Point (approximately 10km southwest of Rukutane Point). These investigations indicate that large eddies are formed near the Bridge during both the flooding and ebbing tide. Recent modelling (Appendix H)shows similar patterns and strength of currents as those reported by MWD. Model output for typical broad scale currents, during the early part of the flood and ebb tides, is shown in Figures 3-3 and 3-4.

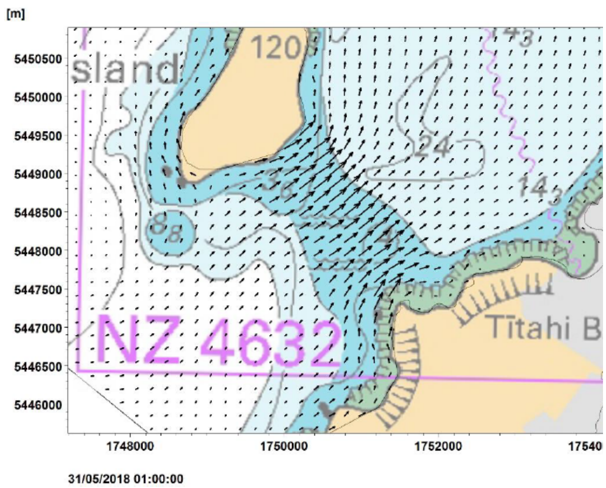

Figure 3-3: Typical broad scale current during the flood tide (from DHI 2018)

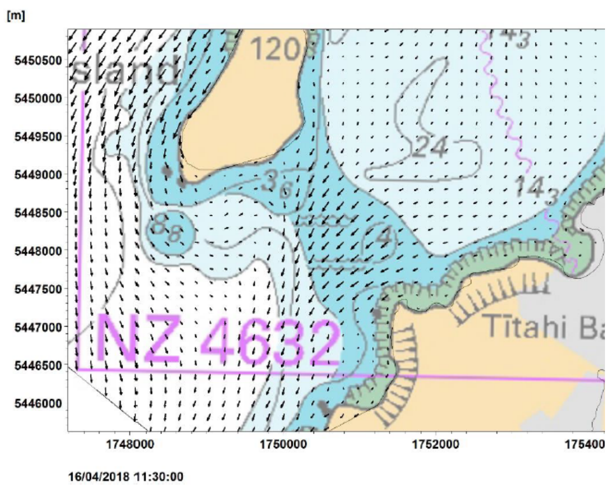

Figure 3-4: Typical broad scale current during the ebb tide (from DHI 2018)

3.3 Coastal water quality

Historically, water quality monitoring conducted along Porirua's west coast by Porirua City Council and Greater Wellington Regional Council has been strongly focused on microbiological quality and the suitability of coastal waters for contact recreational activities such as bathing and shellfish collection.

3.3.1 Routine recreational water quality monitoring

Porirua City Council and Greater Wellington Regional Council monitor three shoreline coastal water sites at Titahi Bay beach weekly for 20 weeks between mid-November and 31 March each year. The recreational water quality sampling locations at Bay Drive, Toms Road and South Beach are indicated in Figure 2-2 above by orange triangles. On each sampling occasion, a single water sample is collected in knee deep water and analysed for enterococci in accordance with the Recreational Water Quality Guidelines (MfE/MoH, 2003). These Recreational Water Quality Guidelines specify single sample Surveillance, Alert and Action levels, as summarised in Table 3-2.

Results for the five-year period from January 2014 to November 2019 are summarised in Table 3-3. Close to 90% of samples achieved the single sample surveillance criteria (≤ 140 enterococci per 100ml) at the northern beach (Bay Drive) and middle beach (Toms Road) sites, while 84% of samples achieved the surveillance criteria at the southern beach (South Beach Access Road) site. (The likely contribution from the Porirua WWTP is discussed in Sections 3.3.3 and 5.7). By comparison, 94.4% of samples collected at the control site, which is well removed from urban areas and the WWTP outfall, achieved the criteria.

Table 3-2: MfE/MoH (2003) surveillance, alert and action levels for marine waters

Mode	Guideline Enterococci (cfu/100ml)	Management Response
Green/Surveillance	Single sample ≤140	Routine monitoring
Amber/Alert	Single sample >140	Increased monitoring, investigation of source and risk assessment
Red/Action	Two consecutive samples within 24 hours >280	Public warnings, increased monitoring and investigation of source

Table 3-3: Summary results for enterococci (cfu/100ml) monitoring results in Titahi Bay (Jan 2014 – Nov 2019, GWRC data)

Site	N. samples	n ≤ 140	% ≤ 140	141-280	>280	Median	95-percentile	
							3-years	5-years
Titahi Bay – Bay Dr	115	103	89.5	9	3	16	238	220
Titahi Bay - Toms Road	175	160	91.4	10	5	12	200	193
Titahi Bay – South Access Rd	122	102	83.6	11	9	22	437	408
Control site	144	136	94.4	3	1	<4	108	94

Two different assessment criteria are identified in the RCP and PNRP for recreational bathing waters:

- Appendix 6 of the RCP sets a guideline level for the median bacterial content in water samples taken over the bathing season at 35 enterococci per 100 ml; and
- The PNRP requires, as a water quality objective in Objective O24, that the 95th percentile enterococci value from at least 30 samples collected over three consecutive summers to be less the 500/100ml.

(Note: the Te Awarua-o-Porirua Whaitua Implementation Programme recommendation for coastal marine waters is that no more than 10-percent of enterococci samples should exceed 500/100ml, and the 95^{th} percentile value should not exceed 200/100ml).

Annual median enterococci values for the three Titahi Bay sites are summarised in Table 3-4. The Regional Coastal Plan (RCP) annual median trigger value (TV) was achieved at Titahi Bay north beach for four of the last five summers, at Titahi Bay middle beach for all five summers, and Titahi Bay South Beach Bay Drive on three of the last five summers, failing on 2017/18 and 2018/19.

Table 3-4: Annual median enterococci values at Titahi Bay, GWRC data (exceedances are highlighted in pink)

Site	N	Annual median enterococci values (cfu/100ml)					
		2014/15	2015/16	2016/17	2017/18	2018/19	RCP Median TV
Titahi Bay at Bay Drive	115	16	6	16	40	16	≤35
Titahi Bay at Toms Road	175	12	6	8	16	12	≤35
Titahi Bay at South Beach	122	20	16	20	84	52	≤35

The PNRP objective for contact recreation requires the 95th percentile enterococci value from at least 30 samples collected over three consecutive summers to be less the 500/100ml. Table 3-5 shows that all sites achieved the three year 95-percentile target over the period 2014 to 2019, but that microbiological water quality was consistently poorer at the south end of Titahi Bay Beach compared to the middle and northern beach sites. The more stringent Te Awarua-o-Porirua Whaitua target was achieved at Titahi Bay middle beach but not at either the north or south beach sites.

Table 3-5: Three year 95-percentile enterococci values at Titahi Bay, GWRC data (exceedances of the Whaitua target are shown in pink)

Site	N	Three year 95%ile enterococci values (cfu/100ml)				
		2014/15 to 2016/17	2015/16 to 2017/18	2016/17 to 2018/19	Te Awarua-o-Porirua Whaitua 95^{th}%ile Target	PNRP 95^{th}%ile Target
Titahi Bay at Bay Drive	115	221	220	238	≤200	≤500
Titahi Bay at Toms Road	175	137	192	200	≤200	≤500
Titahi Bay at South Beach	122	368	454	437	≤200	≤500

Potential causes of poorer microbiological quality at the south end of Titahi Bay include the following:

- stormwater runoff from an urban catchment,
- wastewater network leaks or wet weather overflows into the stormwater system or direct to coastal waters, and
- discharge plume from the Porirua WWTP outfall at Rukutane Point.

3.3.2 Porirua Stormwater Monitoring

Porirua City Council and Wellington Water monitor minor urban streams and stormwater outlets as part of the stormwater monitoring plan. This monitoring includes the stormwater outlet which discharges to Titahi Bay south, near South Beach Access Road. During the 2015/2016 year, the South Beach Access Road stormwater outlet sample results had median and 95-percentile *E. coli* concentrations of 2,200 and 12,885 cfu/100ml, respectively (Table 3-6). This is one of several stormwater outlets that discharge to Titahi Bay which have the potential to cause significant faecal contamination in near-shore waters during and after rainfall events.

Table 3-6: *E. coli.* (cfu/100 ml) summary statistics for minor streams (monthly, Jan 2015 - Aug 2016, (Wellington Water, 2017)

Site No.	Site Name	minimum	Median	95%ile	maximum	n
PCCSWM-01	Taupo Stream	52	350	21,300	23,000	21
PCCSWM-02	Duck Creek	88	240	8,585	17,000	21
PCCSWM-03	Browns Bay Stream	310	3,000	24,400	31,000	21
PCCSWM-04	Kenepuru Stream	110	1,700	11,470	14,000	21
PCCSWM-05	Semple Street	410	16,000	266,000	420,000	21
PCCSWM-06	Te Hiko	12	110	5,815	6,200	21
PCCSWM-07	Onepoto	35	380	24,850	32,000	21
PCCSWM-08	Gloaming Hill	56	1,100	6,895	8,600	21
PCCSWM-09	Titahi Bay South Access	56	2,200	12,885	18,000	21

3.3.3 Porirua WWTP Bypass Event Monitoring

While local stormwater discharges are an important source of faecal contamination in Titahi Bay, it is known that the discharge plume from the Porirua WWTP outfall can contribute to this contamination under certain conditions. This is particularly the case during periods of sustained wet weather when wastewater inflows exceed the hydraulic capacity of the WWTP, causing a partial bypass of plant processes, and when wind and tidal currents carry the discharge plume towards Titahi Bay.

PCC has established seven coastal shoreline monitoring sites (see Figure 2-2), which are monitored in response to each wet weather bypass event at Porirua WWTP. This monitoring is focused on the period during and immediately after a bypass event when the risk of faecal contamination is highest. The results are summarised in Table 3-7 and Figure 3-5, Figure 3-6 and Figure 3-7.

Table 3-7 shows that annual median enterococci values during WWTP bypass events between 2014/15 and 2018/19 complied with the RCP guideline level of ≤35 enterococci per 100ml at sites 200m either side of the WWTP outfall, but exceeded the trigger value at the south end of Titahi Bay beach. These results point to a local source of faecal contamination at the south end of the beach. Monitoring sites close to the WWTP outfall have consistently complied with the annual median enterococci trigger value, indicating that the WWTP discharge is not the cause of elevated median values in Titahi Bay.

Table 3-7: Annual median enterococci values at Titahi Bay (PCC bypass event monitoring 2014/15 to 2018/19)

Site	N	Annual median enterococci values (cfu/100ml)					
		2014/15	2015/16	2016/17	2017/18	2018/19	RCP Median TV
Control site	144	<4	<4	<4	<4	<4	≤35
Mount Couper	177	<4	16	<4	16	<4	≤35
Titahi Bay at Bay Drive	177	8	20	16	16	19	≤35
Titahi Bay at South end	177	20	46	40	46	72	≤35
200m East of Outfall	177	<4	12	4	8	12	≤35
200m South West of Outfall	175	<4	8	8	18	14	≤35
Te Korohiwa Rocks	177	<4	<4	<4	6	<4	≤35

Table 3-8 shows results of monitoring focussed on by-pass events and therefore reflects current 'worst-case' effects of the WWTP. The results show that the three year 95-percentile enterococci values consistently exceed the PNRP enterococci water quality objective at two sites in Titahi Bay and at Mount Couper, all of which are located adjacent to the urban area. By comparison, notwithstanding the focus on by-pass events, the results show that sites located 200m either side of the WWTP discharge complied with the 95-percentile trigger value during the three-year period to June 2019, and showed a marked improvement compared to the three-year period to June 2017. A reducing trend for maximum values between 2015 and 2019 at sites near the outfall is also evident in Figure 3-6 and Figure 3-7. The results summarised in Tables 3-7 and 3-8 confirm that the WWTP discharge is not an important source of faecal contamination in Titahi Bay, although it may contribute to the cumulative level of faecal contamination in Titahi Bay. These results indicate local sources of faecal contamination near the south end of Titahi Bay are more significant than those from the outfall.

Table 3-8: Three year 95-percentile enterococci values at Titahi Bay (PCC monthly + bypass event monitoring)

Site	N	Three year 95%ile enterococci values (cfu/100ml)			
		2014/15 to 2016/17	2015/16 to 2017/18	2016/17 to 2018/19	PNRP 95^{th}%ile TV
Control site	144	50	115	115	≤500
Mount Couper	177	528	1600	509	≤500
Titahi Bay at Bay Drive	177	587	572	866	≤500
Titahi Bay at South end	177	764	736	1028	≤500
200m East of Outfall	177	620	387	285	≤500
200m South West of Outfall	175	1490	680	444	≤500
Te Korohiwa Rocks	177	240	122	120	≤500

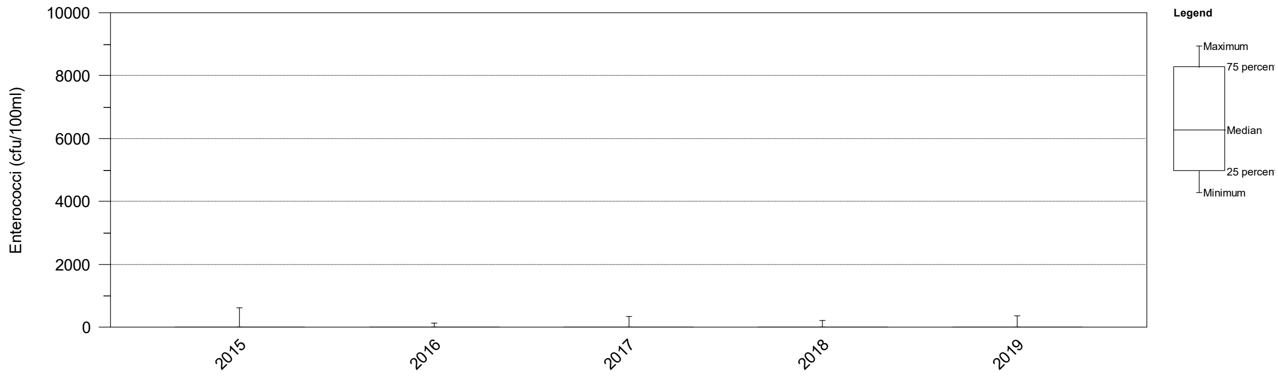

Figure 3-5: Wet weather bypass monitoring results at Te Korohiwa Rocks

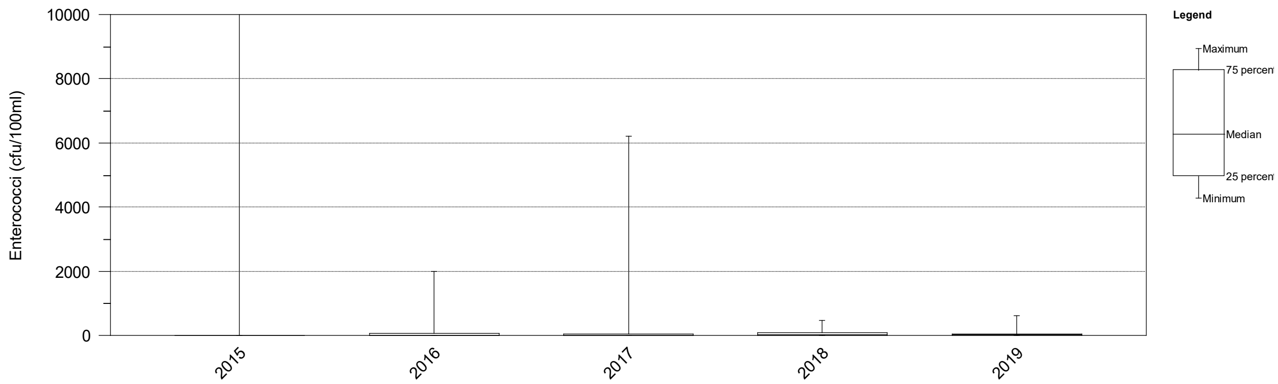

Figure 3-6: Wet weather bypass monitoring results 200m South West of the outfall

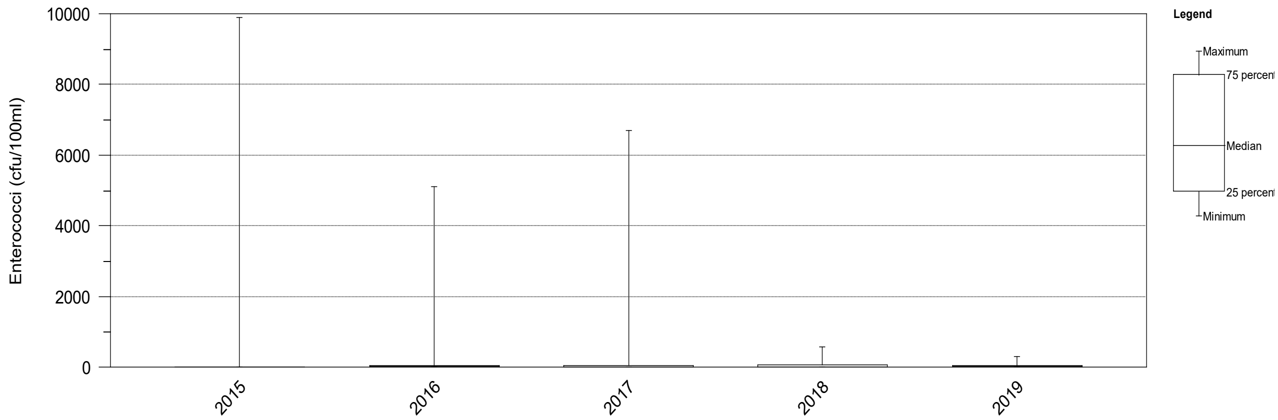

Figure 3-7: Wet weather bypass monitoring results 200m East of the outfall

3.4 Marine ecology

3.4.1 Ecological values

Schedule F5 of the PNRP identifies habitats with significant indigenous biodiversity values in the coastal marine area, several of which are present along Wellington's south-west coastline and are relevant to this assessment. High value habitats present in the area include subtidal rocky reefs and giant kelp (*Macrocystis pyrifera*). Porirua Harbour is identified in the PNRP as a site of significant marine biodiversity, but the effects of the WWTP discharge are not expected to extend as far as the entrance to Porirua Harbour.

Ecological value is also associated with abundance and diversity of organisms in a given habitat compared to other habitats present in and around the survey area. The Cawthron ecological survey (Appendix F) assessed habitats or assemblages of known ecological importance, including macroalgae beds (not necessarily kelp) beds as being of high ecological value. The less diverse intertidal rocky areas were assessed as being of moderate value. Infaunal assemblages of sediments were of moderate ecological importance in comparison with the more uniformly muddy habitats that are generally found in deeper areas offshore.

As part of the preparation work for this application, an assessment of the marine flora and fauna in the receiving environment for the discharge has been undertaken in the context of Policy 11 of the New Zealand Coastal Policy Statement (NZCPS) and Policy 39A of the PNRP (Morrisey, Childerhouse, Clements, & D'Archino, 2020)(Appendix L) . The assessment has identified five algae (Table 3-9) and eight invertebrate species (Table 3-10) that are classified as Threatened or At Risk and could potentially occur in the receiving environment. Two Threatened and two At Risk sharks (Table 3-11) could also potentially occur in the outfall location, but in passage rather than as residents. Nine species of marine mammals have been recorded in the coastal area from Cook Strait to Taranaki, including five species classified as Threatened or At Risk (Table 3-12). Most species are seasonal migrants. Maui's dolphins, and possibly blue whales, are resident in this region but Maui's dolphins have not been recorded along the Kapiti coastline.

Table 3-9: Marine macroalgae listed as Threatened or At Risk: Declining by Nelson et al. (2019).

Species name	Known distribution or habitat	Conservation status
Prasiola novaezelandiae S.Heesch & W.A.Nelson	North I. and South I.	Threatened: Nationally Endangered
Durvillaea antarctica *(Cham.) Har.*	Three Kings, North Is., South Is., Chatham Is and Subantarctic islands	At Risk: Declining
Herpodiscus durvilleae (Lindauer) South	Endophyte of *Durvillaea* spp.	At Risk: Declining
Macrocystis pyrifera (L.) C.Agardh	Southern North I., South I, Stewart I, Subantarctic islands	At Risk: Declining
Pyrophyllon subtumens (J.Agardh ex Laing) W.A.Nelson	Obligate epiphyte of *Durvillaea* spp.	At Risk: Declining

Table 3-10: Marine invertebrates listed as Threatened or At Risk: Declining by Freeman et al. (2014) that could potentially occur at the discharge location.

Species name	Common name	Conservation status
Idioibla idiotica	Stalked barnacle	Threatened: Nationally Critical
Pumilus antiquatus	Dwarf white lampshell	Threatened: Nationally Critical
Smeagol climoi	Gravel maggot	Threatened: Nationally Critical
Smeagol manneringi	Gravel maggot	Threatened: Nationally Critical
Spio aequalis	Giant spionid worm	Threatened: Nationally Endangered
Cellana flava	Golden limpet	At Risk: Declining
Octopus kaharoa	Octopus	At Risk: Declining
Alcithoe davegibbsi	Volute	At Risk: Declining

Table 3-11: List of New Zealand chondrichthyans listed as Threatened or At Risk by Duffy et al. (2018).

Species name	Common name	Conservation status
Carcharodon carcharias	Great white shark	Threatened – Nationally Endangered
Cetorhinus maximus	Basking shark	Threatened – Nationally Vulnerable

Table 3-12: Residency patterns of marine mammal species known to frequent waters of Cook Strait, the Kapiti Coast and the Taranaki Bight. Species conservation threat is listed for both the NZTCS and the International Union for Conservation of Nature system (Baker *et al* 2019)

Common name	Species name	New Zealand threat classification		IUCN red listing	Residency category
RESIDENTS					
Māui's dolphin	*Cephalorhynchus hectori maui*	Native and resident, evaluated, threatened	Threatened - Nationally critical	Critically endangered	Year-round resident
New Zealand fur seal	*Arctocephalus forsteri*	NZ native and resident, evaluated	Not Threatened	Least Concern	Seasonal to year-round resident
Blue whale	*Balaenoptera musculus* (spp. *intermedia* or *brevicauda*)	Native	Data deficient	Critically endangered to data deficient	Potential offshore resident or frequent visitor
MIGRANTS					
Southern right whale	*Eubalaena australis*	Native and resident, evaluated, threatened	At risk - Recovering	Least concern	Seasonal migrant
Humpback whale (oceanic population only)	*Megaptera novaeangliae*	Non-resident native	Migrant	Endangered	Seasonal migrant
VISITORS					
Common dolphin	*Delphinus delphis/capensis*	Native and resident, evaluated	Not threatened	Least concern	Seasonal to frequent visitor

Common name	Species name	New Zealand threat classification		IUCN red listing	Residency category
Bottlenose dolphin	*Tursiops truncatus*	Native and resident, evaluated	Threatened - Nationally endangered	Data deficient	Seasonal to frequent visitor
Bryde's whale	*Balaenoptera edeni/brydei* sp.	Native and resident, evaluated, threatened	Threatened - Nationally critical	Data deficient	Seasonal to frequent visitor
Orca (killer whale)	Orcinus orca	NZ native and resident, evaluated, threatened	Threatened - Nationally critical	Data deficient	Seasonal to frequent visitor
Pilot whale	Globicephala sp.	Native	Data deficient or Not threatened	Data deficient	Seasonal to frequent visitor
Hector's dolphin	Cephalorhynchus hectori hectori	NZ native and resident, evaluated, threatened	Threatened - Nationally vulnerable	Critically endangered	Infrequent to rare visitor

3.4.2 Nearshore and offshore rocky habitats

The results of broadscale and fine-scale surveys of intertidal and shallow sub-tidal rocky habitats are described in detail by Cawthron in Appendix F. Porirua's western coastline has moderate exposure to winds, wave action and tidal currents which result in it being a dispersive rather than depositional environment. The area surrounding the existing outfall is predominantly bedrock with patches of pebbles and shelly sand, grading to sand-dominated habitat at a distance of 150m from shore. The rocky habitats have an abundant and diverse algal flora and associated invertebrate fauna.

