SEAVIEW WWTP TEMPORARY OUTFALL OPTIONS: An Assessment of Effects on the Aquatic Ecology of Waiwhetu Stream, Hutt Estuary and Wellington Harbour

Prepared for Wellington Water Ltd and Hutt City Council

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QUALITY STATEMENT

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Executive Summary

Hutt City Council is considering options for relocation of its Seaview Wastewater Treatment Plant (WWTP) temporary outfall (Seaview Outfall), which is currently located on the lower reach of the Waiwhetu Stream. The Seaview Outfall is operated when the Main Outfall Pipeline (MOP), which discharges to Cook Strait near the entrance to Wellington Harbour at Bluff Point, is temporarily taken out of service for maintenance, or when wastewater flows exceed the capacity of the MOP. Six location options are assessed in this report in terms of the potential effects of wastewater discharges on the water quality and ecology of the receiving environment. These are:

- Option 1- Waiwhetu Stream (status quo)
- Option 2- Hutt River (20m into Hutt River near mouth of Waiwhetu Stream)
- Option 3- Hutt River (100m off-shore of Barnes Street)
- Option 4- Wellington Harbour (2km south of Matiu-Somes Island)
- Option 5- Wellington Harbour (at Hutt River mouth 100m off-shore of Port Road corner)
- Option 6- Wellington Harbour (at Hutt River mouth 600m off-shore of Port Road corner).

Neither Option 1 nor 2 would meet the NPS-Freshwater 'national bottom line' in respect of ammonia. The predicted and measured ammonia concentrations in Waiwhetu Stream during a discharge event at these locations are potentially toxic to some aquatic organisms. Although exposure to ammonia would occur intermittently, typically for brief periods on five or six occasions over the course of a year, the duration of continuous exposure could, in the worst case, extend up to six weeks in the winter and up to two weeks in the summer. That order of exposure has the potential to adversely affect the structure and diversity of invertebrate and fish communities in the lower stream, and could contribute to Objective O25 of the Proposed Natural Resources Plan not being achieved. Pursuant to Policy 70 that could mean that neither option is sustainable beyond the short term.

Options 3 and 5 achieve better dilution and greater separation from sensitive areas, and have a low to moderate risk of causing adverse effects in the receiving environment. Both would comply with relevant environmental assessment criteria most of the time. Both would require a new pump station and pipeline. A significant constraint for option 3 is that it would be located within the GWRC dredging area, and GWRC have indicated they would oppose a new structure at this location.

Table 1: Option assessment summary

Option	Location	Engineering Issues	Environmental Effects/Assessment Criteria	Cost estimates
1	Waiwhetu Stream (existing)	None	Contrary to NPS-FW and Regional Plan (existing and proposed) criteria. Not sustainable beyond short term.	N/A
2	Hutt River near Waiwhetu	Accommodates MOP offline flows and wet weather overflows. Outfall structure only partly submerged.	Contrary to NPS-FW and Regional Plan (existing and proposed) criteria. Not sustainable beyond short term.	$3.2M
3	Hutt River 100m offshore of Barnes St	Accommodates all flows but requires a new pump station and 1050m pumped pipeline. Outfall structure would be located within the GWRC FP dredging area. GWRC are opposed to a new structure at this location.	Meets assessment criteria most of the time and has a low to moderate risk of causing adverse effects in the receiving environment.	$18M
4	Wellington Harbour near Matiu/ Somes	Requires new pump station and 5700m pumped pipeline. Not on ideal alignment for replacement of MOP pipeline to Bluff Point, but could potentially	Meets all assessment criteria and has low risk of causing adverse effects in the receiving environment.	$59.3M – $68.7M

Option	Location	Engineering Issues	Environmental Effects/Assessment Criteria	Cost estimates
		provide an alternative outfall location to Bluff Point (i.e., a harbour outfall, if WWTP were upgraded).		
5	Wellington Harbour at Hutt River mouth, 100m off Port Road	Requires new pump station and 1380m pumped pipeline but is located outside of the GWRC FP dredging area and could potentially form the first stage of a future replacement MOP pipeline to Bluff Point	Meets assessment criteria most of the time and has a low to moderate risk of causing adverse effects in the receiving environment.	$23.5M
6	Wellington Harbour at Hutt River mouth, 600m off Port Road	Requires new pump station and 1880m pumped pipeline but is located outside of the GWRC FP dredging area and could potentially form the first stage of a future replacement MOP pipeline to Bluff Point	Meets all assessment criteria and has a low risk of causing adverse effects in the receiving environment.	$31M

Options 4 and 6 would both comfortably achieve the assessment criteria and have a low risk of causing adverse effects. Option 4 is the highest cost option with the largest construction footprint, requiring a new pump station and 5700m of new pumped pipeline. Option 6 has a lower cost and smaller footprint than does Option 4, with the additional benefit that it could be designed as the first stage of a replacement MOP to Bluff Point in Cook Strait.

Under Condition 34 of Resource Consent WGN120142[31528], an options assessment report must be submitted to Greater Wellington Regional Council (GWRC) by 1 August 2017. This assessment of effects on the aquatic ecology of the Waiwhetu Stream, Hutt Estuary and Wellington Harbour, is one of a number of reports that provides input into the options assessment to be submitted to GWRC.

Wellington Water Ltd and Hutt City Council

Seaview WWTP temporary outfall options: An assessment of effects on the aquitic ecology of Waiwhetu Stream, Hutt Estuary and Wellington Harbour

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1.1 Purpose of this report

Hutt City Council is considering options for relocation of its Seaview Wastewater Treatment Plant (WWTP) temporary outfall (Seaview Outfall), which is currently located on the lower reach of the Waiwhetu Stream. The Seaview Outfall is operated when the Main Outfall Pipeline (MOP), which discharges to Cook Strait near the entrance to Wellington Harbour at Bluff Point, is temporarily taken out of service for maintenance, or when wastewater flows exceed the capacity of the MOP. A preliminary options comparison, which formed part of the 2012 consent application to Greater Wellington Regional Council (GWRC), identified three core outfall locations in addition to the existing outfall on Waiwhetu Stream, with a number of variations in terms of exact location, conveyance routes and supporting infrastructure (see Appendix A). Six core location options are assessed in this report in terms of the effects of wastewater discharges on the water quality and ecology of the receiving environment. These are shown in Figures 1-1 and 1-2:

- Option 1- Waiwhetu Stream (do nothing, rely on existing outfall location);
- Option 2- Hutt River (20m into Hutt River near mouth of Waiwhetu Stream);
- Option 3- Hutt River (100m off-shore of Barnes Street);
- Option 4- Wellington Harbour (2km south of Matiu-Somes Island); and
- Option 5- Wellington Harbour (at Hutt River mouth 100m off-shore of Port Road corner).
- Option 6- Wellington Harbour (at Hutt River mouth 600m off-shore of Port Road corner)

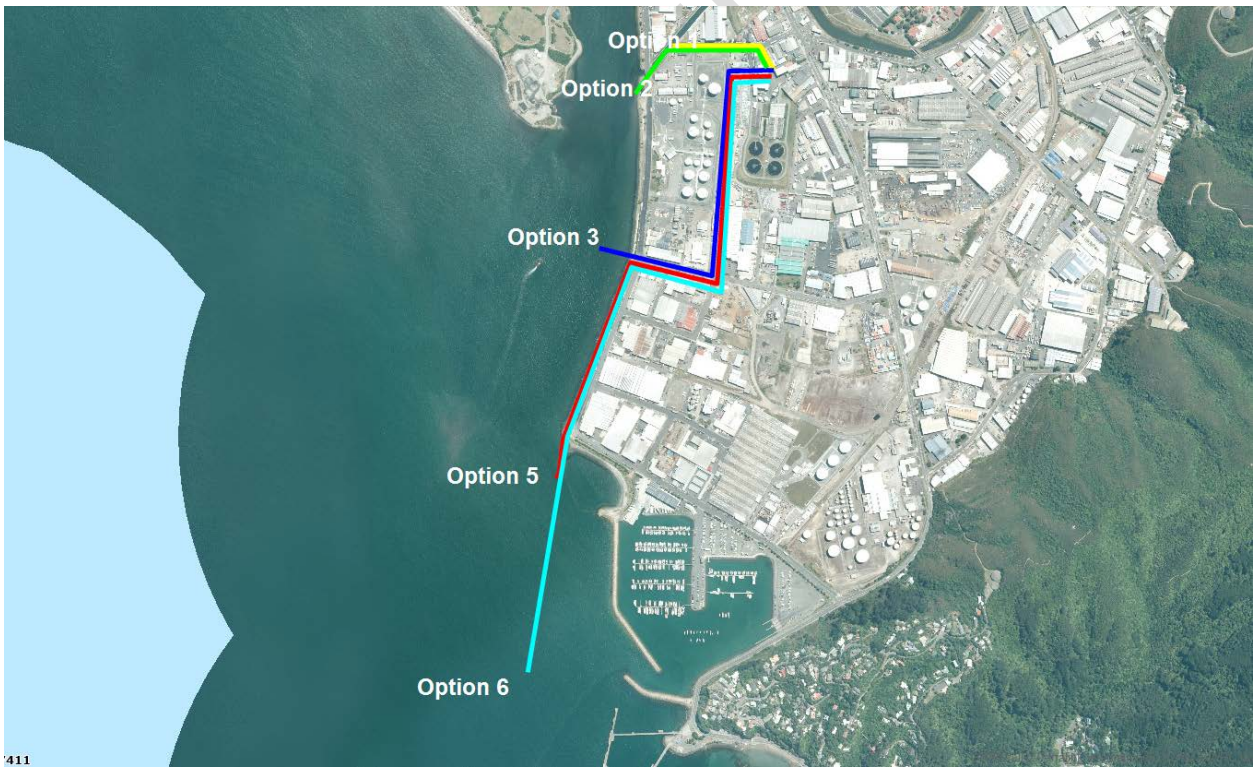

Figure 1-1: Seaview wastewater outfall options 1, 2, 3, 5 & 6.

Figure 1-2: Seaview wastewater outfall option 4

Under Condition 34 of Resource Consent WGN120142[31528][1], an options assessment report must be submitted to Greater Wellington Regional Council (GWRC) by 1 August 2017. This assessment of effects on the aquatic ecology of the Waiwhetu Stream, Hutt Estuary and Wellington Harbour is one of a number of reports that provides input into the options assessment to be submitted to GWRC. This report should be read in conjunction with Mabin, et al, (2016) which outlines alternative options to a concept design and associated cost estimate for each option.

[1] Condition 34 of Resource Consent WGN120142[31528] states that *"The consent holder shall submit an options assessment report to the Manager, Environmental Regulation, Wellington Regional Council and the consultation group required by condition 7 of this consent by 1 August 2017. The report shall comprehensively describe the investigations undertaken as required by condition 33, potential upgrade options and a preferred option (including timeframes for implementation) that reduces the frequency discharges, and/or reduces any adverse effects of the discharge on the receiving environment".*

2 Description of Existing Environment

2.1 Waiwhetu Stream & Estuary

2.1.1 Overview

The Waiwhetu Stream is a small low elevation watercourse which flows from the bush covered Eastern Hutt hills, through urban areas of Naenae, Epuni, Waterloo, Waiwhetu and Gracefield, to its confluence with the Hutt River Estuary at Seaview. It has a total catchment area of about 17.9km^2. The stream has a stony bed in its upper reaches and in part of the estuarine reach, but for most of its length the streambed substrate is soft and muddy. The catchment is heavily urbanised and has a high proportion of impervious surfaces. Consequently stream flows are strongly influenced by stormwater run-off during flood events, resulting in rapid flow fluctuations and highly variable water quality. The estuarine zone extends approximately 2km upstream of the Hutt River confluence, with saline conditions occasionally recorded upstream as far upstream as the Wainui Road Bridge.