Encrusting coralline algae were present at most locations with up to 90% cover. Turfing corallines were consistently present at Round Point but more variable at the other two locations. Macroalgae cover at all locations was dominated by brown algae with a range of smaller green, red and brown taxa living among them. The introduced kelp *Undaria pinnatifida*, common and widespread in Porirua and Wellington Harbour, was only recorded at the shoreward end of the transect at Round Point. Giant kelp was not found within the study area.

Encrusting invertebrates on subtidal hard substrate included several types of sponge, ascidian, bryozoans and anemones. Mobile invertebrates included various herbivorous snails and starfish. Kina were only recorded at Round Point, while a single large sea cucumber was recorded at the existing outfall location. The most conspicuous invertebrates were paua (*Haliotis iris*) which occurred at all three locations but were most abundant at the outfall location. Limited numbers of fish were recorded, but the surveys were not designed to assess fish populations.

3.4.3 Soft sediment habitats

Morrisey et al (2019) (Appendix F) collected sediment grab samples at several locations offshore of the existing outfall, at water depths varying between 10m and 16m. Sediment just beyond the fringing reefs consisted of fine to very fine grey-brown sand, with a small amount of mud. Sediments further offshore included a higher proportion of coarser sand and gravels, with a grey brown appearance. None of the sites sampled showed a distinct redox discontinuity[12], and measurements of TOC, TN, TRP and chlorophyll-*a* showed that these sediments are unenriched and are not likely to be causing stress to aquatic organisms. As would be expected in coastal sediments with low mud content and dispersive water movements, concentrations of trace metals were low, and well below concentrations at which adverse biological effects might be expected.

The infauna (the community of organisms living within marine sediments) is dominated by small polychaete worms, amphipod, cumacean, ostracod and tanaid crustaceans and small bivalves, and is generally homogenous across the area sampled. There was no evidence of beds of large shellfish living in the sediment and none of the camera videos contained horse mussels, scallops or other ecologically or culturally important taxa. Animals living on the surface of the sediment appeared to be scarce, with only the brittle star *Ophiopsammus maculata* being common. Surface films of what appeared to be diatoms were a notable feature of the subtidal sediments (Morrisey *et al* 2019).

3.4.4 Marine mammals

Morrisey, et al (2020) note that marine mammals are often referred to as 'marine sentinel organisms' for ocean-health. With their long life spans, high-trophic-level diets and coastal residency, marine mammals are vulnerable to land-derived microorganisms (e.g. protozoans, bacteria and viruses) and the bioaccumulation of anthropogenic contaminants. As a result, local marine mammals are often considered when assessing the potential effects of industrial or other discharges and / or contaminants on marine ecosystem health.

There have been no dedicated marine-mammal surveys of the coast around the outfall and therefore it is necessary to consider marine mammals that may be found in the broader Kapiti Coast and Cook Strait regions. Based on recorded sightings, at least nine species of cetaceans (whales, dolphins and porpoises) and one pinniped (seals and sea lions) are thought to live or regularly frequent the coastal waters of Kapiti and Cook Strait (Department of Conservation sighting / stranding database; Beaumont et al. 2009; pers. comm. C. Lilley, Department of Conservation).

Of these, four are classified as Threatened and one as At Risk. A further two species are classified as Data deficient. The humpback whale (*Megaptera novaeangliae*), classified as Migrant in the NZTCS, is listed as Endangered by IUCN. A list of all these species is given in Table

[12] Redox discontinuity layer is zone of rapid transition between areas of aerobic and anaerobic decomposition in ocean sediments. Its depth within sediments depends on the quantity of organic matter available for decomposition and the rate at which oxygen can diffuse down from the overlying water.

3-12, categorised by their currently known distribution patterns within this region as either: ‘resident’, ‘migrant’ or ‘visitor’.

Other marine mammal species may also occur in the area but are likely to be rare or infrequent visitors.

The species most likely to be found in the vicinity of the discharge is the New Zealand fur seal (*Arctocephalus forsteri*). Known fur seal haul-out sites are located to the north and south of Porirua, along the Kapiti Coast and Cook Strait (including Mana and Kapiti islands), with an established breeding colony situated at Red Rocks on the Wellington south coast. Haul-out sites are rocky-shore areas where fur seals tend to come ashore regularly and rest, particularly over the colder winter months. While fur seals are considered non-migratory, they easily and repeatedly cover large distances and rarely remain at any one location year-round. Seals are more densely clumped within breeding colonies in summer and pups generally leave these colonies in late winter and spring. Fur seals are classified as Not Threatened under the NZTCS.

Other species in the region include the nationally vulnerable Hector’s dolphin (*Cephalorhynchus hectori*), which is occasionally reported in along the Kapiti Coast, and, to a much lesser extent, other dolphin species (including common and bottlenose) and whales that venture into shallow coastal waters (e.g. Bryde’s and southern right whales). Bottlenose dolphins (*Tursiops truncates*), common dolphins (*Delphinus delphis*) and pilot whales (*Globicephala* sp.) are occasionally sighted in both coastal and offshore waters within the wider region throughout the year. Southern right whales (*Eubaleana australis*) and humpback whales are known to migrate seasonally through Cook Strait and along the Kapiti Coast on their way north in winter and south in spring. Unlike right whales, humpbacks tend to travel in straight lines from headland to headland, only occasionally passing inshore to bays, bights or harbours. Little is known about the seasonal movements of Bryde’s whales (*Balaenoptera* sp.) off the North Island’s west coast. However, the sighting data suggest this species is present in coastal waters of the Taranaki Bight (well to the north of the project area) over summer months.

Further detail on the distribution of marine mammals through Cook Strait and along the Kapiti coast is provided by Morrisey et al (2020) which is included in Appendix L.

3.4.5 Avifauna

In 2015, GWRC reviewed coastal and freshwater habitats of significance for indigenous birds in the Wellington region (McArthur, Robertson, Adams, & Small, 2015). Those sites in the general area of Porirua that are listed in Schedule F2c of the PNRP as ‘Significant Habitats for indigenous birds in the coastal marine area’ are set out in Table 3-1. It is noted that none of the listed sites are in the receving environment for the discharge.

3.5 Landscape and Natural Character

An assessment of landscape and natural character relevant to the discharge is included as Appendix G. The following is a summary of the description of the existing environment provided by that assessment.

The existing outfall is part of a broader landscape that forms Porirua's southern coastal edge between Titahi Bay and Green Point (Komangarautawhiri), extending towards Makara to the southern boundary of Porirua's south-west coast.

Within the terrestrial part of the coastal environment, there is limited modification along much of the coastal edge with the exception of the outfall and associated structures and the WWTP itself. The area has Special Amenity landscape values due to:

- high natural science values associated with an intact coastal landform, steep rocky headlands with pockets of regenerating coastal vegetation in the rural gullies and on the rocky cliff escarpments, including at nearby Stuart Park
- high sensory values derived from the exposure to the high prevailing westerly winds and sunsets which emphasise the dramatic landforms around the coast.

The terrestrial area has an overall moderate-high level of natural character due to the prominent rocky headlands with steep exposed cliffs, exposed to severe gales and salt laden winds with wild and scenic experiential values, vegetation dominated by pasture with some pockets of regenerating native vegetation, and recognizing the presence of structures such as the tunnel portal, in-ground inspection chamber at ground level and pump station Figure 3-8.

The Coastal Marine Area (CMA) section of the coastal environment includes an area mapped as Rocky Reef South in the Porirua Coastal Study (Figure 3-9). This area extends from the start of the rocky reef and coastal cliffs on the south side of Titahi Bay, southwards along the coast adjacent to Pikarere Farm. To the west, it extends out towards Mana Island and includes a submerged isthmus 4-10m deep known as 'The Bridge'.

The overall natural character of this area is High due to its largely unmodified coastal reefs and largely intact submerged Bridge shoal. The limited human interference combined with a wild and rugged setting result in a high experiential rating.

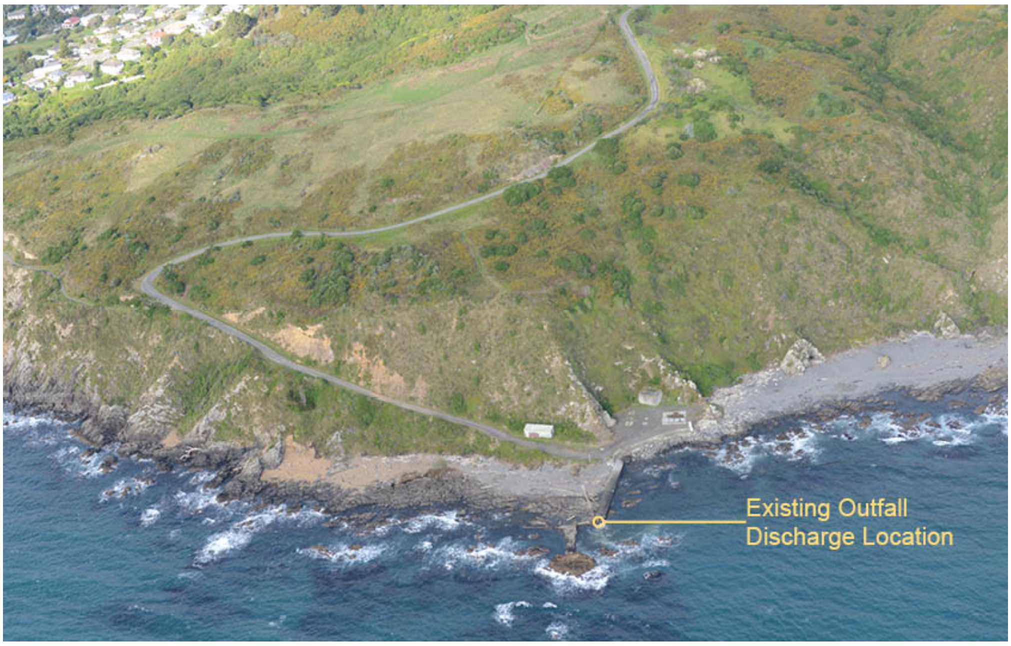

Figure 3-8: Existing outfall at Rukutane Point with access road across Stuart Park headland

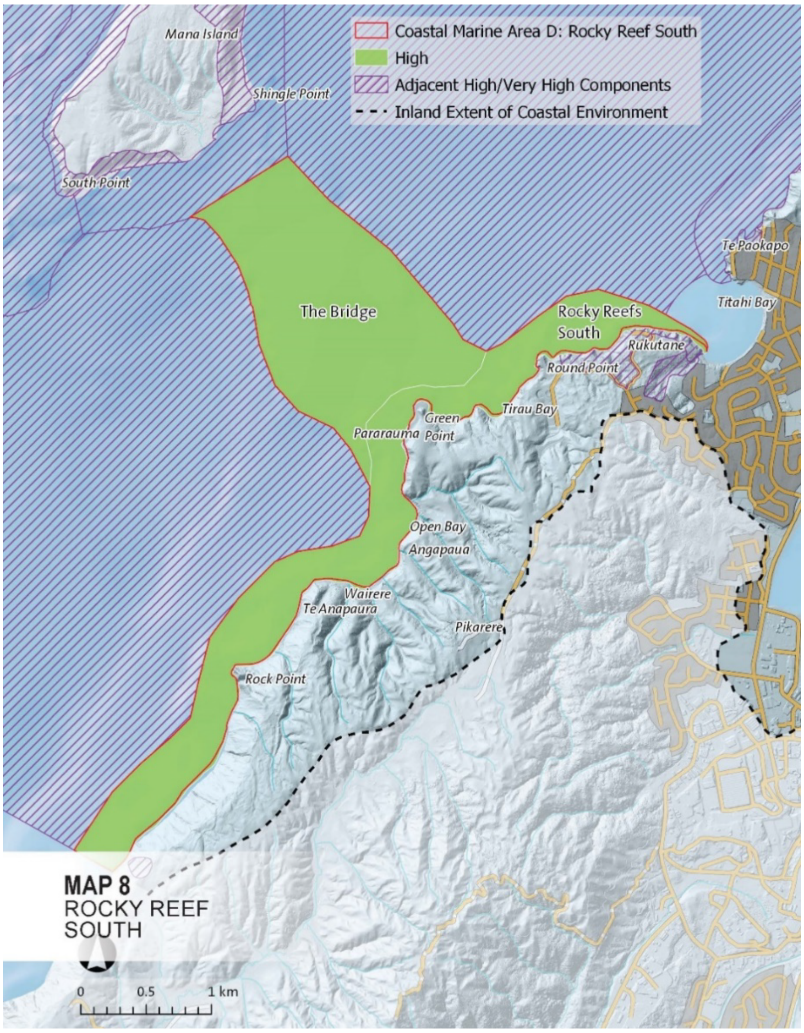

Figure 3-9: Rocky Reef South (Natural Character) - From Porirua Coastal Study, 2018

3.6 Recreation use and values

The receiving environment for the wastewater discharge is heavily used for a wide variety of recreational activities and some parts of it are of regional significance for recreation values.

Within the more immediate receiving environment, Tītahi Bay is a popular surfing site, particularly for beginners, and an important swimming beach, with the Tītahi Bay Surf Lifesaving Club located centre-stage. The Bay has high levels of use for a wide variety of shore- and water-based activities, including walking, dog walking, paddling, windsurfing, events and general family beach recreation, as well as small boat activity, such as kayaking and stand-up paddle boards, and fishing.

Several locally significant surf breaks are located south of the discharge, at Tirau Bay and Open Bay, and the regionally significant Stevo's at Wairere.

Most of the coast in the area has easy public access, and almost all has some form of access. Fishing is popular offshore along the Bridge and from many rocky coastal areas. Morrisey et al (2019) (Appendix F), in their assessment of ecological values in the vicinity of the outfall, noted a relatively high number of pāua at Rukutane Point, most likely due to a reluctance to harvest near the outfall, while they were also present at other nearby sites. Mussels were only represented by the little black variety, which are not taken recreationally. No scallops were observed in the soft sediments offshore. Few kina were found and only at Round Point.

In the wider receiving environment, the Onepoto Arm of Te Awarua-o-Porirua Harbour is used extensively for: waka ama, rowing, wind surfing, flat-water kayaking, kite surfing, small boat sailing and power boating. Five relevant clubs are based around its edge: Toa Waka Ama Club, the Porirua Rowing Club, Tītahi Bay Boating Club, Wellington Power Boat Club and the Porirua Canoe Kayak Club. There are three public boat launching ramps, two areas set aside for personal watercraft, defined boat mooring areas at Onepoto and nearer the Paremata Bridge, and a row of private boat sheds at Onepoto. While shellfish gathering is not advised, cockle harvesting is popular, and flounder are available.

Pāuatahanui Inlet is popular for: small boat sailing and training, swimming – particularly at the Dolly Varden Beach and off the Paremata Bridge – shellfish harvesting, floundering, set-netting, jet skiing, flat water kayaking, waka ama, wind surfing, kite surfing, bird watching and conservation work – particularly at the Pāuatahanui Wildlife Reserve – power boat racing, stand-up paddle boards (SUP) and motor boating. Two relevant clubs are located on the Inlet – the Paremata Boating Club and a waterski club building. Inadequate water depth means the waterski club now operates from Wellington Harbour. There are three reserved water ski lanes and a personal watercraft area, four boat launching ramps (including the Mana ramp at the Paremata Bridge) and four boat mooring areas. Private boat sheds are located at Camborne and Ivey Bay, with several dotted further along the coastal edge. Several bays and beaches provide picnic and swimming opportunities.

The inshore area from the Paremata Bridge to Hongoeka Bay is popular for: swimming, wind surfing, kite surfing, sea kayaking, sailing, surf-casting, surfing and beach activities. Five recreation clubs are located in the area: Plimmerton Boat Club, Ngāti Toa Sea Scouts, TS Taupo Sea Cadet Corps, Mana Pasifika Outrigger Canoe Club and the Mana Cruising Club. Four sites are monitored by the GWRC for water quality for bathing, including at Onehunga Bay on the western side of the channel.

Pukerua Bay supports fishing, shellfish gathering, rock-pooling, conservation work, surfing and swimming.

Figure 3-11 shows the relative levels of use of Porirua coastal area.

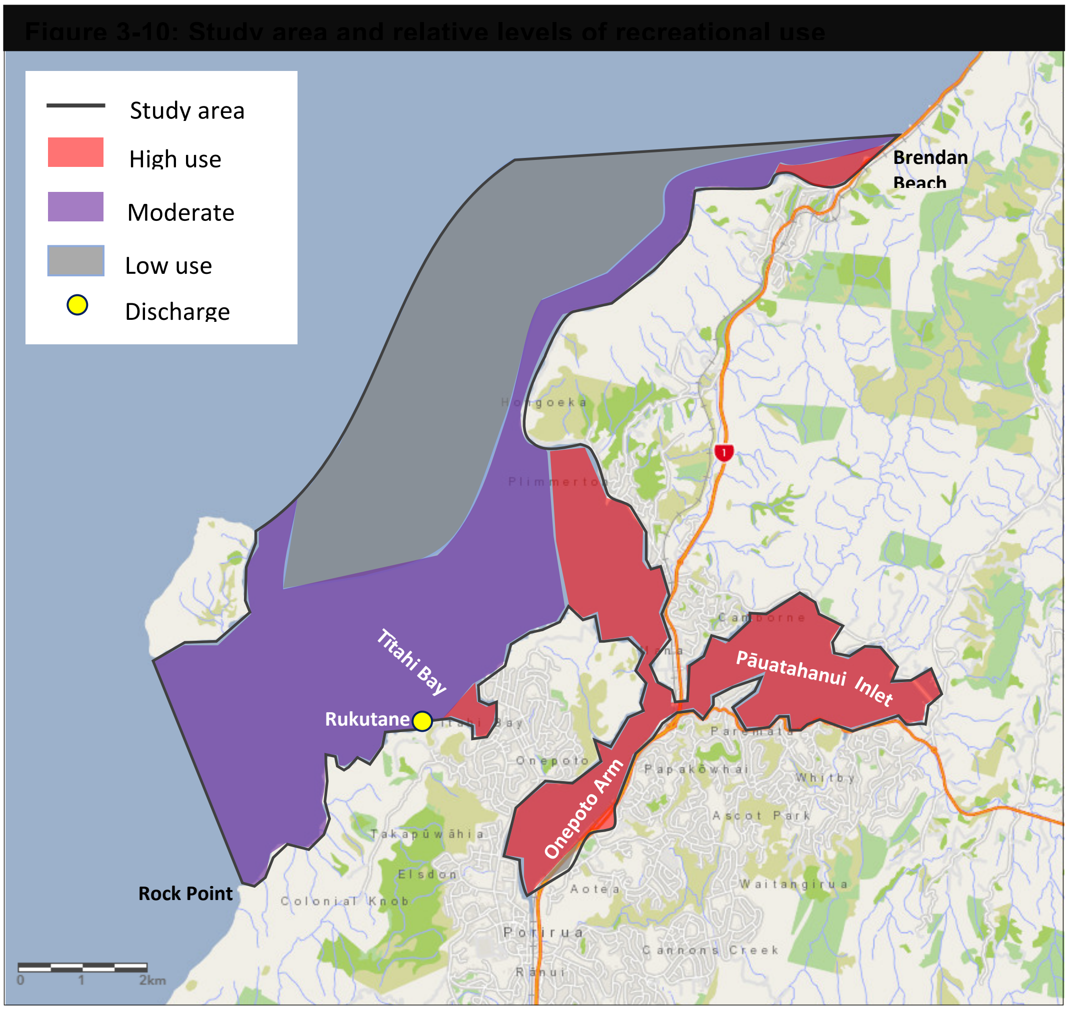

Figure 3-11: Relative levels of recreation use in the coastal waters of Porirua

3.7 The Existing Environment – Te Moana o Raukawa

As part of the preparation of this application Te Rūnanga o Toa Rangātira has prepared a Cultural Impact Assessment (Appendix I). The following description of the existing environment (through to the end of Section 3.7 of this AEE) is extracted directly from that report.

It is important to understand and appreciate that the existing outfall and discharge occur within an environment that continues to be treasured by Ngāti Toa as a 'taonga' of immense historical and cultural significance. The shoreline and marine environment near Rukutane Point, where the existing outfall and wastewater discharges occur, form part of the coastal domain of Te Moana o Raukawa. Not only was this taonga valued as an abundant source of food and other resources, but it also had important strategic and economic advantages which Te Rauparaha was able to exploit for the wider benefit of Ngāti Toa and their allies.

3.7.1 Associations with Polynesian explorers

Te Moana o Raukawa has its own rich and illustrious history extending back to the earliest Polynesian explorers, Maui and Kupe, whose presence endures to this day in the many place names that adorn the landscape and perpetually remind us of their great deeds. The name Te Moana o Raukawa has its origins in the narrative of Kupe's voyage to Aotearoa in pursuit of the giant octopus, Te Wheke a Muturangi. Kupe eventually killed the wheke at the entrance to Tory Channel, Nga Whatu Kaiponu (The Brothers Islands), and so as not to reawaken the wheke, the eyes of people making their maiden crossing of Te Moana o Raukawa were covered with kawakawa leaves – hence the original name 'Te Moana of Raukawakawa'. The name of Mana Island – 'Te Mana o Kupe ki Aotearoa' also commemorates Kupe's defeat of Muturangi and acknowledges his superior skill and ability as a navigator in crossing the vast Pacific Ocean to reach Aotearoa.