Historically the lower estuarine reach was situated within a much wider area of salt-marsh and low lying wetland at the Hutt River mouth, although the Waiwhetu Stream Estuary would have had relatively small areas of intertidal flats and saltmarsh (Stevens and Robertson, 2012). However, over the last 100 years the stream corridor and estuary has been extensively modified by flood protection works, reclamation, and removal of the natural vegetated margin.

Over the same period the stream has received an extensive range of contaminant inputs from sewage overflows, stormwater and in particular from industrial discharges. Surface sediment and water quality investigations (Deely *et al*, 1992; Sheppard & Goff, 2001 & 2002; Stevens and Robertson, 2009) indicate that the lower reaches of the stream have historically been highly contaminated with heavy metals and organic compounds. Stream sediments in the Gracefield area, downstream of Bell Road, were significantly enriched (up to 10-fold) in metals, particularly lead and zinc, beyond levels found in the headwaters of the stream. The sources of the metals were considered to be either upward re-mobilisation from buried contamination and/or present day stormwater discharges from industries in the Gracefield area. Deely *et al* (1992) found that, in the industrial zone, a considerable proportion of the total heavy metal component was free to move between the sediment, interstitial water and overlying water.

An extensive programme of flood control and contaminated sediment remediation was undertaken in the lower reaches of the stream by GWRC and Hutt City Council during 2009 and 2010. Stevens & Robertson (2012), reported in relation to a before/after investigation of the tidal reaches that:

"In conclusion, *a range of physical, chemical and biological monitoring indicators of estuary condition in 2009 showed the lower part of the Waiwhetu Stream to be muddy, with organically enriched sediments that contained a range of industrial contaminants. It had poorly oxygenated soft sediment, an "unbalanced" benthic invertebrate community, high nutrient and organic concentrations, and was considered to be in a eutrophic state. Elevated concentrations of some heavy metals and the presence of other metals, pesticides, and industrial chemicals highlighted historical contaminant inputs, while past stream modification had resulted in the loss of most saltmarsh and most of the vegetated terrestrial buffer. Consequently the stream way rated poorly in terms of the key estuary issues of eutrophication, sedimentation, toxicity and sediment loss.*

In 2012, reassessment of the same indicators showed significant changes to the lower part of the Waiwhetu Stream following flood control work and sediment remediation. Extensive saltmarsh and terrestrial vegetation plantings have expanded this important habitat, although the total area remains low. Any future expansion is greatly limited by the artificial steep sides of the estuary. In addition much of the densely vegetated margins and many shade trees were lost from the upper estuary during remediation. Along the estuary margins, extensive areas of saltmarsh plantings and bank sediments are being eroded by stream flows.

56,331 tonnes (27,314m^3) of contaminated sediments were removed throughout the intertidal and subtidal zones and replaced with clean coarse sands, gravels and cobble. Despite this very significant improvement, sediments retained high nutrient and organic concentrations and were eutrophic, although they supported a slightly improved benthic invertebrate community.

The authors concluded that *".. past stream modification has been significant with the loss of most saltmarsh and the vegetated buffer. While remediation and flood control works have resulted in some improvements to this habitat and a very significant removal of contaminated sediment, overall there has*

been limited improvement to the ecological quality of the estuary which continues to be rated poorly in terms of eutrophication, sedimentation, toxicity and habitat loss."

2.1.2 Hydrology

Waiwhetu Stream at the Whites Line East flow gauge station has a mean annual low flow of 0.016 m^3/s, a mean flow of 0.312 m^3/s and a maximum recorded flow of 36.858 m^3/s (GWRC data). The stream is strongly tidal adjacent to the Seaview Outfall, with flows ranging from 9 m^3/s on the outgoing tide to approximately 8 m^3/s in an upstream direction on the incoming tide (HCC flow data). The water depth in the lower stream near the outfall varies between approximately 1m at low tide and 2.4m at high tide (spring). The channel width at this location is 15m. Approximately 140m downstream of the Seaview Outfall the Waiwhetu Stream flows into the Hutt River. The estuary is well flushed with a very short residence time.

2.1.3 Saltmarsh Habitat

Saltmarsh vegetation is able to tolerate saline conditions where terrestrial plants are unable to survive. It is important because it is highly productive, naturally filters and assimilates sediment and nutrients, acts as a buffer that protects against introduced grasses and weeds, and provides habitat for a variety of species including fish and birds. Stevens and Robertson (2012) observed that while historically the lower Waiwhetu Stream estuary was surrounded by saltmarsh and wetland, in 2009 the stream was confined within narrow banks, often steepened, straightened and reinforced to mitigate flood flows. Due to this modification, combined with extensive historical reclamation and draining of the surrounding land, the only significant saltmarsh habitat remaining in 2009 was a very small remnant (0.06ha, 2.1% of the estuary) downstream of the Seaview Road Bridge. Stevens and Robertson gave it a condition rating of "low" based on the low percentage cover within Waiwhetu Estuary.

By 2012, restoration planting as part of the stream remediation work had doubled the total area of saltmarsh in the estuary (0.14ha, 4.5% of the estuary) – (Table 2-1). The condition rating remained in the "low" category however the increase in saltmarsh from 2009 to 2012 was rated "very good".

Another change associated with the margin redevelopment has been a 65% reduction in in intertidal flats in the estuary which resulted from the channel deepening and bank steepening, including vertical concrete walls, which Stevens and Robertson (2012) consider offer habitat unsuitable for virtually all estuarine species.