The significant headland opposite Mana Island, Komangarautawhiri, was also named by Kupe who first visited the site to take advantage of its strategic position overlooking Raukawa (Cook Strait) while in pursuit of the wheke. The landing site of Kupe's canoe at Komanagrautawhiri, his Tauranga waka, was considered tapu or sacred at that time and is still commemorated as a waahi tupuna or site of ancestral significance today. Centuries later, Ngāti Ira built a pā on this headland and it became the principle home of Whanake and his celebrated wife, Tamairangi who were displaced by Ngāti Toa in the 1820s. During the 1960s-80s the area was proposed as the location for the new sewer outfall. However, Ngāti Toa strongly objected to the outfall in this location due to its traditional associations with Kupe.[13]

3.7.2 Ngāti Toa's maritime trading empire

Te Moana o Raukawa also provided an important means of transport and a critical navigable route between Te Upoko o Te Ika a Maui (the Wellington region) and Te Tau Ihu of Te Waka a Maui (the northern South Island). Land on both sides of the Moana was occupied by Ngāti Toa and other allied iwi groups and Te Moana o Raukawa facilitated a complex network of relationships and connections between the two islands that were vital for trade and the expansion of Ngāti Toa's mana and rangatiratanga into the South Island.
By the mid-1830s Ngāti Toa had established a powerful and unique strategic position in the Te Moana o Raukawa region. This largely emanated from the unassailable mana of Te Rauparaha

[13] Newspaper article; *Māoris oppose sewer outfall;* refer to Appendix E

and his ability to manage a complex network of iwi relationships which was crucial to quashing any resistance and seizing control over the region's vital resources. The re-establishment of Ngāti Toa's mana in Te Moana o Raukawa was vitally important for strengthening Iwi identity following Ngāti Toa's forced withdrawal and abandonment of their ancestral lands in Kawhia. It also provided Ngāti Toa with a virtual monopoly over access to European goods and trade throughout the region.
Widespread coastal settlements created important trading opportunities with Pākehā settlers. The flax trade and whaling industry proved to be extremely lucrative for Ngāti Toa until whaling went into decline in the early 1840s. At the height of the industry, there were numerous whaling stations established along the shores of Te Moana o Raukawa, including Te Korohiwa near the existing WWTP and outfall. Whaling stations at Mana Island and Ngāti Toa Domain also played an important role in Ngāti Toa's maritime trade.

3.7.3 Mahinga kai

The political control Ngāti Toa exercised over the vast wealth of resources within Te Moana o Raukawa was critical to the Iwi's monopoly on trade throughout the region. However, the abundance and diversity of an easily accessible food resource cannot be overstated and was vitally important for the physical sustenance of the Iwi.

Mahinga kai (food gathering areas) and kaimoana could be readily accessed along the coastline, including the vicinity of the outfall, and such resources provided valuable habitat for taonga species including koura, pāua and kina. These traditional mahinga kai would originally have had names and unique characteristics that distinguished one area from another. However, much of the traditional knowledge associated with mahinga kai has been lost as a result of the degradation of the environment and depletion of stocks. This has also led to an intergenerational loss of knowledge in relation to local customary fishing areas and practises. Nevertheless, in places where customary fishing does still occur, some of this traditional knowledge has been retained. For example, 'Te Anga Pāua' is a traditional mahinga kai located south of Komangarautawhiri which continues to be used as an important shellfish gathering area for customary and recreational purposes. As the name suggests, this mahinga kai was traditionally an abundant pāua resource that sustained and preserved large quantities of pāua which were, and still are, the sentinel or taonga species along this particular coastline. Pāua were so revered as a food source that they were likened to the eyes of Topeora - 'Nga whatu o Topeora' - (sister of the Ngāti Toa Chief, Te Rangihaeata) who was a prominent and influential leader in her own right.

Another important mahinga kai is the Toka-a-Papa reef, located in the sea between Te Rewarewa Point (at Hongoeka Bay) and Whitireia Peninsula, which was close to the early Ngāti Toa settlements at Hongoeka, Onehunga and Taupo Pa (Plimmerton). This continues to be fished today primarily as a source of kukutai (mussels). Tawhiti Kuri, the rocky reef at Goat Point, is yet another mahinga kai at the entrance to the harbour. This provided an important food resource for the surrounding settlements, especially Taupo Pa, where Te Rauparaha resided, and which supported a large population occupying the coast to Tawhiti Kuri.
As part of Ngāti Toa's Treaty settlement, Coastal Statutory Acknowledgements have been included over Toka-a-Papa and Tawhiti Kuri to ensure that Ngāti Toa's values in relation to these traditional food sources are properly acknowledged in resource management processes.

3.7.4 Customary fishing practises

Te Moana o Raukawa provided a variety of locations for fishing and shellfish gathering, including a number of sheltered bays, that allowed for customary fishing to occur in all weather conditions. These customary practises or tikanga are still exercised today but have been severely diminished over the decades due to the inaccessibility of traditional food sources. It should be noted though that no matter how abundant resources in Te Moana o Raukawa may have been historically, the primary 'food basket' of the Iwi was Te Awarua-o-Porirua. The variety of fish and shellfish species available in the harbour, including pipi, cockles and tuangi (only in the harbour), complimented the predominant coastal species such as pāua, koura and kina.

Mana Island remains an important area for customary fishing. It is a source of koura, pāua, kina and a number of finfish species including moki, terakihi, kahawai, blue cod and butterfish. Mana Island has also been given special status in Ngāti Toa's Treaty settlement with a Coastal Statutory Acknowledgement overlay to protect its significant cultural values.

3.7.5 Coastal settlement

Widespread coastal settlements provided Ngāti Toa with access to an abundance of resources from the ocean, including extensive fisheries and shellfish resources. From the early 1820s, there were numerous Ngāti Toa settlements in the wider vicinity of the outfall. Mana Island was the primary residence of Te Rangihaeata who exerted considerable influence and control over the flax and whaling industries, from his island stronghold. Following Ngāti Ira's displacement from their principal pa at Komangarautawhiri, Ngāti Toa took up occupation of the area and until recently continued to use the area as a seasonal fishing camp.
Further north along the coast, in the vicinity of the WWTP, is a low headland known as Te Korohiwa where a whaling station was established during the 1830s. The Te Korohiwa or 'Coal heavers' whaling station worked in conjunction with other whaling stations nearby, situated on Mana Island and at the entrance to the harbour. At Titahi Bay, the archealogical remains of Te Pa o Kapo - an iconic Ngāti Ira pa site – area still visible in the landscape and the Pa continues to keep vigil overlooking Te Moana o Raukawa as it did in the days before Ngāti Toa arrived in the area.

Whitireia Peninsula, which forms the southern side of the entrance to the harbour, was also an important area for early Maori settlement. There were numerous pa sites and kainga around the coastal fringes, including Te Kahikatoa, Te Neke, Te Onepoto, Kaiaua, Onehunga and Kaitawa. And on the northern side of the entrance to Te Awarua-o-Porirua, at Plimmerton, stood Taupo Pa - the principle residence of Ngāti Toa chief, Te Rauparaha. Paremata Pa, located at today's Ngāti Toa Domain, was another important Ngāti Toa stronghold and area of intensive occupation and trade. This pa was built in the 1830s and became the residence of Te Rauparaha's brother, Nohorua. The Ngāti Toa settlement at Hongoeka was also established for the descendants of Nohorua and his wife, Miriama Te Wainokenoke.

These are the principle areas of Ngāti Toa settlement and occupation in general proximity to the WWTP and outfall, prior to the Treaty of Waitangi in 1840. These sites are not directly affected by the operation of the WWTP, but they do form an important part of the cultural landscape which remains relevant to our understanding of the cultural effects associated with this application.

Therefore, it is evident from the strong historical and ongoing associations of Ngāti Toa with Te Moana o Raukawa, and the Crown's acknowledgement of Ngāti Toa's cultural values through the CSA's, that the 'existing environment' – Te Moana o Raukawa - for the outfall and wastewater discharge is of immense cultural significance and therefore needs to fully appreciated and acknowledged in the decision-making process for the current application.

4 Resource Consent Requirements

4.1 Section 15 of the RMA

Section 15 of the RMA sets out restrictions on the discharge of contaminants into the environment as follows:

> ***15 Discharge of contaminants into environment***
> *(1) No person may discharge any—*
> *(a) contaminant or water into water; or*
> *(b) …; or*
> *(c) …; or*
> *(d) …—*
> *unless the discharge is expressly allowed by a national environmental standard or other regulations, a rule in a regional plan as well as a rule in a proposed regional plan for the same region (if there is one), or a resource consent.*

Under section 15(1)(a) of the Act no person many discharge any contaminant into water, including coastal water, unless the discharge is expressly allowed by a rule in a regional plan, proposed regional plan, resource consent, or regulations. As set out below, the proposed discharge is not expressly allowed in either the Regional Coastal Plan (RCP) or the Proposed Natural Resources Plan (PNRP) for the Wellington Region. Therefore, resource consent is required. There are no National Environmental Standards or other regulations of relevance.

4.2 Regional Coastal Plan

Under the RCP the discharge of 'human sewage' into the coastal marine area (CMA) is governed by two rules. These are:

- Rule 58 - Discharge of human sewage (except from vessels) outside any Area of Significant Conservation Value is a Discretionary activity
- Rule 60 - Discharge of human sewage (except from vessels) within any Area of Significant Conservation Value is a Non-complying activity.

As the outfall location is not within an Area of Significant Conservation Value, the proposed discharge is a discretionary activity under Rule 58 of the RCP.

4.3 Proposed Natural Resources Plan

Under the decision version of the PNRP, the key rule applying to the discharge of wastewater from the WWTP is Rule R61. Rule R61 states that:

> *The discharge of wastewater:*

(a) into coastal water, or

(b) that is an existing discharge into fresh water and meets the following conditions:

i. The volume of the discharge is reduced
ii. The volume or concentration of contaminants is reduced
iii. The range of contaminants in the discharge is not increased

is a discretionary activity.

As the discharge from the WWTP is to coastal water it will be for a discretionary activity under Rule 61(a) of the PNRP.

4.4 Activity Status Summary

Based on the rule assessment set out in Section 4.2 and 4.3, it is considered that the proposed discharge requires resource consent as a discretionary activity.

4.5 Related Activities

Activities related to the proposed discharge but not covered in this application are:

- The occupation of the CMA by the outfall structure
- The operation of the WWTP
- The discharge of contaminants to air associated with the operation of the WWTP.

4.5.1 Outfall structure

The occupation of the CMA by the existing outfall is consented by Coastal Permit 980083 (03). This resource consent commenced on 28 June 1999 and expires on 28 June 2034.

4.5.2 The operation of the WWTP

The operation of the WWTP is a land use activity. It is provided for by designation K1048 of the Porirua City District Plan. The text of the Porirua City District Plan notes that K1048 is for a designation of “Wastewater Treatment Plant” at a location south of Old Man Point and is part of Lot 1 DP 62407.

The land-based section of the outfall pipe is located outside designation K1048. The operation of existing network utilities, the definition of which includes sewerage reticulation, is a permitted activity under Rule 6.1.2 of the Porirua City District Plan.

4.5.3 The discharge of contaminant to air

A separate resource consent application covering the discharge of contaminants (odour) to air from the WWTP was lodged with the Greater Wellington Regional Council in February 2020.

5 Assessment of Environmental Effects

5.1 Introduction

Section 88 and Schedule 4 of the RMA require the applicant to make an assessment of any actual or potential effects that the proposed activity may have on the environment and the ways in which any adverse effects may be mitigated. Schedule 4 requires that any such assessment shall be in such detail as corresponds with the scale and significance of the actual and potential effects that the activity may have on the environment.

This section of the application provides the assessment of environmental effects (AEE) required under the RMA. In scoping the range of the environmental effects to be covered by the AEE the following matters have been taken into account:

- The nature of the proposed activity and the values of the receiving environment
- Provisions of relevant planning documents
- Issues raised by the project Collaborative Group and during public consultation
- The previous experience of the Project team with respect to the assessment of environmental effects associated with the discharge of treated wastewater.

Taking account of these matters the scope of the AEE is as follows:

- Positive effects
- Water quality effects
    - Suspended solids, colour and clarity
    - Oil and grease
    - Public health effects
    - Effects on marine ecology and aquatic life
- Natural character effects
- Effects on values of significance to Ngāti Toa
- Recreation effects.

5.2 Positive effects

As noted in Section 1.2, the discharge of treated wastewater from the WWTP is a key part of the overall wastewater system that serves Porirua City and the northern suburbs of Wellington City. The key benefits arising from the wastewater system is that it conveys untreated wastewater away from residential and commercial areas of Porirua and the northern suburbs of Wellington, and thereby enables these activities and helps to protect public health.

The wastewater system currently serves an estimated population of 84,000 people as well as the business activity within the catchment. By the end of the proposed resource consent period, it is projected that the wastewater system may serve a population of 121,000 people. Porirua and Wellington cities would not be able to accommodate their projected population growth without the wastewater system, including the allowance for the discharge of treated wastewater.

As detailed in Appendix C, an extensive assessment of alternatives treatment and discharge arrangements has been undertaken. This process concluded that the option for which resource consent is now being sought is the Best Practicable Option to maintain the wastewater treatment and discharge components of the wastewater system while minimizing the adverse effects on the environment of these components.

5.3 Approach to assessment of ecological and water quality effects

5.3.1 Assessment criteria

The following assessment of water quality and ecological effects takes account of the following assessment criteria and water quality objectives:

- The requirements of section 107 of the RMA
- The contact recreation criteria set in Appendix 6 of the RCP
- The water quality objectives set in Objectives O24 and O25 of the PNRP
- The coastal water quality objectives in the Te Awarua o Porirua Whaitua Implementation Plan.

The assessment applies an approach following EIANZ (2015). The levels of adverse effect were derived from the sequential consideration of the following factors:

- The ecological value of the organism or habitat affected;
- The spatial scale and duration of the effect;
- The magnitude or consequences of the effect occuring
- The likelihood of the effect occuring.

The level of an adverse effect is derived from a combination of the value of the ecological feature and magnitude of effect (Table 5-1). If the expected level of adverse effect was more than minor, mitigation would be required and the residual risk estimated after mitigation.

Table 5-1: Level of an adverse effect

		Ecological Value			
		Very High	High	Moderate	Low
Magnitude of effect	High / severe	Significant	Significant	More than minor	Minor
	Moderate / medium	Significant	More than minor	Less than minor	Negligible
	Low / minor	Minor	Less than minor	Less than minor	Negligible
	Negligible	Less than minor	Negligible	Negligible	Negligible

5.3.2 Zone of reasonable mixing

The assessment of water quality effects takes into consideration a 'reasonable mixing zone'. In this respect it is noted that the RMA requires that any standards imposed through classification of waters or under section 107 of the RMA should be met "*after reasonable mixing*". This implies the existence of a zone in which the underlying standards need not be met. However, the RMA stops short of giving clear guidance about what constitutes reasonable mixing.

Policy P72 of the PNRP provides the following guidance in relation the extent of the reasonable mixing zone for discharges requiring resource consent:

> *"When a discharge to water requires resource consent, the zone of reasonable mixing shall be minimised and will be determined on a case-by-case basis. In determining the zone of reasonable mixing, particular regard shall be given to:*
>
> *(a) acute and chronic toxicity effects, and*
>
> *(b) adverse effects on aquatic species migration, and*
>
> *(c) efficient mixing of the discharge with the receiving waters, and*
>
> *(d) avoiding a site with significant mana whenua values identified in Schedule C (mana whenua), and*
>
> *(e) the identified values of that area of water, and*
>
> *(f) avoiding significant adverse effects within the zone of reasonable mixing."*

The existing resource consent specifies a 200m radius mixing zone and requires monthly monitoring at shoreline sites located 200m on either side of the outfall, and at other shoreline locations further afield. There is now a significant body of information for receiving water quality at the edge of the 200m mixing zone and beyond, and it would be reasonable to utilise this as the starting point for the current assessment.

This existing 200 m zone either side of the outfall has been compared against the factors listed in Policy P72 and the following points are noted:

- There is no evidence of any toxicity effects within the 200m radius of the outfall, or that the existing discharge is having significant ecological effects in that zone. A monitoring programme is proposed to determine if the level of adverse effect increases in the future.

- There is no reason to expect that a 200m radius mixing zone would have any adverse effects on the migration of aquatic species;
- Mixing of the discharge in the receiving waters is of comparable efficiency to other short outfalls on Wellington's exposed southwest coast. The discharge permit for the Seaview WWTP provides for a mixing zone of 200m radius, while the much smaller Western WWTP has a two-tier mixing zone of 50m and 100m radius, for microbiological and aquatic ecology criteria, respectively. Wastewater from the Moa Point WWTP is discharged to Lyall Bay via a 1.87 km long ocean outfall which terminates in a multiport diffuser in water with a depth of 21m. The superior mixing characteristics of the ocean outfall allow for a smaller mixing zone of 100m radius.
- A 200m radius mixing zone would not affect any Schedule C of the PNRP sites (the nearest one, Whitireia, is on the northern side of Titahi Bay);
- As set out in Section 3 of this application, the 200 m radius mixing zone includes habitats identified in Schedule F5 of the PNRP. The mixing zone also has recreation value and values of significance to Ngāti Toa. It is noted however that this would be the case no matter how small the zone of reasonable mixing is.
- Significant cultural effects have been identified within the 200 m radius mixing zone, but again, this would be case no matter how small the zone of reasonable mixing is. In other words, it is not the case that some smaller area would avoid effects on particular cultural values.

Based on this assessment, it is considered appropriate to continue to apply a 200 m radius mixing zone to the assessment of water quality effects from the WWTP discharge.

5.4 Dilution and Dispersion

5.4.1 Investigations

In preparation for this application, and to assist the assessment of alternatives, oceanographic data was collected in the area offshore of the Porirua WWTP outfall. The investigations and subsequent modeling conducted by DHI are reported in DHI (2018) & DHI (2019a) (Appendix H). In summary, a current meter deployment was undertaken in November/December 2017 in conjunction with a qualitative dye test to provide an understanding of plume dynamics. Due to equipment failure, a second current meter deployment was carried out during January/February 2018, and a third deployment carried out using both a moored acoustic doppler current meter (ADCP1) and downward facing ADCP. The third deployment was successfully conducted over the period from the 26th April 2018 through to the 2nd June 2018. The instrument site was located ~500 m offshore of the WWTP at a mean water depth of 13.8 m.

DHI developed a MIKE21 hydrodynamic model coupled with an advection dispersion model for the coastal area extending 15 km north and south of the Porirua Harbour entrance, refined in and around the area of the outfall. The calibrated model was used to quantify the dynamics of the treated wastewater plume discharged from the Porirua WWTP to coastal waters south of Titahi Bay. Having developed and calibrated the hydrodynamic model, DHI used it to assess four discharge options. The baseline option is the current (2018) average daily discharge from the existing discharge point at Rukutane Point. Alternative options include a new shoreline discharge at Round Point and two offshore seabed outfalls located 250m and 525 m offshore of the existing outfall discharging into approximately 10 m and 15 m water depth, respectively (the alternative assessment is discussed in AEE Section 6).

The remainder of this assessment focuses on the assessment of WWL's preferred outfall location, which is the existing outfall at Rukutane Point.

5.4.2 Near field and far field processes

A near field mixing assessment for the existing outfall was carried out using the CORMIX modelling system. The near field is defined as the region where the discharge plume momentum dominates over buoyancy. In this region, the plume dynamics are driven by the enhanced velocities of the discharge as it initially enters coastal water. The momentum of the jet generates significant turbulence, which can result in rapid horizontal and vertical mixing of the plume with ambient waters.

Near-field modelling of the Porirua WWTP discharge indicates that rapid vertical mixing will occur due to a combination of entrainment of ambient seawater into the discharge area and downward vertical mixing due to the outfall configuration. Within 25-50 m of the discharge point, the near-field modelling indicates that the treated wastewater plume would occupy the top 70-90% of the water column and that significant increases in salinity would occur. Increases in salinity result in reduced buoyancy of the treated wastewater plume which is likely to be broken down by vertical diffusion and turbulent mixing (due to currents and waves).

Following the near field mixing phase, a reasonably coherent surface plume moves away from the discharge site under the impetus of coastal currents. As it moves, it continues to spread and dilute, but at slower pace than in the near field. In order to characterise the far field dilution, DHI conducted a series of long-term model runs which provide quantification of the levels of dilution achieved and the dynamics of the plume under a broad range of tide and wind conditions for three different discharge regimes.

5.4.3 Scenario Results

The calibrated model was initially run for a four-month simulation at the three discharge rates as described by DHI (2018). For each of these scenario runs the time-series of predicted plume concentrations at the beach monitoring sites was calculated (as % wastewater concentration). Model results for the simulation of the existing shoreline discharge compare favorably to shoreline monitoring results collected in the immediate vicinity of the existing discharge and at Titahi Bay beach.

DHI (2018) estimated dilutions for existing and future instantaneous average daily flows (ADF) and the peak wet weather flows (PWWF). The 10th and 50th percentile dilutions and average dilutions are summarised in Table 5-2. The 10th percentile is the value exceeded in 90-percent of observations (i.e. water quality will be better than this value 90% of the time) while the 50th

-percentile value is the middle-ranked value, exceeded in 50-percent of observations. These values cover the range from 'realistic worst case' to 'mid-range' (conservative to typical) and both are used in the following assessment.

PWWF's are, by definition, extreme events. They are used in the following assessment to represent rare worst-case conditions, coinciding with minimum dilutions.

Table 5-2: Dilution estimates (x-fold) from DHI data

Site	306 L/s ADF[1] 2018		440 L/s ADF 2043		1100 L/s PWWF[2, 3] 2018	1500 L/s PWWF[2, 3,] 2043
	10th percentile	50th percentile	10th percentile	50th percentile	Average	Average
Ti Korohiwa Rocks	32	59	21	33	28	18
200m SW	7	9	5	6	3.6	2.8
200m E	14	29	10	17	7.9	6.2
Titahi Beach (S)	38	71	26	43	23	16
Titahi Beach	69	219	42	99	80	56
Mount Cooper	541	2038	321	1234	1492	1087

[1]ADF means Average Daily Flow

[2] PWWF means Peak Wet Weather Flow

[3]For years 2016 to 2019 the PWWF of 1100L/s occurred less than 1% of the time; the PWWF dilutions indicate rare worst-case events.

[4]The 306 and 440L/s runs are from an annual simulation whereas the 1100 and 1500L/s are from a representative 4-month period

5.5 Effects on physico-chemical water quality

Under Section 107 of the RMA and under the RCP, the wastewater discharge should not after reasonable mixing, cause any of the visual and/or aesthetic effects within the receiving water covered in Section 107 of the RMA. These include:

- Conspicuous oil or grease films, scums, foams, floatables or suspended materials
- Conspicuous changes in colour or visual clarity

These aspects are discussed below.

5.5.1 Oil and grease films, scums and foam

Oil and grease films, scums and foams result from a group of thousands of chemicals with varying physical, chemical and toxicological properties, which can cause a variety of environmental effects.

The development of surface slicks is dependent upon the concentration of oil and grease in the treated wastewater, the initial dilution available as the plume surfaces, and the wave conditions (turbulence) at the surface. The secondary treatment processes employed at the Porirua WWTP ensure that the treated wastewater is substantially free of oil, grease and scums. Grease traps in the Porirua catchment are disposed of at the landfill however domestic wastewater does contain small amounts of oil, grease and scums. These float on the surface of the clarifiers and are collected with the skimmers and removed from the discharged treated wastewater. Given this, it is expected the formation of a conspicuous oil or grease film or scum will not occur beyond a 200m mixing radius and would occur very infrequently within the mixing zone.

The formation of foam results from the agitation of wastewater when it contains higher concentrations of dissolved organic matter (including proteins, lignins and lipids). Dissolved organic matter is mostly but not entirely removed by secondary treatment processes. It is noted that at times, the wastewater discharge can form foam in the immediate area of the outfall, visible up to 50m from the outfall, and confined by nearby rock outcrops and the concrete deflection wall (see Figure 2-3). It should also be noted that foam (or spume) can form naturally in seawater from sources such as the offshore breakdown of algal cells.

5.5.2 Effects on suspended solids, colour and visual clarity

The effects of the proposed wastewater discharge on receiving water total suspended solids levels (TSS) can be calculated by a balance on mass loads. The predicted receiving water contaminant concentration (C_x) at any location x is given by equation 1:

$$Cx = \frac{(Co-Cb)}{TD} + Cb \quad (1)$$

Where Co = the wastewater concentration of the contaminant: Cb = the background concentration in the ocean; and TD = the total dilution.

The assessment in Table 5-3 is based on estimated background TSS concentrations, predicted treated wastewater TSS median values, and the dilution value that is exceeded 90% of the time (except for PWWF dilutions which are average values). Neither a typical ADF discharge in 2018, nor the predicted ADF discharge for 2043, would increase the TSS concentration at any coastal monitoring site because the discharge has a similar TSS concentration to the receiving waters.

The peak wet weather flow (PWWF) of 1500 L/s has a higher TSS concentration than dry weather discharges, predicted by the process model at up 60 g/m^3 , but background TSS concentrations are also likely to increase at such times due to higher wind and wave activity and increased sediment run-off from the land. The net result is that the PWWF discharge is predicted to cause a measurable increase in TSS at 200m distance from the outfall, but negligible change at Ti Korohiwa Rocks or Titahi Bay south beach.

Table 5-3: Predicted total suspended solids concentrations (g/m^3) in Porirua coastal waters

Wastewater flow (L/s)	Year	Discharge concentration[14]	Background seawater concentration[15],	Predicted receiving water concentration[16]			
				200m SW	200m E	Ti Korohiwa Rocks	Titahi Beach (S)
ADF of 306	2018	15	20	19.3	19.6	19.8	19.8
ADF of 440	2043	21	20	20.2	20.1	20.1	20.0
PWWF 1100	2018	60	30	38.3	33.8	31.1	31.3

[14] The ADF and PWWF treated wastewater TSS concentrations are predictions from the process model for 2018 and 2043 scenarios (Table 2-13)

[15] A coastal water TSS concentration of 27 g/m^3 is the minimum value from 6 samples collected at Plimmerton Beach and six samples collected at the Paramata Boat Ramp during a PCC wet weather water quality survey in 2018 (Cameron, 2019). This value was adjusted down to 20 g/m^3 to indicate dry weather background conditions and up to 30 g/m^3 for wet weather background conditions.

[16] ADF concentrations are based on the 10th percentile dilution (i.e., the value exceeded 90% of the time), PWWF concentrations average values (refer Table 5-2)

Wastewater flow (L/s)	Year	Discharge concentration[14]	Background seawater concentration[15],	Predicted receiving water concentration[16]			
				200m SW	200m E	Ti Korohiwa Rocks	Titahi Beach (S)
PWWF of 1500	>2022	60	30	40.7	34.8	31.7	31.9

It is concluded that the 2018 and projected 2043 discharge of TSS would have the following consequences for colour and visual clarity:

- During normal dry weather operation, the discharge will cause no reduction in water clarity, and negligible change in water colour, brightness or light penetration at the point of discharge and at distances further afield;
- During periods of peak wet weather flow, the discharge is expected to cause a measurable reduction in receiving water clarity, and a visible change in water colour at up to a 200m distance from the outfall, but negligible change at Ti Korohiwa Rocks or Titahi Bay south beach. These effects will be temporary, gradually dissipating as the flow peak passes.

The relatively low suspended sediment concentration of the discharge combined with the moderate exposure to a high energy wind and wave environment ensures that fine sediment is rapidly dispersed away from the intertidal and shallow subtidal areas. The dispersive characteristics of nearshore and offshore habitats are confirmed by the marine ecology studies conducted by Cawthron (Morrisey 2019).

Summary of effects on physico-chemical water quality characteristics

The potential effects of the existing and proposed (to 2043) discharge of wastewater from Porirua WWTP to coastal waters include the following:

- Negligible risk of conspicuous oil or grease films, or scums;
- Some formation of foam occasionally visible in the immediate vicinity of the outfall but not beyond 50m of the outfall;
- A change in colour and visual clarity of coastal waters occasionally visible within the 200m radius mixing zone, but unlikely to be conspicuous beyond the mixing zone.

5.6 Effects on microbiological water quality

5.6.1 Enterococci concentrations in coastal waters

Faecal indicator bacteria (FIB) are bacteria that come from the gut of warm-blooded animals, including people. Enterococci is the recommended faecal indicator bacteria for use in marine waters.[17] Its presence, especially at high concentrations, indicates that harmful pathogens such as viruses and protozoa may also be present. FIB monitoring is the primary means of assessing the risks associated with faecal contamination because monitoring of viruses is time consuming and expensive and therefore not practicable on a routine basis.

The results of faecal indicator bacteria monitoring in coastal waters adjacent to the WWTP outfall and in Titahi Bay are presented in Section 3.3. Faecal contamination of these coastal waters is derived from several sources but primarily from the discharge of urban stormwater, faults in the wastewater conveyance network and the discharge of treated wastewater from the WWTP. In other words, the faecal indicator bacteria monitoring results identify the cumulative effect from all sources of microbiological contamination.

The contribution received from the WWTP discharge is estimated by dispersion modelling described in DHI (2018) & DHI (2019a). Table 5-4 combines dilution estimates (from Table 5-2) with 95-percentile source concentrations to indicate realistic worst case plume concentrations of enterococci (cfu/100ml) at specified shoreline locations as a result of the WWTP discharge only. The discharge scenarios are:

- 2018 instantaneous average daily flow (ADF) of 306 L/s, 10-percentile dilution and 500 enterococci[18] per 100ml;
- 2018 peak wet weather flow (PWWF) of 1,100 L/s, average dilution and 15,000 enterococci[19] per 100ml;
- 2043 ADF of 440 L/s, 10-percentile dilution and 1,000 enterococci[20] per 100ml.
- 2043 PWWF of 1,500 L/s, average dilution and 1,000 enterococci[20] per 100ml.

Dispersion modelling based on the 2018 ADF of 306 L/s and 95-percentile enterococci concentration of 500 enterococci per 100ml predicts discharge plume enterococci concentrations of between 36 and 71 cfu/100ml at a distance of 200m from the outfall, and approximately 13 cfu/100ml at the south end of Titahi Bay. These values represent the contribution from the WWTP, excluding other sources of faecal contamination. When compared against the PNRP 95-percentile target, the 2018 ADF enterococci contribution from

[17] Notwithstanding this, faecal coliform bacteria, a subset of FIB, are required to be monitored in the treated wastewater by consent conditions 11(b).

[18] From Table 2-4 the long term faecal coliform 90-percentile concentration is 800 cfu/100ml, indicating an enterococci 90-percentile concentration in the order of 500 cfu/100ml.

[19] Extrapolation from WWL monitoring data for the final discharge during wet weather from May to August 2018

[20] The upgraded UV system post 2023 is specified to achieve a 95-percentile enterococci concentration of <1000 cfu/100ml.

the WWTP accounts for less than 20 percent of the PNRP target at sites 200m from the outfall and less than 2 percent of the PNRP Target at Titahi Beach South.

Table 5-4: Predicted WWTP discharge plume enterococci concentrations based on 95%ile source concentrations

Site	2018 ADF; 306 L/s, 10%ile Diln	2018 PWWF; 1,100 L/s, average Diln	2043 ADF 440 L/s, 10%ile Diln	2043 PWWF; 1,500 L/s average Diln	PNRP 95th%ile Enterococci Target (cfu/100ml)
	500 (cfu/100ml)	15,000 (cfu/100ml)	1,000 (cfu/100ml)	1,000 (cfu/100mll)	
Ti Korohiwa Rocks	16	536	48	56	<500
200m SW	71	4167	200	357	
200m E	36	1899	100	161	
Titahi Beach south	13	652	38	63	
Titahi Beach	7	188	24	18	
Mount Cooper	1	10	3	1	

Modelling predictions for the 2018 PWWF of 1,100L/s and estimated enterococci concentration of 15,000 cfu per 100ml (including bypass flow) indicate worst case discharge plume concentrations of between 1899 and 4167 enterococci per 100ml at a distance of 200m from the outfall, and approximately 652 cfu/100ml at the south end of Titahi Bay. These results are elevated but would still meet the PNRP target (95^{th} percentile enterococci of <500 per 100ml) because such bypass events are rare (occurring between one and three percent of the time from 2016 to 2019), and could be accommodated within the 5 percent of samples permitted to exceed 500 per 100ml ml.

The predicted worst-case enterococci concentrations at sites near the outfall align well with the actual maximum concentrations recorded during the years 2015, 2016 and 2017, as shown in Figure 3-6 and Figure 3-7. The declining trend for maximum values recorded at sites near the outfall from 2015 to 2019 correspond with WWTP improvements and an improved discharge quality over that period.

Further upgrades scheduled for completion by June 2023 would ensure that all wastewater flows received at the WWTP are secondary treated and UV irradiated, achieving a 95th-percentile enterococci concentration of ≤1000 cfu/100ml. After June 2023, the predicted worst-case enterococci concentration in receiving waters at a distance of 200m from the outfall is between 161 and 357 cfu/100ml, reducing to 63 cfu/100ml at the south end of Titahi Bay (Table 5-4). As noted, these worst-case events will be very rare occurrences when flows through the WWTP approach 1,500 l/s.

This assessment incorporates output from PCC's routine monitoring of a stormwater outlet to Titahi Bay, the PCC/GWRC routine recreational water quality monitoring data for Titahi Bay, PCC's WWTP bypass monitoring of receiving waters, and the dispersion model developed for WWL to characterise the WWTP discharge plume. Taken together, these inputs allow a good understanding of the degree to which RCP and PNRP recreational water standards are achieved, and the degree to which the WWTP discharge contributes to faecal contamination of the receiving waters. The key results are summarised as follows:

- The RCP annual median enterococci standard was achieved at Titahi Bay north beach for four of five summers, at Titahi Bay middle beach for all five summers, and Titahi Bay South Beach Bay Drive for three of the last five summers, failing on 2017/18 and 2018/19.
- Enterococci counts at all three sites in Titahi Bay sites complied with the PNRP 95-percentile standard throughout the period from 2014 to 2019, but neither the Titahi Bay north nor south beach sites achieved the more stringent Te Awarua-o-Porirua Whaitua target.
- A stormwater outlet discharging onto the southern end of the Titahi Bay Beach is known to be a significant source of faecal contamination, probably accounting for most of the faecal contamination reported in near shore waters at the southern end of Titahi Bay.
- Coastal water monitoring focused on WWTP bypass events indicates that, in the three years to mid-2017, bypass events occasionally caused very high receiving water concentrations of enterococci at sites close to the outfall. Maximum enterococci values in the vicinity of 10,000 cfu/100ml were recorded at the 200m sites, consistent with modelling predictions for these sites. It is likely that bypass discharges during this period occasionally contributed to faecal contamination within Titahi Bay.
- Wet weather coastal water quality at sites close to the outfall improved markedly in the three-year period to mid-2019, and especially during years 2018 and 2019. Over that period, enterococci concentrations at sites near the outfall were considerably lower than at sites within Titahi Bay. That improvement is a direct result of the upgrades implemented at the WWTP during 2016, 2017, 2018 and 2019, which have reduced the frequency of bypass flows, and reduced the level of contamination in surrounding waters (the average annual rainfall for years 2017, 2018 and 2019 is similar to the long term average).
- It is anticipated that further WWTP upgrades scheduled for completion by June 2023 will ensure that all wastewater received at the WWTP can be secondary treated and UV disinfected, delivering further improvements to the quality of surrounding coastal waters, and reducing the effect on the microbiology water quality after reasonable mixing to less than minor.
- Following completion of the proposed capacity upgrades, it is anticipated that all wastewater received at the WWTP will be fully treated for the proposed duration of the consent to 2043 and that the microbiological quality of the discharge will remain high throughout that period.

This section has focused on faecal indicator bacteria monitoring results, which indicate the microbiological risk of the current discharge, and the combined risk that arises from the cumulative effect of the WWTP and other contamination sources (e.g. stormwater discharges). The next section addresses a quantitative microbial risk assessment which has assessed the potential viral health risks of the proposed WWTP discharge at 2043.

5.6.2 Quantitative microbial risk assessment

Introduction

Treated municipal wastewater may contain disease-causing microorganisms (pathogens) – most of which are enteric i.e., they affect the digestive system. These pathogens include protozoa (causing gastrointestinal diseases such as giardiasis and cryptosporidiosis), viruses (causing upper respiratory tract and gastrointestinal diseases) and bacteria (causing mainly gastrointestinal diseases including dysentery and diarrhoea).

Numerous studies referenced by McBride (2012) show that discharging treated wastewater to marine waters (such as occurs at the Porirua WWTP outfall at Rukutane Point), can present a potential public health risk if there is ingestion of contaminated sea water, either during recreational activities such as swimming, or through consumption of uncooked shellfish collected from contaminated sea water. The risk of respiratory disease associated with inhalation of pathogens in spray droplets by people accessing the shore near the outfall is also noted.

Most of these studies have relied on an assessment of the presence of faecal indicator bacteria (such as enterococci) in the discharge and receiving water to assess human health risks. The Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas (MfE/MoH 2003) support the management of bacteriological water quality using faecal indicator bacteria. However, these guidelines also note that they should not be directly applied when assessing the microbiological quality of water that is impacted by discharges of treated wastewater as there is a potential for the relationship between faecal bacterial indicators (such as enterococci) and pathogens (such as norovirus) to be altered by the treatment and disinfection process. For example, UV disinfection which causes genetic damage and prevents reproduction, is most effective on bacteria which are larger and more genetically complex. However, specific viruses (e.g. adenoviruses that can cause respiratory disease), which are simpler genetically, are more resistant and require higher doses of UV for inactivation.

The relationship between bacterial indicators and pathogens therefore needs to be established before the public health risks of a discharge can be quantified. There is also good evidence that viral pathogens are the leading causative agents of recreational waterborne illnesses. A unique characteristic of viral infections is that a high proportion of the exposed populations could be potentially affected, often leading to very high incidences of gastroenteritis that can then be spread by person-to-person contact to other individuals who were not directly exposed to the polluted waters.

For these reasons, Quantitative Microbial Risk Assessment (QMRA) has become the preferred means of assessing the health risks to recreational users (e.g. swimmers) and consumers of raw shellfish gathered from near the outfall.

A QMRA has been prepared by Streamlined Environmental Ltd (Dada 2019) to support the WWTP consent application for the ongoing discharge of treated wastewater to marine waters at Rukutane Point (see locality plan in Figure 2-1). This assessment has been peer reviewed by NIWA Ltd. A copy of the QMRA report is attached as an Appendix J, and the results are summarised below.

The QMRA process

QMRA applies information and data from hydrodynamic and mathematical modelling to assess the potential public health risks from the discharge of pathogens (viruses) after discharge into a receiving environment such as coastal waters. Typically, four stages are involved including hazard identification, exposure assessment, dose-response analysis and risk characterisation.

The QMRA was carried out for both the current WWTP connected population and flows as well as the predicted long term (2043) connected population and flow scenario. The QMRA relates specifically to the risk from the WWTP discharge; other discharges in the area are not taken into account.

The following scenarios were considered:

(i) A baseline case, i.e., no expansion in the current discharge levels and the existing (2018) population: ADF discharge flow of 306L/s based on 84,000 population equivalents; and

(ii) Long term (2043), i.e., ADF discharge flow of 440L/s based on a future population of 121,000.

Norovirus and enterovirus were used as reference pathogens for primary contact recreation (such as swimming) and shellfish consumption. For secondary contact recreation, which includes activities such as shoreline walking, jogging, paddling, wading, boating and fishing (where there may be some direct contact but the chance of swallowing water is unlikely), adenovirus was used for assessing risks associated with inhalation of potentially polluted water (e.g. from wind or wave-induced spray). The assessment considers the risks to children, as a worst case, as studies show that water ingestion rates by children are twice as much as that of adults.

Influent virus concentration assumptions were based on the results of limited virus sampling at the WWTP in September 2019 (see Table 2-7), as well as an assessment of monitoring data reported from other QMRAs carried out in New Zealand (e.g., McBride 2016).

Long term model simulations were carried out by DHI Ltd (Appendix H) to assess dilutions at key sites in the vicinity of the outfall. The overall dilutions achieved were modelled for the QMRA using conservative tracers (which assume no die-off). Monte Carlo simulations were then carried out using @Risk software to determine the likelihood of illness from an individual’s exposure to viral pathogens. This approach involves taking a random sample (i.e., as a roll of the dice hence the name “Monte Carlo”) of 100 individuals “exposed” on a given day. The process is repeated 1000 times to give a total of 100,000 “exposures”.

Contact recreation and shellfish gathering “exposure” sites

Fifteen contact recreation and shellfish gathering “exposure” sites (Figure 5-1) were identified from the DHI hydrodynamic modelling and the results of the recreation assessment. Three shellfish gathering sites were included to capture risks due to shellfish gathering within Porirua Harbour (i.e. SF4, SF5 and CR7); there are no significant filter feeding shellfish populations present in the vicinity of the outfall, except for the little black mussel, which is generally not taken for human consumption because of its small size (<3cm).

Figure 5-1: Location of 15 exposure site (Source: Streamlined Environmental)

Assessment of health risks

The QMRA results are reported in terms of both risk of infection and illness, noting that not all individuals that become infected eventually become ill. In line with other QMRAs, illness/infection ratios of 0.6 and 0.5 were applied for noroviruses and adenoviruses (e.g., McBride 2016), respectively. Due to the relative unavailability of dose-response and morbidity data for enterovirus, it was assumed that every individual who contracted enterovirus infections also became ill, hence a conservative infection/illness ratio of 1 was applied.

The predicted risk is reported as the IIR (individual illness risk), calculated as the total number of infection cases divided by the total number of exposures, expressed as a percentage. The IIR is then compared with thresholds defined in the MfE/MoH (2003) “Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas”. The virus illness risk thresholds for contact recreation, shellfish consumption and spray inhalation, against which the modelling results are compared, are shown in Table 5-5.

Table 5-5: Virus illness risk thresholds for contact recreation, consumption of shellfish and inhalation of spray/aerosols

Contact recreation or shellfish consumption	Inhalation of pathogens in spray/aerosols
High illness risk (>10% gastrointestinal illness)	High illness risk (>3.9% acute febrile illness)[1]
Moderate illness risk (5-10% gastrointestinal illness)	Moderate illness risk (1.9% - 3.9% acute febrile illness)
Low illness risk (1-5% gastrointestinal illness)	Low illness risk (0.3 – 1.9% acute febrile illness)
No observable adverse effects level (<1% gastro-intestinal illness)[2]	No observable adverse effects level (<0.3 acute febrile illness

Notes: [1.] Acute febrile illness is the medical term used to describe a sudden fever or elevation in body temperature typically in response to a bacterial or viral respiratory infection.

[2.] The NOAEL is the widely accepted threshold when assessing the health risks from wastewater discharges (eg McBride G (2016) *Quantitative Microbial Risk Assessment for the Discharge of Treated Wastewater: Warkworth Wastewater Treatment Plant*. Report Prepared by NIWA for Watercare Services Limited. HAM2016-037.

QMRA conclusions

To optimize the protection of public health, a precautionary approach has been taken in the QMRA. This includes:

- Using a hockey stick distribution[21] fitting in modelling in consideration of occasional very high influent virus concentration in communities
- Reporting children's illness risks which is consistent with other QMRAs (e.g. McBride, 2017)
- Using a dilution-only scenario which does not include solar- based UV irradiation to capture risks to early morning water users.

The QMRA assesses a child's risks of contracting an illness from ingesting enterovirus or norovirus contaminated water, or inhaling adenovirus during contact recreation at selected exposure sites, for current (2018) and future predicted average flows (2043). The QMRA does not consider peak wet weather flow scenarios which result from stormwater inflow and infiltration into the wastewater network. Peak wet weather flows are rare, short term events occurring less than 1% of the time, invariably in storm conditions when recreational use of coastal marine area is low.

As noted earlier, the QMRA only relates to the risk from the WWTP discharge - i.e. other discharges in the area are not taken into account in the QMRA. The combined microbiological risk from the WWTP discharge and other sources (such as stormwater discharges) are indicated by the faecal indicator bacteria monitoring results. .

Contact recreation

[21] A hockey stick distribution is characterised by sharp rises or falls in data points after a relatively flat period- e.g. the number of infected persons and viral load received at the WWTP during an infrequent norovirus outbreak in a community.

Table 5-6 combines the child's risk estimates with virus removal rates for secondary treatment and UV disinfection at Porirua WWTP (from Table 2-13) to summarise the risks to contact recreational users of coastal waters at selected locations between Mt Cooper and Te Korohiwa Rocks (defined in terms of the risk thresholds noted in Table 5-6).

The QMRA has determined that with greater than or equal to 3 log removal of virus at the WWTP, the illness risk at all exposure sites will fall into the 'no risk' band. It is of note that for enteroviruses and noroviruses the WWTP is expected to provide 5 and 7 log removal respectively.