Table 2-1: Summary of dominant estuary features downstream of the Bell Road Bridge, January 2009 and February 2012 (from Stevens and Robertson, 2012)

Feature		*2009 Area – Ha (%)*	*2012 Area (%)*
Saltmarsh Class	Dominant saltmarsh species	0.06 (2.1)	0.14 (4.5)
Rushland	*Juncus krausii* (searush)	0.01 (0.4)	0.10 (3.1)
	Apodasima similis (jointed wire rush)	0.02 (0.7)	0.04 (1.4)
Reedland	*Spartina anglica* (cord grass)	0.01 (0.2)	0 (0)
Herbfield	*Sarcocornia quinqueflora* (glasswort)	0.02 (0.8)	0 (0)
Un-vegetated intertidal flats		1.14 (40.2)	0.32 (10.3)
Water		1.64 (57.7)	2.63 (85.2)
TOTAL		**2.8 (100)**	**3.1 (100)**

2.1.4 Vegetation of Terrestrial Margins

A densely vegetated terrestrial margin naturally filters and assimilates sediment and nutrients, is an important habitat for a variety of species, and provides shading to help moderate stream temperature fluctuations. Stevens and Robertson observed that there was very little change in this habitat type from 2009 to 2012 (Table 2-2). In 2012 98% of the estuary still lacked a densely vegetated terrestrial margin giving a terrestrial cover ranking of "poor". There had been a tripling of the cover of native tussock-land from 2009 to 2012 (which included small native trees), but a halving of scrub/forest cover – mainly of established trees downstream of the Bell Road Bridge. The net decrease in densely vegetated terrestrial margin from 2009 to 2012 was rated "poor".

Table 2-2: Summary of dominant terrestrial margin features, 2009 and 2012 (from Stevens and Robertson, 2012)

Dominant Feature	Jan 2009 Area – Ha (%)	Feb 2012 Area – Ha (%)
Scrub/Forest	0.5 (1.8)	0.2 (0.7)
	Mostly plantings of pohutukawa, ngaio, willow, taupata, karo, and flax. Saltmarsh ribbonwood, five finger and manuka also present adjacent to the saltmarsh by Seaview Road bridge.	Established pohutukawa remains within grassland. Most ngaio, willow, taupata, karo, and flax upstream of Hutt Park Road removed. Ribbonwood, five finger and manuka remain by Seaview Road bridge
Tussockland	0.1 (0.4)	0.35 (1.2)
	Predominantly flax, often mixed with introduced weeds	Almost exclusively recent plantings of toetoe, flax, carex and umbrella sedge.
Grassland	5.5 (18.4)	5.5 (18.2)
	Mainly grass amenity areas (with occasional trees) and small overgrown areas of tall fescue and introduced weeds.	Mainly grass amenity areas (many with 2009 trees removed). Areas overgrown with tall fescue and introduced weeds reduced.
Artificial Structures	4.7 (15.7)	4.8 (15.9)
Residential	0.5 (1.6)	0.5 (1.6)
Commercial	3.5 (11.6)	3.5 (11.6)
Industrial	15.3 (50.7)	15.3 (50.8)
Total	**30.1 (100)**	**30.1 (100)**

2.1.5 Macroalgae

Macroalgae is an important feature of estuaries, contributing to their high productivity and diversity. However when high nutrient inputs combine with suitable growing conditions, nuisance blooms of rapidly growing algae can occur. Stevens and Robertson (2012) observed that macroalgae was not widespread in the Waiwhetu Estuary in 2009 but in 2012 growths of *Ulva intestinalis* were more widespread and were present over the vast majority of the intertidal area (84.4% of the intertidal area had greater than 5% cover and 20% of the intertidal area exceeded 50% cover). The authors noted that despite the relatively high cover, nuisance conditions (e.g. rotting macroalgae and poorly oxygenated and sulphide rich sediments) were not evident in intertidal areas, possibly due to macroalgae being regularly washed out to sea. It was concluded that the extent of macroalgae growth in the Waiwhetu and adjacent Hutt Estuary, while currently below nuisance conditions, indicates an excess of available nutrients.

2.1.6 Sediments

In 2012 the un-vegetated intertidal flats of Waiwhetu Stream were dominated by a mix of cobble, gravel and sand, in stark contrast to 2009 where soft muds were the dominant feature (Table 2-3). Consequently the condition rating provided by Stevens and Robertson (2012) improved from 'poor' in 2009 to 'very good' in 2012.

Table 2-3: Summary of dominant intertidal substrate, 2009 and 2012 (from Stevens & Robertson, 2012)

Dominant Feature	2009 Area – Ha (%)	2012 Area – Ha (%)
Rock field (man-made)	0.01 (1.2)	0.04 (11.0)
Boulder field (man-made)	0.08 (6.7)	0.003 (0.9)
Cobble field	0.39 (32.6)	0.07 (16.2)
Gravel field	0.11 (9.4)	0.15 (33.6)
Firm sand	0.16 (5.2)	0.17 (38.3)
Soft mud	0.36 (30.4)	0 (0)
Very soft mud	0.17 (14.5)	0 (0)
Total	**1.28 (100)**	**0.46 (100)**

2.1.7 Water Quality

Surface water quality is routinely monitored by GWRC in the Waiwhetu Stream at Whites Line East (RSOE site RS57), approximately 3.2 km upstream of Seaview Outfall. HCC has established an additional monitoring site at Seaview Road Bridge approximately 0.3 km upstream of the outfall for the purpose of characterising background conditions near the outfall on the ebb tide. It is noted that the Whites Line East site is above the tidal influence while the Seaview Road site is strongly affected by tidal inflows. Monthly monitoring results for the period May 2015 to January 2016 at both locations are summarised in Table 2-4.

Water quality at Whites Line East is poor; median values for TN, DRP, TP and *E. coli* all exceed recommended guideline values (shown in bold). Further downstream at Seaview Road, median values for DRP, TP and Zn exceed guideline values. Key differences between the two sites (see Figures 2-1, 2-2 and 2-3) are that:

- Nitrite-N, nitrate-N, and total-N and *E. coli* concentrations are higher at the upstream site (and are possibly reduced at the downstream site by tidal inflows of relatively uncontaminated seawater)
- DRP and total-P concentrations are higher at the downstream site (indicating a source of phosphorus affecting the lower stream)
- pH is higher at the downstream site (due to the influence of tidal inflows).

Of the dissolved metals and metalloids tested in stream water at Seaview Road Bridge, zinc is significantly elevated and consistently exceeds the guideline trigger value, while copper is occasionally elevated. Concentrations of all other metals were low and below guideline values.

Table 2-4: Summary of monthly water quality data at RSoE site RS57 (GWRC data) and at Seaview Road Bridge (HCC data) from May 2015 to May 2016 (N=11)

Determinant	*Waiwhetu Stream at Whites Line East (GWRC RS57)*			*Waiwhetu Stream at Seaview Road (HCC)*			*Guideline value*
	median	*min*	*max*	*median*	*min*	*max*	
Water temp. (°C)	12.3	9.7	20.2	13.9	9.4	21.5	≤19
Electrical Conductivity				1830	544	4560	
DO (mg/L)				8.4	7.2	10.0	
pH	6.65	6.30	7.02	7.4	6.8	8.0	6.5-9.0
Turbidity (NTU)	5.1	2.3	50	3.54	1.60	8.80	≤5.6
Suspended solids (mg/L)				14	3	37	--
Visual clarity (m)	0.945	0.240	2.040				≥1.6
NNN (mg/L)	0.440	0.003	0.650	0.102	0.005	0.310	≤0.444
Ammoniacal N (mg/L)	0.066	0.003	0.146	0.070	0.005	0.120	≤0.900
Total N (mg/L)	0.750	0.250	0.980	0.480	0.290	0.780	≤0.614
DRP (mg/L)	0.020	0.014	0.035	0.032	0.003	0.065	≤0.010
Total P (mg/L)	0.046	0.020	0.120	0.068	0.017	0.190	≤0.033
E. coli (cfu/100ml)	950	220	3600	310	99	1300	≤550
Dissolved metals: As (mg/L)				<0.001	<0.001	0.003	0.013
Cd (mg/L)				<0.0002	<0.0002	<0.0002	0.0002
Cr (mg/L				<0.001	<0.001	<0.001	0.001
Cu (mg/L)				<0.001	<0.001	0.0023	0.0014
Pb (mg/L)				<0.0005	<0.0005	<0.0005	0.0034
Hg (mg/L)				<0.0005	<0.0005	<0.0005	0.0006
Ni (mg/L)				<0.0005	<0.0005	0.0007	0.011
Zn (mg/L)				0.014	0.003	0.024	0.008

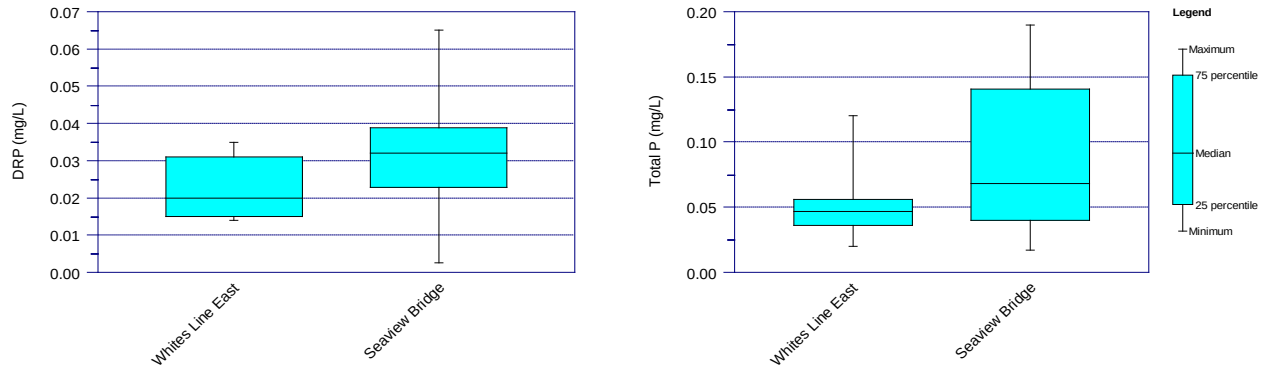

Figure 2-1: Box plots of dissolved nutrients in Waiwhetu Stream (May 2015 to May 2016, N=11)

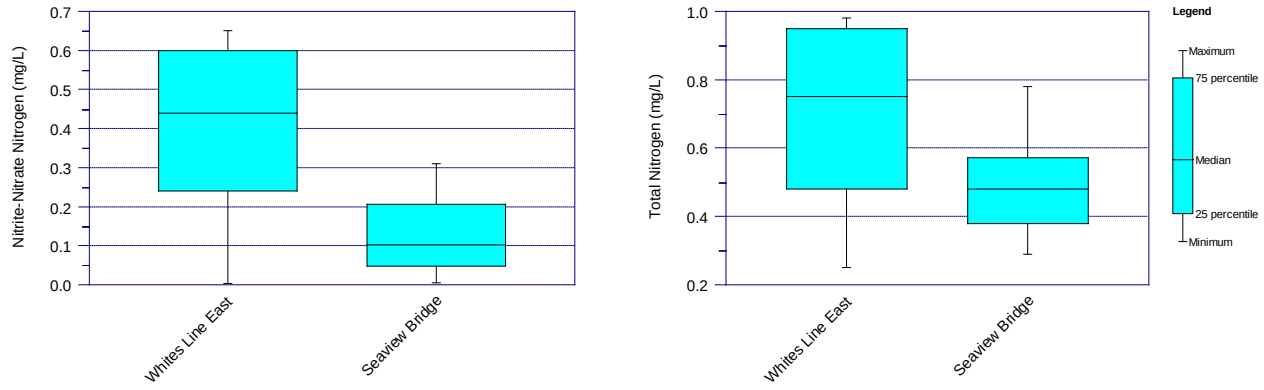

Figure 2-2: Box plots of Nitrate+Nitrite N and TN in Waiwhetu Stream (May 2015 to May 2016, N=11)