Table 5-6: Child's enteric and acute febrile illness risk at 9 sites for two WWTP treated wastewater discharge scenarios (conservative tracer)

Site	2018 (84,000 PE)			2043 (121,000 PE)		
	Enteric illness risk		Febrile risk	Enteric illness risk		Febrile risk
	Entero-virus. (≥3 log)	Norovirus. (≥3 log)	Adeno-virus. (≥3 log)	Entero-virus (≥3 log)	Norovirus (≥3 log)	Adeno-virus (≥3 log)
Mt Cooper	No risk	No risk	No risk	No risk	No risk	No risk
Titahi Beach - North	No risk	No risk	No risk	No risk	No risk	No risk
Titahi Beach – Mid (Contact rec 1)	No risk	No risk	No risk	No risk	No risk	No risk
Titahi Beach - South	No risk	No risk	No risk	No risk	No risk	No risk
200m E	No risk	No risk	No risk	No risk	No risk	No risk
200m Offshore	No risk	No risk	No risk	No risk	No risk	No risk
200m SW	No risk	No risk	No risk	No risk	No risk	No risk
Te Korohiwa	No risk	No risk	No risk	No risk	No risk	No risk
Tirua Bay	No risk	No risk	No risk	No risk	No risk	No risk

Legend:	Enteric illness risk		Acute Febrile illness risk	
	Individuals illness risk >10%	High illness risk	Individuals illness risk >3.9%	High illness risk
	Individuals illness risk (5.0-10%)	Moderate illness risk	Individuals illness risk (1.9-3.9%)	Moderate illness risk
	Individuals illness risk (1-<4.9%)	Low illness risk	Individuals illness risk (0.3-<1.9%)	Low illness risk
	Individuals illness risk (< 1%)	No illness risk	Individuals illness risk (< 0.3%)	No illness risk

It is noted that this assessment of risk indicates that:

- individual illness risks increase with increasing wastewater flows up to 2043 but remains in the "no risk" band.
- The contact recreation risks are greatest at the sites 200m southwest (SW) of the outfall and 200m east (E) of the outfall, but because of level of treatment provided the individual illness risk is <1% at all sites, i.e., in the "no risk" band. Risks at sites further from the outfall diminish in the following order Ti Korohiwa Rocks > Titahi Beach (South) > Contact Recreation 1> Titahi Beach > 200 m Offshore > Tirua Bay > Mount Cooper.

Shellfish consumption

The risks of contracting a gastrointestinal illness from consuming raw shellfish gathered from the 3 exposure sites in Porirua Harbour are described for current (2018) and future predicted flows (2043) in Dada (2019).[22] Table 5-7 combines the risk estimates with preliminary virus removal rates at Porirua WWTP (from Table 2-11), indicating that there is no effective risk associated with the WWTP discharge plume at both the 2018 and 2043 populations.

The QMRA has determined that with greater than or equal to 3 log removal of virus at he WWTP, the illness risk at all exposure sites will fall into the 'no risk' band. It is of note that for enteroviruses and noroviruses the WWTP is expected to provide 5 and 7 log removal respectively.

Table 5-7: Gastrointestinal illness risk from eating raw shellfish collected at 3 sites for two WWTP treated wastewater discharge scenarios (conservative tracer)

Site	2018 (84,000 PE)		2043 (121,000 PE)	
	Enterovirus (≥3 log)	Norovirus (≥3 log)	Enterovirus (≥3 log)	Norovirus (≥3 log)
Contact Rec 7	No risk	No risk	No risk	No risk
Shellfish 4	No risk	No risk	No risk	No risk
Shellfish 5	No risk	No risk	No risk	No risk

Legend:

Enteric illness risk	
Individuals illness risk >10%	High illness risk
Individuals illness risk (5.0-10%)	Moderate illness risk
Individuals illness risk (1-<4.9%)	Low illness risk
Individuals illness risk (< 1%)	No illness risk

[22] There are no significant filter feeding shellfish populations present in the vicinity of the outfall except for the little black mussel, which is not commonly taken for human consumption because of its small size (<3cm)

Summary of effects on microbiological water quality and illness risk

Faecal contamination in recreational waters of Titahi Bay:

- Of the three routine shoreline water quality monitoring sites on Titahi Bay Beach only the Toms Road site, near the middle of the beach, has consistently achieved all RCP, PNRP and Whaitua enterococci targets.
- Monitoring results indicate that combination of all local sources of faecal contamination in urban Titahi Bay are having a measurable cumulative effect on microbiological water quality at both the southern and northern ends of the beach. These sources are most likely wastewater network faults, in combination with general stormwater runoff.
- After completion of the WWTP upgrades in 2023, the treated wastewater discharge contribution to faecal contamination of Titahi Bay is predicted to be minor.

Quantitative microbial risk assessment for WWTP discharge:

- The QMRA assessment for both the 2018 and 2043 scenarios is that the WWTP wastewater discharge presents no risk (<1%) of respiratory and gastrointestinal illness for recreational water users at shoreline sites of 200m either side of the outfall and at all sites further afield.
- The QMRA assessment is that the WWTP wastewater discharge presents no risk of contracting a gastrointestinal illness from consuming raw shellfish[23] from the nearest significant shellfish beds for both the 2018 and 2043 populations. It is noted, however, that all shellfish in coastal waters adjacent to urban areas are assumed to be unsuitable for human consumption due to the risk of wastewater network faults or overflows.

5.7 Recreation effects

As shown in Table 5-8, the conclusions about the adverse effects of the discharge on recreation values have considered:

- the value of the setting for recreation
- the magnitude of the effect (i.e. the public health risk).

Table 5-8: Scale of impact on recreation values considering magnitude of effect

		Recreation value			
		Very High	High[24]	Moderate	Low
Magnitude of effect	High or severe	Significant	Significant	Moderate	Minor
	Moderate or medium	Significant	Moderate	Minor	Minor
	Low or minor	Moderate	Moderate	Minor	Minor
	Negligible	Negligible	Negligible	Negligible	Negligible

The magnitude of the effect is based on the assessment of illness risk in the previous section. Recreation value correlates to the different levels of recreation use identified in Figure 3-11 and described in Section 3.6 of the AEE.

The Recreation Assessment has determined that given there is 'no risk' of illness from the WWTP at any of the exposure sites that the magnitude of effect from the proposed WWTP is negligible. Therefore, notwithstanding the high recreation values in significant parts of the receiving environment, the adverse effects will be negligible.

[24] There is no 'minor' scale of adverse effect for 'high' or 'very high' use recreation settings. This reflects community expectations that very popular settings are managed for extremely small or negligible human health risk.

5.8 Effects on aquatic Life

5.8.1 Introduction

Wastewater discharges to the ocean can affect marine habitats and aquatic life in diverse ways but primarily by way of:

- Temperature changes, pH differentials or oxygen depletion
- Suspended sediment (reducing visual clarity) or sediment deposition on the seabed (reducing habitat quality for aquatic plants, invertebrates and fish)
- Salinity change
- Nutrient enrichment (increased or excessive production of plants and invertebrates), or
- Toxic effects of contaminants (including EOCs).

5.8.2 Temperature, pH, oxygen depletion

Wastewater is retained for some hours during conveyance to and treatment at the WWTP before discharge at Rukutane Point. Wastewater temperature is not routinely measured at the WWTP, however, Connect Water (2019) reported a wastewater temperature of 16 to 16.5 ^{o}C during September 2019. Ambient seawater temperature in Titahi Bay at that time was 13 ^{o}C (GWRC live data viewer), indicating a difference of 3.5 ^{o}C which, after 5-fold dilution at the edge of a 200 m radius mixing zone, would increase the receiving water temperature by less than 1^{o}C. A change of that order is minor in terms of the normal range for Titahi Bay, which varied between 12 and 22 ^{o}C during 2019 (GWRC live data viewer), and the risk to aquatic life from the existing and proposed discharge is assessed as less than minor.

The pH of wastewater can affect the toxicity of ammonia, sulphide and most metals. Treated municipal wastewater will typically have a pH around 7.2 compared with the more alkaline seawater of Cook Strait which normally has a pH around 8.1. Seawater is heavily buffered by dissolved salts which render it relatively resistant to pH change and unlikely to be influenced by the discharge plume beyond the 200m radius mixing zone. The risk to aquatic life from the pH of the existing and proposed discharge is assessed as less than minor.

Low dissolved oxygen (DO) concentrations can have an adverse effect on many aquatic organisms which depend on oxygen dissolved in water for efficient functioning. It can also cause reducing conditions in sediment, causing sediments to release previously bound nutrients and toxicants to the water column (ANZECC, 2000).

The dissolved oxygen concentration of treated wastewater may be below 100% saturation and may draw off oxygen from surrounding seawater during initial mixing. However, the waters off Wellington's southwest coast are well oxygenated and given the very large dilution available, no significant oxygen depletion is anticipated. Furthermore, no signficant oxygen depletion is anticipated in the marine sediments near the outfall because of the low suspended solids concentration of the discharge and the dispersive character of

Porirua coastal waters. Overall, the risk to aquatic life from the existing and proposed discharge is assessed as less than minor.

5.8.3 Suspended and deposited sediment

The risks associated with the suspended and deposited sediment concentrations of the existing and proposed discharge has been assessed in Section 5.6 as less than minor.

5.8.4 Salinity

Modelling studies conducted by DHI (2018) (Appendix N) show that salinity will be reduced below the ambient concentration of 32 PSU (Practical Salinity Unit) in the coastal area between Green Point and the north side of Titahi Bay under average wastewater flow conditions, and in the area from Green Point to the mouth of Porirua Harbour at peak discharge (1500 L/s). Morrisey et al (2019) (Appendix F) consider that the predicted reduction of salinity to 25 – 29 PSU caused by the average discharge in an area extending 200m either side of the outfall is potentially ecologically significant, but note that this reduction applies to the surface plume of the discharge and will only impact the seabed in the area immediately below the discharge and for short periods in the intertidal areas as the tide rises and falls. The effect of the WWTP discharge with respect to salinity is similar to that of a moderately sized stream discharging to coastal waters; the risk to aquatic life is assessed as less than minor.

5.8.5 Nutrients

The existing discharge

Nutrients, especially nitrogen and phosphorus, are vital to the coastal marine ecosystem and both generally become depleted in shallow coastal waters during the spring and summer period. Nitrogen is normally the main limiting nutrient in New Zealand coastal waters. The principal cause of nutrient depletion is uptake by phytoplankton, which typically reach their highest concentration in spring. Three sources of nutrient replenishment are identified, these being recycling from the seafloor, inputs from deep oceanic upwelling and inputs from terrestrial sources following high flows in watercourses. Within the Porirua Harbour catchment these watercourses include the Porirua, Pauatahanui, and Horokiri streams, and on the west coast the Makara and Karori streams. It has been suggested that the scarcity of mussels and other filter feeding shellfish along Wellington's southwest coastline is due to low concentrations of organisms and non-living organic material in the water column, collectively known as seston, which constitutes their food supply (Gardner, 2000).

The WWTP discharge contains nutrients which have the potential to alter the natural nutrient concentrations in the receiving water and thereby affect the marine ecology around the outfall. The potential effect of wastewater discharges on receiving water concentrations of total phosphorus (TP) and total nitrogen (TN), based on the 10^{th} to 50^{th} percentile dilution range, are indicated for average wastewater flows in Table 5-10. The 2018 average wastewater flow of 306 L/s is predicted to result in up to a 15-fold increase in

TP 200m from the outfall, and up to a 3-fold increase in TN. Concentrations of both nutrients decline with distance from the outfall due to dilution, dispersion and uptake by phytoplankton.

Table 5-9: Predicted TP and TN concentrations in Porirua coastal receiving waters (mg/L)

Contaminant	Year	Wastewater ADF (L/s)	Discharge median concentration (summer)[25]	Background concentration[26]	Predicted receiving water concentration range[27]			
					200m SW	200m E	Ti Korohiwa Rocks	Titahi Beach (S)
TP	2018	306	2.5	0.018	0.29 - 0.37	0.10 - 0.20	0.06 - 0.10	0.03 - 0.08
TN	2018	306	3.1	0.200	0.52 - 0.61	0.30 - 0.41	0.25 - 0.29	0.21 - 0.28
TP	2043	440	2.6	0.018	0.45 - 0.53	0.17 - 0.28	0.10 - 0.14	0.04 - 0.12
TN	2043	440	5.2	0.200	1.03 - 1.20	0.49 - 0.70	0.35 - 0.44	0.25 - 0.39

Table 5-10: ANZECC (2000) default coastal water trigger values for South-East Australia (mg/L)

Ecosystem type	TP (mg/L	DRP (µg/L)	TN	NOx	Total ammonia-N
Estuaries	0.03	0.005	0.300	0.015	0.015
Marine	0.025	0.010	0.120	0.005	0.015

ANZECC (2000) do not provide nutrient guidelines for marine waters in New Zealand, but comparisons against the guidelines developed for South-East Australia (Table 5-11) indicate that predicted plume nutrient concentrations exceed the default trigger levels at most shoreline locations.

Whether the projected increases in nutrients and loadings between 2018 and 2043 will stimulate nuisance blooms of algae and macroalgae, is very difficult to determine because of the range of factors and complex processes that affect plant growth. In particular, it is noted that the discharge plume floats on the seawater surface, its movement determined by wind and tide conditions, only impacting the seabed in the area immediately below the discharge and for short periods in the intertidal areas as the tide rises and falls. Benthic algae are only intermittently exposed to the nutrient rich plume and their scope for growth is constrained accordingly.

Morrisey *et al* (2019) (Appendix F) noted that nutrients from the WWTP may make their way into the local ecosystem and that there is potential for increased nutrients to cause increased abundances and biomass of planktonic algae (phytoplankton) and benthic micro and macroalgae. This increase may, in turn, result in increased abundances of herbivorous zooplankton and benthic invertebrates, such as grazing gastropods (including paua). Very

[25] TP and TN concentrations for 2018 and 2043 are summer median values from the Connect Water Process model (Table 2-10). While TN values are considerably higher in winter, the risk of nuisance algal growth is no higher because of lower sunlight hours, lower sunlight intensity, and lower water temperatures.

[26] Background TP and TN from Statistic NZ website (Coastal water quality).

[27] The concentration range is based on dilutions exceeded 50% to 90% of the time (Table 5-2).

large increases in biomass of macroalgae can smother the seabed, adversely affecting other species, and may be dislodged and carried to more sheltered areas (such as Titahi Bay) where they could accumulate and decompose, creating adverse ecological effects and a nuisance for human users in the area.

However, the 2019 surveys of intertidal and shallow subtidal hard strata around the existing outfall, and at adjacent reference sites, did not provide any clear evidence that the current discharge has resulted in increased growth of algae, or abundances of grazing invertebrates, as a consequence of increased nutrient availability (See Appendix F).

The lack of any observed effects suggests that dispersion and dilution of the discharge at Rukutane Point is sufficient to reduce concentrations of nutrients to ecologically acceptable concentrations. The overall risk to hard-substratum habitats from the existing discharge at Rukutane Point is therefore assessed as *less than minor*.

In terms of the soft sediments, which begin 150-200m offshore, none of the sites sampled showed a distinct redox discontinuity[28] and measurements of TOC, TN, TRP and chlorophyll-*a* showed that these sediments are unenriched and are not likely to be causing stress to aquatic organisms. Morrisey *et al* (2019) (Appendix F) did not draw any conclusions about the risk of nutrient enrichment in soft sediment habitats from the existing discharge at Rukutane Point, however given that these habitats are well separated from the discharge, it can be inferred that the overall risk is *less than minor*.

The 2043 discharge

Summer WWTP discharge plume concentrations of TN and TP are predicted to gradually increase over the next twenty years in response to population growth, potentially by as much as 76% for TN and 40% for TP at sites 200m either side of outfall (Table 5-10). Winter discharge plume TN concentrations are predicted to be higher than shown in Table 5-10, but the risk of nuisance growth of phytoplankton or benthic algae is not expected to increase under winter conditions.

The ecological response to a gradual increase in the availability of nutrients in the vicinity of the outfall cannot be predicted with certainty. Nevertheless, a comparison can be made with the Seaview wastewater treatment plant which discharges secondary treated and UV disinfected wastewater through a shoreline outfall to Fitzroy Bay at Bluff Point, on Wellington's south coast. The receiving environment for both discharges consists of rocky reef habitat with a high level of exposure to wind and wave action. Seaview wastewater discharges at an average flow of approximately 600 L/s, well above the 440 L/s projected for Porirua, and nutrient loads discharged from Seaview are well in excess of those expected from the Porirua WWTP by year 2043.

Dunmore & Peacock (2015) conducted a marine ecology survey for the Seaview WWTP discharge at Bluff Point and made the following conclusion:

[28] Redox discontinuity layer is zone of rapid transition between areas of aerobic and anaerobic decomposition in ocean sediments. Its depth within sediments depends on the quantity of organic matter available for decomposition and the rate at which oxygen can diffuse down from the overlying water.

"*Overall, the "marked trend" noted in 1998* [before commissioning of the Seaview WWTP] *for variation in species diversity with distance from the outfall is no longer discernable. The number of taxa observed in each transect were similar, with the lowest number recorded from Transect 1, the furthest from the outfall. Abundances of dominant, large brown algae appeared to be similar across transects. Anderlini (1998) concluded that "Any modification to the present treatment process that reduces the level of suspended sediment, decreases the organic load, and/or increases… the dilution of the effluent discharged…should result in a rapid improvement in the condition of macroalgae within the immediate outfall area. Such an improvement would be followed by a noticiable increase in the number and variety of macrofaunal species that are associated with these algal species" This conclusion is strongly supported by the 2004 and the current survey.*"

Despite the larger wastewater flow and greater nutrient load discharged at Bluff Point, the lack of evidence of nutrient enrichment in receiving waters suggests that the available dilution and dispersion is sufficient to reduce concentrations of nutrients to ecologically acceptable levels. Given the similarities in the receiving environments, the example of Bluff Point provides a level of confidence that larger wastewater flows will not necessarily result in excessive algae growth or abundances of herbivorous zooplankton and benthic invertebrates at Rukutane Point.

It would be prudent however to repeat the marine ecology survey conducted by Morrisey et al (2019) at approximately 10-year intervals, or midway through the term of the new consent if it is granted for a duration of 20 years. See Section 5.13 – *'Proposed Mitigation Measures'* for further details on the proposed monitoring regime.

5.8.6 Potential toxic effects on benthic biota

This assessment has adopted an integrated approach comprising:

- Chemical specific toxicity guidelines coupled with dispersion modelling and water quality monitoring,
- Direct toxicity assessment of the wastewater discharge as whole coupled with dispersion modelling, and
- Biological monitoring within the receiving environment.

Toxic effects can result from either short term (acute toxicity) or long term (chronic toxicity) exposure, relative to the life span of the organism. Toxicity can also result from the accumulation of contaminants through consumption of food containing the toxicants (bioaccumulation).

Chemical specific toxicity

The majority of toxicants carried in Porirua wastewater are removed by the treatment process hence concentrations in the discharge are generally low (see Tables 2-4 to 2-6).

Ammonia, a potential toxicant, is currently present at only low or moderate concentrations in the treated wastewater discharge. However, concentrations are projected to increase substantially over the term of the consent as wastewater flows and loads increase. Treated wastewater ammonia concentrations also vary seasonally, being lower in summer and higher in winter. By 2043, the discharge may cause receiving water ammonia concentrations to exceed ANZG (2018) default guideline values (DGVs) for "slightly to moderately disturbed ecosystems" at a distance of 200m from the outfall, potentially creating toxic conditions for some benthic biota in intertidal and shallow subtidal habitats (Table 5-12). In practical terms, this might result in localised changes in community composition as sensitive taxa are unable to tolerate elevated ammonia concentrations.

Table 5-11: Predicted total ammonia nitrogen concentrations (mg/L) in receiving waters

Year	Season	Wastewater ADF (L/s)	Discharge 90%ile	Background conc.	Predicted receiving water concentration[29]				ANZG (2018) DGV
					200m SW	200m E	Ti Korohiwa Rocks	Titahi Beach (S)	
2018	Summer	306	1.7	0.05	0.23 – 0.29	0.11 – 0.17	0.08 – 0.10	0.06 – 0.09	0.91
2018	Winter	306	6.5	0.05	0.77 – 0.97	0.27 – 0.51	0.16 – 0.25	0.08 – 0.22	
2043	Summer	440	4.8	0.05	0.84 – 1.00	0.33 – 0.53	0.19 – 0.28	0.10 – 0.23	
2043	Winter	440	25.8	0.05	4.34 – 5.20	1.56 – 2.63	0.83 – 1.28	0.31 – 1.04	

This assessment is conservative at several levels, being based on the following assumptions:

- High population growth to 121,000 by year 2043
- increased wastewater flows and loads driving increased ammonia-N and TN and
- Near worst-case treated wastewater concentration (90th percentile ammonia concentrations).

Nevertheless, it does signal the potential for unacceptable adverse effects during the second half of the proposed 20-year consent duration. This risk could be managed by establishing a routine monitoring programme to determine if unacceptable ammonia concentrations are likely within the term of the consent, and to trigger the need for an appropriate management response. Suitable treatment responses are available and can feasibly be incorporated into the WWTP, e.g. by extending the aerobic zone within the aeration basin. However, it is not considered appropriate to commit to a specific response at this point given that the need for such upgrades are not certain and given that technology and management responses may evolve with time. Given this, it is proposed that the potential risks are managed through a monitoring, review and respond-based mitigation approach (see Section 5.13). Based on these proposed mitigation measures, it is considered that the actual adverse effects associated with ammonia toxicity can be managed to ensure that they are no more than minor.

Metals are a group of chemicals present in untreated wastewater that are potentially toxic if discharged into the marine environment at high concentrations. However, the Porirua WWTP provides effective removal of metals as detailed in Section 2.7. Consequently,

[29] The concentration range is based on dilutions exceeded 50% to 90% of the time (Table 5-2)

receiving water metal concentrations are relatively low and are predicted to remain below the ANZG (2018) DGVs at a distance of 200m from the outfall, indicating a low risk of toxicity occurring in the water column beyond the mixing zone (Table 5-13).

The risk of toxic effects in marine sediment is largely avoided because the area close to the outfall is dominated by bedrock with patches of pebbles and shelly sand, grading to sand-dominated habitat at a distance of 150m from shore. Morrissey et al (2019) (Appendix F) found that metal concentrations were consistently low in marine sediments, and well below concentrations at which adverse biological effects might be expected (ANZG 2018). Those findings are consistent with a dispersive environment in which neither fine sediments nor associated contaminants are accumulating on the seafloor.

That conclusion applies to both existing and predicted 2043 wastewater flows, including peak wet weather flows.

Table 5-12: Predicted worst case metal concentration (ug/L) at the edge of a 200m mixing zone

Wastewater constituent	Treated wastewater concentration[30]	Background seawater concentration[31]	Worst case receiving water concentrations 200m from outfall			(ANZG, 2018) DGVs
			ADF 306 L/s	ADF 440 L/s	PWWF 1500 L/s	
Arsenic - total	<2	1.5	<1.57	<1.6	<1.6	ID
Chromium - total	<1	0.1	<0.23	<0.28	<0.28	4.4
Copper - total	<2	0.06	<0.34	<0.45	<0.45	1.3
Lead - total	<1	0.003	<0.15	<0.2	<0.2	4.4
Mercury - total	<1	0.0006	<0.14	<0.2	<0.2	0.1
Nickel - total	2	0.3	0.54	0.64	0.91	7
Zinc - total	22	0.08	3.21	4.46	7.91	15

Note, worst case dilutions at 200m for 306, 440 and 1500L/s are 7-fold, 5-fold and 2.8-fold respectively (see Table 5-2)

Direct toxicity assessment

Direct toxicity assessment is complementary to the chemical specific assessment described above and the marine ecology surveys described in Section 3.4. Direct toxicity assessment measures the aggregate effect to organisms from all contaminants contained in the treated wastewater, including the synergetic effect of several contaminants acting together.