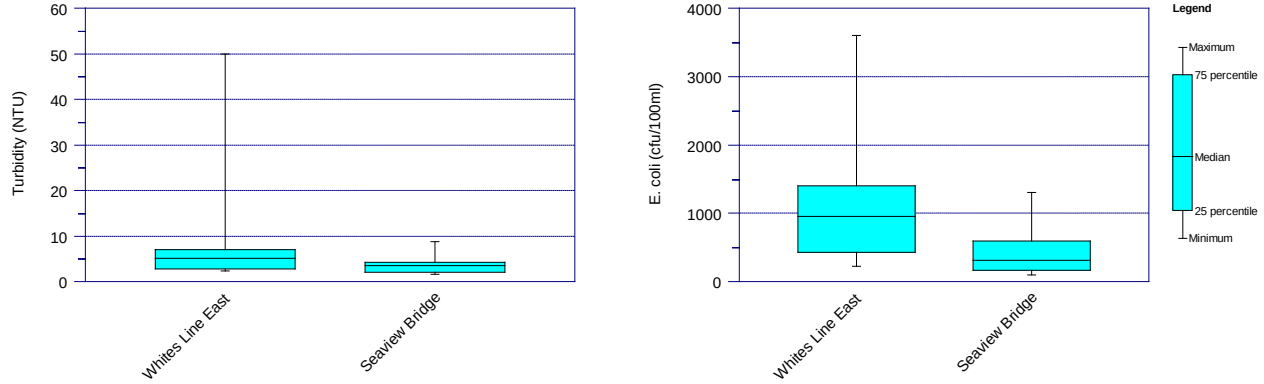

Figure 2-3: Box plots of turbidity and *E. coli* in Waiwhetu Stream (May 2015 to May 2016, N=11)

2.1.8 Eutrophication

Excessive organic input is a principle cause of degradation in estuarine benthic environments. In river mouth estuaries like the Waiwhetu, an oversupply of nutrients often promotes nuisance algal growth, and related sediment deoxygenation. As a consequence, the number of suspension-feeders (e.g. bivalves and certain polychaetes) declines, and deposit-feeders (e.g. opportunistic polychaetes) increase in response to increased organic input to the sediment (Pearson & Rosenberg, 1978).

Stevens & Robertson (2012) used a number of indicators to assess eutrophication in the Waiwhetu Estuary. These include redox potential discontinuity (RPD), sediment organic matter (total organic carbon, total nitrogen, total phosphorus), macroalage cover and soft mud. The RPD is the grey layer between the oxygenated yellow-brown sediments near the surface and the deeper anoxic black

sediments. It is an effective ecological barrier for most but not all sediment-dwelling species. A rising RPD will force most macrofauna towards the surface to where oxygen is available. The authors concluded that the shallow RPD, elevated organic matter and moderately extensive macroalgae cover indicate eutrophic conditions in key parts of the estuary. They note that the presence of such conditions following site remediation indicates ongoing sources to the estuary are likely, and that estuary condition will continue to decline if they are not managed.

As shown in Table 2-4, water column total phosphorus (TP) and total nitrogen (TN) are significantly elevated in the Waiwhetu Stream at Whites Line East, and it is likely that settlement of particulate material further downstream in the estuarine reach will contribute to enrichment of subtidal sediments. It is noted that both monitoring sites shown in Table 2-4 are located upstream of the Seaview outfall and that although the discharge plume can move upstream on the incoming tide, intermittent wastewater overflows via the Seaview outfall do not occur frequently enough to have greatly influenced the routine monitoring results.

2.1.9 Sediment Metal Contamination

Stevens & Robertson (2012) used heavy metals and the metaloid arsenic as indicators of sediment toxicants. The results, summarised in Table 2-5, showed a reduction in metal concentrations in stream sediments at sites A2 and B1 following the remediation work, with variable results at A1 and a signficant increase in concentrations at site B2 (site locations are shown in Figure 2-4). Lead and zinc in particular remained significantly elevated at B2 and indeed concentrations were much higher in 2012 after remediation. GWRC staff have advised that these sediments are thought to have originated from a seam of contaminated stream bank material which was capped during completion of the remediation project, and susequently re-exposed by erosion.

In 2012, post remediation, stream sediments exceeded ANZECC (2000) ISQG-High trigger values for zinc and lead at two and three sites, respectively, while ISQG-Low trigger values for arsenic, cadmium, copper, mercury and nickel were all exceeded at at least one site. These results indicate on ongoing risk of toxicity for invertebrates living in stream sediments in the lower Waiwhetu Stream. It is noted that sites A, B, and D are all located upstream of the Seaveiw outfall, but that the discharge plume can move upstream on the incoming tide.

Table 2-5: Summary results for Waiwhetu Stream, 2009 and 2012 (Stevens & Robertson, 2012)

	Site	RPD	TOC	TN	TP	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
	Waiwhetu	cm	%	Mg/kg (dry weight)									
2009	A-01 Subtidal	0.1	4.2	2,600	650	10	1.2	32	65	0.27	15	440	860
	A-02 Intertidal	0.1	3.8	2,100	460	10	1.2	42	49	0.56	18	490	660
	B-01 Subtidal	0.1	4.8	3,100	730	11	1.3	34	76	0.44	16	1,900	920
	B-02 Intertidal	0.1	4.7	3,300	550	11	1.2	34	74	0.34	16	1,200	850
2012	A-01 Subtidal	0	5.9	4,000	720	12.9	0.63	32	66	0.26	19	193	490
	A-02 Intertidal	>10	0.6	900	420	3.0	0.07	16	8.4	0.11	12	400	89
	B-01 Subtidal	0	2.4	1,800	600	6.8	0.41	26	38	0.25	14	1,010	380
	B-02 Intertidal	>10	2.4	1,900	620	21.0	6.0	63	64	0.53	24	7,900	1,350
	D-01 Subtidal	4	2.0	1,800	640	6.3	0.75	47	40	0.11	27	142	290
	D-02 Intertidal	4	1.9	1,800	630	8.5	0.18	16	30	0.08	11	99	143
	ANZECC ISQG-Low	-	-	-	-	20	1.5	80	65	0.15	21	50	200
	ANZECC ISQG-High	-	-	-	-	70	10	370	270	1	52	220	410

2.1.10 Semi-Volatile Organic Compounds

Stevens & Robertson (2012) also assessed semi-volatile organic compounds (SVOC's) to screen for key pollutants including organochlorine presticides (OCPs), polycylclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPHs) and pthalates. Overall, between 2009 and 2012 there was relatively little change in the subtidal sites A1 and B1, a marked improvement at Site A2 (downstream intertidal), and a significant decline at Site B2 (intertidal upstream) where contaminantion was greater following remediation than prior to it (refer Figure 3-1 for site locations). Key findings were:

- Site B2 (intertidal upstream) was the most contaminanted in 2012, where the OCP's 4,4'-DDD and 4,4'-DDE and TPHs were present above ANZECC ISQG-High trigger values, and a variety of PAH's were present above ANZECC ISQG-Low trigger values.
- Site D2 (intertidal site located immediately upstream of the rehabilitation area) was the next most contaminated, where a variety of PAH's were present above ANZECC ISQG-Low trigger values, then Site A1 (subtidal downstream) with a single PAH exceedance.

These results indicate on ongoing risk of toxicity for invertebrates living in stream sediments at B2 and D2 associated with pesticides and PAHs. However, it is noted that the high organic carbon content is likely to reduce the bioavailability of OCP's, consistent with TCLP leaching tests that showed contaminants tightly bound to stream sediments (Stevens & Robertson, 2012).

Figure 2-4: Location of monitoring sites in Waiwhetu Stream (from Stevens and Robertson, 2012)

2.1.11 Shellfish Flesh Toxicity

Stevens & Robertson (2012) collected blue mussels (*Mytilus galloprovincialis*) from the mouth of Waiwhetu Stream at Port Road Bridge and had the flesh analysed for metals, OCP's and PAHs. All results were relatively low, below the Australia New Zealand Food Standards Code (2002).

A study of shellfish quality conducted during a 16-day MOP maintenance discharge to Waiwhetu Stream concluded that shellfish at the Waiwhetu Stream mouth, Petone Beach and Lowry Bay are likely to be unsuitable for human consumption for up to four weeks after a discharge of treated wastewater to Waiwhetu Stream, or after a significant high flow event in the Hutt River, due to the risk of pathogen contamination (MWH, 2013). It was noted that this restriction would rule out most of the year, but would be consistent with the general advice from Regional Public Health, and NZFSA, not to collect shellfish near urban areas because of the ongoing impact of stormwater and sewage related contamination.

On the basis of this information it is concluded that microbiological contaminant (pathogens) are likely to be the primary limiting factor for shellfish consumption by humans, as is generally the case in coastal waters near urban areas.

2.1.12 Benthic Invertebrate Community

The benthic invertebrate community living in and on the sediments of the Waiwhetu Estuary during 2012 was dominated by "disturbance tolerant" gastropods, polychaetes and oligochaetes (Stevens & Robertson, 2012). Crustacean, nermerteans, nemotodes and fly larvae were also present but in low numbers. The relatively high diversity was explained by the majority of the animals being juveniles or small immatures, which are mainly recent recruits, bred elsewhere, being washed into the area in low numbers, but not able to survive to adulthood.

The results indicate a slight improvement in macroinvertebrate life in 2012 compared with 2009. The results also indicate a dominance of species that tolerate moderate organic enrichment and which live predominantly in a relatively clean layer of oxygenated surface mud that was present above the underlying anoxic sediments. For example, the gastropod *Potamopyrgus* is intolerant of anoxic surface muds, but its presence in very high number indicates suitable surface conditions.

2.1.13 Fish Community

Five species of fish have been identified in Waiwhetu Stream by electro-fishing surveys over the last 10 years (New Zealand Freshwater Fish database: NIWA). The short finned eel (*Anguilla australis*) was abundant throughout and was the dominant species. Adult inanga (*Galaxius maculatus*) have been recorded in large shoals in the lower/middle stream and banded kokopu (*G. fasciatus*) and redfinned bully (*Gobiomorphus huttoni*) have been locally abundant in the upper stream. Common smelt (*Retropinna retropinna*), yelloweyed mullet (*Aldrichetta forsteri*) and estuarine triplefin (*Grahamina sp*.) have been recorded in the lower stream.

Juvenile trout from the Hutt River fishery are known to make occasional use of the lower Waiwhetu Stream, although trout have not been recorded in the electro-fishing surveys.

2.2 Hutt Estuary

2.2.1 Physical characteristics

The Hutt Estuary is a moderate sized (3km long) "tidal river mouth" type estuary which drains into Wellington Harbour at Petone. It has been extensively reclaimed and modified, and the banks clad with large rip-rap boulders (Robertson & Stevens, 2007). Saltwater extends up to 3km, nearly as far as Ewen Bridge (and well upstream of the Estuary Bridge). The estuary is highly modified from its original state. In 1909 it was much larger and included several large lagoon arms and extensive intertidal flats and saltmarsh vegetation. Between 1900 and 1960 most of the intertidal flats and lagoon areas were re-claimed and the estuary was trained to flow in one channel between rock rip-rap lined banks. The terrestrial margin, which was originally vegetated with coastal shrub and forest species, was replaced with urban and industrial land-use (Robertson & Stevens, 2011).