Direct toxicity testing of whole treated wastewater samples has been conducted on algae, amphipods and early life stage blue mussel embryos (*Mytilus galloprovincialis*) as described in Section 2.7. The treated wastewater discharge did not produce a toxic response in either the algae or amphipod test species but did adversely affect blue mussel embryos. The composition of discharge plume required to ensure no toxicity ranged between 0.55% and 1.1% treated wastewater, corresponding with a dilution in receiving waters between 91 and

[30] Worst case from Table 2-5.

[31] Selected values from ANZECC (2000) & Roper et al (2006).

182-fold, suggesting that more than minor adverse effects could potentially occur well beyond the 200m mixing zone where dilutions less the 10-fold frequently occur.

Morrisey (2019) (Section 3.4 and Appendix F) reported the presence of the little black mussel (*Limnoperna pulex*) in intertidal habitats close to the outfall location where the discharge plume would, at times, be diluted less than 10-fold. Furthermore, the ecological study results did not detect any clear differences between the fauna and flora around the existing outfall and those at Round Point or the reference location, suggesting that the existing WWTP discharge has not had a marked ecological effect.

The apparent discrepancy between the direct toxicity test results and the ecological survey results are likely due to intertidal areas and rocky reef habitats being only intermittently exposed to the WWTP discharge plume. The plume floats on the seawater surface, its movement determined by wind and tide conditions, only impacting the seabed in the area immediately below the discharge and for short periods in the intertidal areas as the tide rises and falls. This is very different from laboratory toxicity test assays which are based on continuous exposure at a known concentration for extended periods (typically 48 or 96 hours).

Emerging organic contaminants

Northcott (2019) (Appendix E) identified three potential endocrine disrupting chemicals in the Porirua treated wastewater at concentrations above their respective 'Predicted No Effect Concentration', these being bisphenol-A, 17β-estradiol and estrone (Table 2-9). The calculated minimum dilution required to achieve no risk to aquatic organisms is 36-fold, suggesting that adverse effects could potentially occur beyond the 200m mixing zone where dilutions are often less than 10-fold.

However, as noted already, the ecological survey conducted by Cawthron in 2019 found no evidence of adverse effects from the existing WWTP discharge, probably because intertidal areas and rocky reef habitats beyond approximately 50m from the outfall are only intermittently exposed to the WWTP discharge plume, As a consequence, the duration of exposure is not sufficient to have an observable effect on biota.

Bioaccumulation

Some chemicals can pose indirect risks associated with their longer-term concentration in organism and hence the potential for secondary poisoning of other animals or humans through consumption of these contaminated organisms. The main criteria for determining whether the discharge could lead to significant bioaccumulation of contaminants are:

- substantial concentration of bio-accumulative substances in treated wastewater;
- evidence of plume impacting upon food gathering areas for higher organisms; or
- evidence of sediment accumulation near the outfall.

Measured concentrations of bio-accumulative substances such as lead, mercury, cadmium, chromium and arsenic are all low in the treated wastewater (Table 2-5). While it is likely that seafood such as paua is collected from coastal water in the vicinity of the outfall from time to time, measured concentrations of heavy metals in paua muscle tissue are not significantly elevated above background concentrations in the receiving water outside of a 200m radius from the outfall (Cameron, 1993). Finally, there no evidence of fine sediment accumulation near the outfall, the substrate is predominantly hard rocky reef.

Toxicity of future discharges

The treatment process modelling predicts, if population growth occurs as projected, that over the proposed 20-year term of the consent the duration of solids retention time will need to decrease to accommodate the additional flow and load. Under this scenario, if there is no further improvement to the WWTP discharge quality, concentrations of some contaminants will gradually increase over time (as described in Section 2.7.3), potentially increasing the risk of toxic effects in the receiving environment.

It is considered that the potential for more than minor adverse effects associated with a changing discharge quality can be adequately mitigated by the proposed monitor, review and respond based mitigation approach proposed in Section 5.13.

5.8.7 Effects on marine mammals

Based on recorded sightings, at least nine species of cetaceans (whales, dolphins and porpoises) and one pinniped (seals and sea lions) are thought to live or regularly frequent the coastal waters of Kapiti and Cook Strait. A list of all these species is given in Table 3-11, categorised by their currently known distribution patterns within this region as either: ‘resident’, ‘migrant’ or ‘visitor’.

The species most likely to be found in the vicinity of the WWTP discharge is the New Zealand fur seal (*Arctocephalus forsteri*). Known fur seal haul-out sites are located to the north and south of Porirua, along the Kapiti coast and Cook Strait (including Mana and Kapiti islands), with an established breeding colony situated at Red Rocks on the Wellington south coast. Haul-out sites are rocky-shore areas where fur seals tend to come ashore regularly and rest, particularly over the colder winter months. While fur seals are considered non-migratory, they easily and repeatedly cover large distances and rarely remain at any one location year-round. Seals are more densely clumped within breeding colonies in summer and pups generally leave these colonies in late winter and spring. Fur seals are classified as Not Threatened under the NZTCS.

All of the species listed in Table 3-11 are generalist feeders which range over a large area of Cook Strait. Individuals would be expected to forage on prey fish that have been exposed to the wastewater discharge only rarely, and the consequent risks associated with the treated wastewater discharge are assessed as negligible.

5.8.8 Effects on avifauna

The physical works proposed as part of the WWTP upgrade include installation of new piping between the milli-screens and aeration basin, and construction of a new UV channel. These activities will all occur within the existing footprint of the WWTP site. No physical works are proposed along the foreshore or within the CMA, or in other areas which might provide important habitat for indigenous birds. The increased capacity of the WWTP will ensure that all wastewater discharged is fully treated and substantially free of particulate material that might otherwise attract scavengers such as gulls. Consequently, the risks to indigenous birds associated with the discharge of treated wastewater are assessed as negligible.

Summary of potential effects on aquatic life

The potential adverse effects of the existing and proposed (to 2043) discharge of wastewater from Porirua WWTP on marine habitats and aquatic life are summarised as follows:

- Less than minor adverse effect from changes in coastal water temperature, pH and oxygen depletion.
- Less than minor effects from suspended sediment in the water column and deposited sediment on the seabed.
- Less than minor effects from changes in coastal water salinity.
- Potentially more than minor adverse effects from increased nutrient concentrations on abundances of plankton algae, benthic algae, herbivorous zooplankton and benthic invertebrates, if wastewater flows and loads increase as predicted.
- Potentially more than minor toxicity effects from increased ammonia concentrations on benthic organisms in intertidal and shallow subtidal habitats, if wastewater flows and loads increase as predicted.
- Potentially more than minor toxicity effects from other unspecified wastewater constituents, including emerging organic contaminants, if wastewater flows and loads increase as predicted.
- Less than minor adverse effects from bioaccumulation of contaminants such as lead mercury, cadmium and arsenic because discharge concentrations are low and there is no accumulation of these contaminants on the seabed around the outfall.
- Less than minor adverse effects on marine mammals and avifauna.

It is considered that the potential for more than minor adverse effects to occur can be adequately mitigated by the proposed monitor, review and respond based mitigation approach proposed in Section 5.13.

5.9 Natural character, landscape and visual effects

5.9.1 Natural Character

As described in Ssection 3.5, the discharge of treated wastewater from the WWTP is to an area within the 'Rocky Reef south' area which has high natural character arising from high abiotic and experiential values; and moderate-high biotic values .

In assessing the effects on natural character resulting from the proposed discharge, the moderate-high biotic values in the Cawthron Ecological Survey (Appendix F to the AEE) Study indicate that the area is not pristine. This indicates that the effects from the discharge are unlikely to result in any significant biophysical effects, particularly in light of the proposed monitoring and review conditions. While the potential for more than minor adverse effects on the biota of the rocky reef from the proposed discharge is acknowledged, the proposed 'monitor, review and respond' mitigation regime will adequately mitigate any natural character effects.

A possible abiotic effect arising from the discharge would be a slight change in surface texture of the water in very calm conditions due to freshwater – being lighter than salt-laden water - floating on the surface. This may appear as a smooth patch of water in the area of the discharge at close range. The conditions which give rise to this effect would be very rare, given the strong wave action that occurs at the site. It is therefore unlikely that the increased level of discharge volume would create any discernible difference (either as compared to the existing discharge, or, logically, as compared to a no discharge scenario).

Overall, the effects on natural character from the proposed discharge are therefore assessed as very low.

5.9.2 Landscape Effects (Including effects on Seascape Character)

Landscape, or seascape character, is derived from the distinct and recognisable pattern of elements that occur consistently in a particular landscape. It reflects particular combinations of geology, landform, soils, vegetation, land use and features of human settlement. It creates the unique sense of place defining different areas of the landscape.

It is expected that the proposed discharge will not alter any biotic, abiotic or experiential values as described above. The effects on the character of the seascape are assessed as very low to the point of negligible.

5.9.3 Visual Effects

Visual amenity effects are influenced by several factors, including the nature and scale of the proposal, the character of the site, the ability of the landscape to absorb change, the nature of the viewing audience and expectations of the viewer. Distance and context are important factors in determining effects on visual amenity as is, the complexity of the intervening landscape and the nature of the view.

In this case, the visual effects of the proposal are limited to those from the discharge at the existing outfall, not the outfall structure itself. This view is only possible from the immediate coastal area in close proximity to the pipe where it is publicly accessible from the road at Stuart Park, managed as a reserve by PCC. Any visual effects arising from the discharge are likely to be indiscernible thus very low or negligible.

5.10 Effects on Values of Significance to Ngāti Toa

An assessment of the proposed discharge on Ngāti Toa's cultural values is included in Appendix I. The following is a summary of the main findings of that assessment.

The assessment notes that, based on information currently available (largely the Cawthron Report – see Appendix F), the discharge does not appear to cause significant adverse effects on customary fishing and the maintenance of mahinga kai in areas beyond the 200m radius mixing zone. However, in the immediate vicinity of the outfall Ngāti Toa are clearly inhibited from exercising their customary fishing rights and traditional practices.

Ngāti Toa divers have had to adapt to the presence of the discharge over the years by adopting the 'tikanga' of avoiding the outfall area for shellfish gathering, this is despite the abundance of pāua in the area. Ngāti Toa's avoidance of the outfall for shellfish gathering has little to do with potential health risks but is intended to avoid the calamitous cultural and spiritual effects of coming into contact with, and potentially consuming, kaimoana that has been desecrated by human wastewater (irrespective of whether it is treated or not).

In this sense the discharge has had a similar impact to a 'rahui', except that the restrictions were not imposed by Ngāti Toa and have therefore come at the expense of Ngāti Toa's mana and rangatiratanga as tangata whenua. The inaccessibility of the outfall area for customary purposes over the last 30 years has continued to undermine Ngāti Toa's traditional relationship with the area and has prevented opportunities for maintaining and improving customary use of the coastal marine area and maintaining the area as a mahinga kai in accordance with tikanga Maori

The most significant impacts of the discharge from a tikanga Maori perspective relate to the deep cultural and spiritual aversion of direct discharges of human waste (via wastewater) to natural water, regardless of the level of treatment. The discharge of human waste into waterways, the estuary and sea over the years has caused great concern to Ngāti Toa for cultural, environmental and public health reasons. This has had an ongoing impact on the Iwi's ability to harvest traditional sources of food and other resources, and the knowledge and practices associated with the gathering, utilisation and protection of those resources. In addition to not being able to provide for its own people, Ngāti Toa now has a diminished ability to provide manaakaitanga to its manuhiri. While it has to be acknowledged that the establishment of the Porirua WWTP has led to improvements in local sewage disposal, the cultural and spiritual aversion to mixing human waste with water has never been addressed and has instead continued to be exacerbated over the years by the discharge of increasing volumes of wastewater to the sea.

The elimination of bypass flows as a result of WWTP upgrades will help to reduce human waste in wastewater discharges and improve water quality in the vicinity of the outfall. This, in turn, should have a positive flow on effect for the enhancement of mauri (although over time, with population growth treated wastewater quality is expected to degrade).

However, Ngāti Toa remains fundamentally opposed to the practice of disposing human waste to water as this is an affront to tikanga Maori which requires the filtration of human waste through land (to remove the 'tapu') before it can be discharged to water.

In summary, the continued operation of the WWTP and outfall will inevitably result in adverse effects, of varying intensity, on identified cultural values, particularly in relation to the sustainability of mauri, mahinga kai, customary fishing practices and rangātiratanga. The culmination of these effects will inhibit Ngāti Toa's ability to fulfil inherent kaitiaki responsibilities towards the coastal environment. Although these effects will be confined to a relatively small area of the coast (generally within the outfall area and mixing zone), they will nonetheless have ongoing and long-term effects (should consent be granted for the proposed 20 years). The continued operation of the WWTP for an additional 20 years, will potentially result in additional cumulative effects on cultural values due to the degradation of mauri over time. These effects, spanning 50 years or more, and will impact on two generations of Ngāti Toa whanau.

5.11 Effects of WWTP discharges until 2023

In the interim period between the lodging of this consent application and completion of scheduled WWTP upgrades in 2023, the wastewater discharge will be essentially as described in this AEE for the year 2018 population. That is, for the great majority of the time the discharge will receive preliminary and secondary treatment and UV disinfection; these processes providing very effective reduction of BOD_5, suspended solids and faecal bacteria, as shown in Table 2-4. However, until the capacity upgrade is complete, there will continue to be periods when the volume of wastewater inflow to the plant exceeds the treatment capacity during heavy rainfall events, and part of the flow bypasses the secondary treatment process and the UV disinfection process. At those times, the quality of the wastewater discharge would decline and the potential for adverse effects in the receiving environment will increase. The potential for adverse effects during this interim period is essentially as described in this section for the 2018 population.

5.12 Summary of potential environmental effects

As is summarised in Table 5-14, it is predicted that most adverse ecological effects will be less than minor. However, without additional mitigation there is the potential for adverse effects to be more than minor on the biota of subtidal rocky strata as a result of nutrient enrichment and ammonia / EOC toxicity. As consequence, without additional mitigation, the adverse effects of the discharge on natural character may also be more than minor.

The potential for these adverse ecological effects arises because projected population growth over the proposed 20-year term of the consent may cause a gradual increase in concentrations of total ammonia nitrogen and total nitrogen in the discharge, potentially to the point where adverse effects due to ammonia toxicity and nutrient enrichment occur.

While the potential for more than minor adverse effects has been identified, the assessment is based on high population growth, the implications for wastewater quality and predicted receiving water concentrations. If the conservative assumptions which underpin the assessment of effects do not eventuate, it is possible that the level of adverse effect over the next 20 years (even without further mitigation) would be lower than indicated in Table 5-14 and that further mitigation, including amendments and upgrades to the WWTP, will not be required during the proposed consent period. Given the conservatism in the assessment of effects, a monitor-review-respond approach to addressing these potential adverse effects is proposed (see Section 5.13 and Appendix M for further details).

The AEE identifies that adverse effects on landscape and visual amenity will be very low.

With the proposal for an increased level of UV disinfection, the assessment is that adverse effects on contact recreation and shellfish gathering will be negligible.

Without additional mitigation, the AEE identifies the potential for significant adverse effects on the cultural values of significance to Ngāti Toa. These values include the mauri of the receiving water, access to mahinga kai and kaimoana and Ngāti Toa's ability to exercise rangatiratanga and fulfil kaitiakitanga responsibilities. Further work is continuing with Ngāti Toa to reduce the significance of these adverse cultural effects.

Table 5-13: Summary of potential environmental effects of the Porirua WWTP discharge at year 2043 (without mitigation)

General nature of potential effect	Feature	Relevant AEE section	Factors considered in determining 'Magnitude of effects'		Factors considered in determining the 'Level of effect'		Unmitigated level of effect
			Spatial scale of effect	Duration of effect	Magnitude of effect	Value	
Conspicuous change in water column colour or clarity	Biota of intertidal rocky substrata Biota of subtidal rocky substrata Biota of sandy sediments	Sections 5.5.1 & 5.5.2	Small Small Small	Short Short short	Negligible Negligible Negligible	Moderate High Moderate	Less than minor Less than minor Less than minor
Fine sediment deposition	Biota of intertidal rocky substrata Biota of subtidal rocky substrata Biota of sandy sediments	Section 5.5.2	Small Small Small	Short Short short	Negligible Negligible Negligible	Moderate High Moderate	Less than minor Less than minor Less than minor
Oil/grease, foam, scum	Biota of intertidal rocky substrata Biota of subtidal rocky substrata Biota of sandy sediments	Section 5.5.1	Small Small small	Short Short Short	Negligible Negligible Negligible	Moderate High Moderate	Negligible Negligible Negligible
Water temperature, pH, DO	Biota of intertidal rocky substrata Biota of subtidal rocky substrata Biota of sandy sediments	Section 5.8.2	Small Small Small	Short Short Short	Negligible Negligible Negligible	Moderate High Moderate	Negligible Less than minor Negligible
Reduced salinity	Biota of intertidal rocky substrata Biota of subtidal rocky substrata Biota of sandy sediments	Section 5.8.4	Small Small Small	Moderate Moderate Moderate	Low Low Low	Moderate High Moderate	Less than minor Less than minor Less than minor
Nutrient enrichment	Biota of intertidal rocky substrata Biota of subtidal rocky substrata Biota of sandy sediments	Section 5.8.5	Medium Medium Medium	Moderate Moderate Moderate	Moderate Moderate Moderate	Moderate High Moderate	Less than minor More than minor Less than minor
Toxicity (ammonia, whole treated wastewater, EOCs)	Biota of intertidal rocky substrata Biota of subtidal rocky substrata Biota of sandy sediments	Section 5.8.6	Medium Medium Medium	Moderate Moderate Moderate	Moderate Moderate Moderate	Moderate High Moderate	Less than minor More than minor Less than minor
Bioaccumulation	Biota of intertidal rocky substrata Biota of subtidal rocky substrata Biota of sandy sediments	Section 5.8.6, 5.8.7 and 5.8.8	Small Small Small	Moderate Moderate Moderate	Low Low Low	Moderate High Moderate	Less than minor Less than minor Less than minor

General nature of potential effect	Feature	Relevant AEE section	Factors considered in determining 'Magnitude of effects'		Factors considered in determining the 'Level of effect'		Unmitigated level of effect
			Spatial scale of effect	Duration of effect	Magnitude of effect	Value	
	Marine mammals/Avifauna		Small	Short	Negligible	High	Less than minor
Natural character	As a direct consequence of the adverse effects from nutrients and toxicity identified above.	Section 5.9.1	Medium	Persistent	Low	Moderate-high, high	More than minor
Landscape		Section 5.9.2	Small	Persistent	Very Low	Special Amenity	Less than minor - negligible
Visual amenity		Section 5.9.3	Small	Persistent	Very low	Special Amenity	Less-than minor - negligible
Ngāti Toa cultural values	Mauri, mahinga kai, customary fishing practices, rangatiratanga and kaitiakitanga	Section 5.10	Medium – mainly within the mixing zone	50 years – 2 generations	High	High	Significant
Assessment of recreation effects due to public health risk	Within and adjacent to the 200 m radius mixing zone	Sections 5.6 & 5.7	Medium	Persistent	Negligible	Moderate	Negligible
	Within Titahi Bay		Medium	Persistent	Negligible	High	Negligible
	Cockle harvesting at sites near Paremata and Dolly Varden Beach		Medium	Persistent	Negligible	High[32]	Negligible

Definition of terms

Spatial scale of effect: Small (tens of metres), Medium (hundreds of metres), Large (>1km)

Duration of effect: Short (days to weeks), Moderate (weeks to months), Persistent (years or more)

Magnitude of effect: Negligible (no or very slight change from existing condition, Low/Minor (minor change from existing conditions, minor effect on population or range of feature), Moderate / Medium (loss or alternation to key elements of existing conditions, moderate effect on population or range of the feature), High / Severe (major or total loss of key elements of existing conditions, large effect on population or range of the feature).

[32] This rating of 'high' recreation value applies to the whole of Te Awarua-o-Porirua and to all recreation activities (see Figure 3-11). It does not specifically apply to the single activity of shellfish gathering. The assessment of recreation value set out in Table 5-9 identifies that while there are high cockle densities at both Paremata Bridge and Dolly Varden only low levels of cockle gathering has been reported.

5.13 Standard conditions and additional mitigation measures

As this application is for a discretionary activity, consent may be granted or refused under section 104B, and if granted, conditions may be imposed under section 108 of the RMA. In accordance with section 108, Porirua City and Wellington Water are proposing a series of conditions that are intended to:

- establish the 'limits' of the discharge in line with the activity description set out in Section 2 of the AEE
- confirm the mitigation that is proposed to address the more than minor adverse effects identified in Section 5 of the AEE
- provide for the reconsideration of the best practicable option (BPO) within the proposed consent duration.

In this respect, the following sections describe both standard conditions (i.e. those which establish the limits of the activity) and additional mitigation measures and conditions to address the more than minor adverse effects.

It is noted that section 108(2)(e) of the RMA allows conditions that require the BPO to control any adverse effects caused by a discharge. The BPO for the discharge of contaminants is defined in section 2 of the RMA as:

> *Best practicable option, in relation to a discharge of a contaminant or an emission of noise, means the best method for preventing or minimising the adverse effects on the environment having regard, among other things, to:*
> *(a) the nature of the discharge or emission and the sensitivity of the receiving environment to adverse effects; and*
> *(b) the financial implications, and the effects on the environment, of that option when compared with other options; and*
> *(c) the current state of technical knowledge and the likelihood that the option can be successfully applied.*

Section 108(8) of the RMA restricts the imposition of BPO conditions to situations where this is the 'most efficient and effective means of preventing or minimising any actual or likely adverse effect on the environment'.

Porirua City Council and Wellington Water consider that the proposal as set out in Section 2 of the AEE is currently the BPO. This conclusion is based on:

1. the alternatives assessment that is briefly described in Section 6 of the AEE and fully described in Appendix C of the AEE
2. the nature of the discharge (described in Section 2) and the receiving environment (described in Section 3).

However, it is acknowledged that with the projected population growth, and potential for resulting reductions in the quality of the wastewater discharged from the WWTP, the BPO may change over the proposed 20-year consent duration.

For this reason, Porirua City and Wellington Water are proposing a series of conditions that are not only intended to mitigate the potential adverse effects of the discharge, but which provide for the reconsideration of the BPO. These conditions are encapsulated in the 'Monitor, Review and Respond' approach that is described below. The proposed conditions are set out in full in Appendix M. Porirua City and Wellington Water consider that these proposed conditions are the 'most efficient and effective means of preventing or minimising any actual or likely adverse effect on the environment' in accordance with s108(8) of the RMA.

5.13.1 Standard conditions

To define the limits of the proposed discharge and to provide certainty in relation to commitments made in this application, a range of standard consent conditions are proposed. These standard conditions cover:

- The location of the discharge
- The proposed maximum average daily inflow volumes (38,016 m^3) and peak daily inflow volumes[33] (129,600 m^3)
- The requirement to continuously monitor the WWTP inflow
- The requirement for discharges of partially treated wastewater, which result from inflow to the WWTP exceeding the plant's capacity, to cease on or before 30 June 2023
- Wastewater quality compliance requirements, associated monitoring (consistent with current sampling requirements) and reporting requirements
- The requirement to comply with the requirements of section 107 of the RMA
- The requirement to maintain signage in the vicinity of the outfall which identifies the risk to public health from contact recreation and the collection of shellfish in the vicinity of the outfall
- The preparation and implementation of an Operational Management Plan. The objective of the OMP is to provide a framework for the operation and management of the wastewater treatment plant in accordance with good industry practice. Proposed conditions set out the minimum content of the OMP and that it shall be certified by the Regional Council
- The continuation of the Community Liaison Group (CLG) already established under the existing consent and which involves stakeholders in the WWTP and provides an avenue through which these stakeholders can be informed about the operation,

[33] As noted in Section 2.1, inflow is used as a proxy for the discharge volume as measurement of inflow is more reliable and given the nature of the Porirua WWTP inflow and discharge volumes generally align.

maintenance and upgrade of the WWTP and its compliance with the conditions of the resource consent.

The wastewater compliance requirements are a core component of the proposal. These core compliance requirements relate to:

- Suspended solids
- Metals and other specified compounds
- Faecal coliforms.

Appendix M to this AEE contains proposed consent conditions which set out the details of these standard conditions and the numerical compliance requirements for each of the wastewater attributes list above.

5.13.2 Additional mitigation measures

In addition to these core compliance requirements, mitigation is proposed to address the potential 'more than minor' adverse effects on the biota of subtidal rocky substrata, and consequential effects on the natural character of this aspect of the CMA which have the potential to arise over the longer term with population growth.

Table 5-15 summarises the additional mitigation measures that are proposed and a diagrammatic overview is provided in Figure 5-2. As Figure 5-2 illustrates, it is proposed that the monitor, review and respond approach would have both 'default' and 'triggered' pathways. More detail on each step in the mitigation approach is set out in Sections 5.13.3 to 5.13.8. Proposed consent conditions to implement this approach are provided in Appendix M.

Table 5-14 – Summary of the Proposed Mitigation Measures

Potential effect	Proposed mitigation measure
Nutrient enrichment, Ammonia/EOC toxicity, (and consequential effects on natural character)	• Receiving water trigger for total ammonia • Ecological survey (repeat of the 2019 assessment by Cawthron) • Monitoring and technology review • S128 Review of consent conditions

The proposed additional mitigation is based on a monitor, review and respond approach. This approach generally involves the following steps:

1. Monitor – undertake monitoring of the wastewater quality, of the receiving water quality and of the habitat/ecological condition of the immediate receiving environment.
2. Review – identify alternatives to the current WWTP operation and technology and assess if any of these alternatives are the Best Practicable Option for preventing or minimizing the adverse effects of the discharge

3. Respond – decide whether to adopt the BPO (if an alternative is identified through the review step) and develop and implement an action plan. If necessary, review the conditions of the resource consent.

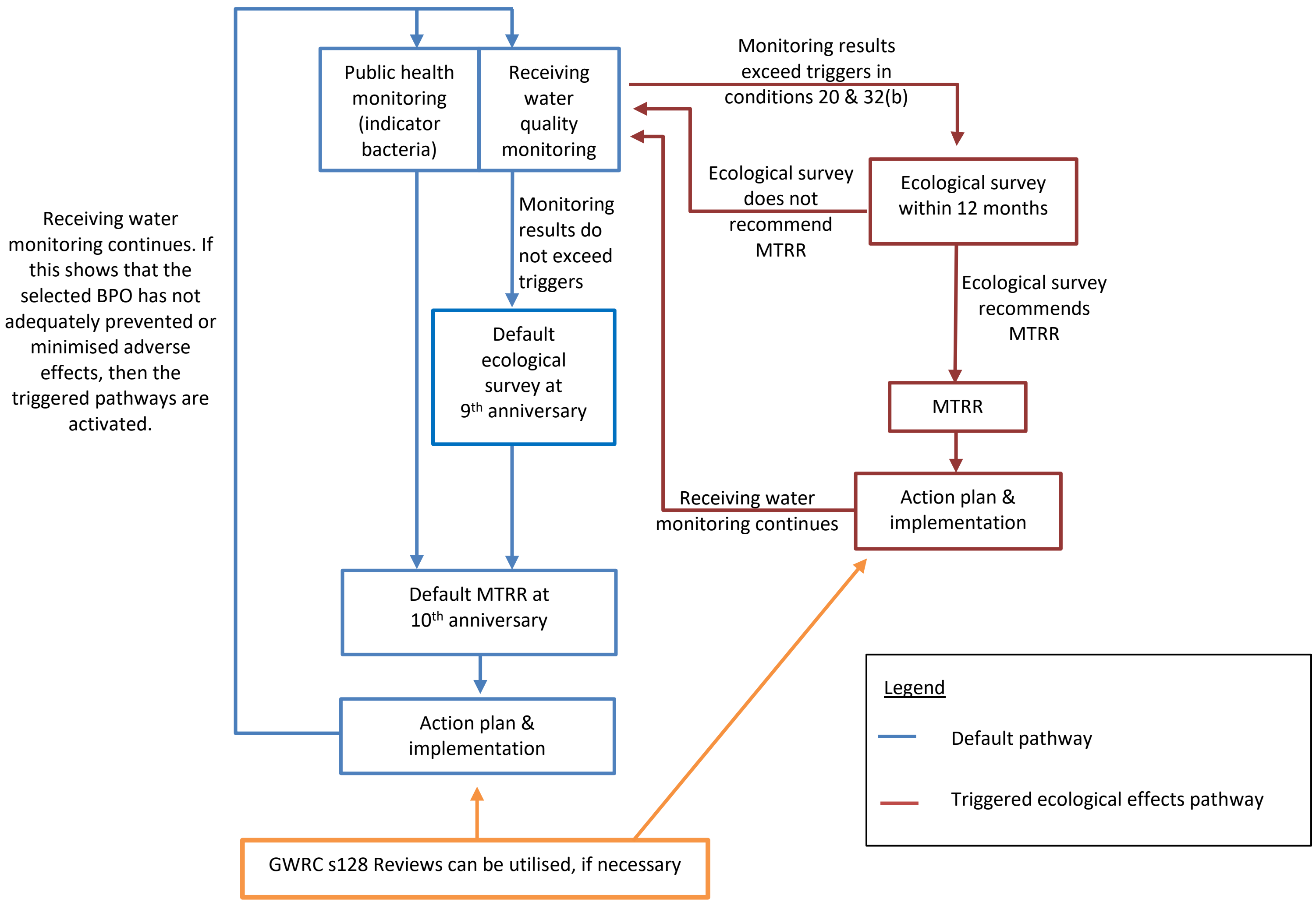

Figure 5-2 - Overview of the 'monitor, review & respond' mitigation approach

This approach is considered an appropriate response because:

- the assessment of effects incorporates a high degree of conservatism, i.e. the adverse effects may not eventuate, or may take longer to eventuate than is anticipated in the AEE (for example, if population growth is less than projected), so that committing to WWTP changes or upgrades at this point could be unnecessary or inefficient expenditure
- there is a good body of knowledge about how to effectively undertake the proposed monitoring regime
- there is confidence that the proposed monitoring regime will identify negative trends in the relevant attributes before significant or irreversible adverse effects occur
- There are well understood options to upgrade the WWTP and / or amend the operation of the WWTP to address adverse effects which may be identified through monitoring
- linking the outcomes of the monitoring and technology reviews to Greater Wellington Council's power to review resource consent conditions under s128 of the RMA provides certainty that the findings of the technology reviews will be implemented.

With respect to the adverse effects on Ngāti Toa's cultural values, Porirua City Council and Wellington Water are working with representatives of Ngāti Toa to develop appropriate mitigation measures. It is expected that these will be presented in evidence at the future hearing.

5.13.3 Monitor – Wastewater quality and receiving water quality

Water quality monitoring will be undertaken with respect to both the wastewater and the receiving water.

The wastewater monitoring will be undertaken as the wastewater leaves the Plant. It will include monitoring undertaken for compliance purposes (described in the section on standard conditions above) and it will also include regular monthly monitoring that will assist the analysis of receiving water monitoring results. Therefore, in addition to compliance monitoring, the wastewater leaving the Plant will also be analysed for:

- total ammonia nitrogen
- Nitrate + nitrite nitrogen
- Dissolved reactive phosphorus
- Enterococci.

Receiving water monitoring will involve regular monitoring at coastal shoreline sites 200m east and 200m southwest of the outfall, and at a control site. The receiving water at these locations will be monitored for:

- total ammonia nitrogen
- Nitrate + nitrite nitrogen
- Dissolved reactive phosphorus
- Enterococci.

In addition, a site in Titahi Bay will also be monitored for Enterococci.

The results from the regular monthly monitoring will be reported to GWRC quarterly. Data from both the wastewater and receiving water monitoring results will then be used to:

1. to determine if the ecological survey (based on the survey described in Appendix F) needs to be undertaken earlier than the 'default' completion date
2. determine if the wastewater quality is deteriorating at the rate anticipated based on the projected population growth and increase in WWTP inflow
3. determine if the receiving water is being adversely affected as a result of a reduction in the wastewater quality
4. inform the monitoring and technology review.

5.13.4 Monitor – Ecological Survey

It is proposed to undertake a survey of the biota of the intertidal and shallow-subtidal habitats adjacent to the existing outfall at Rukutane Point, at Round Point to the west of the existing outfall and at a reference location 300m east of the existing outfall. The survey would be undertaken by a suitably qualified expert and the methods would be comparable to those used by Cawthron and reported on in Appendix F. The survey results will be used to assess the effects of the wastewater discharge on the flora and fauna of intertidal and shallow-subtidal habitats, and to identify any changes in community composition or taxa abundance compared with the 2019 condition survey, including any evidence of eutrophication or toxicity.

The 'default' completion date for the ecological survey will be 9 years after the commencement of the consent. This is timed to feed into the completion of the monitoring and technology review, which is proposed to have a default completion date of 10 years after the commencement of the consent (see below). However, it is acknowledged that in GWRC's decision on this consent the default completion date may need to be adjusted to take into account the timing of the decision, its decision on the default completion date for the 'monitoring and technology review' and to fit into the timing of Porirua City Council's Long Term Plan.

The ecological survey will be undertaken at times other than the default completion date if the results of the receiving water quality monitoring identify that this is necessary. These 'triggered' surveys would be undertaken if monitoring results for Total ammonia nitrogen exceed the trigger levels in Conditions 20 and 32(b) (see Appendix M).

If it is determined that the ecological survey needs to be undertaken outside the default pathway it must be completed as early as possible, but at the latest within 12 months of the trigger. Further, if the ecological survey is triggered through monitoring results, then the Ecological Survey Report must include a recommendation about whether or not a monitoring and technology review (see Section 5.13.6) needs to be undertaken to address either specific contaminants or all contaminants discharged from the WWTP. The Ecological Survey Report may also recommend that changes be made to the ammonia trigger level.

The Ecological Survey Report will be completed a suitably qualified and experience coastal ecologist.

5.13.5 Monitor – Monitoring related to public health and recreation effects

Standard monitoring of faecal coliforms and enterococci (i.e. indicator bacteria) will be undertaken in accordance with the proposed conditions (Appendix M). This data will inform the summary of the actual adverse effects of the discharge that needs to be prepared as part of the monitoring and technology review (see below).

5.13.6 Review – Monitoring and technology review

All data collected under the consent's monitoring requirements would inform a review of the monitoring requirements and the WWTP operation and technology. The purposes of the monitoring and technology review are to:

- identify the actual adverse environmental effects that are caused by the future WWTP discharge
- identify whether any new technologies or advances in management practices would provide more effective mitigation of the adverse environmental effects
- confirm that the monitoring regime remains appropriate, including whether based on experience elsewhere additional attributes should be monitored.

More specifically, its proposed that the monitoring and technology review would:

- have a default completion date of the tenth anniversary of the commencement of the resource consent
- take into account compliance with other resource consent conditions, compliance with relevant national and regional policy, standards or guidelines, the results of receiving water monitoring undertaken under the consent conditions
- set out improvements made to the WWTP since the commencement of the resource consent
- based on receiving water quality monitoring and ecological survey results, summarise the actual adverse effects that are arising from the wastewater discharge
- outline technological options and other methods which may be available to reduce the adverse effects
- assess whether any option or combination of options represents the Best Practicable Option (as defined under the Resource Management Act) to prevent or minimize the effects of the discharges
- culminate in a report, the Monitoring and Technology Review Report (MTRR), submitted to GWRC.

It is proposed that the monitoring and technology review would be undertaken outside of the default pathway if this is recommended by the author of the Ecological Survey Report. In this case, the MTRR must be submitted to GWRC within 9 months. Further, in the case of a 'triggered' monitoring and technology review, the scope of the review may be more focused than the review undertaken at the default mid-point of the consent term. A monitoring and technology review triggered by an ecological survey may be focused on specific contaminants, if this is recommended by the author of the Ecological Survey Report.

It is noted that monitoring and technology review conditions have been placed on several WWTP discharge consents around the country. Examples include:

- Nelson Regional Sewerage Business Unit's resource consents associated with the operation of the Bell Island Wastewater Treatment Plant (granted in February 2020 with a 20-year duration)
- Wellington City's resource consents for the Western Wastewater Treatment Plant – these were originally granted in 2010, but the monitoring and technology review condition was amended in 2018
- Watercare's discharge consent for the Pukekohe WWTP, granted in 2017 with a 35-year duration
- Watercare's discharge consent for the South West sub-regional WWTP granted (although appealed) with a 35-year duration
- Whangarei District Council's Ruakaka Wastewater Treatment Plant discharge consent, granted in 2012 with a 35-year duration
- Hastings District Council's WWTP discharge consent, granted in 2014 with a 35-year duration.

By requiring such reviews, a balance is achieved between the certainty provided to the consent holder by the long consent duration and the certainty provided to the consent authority and stakeholders that the WWTP technology and management will not remain fixed, become outdated, or fail to respond to the actual adverse effects of the wastewater discharge.

5.13.7 Respond – Action Plan

The MTRR, described above, will include an action plan setting out if and when Porirua City Council intends to implement the Best Practicable Option.

5.13.8 Respond – Review conditions

It is anticipated that a review condition under section 128 of the Resource Management Act would be imposed on the resource consent for the discharge and that this would provide GWRC with the ability to review the conditions of the permit to address adverse effects identified through the monitoring described above and in response to the conclusions of a monitoring and technology review report with respect to the BPO.

6 Alternatives Assessment

A detailed report outlining the alternatives assessment undertaken by Wellington Water, and which culminated in the selection of the option for which consent is currently being sought, is included in Appendix C. With respect to the WWTP discharge the options considered through the alternatives assessment included:

- alternative receiving environments (e.g. land, marine water, groundwater and surface, freshwater)
- alternative treatment plant locations
- higher levels of treatment
- alternative coastal discharge systems and locations.

A range of elements were also identified as having the potential to be included as part of any option. These included measures such as addressing the treatment by-passes, reducing wastewater at source and re-using wastewater.

Table 6-1 provides a summary of the steps that were following in assessing these options. Early in the process, Wellington Water and Greater Wellington established a project collaborative group to ensure Ngāti Toa and key stakeholder had input to the alternatives assessment process. Establishing this group is consistent with the guiding principles and objectives (particularly objectives (d) and (e)) for the alternative assessment process. See sections

The collaborative group involved representatives from:

- Wellington Water
- Greater Wellington Regional Council
- Porirua City Council
- Wellington City Council
- Ngāti Toa
- Regional Public Health
- Porirua Harbour Trust
- Te Awarua o Porirua Whaitua Committee.

The technical team provided support and advice to the Collaborative Group. The Collaborative Group had active involvement in the traffic light workshops on the long list and the MCA workshop on the combined short list. In addition, the Collaborative Group met semi-regularly, as required, to ensure that members were kept informed about and were able to have input to the alternatives assessment process.

Table 6-1 - Summary of alternatives assessment steps

Timing	Project phase	Description
October – November 2017	Identification of options long lists	Set project objectives & guiding principles for the alternatives assessment process Identify 'all' of potential options for the wastewater network and WWTP Assess these potential options against fatal flaw criteria Report preliminary long lists to the Collaborative Group Refine long list options based on Collaborative Group feedback and further work by the technical team Confirm long lists with the Collaborative Group at the first long list assessment workshop (29 November 2017)
November 2017 – April 2018	Long list evaluation & selection of combined short list	Determine long list assessment criteria with the Collaborative Group, taking project objectives into account (25 October & 13 November 2017) Prepare comparative assessments of all long list options Traffic light assessment against multiple criteria Collaborative Group workshops (29 November 2017 & 19 January 2018) Meeting with Ngāti Toa (22 February 2018) Recommended combined short list agreed to by the Collaborative Group, involving 3 network options matched with 3 WWTP to make 9 combined options (3 April 2018)
April 2018 to June 2019	Evaluation of the combined network and WWTP short list	Completion of technical investigations, including network, WWTP process and dispersion modelling Comparative assessments of the combined short list options, including recommended multi-criteria analysis (MCA) scores Confirmation of MCA criteria and weight to be given to each criterion (30 November 2018 & 25 March 2019) MCA workshop with the Collaborative Group (25 June 2019)
July to November 2019	Evaluation of the WWTP short list & selection of the Proposed Solution	Wellington Water and Porirua City Council decision to exercise the return loops in Figure 1 of Appendix C and separate the WWTP short list from the wastewater network process Comparative assessments of the WWTP short list, including recommended multi-criteria analysis (MCA) scores Technical team MCA workshop (28 August 2019) Presentation to the Collaborative Group (29 October 2019) of the results of the WWTP short list MCA and of the technical team's recommended 'proposed solution' Wellington Water selection of the 'proposed solution' taking into consideration the definition of Best Practicable Option from the RMA (15 November 2019)

7 Stakeholder engagement

7.1 Overview

Through the alternatives assessment process and in preparing to lodge this resource consent application Wellington Water has engaged with stakeholders. The two key processes that Wellington Water has used for engagement are the Collaborative Group and public consultation.

The following sections described this engagement and address obligations imposed by the Marine and Coastal Area Act.

7.2 Collaborative Group

As noted in the description of the alternatives assessment process (Section 6), Wellington Water and Greater Wellington established a Collaborative Group for Porirua wastewater programme. The purpose of the group was to help ensure that Ngāti Toa Rangatira and key stakeholders had input to the alternatives assessment process.

The Collaborative Group met regularly during the alternatives assessment process to guide that process and have input to the evaluation of options. The Collaborative Group's input into to the alternatives assessment process is described in full in Appendix C to this application.

The Collaborative Group also met in March 2020 to discuss potential resource consent conditions. Feedback from the March 2020 meeting has been incorporated into the mitigation measures described in section 5.13 and draft conditions proposed in Appendix M. Particularly, concern was raised that only providing for the ecological survey and technology review at a default mid-point in the consent period, may result in adverse effects going undetected and without response for an inappropriate length of time. In response to this feedback trigger for the early completion of both the ecological survey (see Section 5.13.4) and monitoring and technology review (see Section 5.13.6) have been incorporated into the mitigation proposals and related conditions (see Appendix M).

A further meeting is proposed to be held with the Collaborative Group following lodgement of the application, and once all parties have access to the full AEE.

7.3 Public Consultation

Development of the proposal has been informed by consultation and engagement with the public.

7.3.1 Engagement Approach

Using the International Association for Public Participation framework[34] the overall approach for public engagement has been to **consult** - provide balanced and objective information about the proposal to assist their understanding and obtain their feedback.

Figure 7-1:IAP2 Spectrum

Inform	Consult	Involve	Collaborate	Empower
To provide with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions	To obtain feedback on analysis, alternatives and/or decisions	To work directly with throughout the process to ensure concerns and aspirations are consistently understood and considered.	To partner with in each aspect of the decision including the development of alternatives and the identification of the preferred solution.	To place final decision making in their hands.

7.3.2 Previous Engagement

Engagement with the general public on issues related to the proposal had been undertaken through the review of the Porirua Harbour and Catchment Strategy (2019), Community Perception Survey, (2014), Community Satisfaction Survey (2019). The strong feedback received through these processes was that the water quality issues in the Porirua catchment, and in particular the Porirua harbour, were a major concern and there was strong support to improve the infrastructure in order to address these issues in a timely manner.

7.3.3 Engagement Actions

Low level public information campaign: November 2018 – present

In November 2018 Wellington Water released a joint media statement announcing plans to upgrade the Porirua wastewater system and seeking feedback from the community. At this time a dedicated website was established outlining key details about the project, including key background documents, frequently asked questions, news items and contact details for those wanting to provide their views or find out more. See https://www.wellingtonwater.co.nz/pwp/

[34] https://www.iap2.org/

During this time several requests for information about the wastewater system (some of which related to the proposal) were received and responded to in full, in particular from the community group 'Our Bay Our Say'.

Stakeholder meetings

A series of stakeholder meetings were held with interested community groups to update them on the project, proposed next steps and to seek their views. These meetings included:

- 2 April 2019 – the project team and key Wellington Water advisers made a presentation to the Porirua Harbour Trust at one of their regular meetings in Porirua
- 10 June 2019 – the project team met with the Titahi Bay Community Group at their monthly meeting in Titahi Bay. Following the meeting the Titahi Bay Community Group provided a list of 10 questions about the project which were answered in full
- 19 August – a public meeting was held at Titahi Bay School which was attended by 133 people. Wellington Water representatives attended the meeting and responded to concerns from the public on a wide range of issues including the reconsenting of the WWTP
- 2 September 2019, the project team meet again with the Titahi Bay Community Group to update them on the project and introduce them to the new WWTP operators Veolia who also attended the meeting. The idea of a WWTP site visit was discussed at this meeting and subsequently incorporated into the public open days.

Public open days

Two public open days were held in November 2019.

- Thursday 7 November, 6pm-8.30pm at Te Rauparaha Arena; and
- Saturday 9 November, 11am-2pm Titahi Bay Bowling Club

These public open days were publicised through:

- A media release covered by the Kapi-Mana news
- Quarter page advertisements in the Kapi-Mana News (in the two preceding editions)
- Leaflet drops in Porirua City Council Office, Porirua Library, Te Rūnanga o Toa Rangātira, and at a local cafés
- Letter box drop to residents close to the existing WWTP
- Emails to local community groups
- Social media promotion through Wellington Water and PCC channels
- Facebook advertising targeting those living in the Porirua area.

At each open day seven large information boards were displayed outlining the key elements of the proposal and its effects (which can be found https://www.wellingtonwater.co.nz/pwp/documents). More detailed scientific reports were also available to be read and also uploaded to the website. Several members of the project team (covering a range different expertise) were available at both open days to discuss the proposal and answer questions from the public. Following the open days the electronic copies of the information were emailed to attendees.

Approximately 80 people attended the open days across the two days.

Wastewater Treatment Plant Site visits

On Saturday 9 November three site visits of the WWTP were organised at 12pm, 1pm and 2pm. The site visits ran alongside the second open day and were included in all promotional material for the open days. Each site visit lasted between 30-45min and included a safety induction and a guided tour of the plant including a discussion about the proposed improvements to the plant. Approximately 40 people participated in the site visits.

7.3.4 Feedback Received

Table 7-1 provides a summary of the feedback received during the two open days.

Table 7-1: Summary of feedback from public open days

Theme	Feedback	Relevance to the proposal
Concern for Titahi Bay	Many people expressed concern about the water quality in Titahi bay and the impact of the WWTP	Aligns with the objectives of the proposal and a key effect considered in the resource consent application.
Concern about Porirua Harbour	Many people expressed concern about the environmental state of the Porirua Harbour, many of which noted that it is getting worse in recent years	Not directly related to the current resource consent application. However, in determining the best practicable option for the WWTP, opportunity costs for resolving network issues were taken into account.
Support for the proposed improvements to the WWTP	Several people noted their support for the proposed upgrades to the WWTP	Support for the proposal
Speed of proposed improvements to WWTP	Some people questioned why the proposed improvements could not happen faster.	The capacity upgrades will be completed by June 2022. This is the time required for detailed design, contractor procurement and construction.
Public education	Several people thought the educating the public about the wastewater system was important, including about what people can do on their own private property.	Wellington Water undertake a range of educational activities to improve the communities understanding of the wastewater system, including what they can do on their own

Theme	Feedback	Relevance to the proposal
		properties. Education will likely form part of the waster network improvement plan.
Signage at Titahi bay	Many people commented that the signage at Titahi Bay when there is a bypass (or similar) could be improved and more user friendly	Requirements for signage is included in the resource consent application. Discussions with community representatives regarding the details of proposed signage has commenced.
Improvements needed to the network	Several people suggested investment more storage capacity in the network	Not directly related to the current resource consent application. However, Wellington Water is continuing to develop its network improvement plan, including considering installing storage tanks.

7.4 Marine and Coastal Area Act 2011

Te Rūnanga o Toa Rangatira has applied under the Marine and Coastal Area Act 2011 (MACA) for protected customary rights and Customary Marine Title over an area relevant to this application.

Representatives of Te Rūnanga o Toa Rangatira have been regularly engaged through the assessment of alternatives and in the preparation of this resource consent application. On behalf of Te Rūnanga o Toa Rangatira, Miria Pomare prepared the Cultural Impact Assessment for this application.

Wellington Water has therefore satisfied the MACA obligations.

8 Statutory Considerations

8.1 Section 104 of the Resource Management Act 1991

Before making a decision on a discretionary activity pursuant to Section 104B of the RMA, Council must consider the proposal in terms of Section 104 of the RMA. Section 104 of the RMA outlines the matters that the consent authority is required to have regard to when considering consent applications. The matters relevant to these applications are discussed in the following sections. Section 104 (2A) of the RMA is addressed in Section 10 of this AEE.

8.1.1 Section 104(1)(a) RMA: Actual and Potential Environmental Effects

The actual and potential adverse effects are assessed in Section 5 of this application. Section 5 is supported by a series of technical assessments, which are included in the Appendices of this application.

It is considered that the effects have been assessed in a level of detail that corresponds with the scale and significance of the potential significance of the adverse effects of the proposal.

8.1.2 Section 104(1)(b) RMA: Relevant Provisions

Appendix K provides an of the proposal in relation to relevant Policy Statement and Plan provisions. This concludes that the proposal is broadly consistent with the relevant provisions of relevant planning documents, although further measures remain to be developed with respect to the planning provisions that relate to tangata whenua values.

8.1.3 Section 104 (1) (c) RMA: Other Matters

The Te Awarua-o-Porirua Whaitua Implementation Programme (WIP) is a non-statutory report developed by Te Awarua-o-Porirua Whaitua Committee that directs how to manage land and water within Porirua and northern Wellington's catchments. Some of the recommendations of the WIP are intended to be implemented by the Wellington Regional Council through a plan change to Te Awarua-o-Porirua Whaitua section of the proposed Natural Resources Plan (PNRP). At this point, no plan change or variation has been proposed by the Regional Council.

The WIP includes numerical water quality objectives. Most of these relate to the Whaitua streams and Te Awarua-o-Porirua Harbour itself. The one numerical objective that applies to the 'Coast' water management unit (WMU), which is the receiving environment for the WWTP discharge, relates to enterococci. The objective is to maintain the existing attribute state of B, which requires that no more than 10-percent of enterococci samples should exceed 500/100ml, and the 95th percentile value should not exceed 200/100ml.

Notwithstanding that the WIP indicates that the 'Coast' WMU, as a whole, meets this objective, the assessment in Section 3 of the AEE identifies that Titahi Bay does not (see Table 3-5). The proposed upgrade to the UV disinfection system and overall capacity at the WWTP will contribute to improving the water quality in Titahi Bay.

In addition to the numerical objective for the Coast WMU, the WIP makes recommendations regarding the future management of wastewater discharges. These are focussed on the wastewater network, including privately owned pipes. This focus reflects the conclusion that:

> *In urban areas, the biggest reductions in E. coli will come from wastewater network improvements, including reducing overflows, improving capacity, fixing leaking pipes and identifying and addressing laterals and cross connections on private properties.* (WIP, pg 71).

The WIP acknowledges that:

> *Wellington Water has indicated that the focus of its consent renewal and investment programme has shifted from upgrading the treatment plant to investment in the overall network as this is where the biggest improvements can be made in terms of water quality and in achieving the requirements, under the NPSFM, for streams to be suitable for primary contact recreation.*

The Titahi Bay Village Plan 2014 identifies opportunities for action within the suburb and sets out how the local community wants Titahi Bay to be as a place to live, to grow and to work. The Plan was drafted following a series of public meeting, the formation of a Village Plan working group and a residents' survey.

The Plan mainly focusses on land based actions to improve the quality of Titahi Bay. However, under the heading 'Natural Environment' the Plan notes that 'ensuring good water quality' is also of importance. The proposal to upgrade the UV disinfection at the WWTP will assist to improve water quality in Titahi Bay.

8.2 Section 105 of the Resource Management Act 1991

Section 105 of the RMA requires that, for any coastal permit to do something that would contravene section 15 of the RMA, the consent authority must have regard to the following matters:

- the nature of the discharge and the sensitivity of the receiving environment to adverse effects; and
- the applicant's reasons for the proposed choice; and
- any possible alternative methods of discharge, including discharge into any other receiving environment.

The nature of the proposed discharge is set out in section 2 of this application. The sensitivity of the receiving environment is described in section 3.

The reasons the proposal has been selected are set out Alternatives Assessment Report included in Appendix C. This same report sets out the possible alternative methods of discharge, including discharged into other receiving environments. These alternative receiving environments were considered and then discounted at the long list stage of the alternatives assessment, as set out in the alternatives report (Appendix C).

8.3 Section 107

Section 107 of the RMA states that a consent authority shall not grant (relevantly) a coastal permit allowing a discharge of contaminants to water if, after reasonable mixing, the contaminant (by itself or in combination with other contaminants) is likely to give rise to:

(c) The production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials
(d) Any conspicuous change in the colour or visual clarity
(e) Any emission of objectionable odour
(f) The rendering of fresh water unsuitable for consumption by farm animals
(g) Any significant adverse effects on aquatic life.

Clause (c) is addressed in section 5.5 of this application. This section concludes that the formation of a conspicuous oil or grease film is expected to occur as a result of the proposed discharge. Foam does occur immediately at the discharge point, as a result of the turbulence caused by the discharge. However, this is very much within the immediate discharge area no more than approximately 10-15 m from the outfall and confined by nearby rock outcrops and the concrete deflection wall. As such this effect will not occur beyond the reasonable mixing zone.

Clause (d) is addressed in section 5.5.2 of this application. This section concludes that the discharge will cause no reduction in water clarity, and negligible change in water colour, brightness or light penetration. Accordingly, it is unlikely that there will be 'any conspicuous change in the colour or visual clarity' of the receiving waters beyond the 200m zone of reasonable mixing.

In relation to clause (e), it is noted that any odour associated with the treated wastewater discharged via the outfall at Rukutane Point is barely discernible. The outfall is at sea level and the Rukutane Point area is remote and well away from the nearest residences. Recreational users of the shoreline area and the walking track are unlikely to experience any adverse effects from the low levels of odour associated with the treated wastewater discharge. In addition, this ocean environment area is exposed to typically strong winds and the low levels of odour possibly emitted at the outfall will be rapidly and completely dispersed.

Clause (f) relates to fresh water and is not relevant to this application, which is for a discharge to coastal water.

Clause (g) is addressed throughout Section 5, including in the proposed mitigation measures. Based on this, it is not anticipated that any adverse effects on aquatic life will be significant after reasonable mixing.

8.4 Part 2 of the Resource Management Act 1991

Schedule 4 to the RMA requires that applications for resource consent include an assessment of the activity against matters set out in Part 2 of the RMA. Within Part 2, section 5 outlines the Act's purpose. Section 6 sets out matters of national importance, section 7 outlines 'other' matters and section 8 requires those exercising function and powers under the RMA to take into account the principles of the Treaty of Waitangi.

An assessment against the relevant elements of the sections of the RMA is provided in Table 8-1 below.

Table 8-1: Part 2 Assessment

Provision	Assessment
Section 5	
In this Act, sustainable management means managing the use, development and protection of natural and physical resources in a way or at a rate that allows people and communities to provide for their social, economic and cultural wellbeing and for their health and safety, while….	The Porirua wastewater system is an important physical resource, which enables the community of the catchment to provide for their social and economic wellbeing, and health and safety. The discharge from the WWTP, which is the subject of this application, is integral to the wastewater system.
Section 5(2)(a)	
Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations.	The discharge of wastewater from the WWTP will have adverse effects on the natural resources of the Porirua coast. However, it is considered that these adverse effects will be adequately mitigated to ensure that the natural resource is sustained to meet the reasonably foreseeable needs of future generations.
Section 5(2)(b)	
Safeguarding the life-supporting capacity of air, water, soil, and ecosystems.	The proposed mitigation approach set out in section 5.13 will safeguard the life supporting capacity of the marine waters.
Section 5(2)(c)	
Avoiding, remedying or mitigating any adverse effects of activities on the environment.	All potential adverse effects of the proposal will be adequately mitigated.

Provision	Assessment
Section 6(a)	
The preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development:	The proposal enables the natural character of the area of the discharge to be preserved and protected.
Section 6(c) and Section 7 (d)	
The protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna	The proposal enables the significant habitats around the outfall to be protected.
Section 6(e)	
The relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu and other taonga.	Porirua City and Wellington Water are continuing to work with representatives of Ngāti Toa to identify ways to help restore Ngāti Toa's culture and traditions associated with the area impacted by the discharge.
Section 7(a)	
Kaitiakitanga	Porirua City and Wellington Water are continuing to work with representatives of Ngāti Toa to identify ways to help restore Ngāti Toa's kaitiaki role over the area impacted by the discharge.
Section 7(b)	
The efficient use and development of natural and physical resources.	This proposal is an efficient use of the physical environment as it is utilising and upgrading existing infrastructure.
Section 7(c)	
The maintenance and enhancement of amenity values.	The adverse effect of the proposal on the visual amenity values of the area will be very low or negligible.
Section 7(f)	

Provision	Assessment
Maintenance and enhancement of the quality of the environment.	The Assessment of Effects provided for in Section 5 of the report has assessed the effects of the discharge. Taking account of the mitigation measures proposed in section 5.14 all adverse effects, with the exception of those relating to Ngāti Toa's cultural values, it is expected that the adverse effects can be managed so that they are minor. Porirua City and Wellington Water are continuing to work with representatives of Ngāti Toa to identify ways to mitigate the adverse effects on Ngāti Toa's cultural values.
Section 8	
In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall take into account the principles of the Treaty of Waitangi (Te Tiriti o Waitangi).	Porirua City and Wellington Water have consulted Ngāti Toa extensively during the assessment of alternatives and in preparation of this resource consent application. Work continues with representatives of Ngāti Toa to identify ways to mitigate the adverse effects on Ngāti Toa's cultural values and to find ways to restore Ngāti Toa's culture and traditions associated with the area impacted by the discharge.

Overall its considered that the proposed activity is consistent with the provisions of Part 2 of the Resource Management Act.

9 Notification

Porirua City Council requests that this application be notified in conjunction with the application for the discharge of contaminants to air from the WWTP.

10 Consent Duration Considerations

Section 123 of the Act sets out the resource consent duration provisions and sets a maximum 35-year duration for resource consents such as that sought in this application.

Court decisions provide guidance on the factors that should be considered in determining consent duration. These include:

- Potential environmental risks
- Uncertainty / certainty
- Investment security

In most respects it is considered that potential environmental risks are minimal as the potential adverse environmental effects can be predicted as being less than minor with certainty. However, there are exceptions to this general conclusion. The exceptions are:

1. The risk to the biota of subtidal rocky substrata (and consequential potential natural character effects), due to nutrient enrichment and ammonia / EOC toxicity arising from population growth and consequential increases in wastewater volumes
2. The risk to Ngāti Toa cultural values from the adverse effects of the discharge.

Environmental risk 1 will be adequately mitigated through proposed monitor, review and respond approach described in Section 5.13.

As a result of these proposed measures and associated conditions, any uncertainty about the nature and magnitude of the potential environmental risk will be mitigated and there can be confidence that the discharge will achieve an appropriate environmental outcome. It is noted that the proposed monitoring and technology review is key to this conclusion. It requires Porirua to review both the monitoring regime and technology in use at the WWTP to ensure both remain appropriate and take account of the actual adverse effects of the WWTP discharge (as identified by the monitoring results) and advances in the WWTP technology and operation.

Porirua City Council, Wellington Water and Ngāti Toa are continuing to work together to develop mitigation measures in relation to the risks to Ngāti Toa's cultural values. It is anticipated that these measures will be confirmed prior to the hearing on this application.

With respect to investment security, it is noted that consideration of a replacement consent application must consider the investment in a development in accordance with Section 104(2A) of the RMA. This states that:

104 Consideration of applications

(2A) When considering an application affected by section 124 or 165ZH(1)(c), the consent authority must have regard to the value of the investment of the existing consent holder.

Porirua City Council is applying for a 20-year term for the discharge of wastewater. Porirua City Council and its ratepayers have invested in a substantial and significant infrastructure asset in terms of the existing WWTP. Significant investment continues to be made as part of the regular maintenance and upgrade of this asset and further investment is on-going in the form of the upgrades to the UV disinfection system and other capacity upgrades due for completion in mid-2023. It is important that Council has financial security for this substantial infrastructural asset and is also able to provide future flexibility to accommodate domestic and business / trade waste growth.

Given these factors it is considered that a 20-year duration is appropriate for the wastewater discharge permit.

11 Conclusion

Porirua City Council is applying for coastal permit (a discretionary activity) to discharge wastewater from the Porirua WWTP to the CMA off Rukutane Point. The proposed discharge will:

- involve secondary treated and UV disinfected wastewater
- involve intermittent, partially treated discharges during heavy rain events until capacity upgrades of the treatment plant are completed by 30 June 2023
- have a maximum peak daily discharge volume of 129,600 cubic metres (m^3) per day, which equates to the upgraded WWTP peak capacity of 1,500 l/s operating continuously for 24 hours
- have a maximum average daily discharge volume of 38,016 m^3/day, which equates to the projected average flow of 440 l/s occurring continuously for a 24-hour period. Initial average daily discharge volumes will be significantly lower than this amount, increasing over the proposed 20-year consent duration with population growth.

The assessment of environmental effects has identified that most adverse effects will be less than minor. However, without further mitigation it has been identified that:

1. adverse effects on the biota of subtidal rocky substrata (and consequential potential natural character effects) could be more than minor due to nutrient enrichment and ammonia / EOC toxicity arising from population growth and consequential increases in wastewater volumes
2. adverse effects on Ngāti Toa's cultural values will be more than minor, particularly within the proposed 200 metre mixing zone.

To mitigate these potential adverse effects a monitor, review and respond approach is proposed as part of the application, and related conditions have been volunteered. This approach will adequately mitigate the potential adverse effects and risks.

Further work is continuing with Ngāti Toa to develop mitigation measures to adequately address the adverse effects on their cultural values. This will be presented at the hearing on this application.

The statutory assessment in Section 8 of the application identifies that the proposal is broadly consistent with the relevant provisions of relevant planning documents. However, further measures remain to be developed with respect to the planning provisions that relate to tangata whenua values. The statutory assessment also identifies that proposal is consistent with Sections 105 and 107, and Part 2 of the RMA.

For these reasons, and assuming that appropriate measures can be developed with Ngāti Toa to address adverse effects on their values, Porirua City Council considers that the coastal permit should be granted for 20 years and subject to the conditions set out in Appendix M.

Abbreviations & Glossary

Term or Abbreviation	Meaning
Acute Toxicity	Short term exposure
ADCP	Moored Acoustic Doppler Current Meter
ADF	Average Daily Flow
AEE	Assessment of Environmental Effects
Ammonia-N	Ammonia Nitrogen
ANZECC	Australian and New Zealand Guidelines for Fresh and Marine Water Quality
ANZG	Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Toxicant default guideline values
Bioaccumulation	The accumulation of contaminants from the water column or sediments, either directly or through consumption of food containing the toxicants.
BOD_5	Biochemical Oxygen Demand – 5 day test
Chronic Toxicity	Long term exposure
CMA	Coastal Marine Area
CORMIX Modelling System	A hydrodynamic mixing zone model
Distinct Redox Discontinuity	Redox discontinuity layer is zone of rapid transition between areas of aerobic and anaerobic decomposition in ocean sediments. Its depth within sediments depends on the quantity of organic matter available for decomposition and the rate at which oxygen can diffuse down from the overlying water.
DGV	Default Guidance Value
DO	Dissolved Oxygen
DTA	Direct Toxicity Assessment
EIANZ	Environmental Institute of Australia and New Zealand
Enteric	Disease causing micro-organisms (pathogens) that effect the digestive system
EOCs	Emerging organic contaminants, which include a vast number of chemicals used in industrial and domestic cleaning products, paints, inks and surface treatments, kitchen and laundry detergents, personal care products, cosmetics, pharmaceuticals and medicines.
Eutrophication	This is when a body of water is overpopulated with nutrients producing excessive algae growth, which can cause a depletion in oxygen supply.

Term or Abbreviation	Meaning
Flow Proportional Composite Sampling	A composite sample represents the average wastewater characteristics during the compositing period, typically by collecting a constant sample volume at varying time intervals proportional to the wastewater flow
Geometric Mean	Indicates the central tendency or typical value of a set of numbers by using the product of their values
Grab Samples	A small sample taken to represent the wider material
GWRC	Greater Wellington Regional Council
Hockey Stick Distribution	A hockey stick distribution is characterised by sharp rises or falls in data points after a relatively flat period- e.g. the number of infected persons and viral load received at the WWTP during an infrequent norovirus outbreak in a community
IIR	Individual Illness Risk
Infauna	Animals living in the sediments of ocean floors, river and lake beds
Infiltration	Infiltration is the process of water other than wastewater, such as stormwater and groundwater, entering the wastewater system
Influent	The wastewater flow into the WWTP
Inflow	Inflow is the process of water other than wastewater, such as stormwater and groundwater, entering the wastewater system
MACA	Marine and Coastal Area Act 2011
MCA	Multi-Criteria Analysis
MfE	Ministry for the Environment
MoH	Ministry of Health
MSB	Main Switch Board
NIWA	National Institute of Water and Atmospheric Research
NOAEL	The NOAEL is the widely accepted threshold when assessing the health risks from wastewater discharges (eg McBride G (2016) Quantitative Microbial Risk Assessment for the Discharge of Treated Wastewater: Warkworth Wastewater Treatment Plant. Report Prepared by NIWA for Watercare Services Limited. HAM2016-037
NRC Ltd	Northcott Research Consultants Limited
Nucleic Acid	Nucleic acid is the name for DNA and RNA which carry the genetic blueprint for the cell
NZCPS	New Zealand Coastal Policy Statement
OMP	Operational Management Plan

Term or Abbreviation	Meaning
PCC	Porirua City Council
Phytoplankton	A marine alga
Predicted No Effect Concentration (PNEC)	Toxicity values that present either no risk or a low level of risk to aquatic organisms
PNRP	Proposed Natural Resources Plan – The Proposed Regional Plan that will replace all previous regional plans in the Wellington Region. The PNRP remains subject to appeals, so is not fully operative
PSU	Practical Salinity Unit
PWWF	Peak Wet Weather Flows
QMRA	Quantitative Microbial Risk Assessment
RAS	Return Activated Sludge
RCP	Regional Coastal Plan – the regional plan for the coastal marine area in the Wellington Region. This plan will be superseded by the PNRP once appeals on the PNRP are resolved.
Reduction equivalent dose	Reduction equivalent dose (or RED) where all water passing through the UV system receives the prescribed UV dose. The dose (i.e., the product of the average UV intensity within the channel multiplied by the contact time of wastewater passing through) is typically given in millijoules (i.e., energy) per square centremetre (mJ/cm2).
RMA	Resource Management Act
Seston	Concentrations of organisms and non-living organic material in the water column, collectively known as seston, which constitutes their food supply.
Solids Retention Time	The time in days that the solid fraction of the wastewater spends in a treatment process.
SUP	Stand-up Paddle Board
TAK UV Disinfection System	The original Wedeco TAK UV system with horizontal low pressure UV lamps installed at the treatment plant in 2003.
Te Awarua o Porirua Whaitua Implementation Plan	This Whaitua Implementation Programme (WIP) is a non-statutory report developed by Te Awarua-o-Porirua Whaitua Committee (the Committee) providing advice and direction on how best to manage land and water within Porirua and northern Wellington's catchments.
TN	Total Nitrogen
TOC	Total Organic Carbon
TP	Total Phosphorus
TRP	Total Reactive Phosphorous

Term or Abbreviation	Meaning
TSS	Total Suspended Solids
UV	Ultraviolet
UVT	UV Transmittance is the percentage of light that passes through a wastewater sample at the wavelength of 254 nm
WAS	Waste Activated Sludge
WIP	Te Awarua-o-Porirua Whaitua Implementation Plan
WMU	Water Management Unit from the WIP
WWL	Wellington Water Limited
WWTP	Wastewater Treatment Plant

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