2.2.2 Hydrology

The Hutt River at Taita has a catchment area of 556 km^2, a median flow 14.243 m^3/s and a 7-day mean annual low flow of 3.744 m^3/s. The maximum recorded flow of approximately 2000 m^3/s occurred in 1898 (Wellington Regional Council, 1996).

2.2.3 Ecological values

As a result of modifications over the last 100 years, including loss of most of the intertidal flats, lagoon areas and much of its riparian vegetation, the Hutt Estuary now has low habitat diversity. High value habitats such as tidal flats, saltmarsh and sea-grass beds are virtually absent. Instead, the estuary is dominated by lower value, sub-tidal sands and muds and artificial sea walls (Robertson & Steven, 2011). Nevertheless, parts of the estuary including the western mudflat embayment are considered to be important areas for juvenile flatfish and significant feeding/refuge areas for wading and non-wading birds (Weir, 2010; Stevens, Robertson, & Robertson, 2014; McArthur *et al*, 2015).

2.2.4 Macroalgae

Macroalgal monitoring has been undertaken annually in Hutt Estuary from 2010 to 2014 and is reported by Stevens & Robertson (2014). The authors note that *Ulva intestinalis* grows on almost every part of the intertidal habitat with an extensive cover extending from the railway over-bridge to the Hutt River mouth. *Gracilaria* and the green alga *Ulva* (sea lettuce) is largely confined to the lower intertidal reaches. Despite the high cover, nuisance conditions (rotting macroalgae and poorly oxygenated and

sulphide rich sediments) are not widespread in intertidal areas. Regular flushing of the estuary appears to currently restrict the presence of nuisance conditions to localised areas on intertidal flats, and in subtidal areas near the Hutt River mouth. The distribution of macroalgae on 22 January 2014 is illustrated in Figure 2-5.

Figure 2-5: Map of intertidal macroalgal cover in the Hutt Estuary (from Stevens & Robertson, 2014)

2.2.5 Sediments

The results of annual sediment monitoring in the Hutt Estuary from 2010 to 2014 are reported by Stevens & Robertson (2014). Measurement of depths to four concrete plates buried in intertidal sediment in 2010 was undertaken to assess the sedimentation rate. Redox potential discontinuity (RPD) depth and sediment grain size were assessed to indicate sediment condition.

The results show that the overall mean sedimentation rate across the four years of monitoring was a decrease of 4.2mm/yr. Regular dredging of sediment from the channel in the lower estuary, and

scouring of the tidal flats during high river flows, are likely reasons for the low mean annual deposition rate. In the 2014 survey the sediment mud content was 21.9%, reflecting firm muddy sands and the average RPD depth was 1.5cm. The authors concluded that: "*The sedimentation rate over the past 4 years showed slight erosion, but the high sediment mud content and shallow RPD depth indicate the estuary is susceptible to sediment related impacts from poor clarity and muddy intertidal substrates, with a macrofaunal community dominated by mud tolerant species – a common situation in NZ tidal river estuaries*".

The results of fine scale monitoring in 2010, 2011 and 2012 show that, as may be expected for such a heavily modified estuary and developed catchment, the sub-tidal sediments had moderate levels of sediment oxygenation and moderate nutrient levels. Perhaps less expected, given the exposure to urban runoff, were low concentrations of potential toxicants (heavy metals and PAH's) in all three years of baseline monitoring (Robertson & Stevens, 2012).

The authors noted that overall, while the greatest impact to the estuary has undoubtedly been from the extensive historical loss of high value natural vegetated margin, saltmarsh, sea-grass, and intertidal habitat, the findings indicate that the estuary currently:

- is moderately enriched with nutrients (mesotrophic),
- has elevated muds but low sedimentation rates, and
- has low levels of toxicity.

2.2.6 Water Quality

Surface water quality monitoring is routinely monitored by GWRC at three RSoE site in the main stem of the Hutt River, the most downstream of which is site RS22 at Boulcott, which is located upstream of the estuarine reach and approximately 3.2 km upstream of the Waiwhetu Stream mouth. Monthly monitoring results summarised in Table 2-6 show that the lower reaches of the Hutt River retains moderately high water quality and mostly achieve recommended guideline values.

Table 2-6: Summary of water quality data from Hutt River RSoE site at Boulcott sites sampled monthly between Jan 2010 and March 2015 (n=63). Median values that did not meet a guideline are shown in bold font (GWRC data).

Determinant	*Hutt River at Boulcott (RS22)*			*Guideline value**
	median	*min*	*max*	
Water temp. (°C)	14.2	8.27	21.52	≤19
DO (%saturation)	103	96	126	≥80
pH	7.26	6.57	8.23	6.5-9.0
Visual clarity (m)	1.59	0.04	7.5	≥1.6
Turbidity (NTU)	2.1	0.3	230	≤5.6
Suspended solids (mg/L)	<1	<1	470	--
Conductivity (µS/cm)	91	67	116	--
TOC (mg/L)	2.7	0.8	9.8	--
NNN (mg/L)	0.172	0.044	0.560	≤0.444
Ammoniacal N (mg/L)	0.005	0.003	0.01	≤0.021
Total N (mg/L)	0.310	0.120	1.83	≤0.614
DRP (mg/L)	0.004	0.001	0.011	≤0.010
Total P (mg/L)	0.009	0.002	0.39	≤0.033
E. coli (cfu/100ml)	80	10	3600	≤550

2.2.7 Macroinvertebrates

Fine scale monitoring reported by Robertson & Stevens (2012) includes survey of infauna from sediment core samples collected at two Hutt Estuary sites (A & B) in 2010, 2011 and 2012. In all three years the macroinvertebrate community was found to have low-moderate numbers of species at both sites. In terms of abundance, the results show a large reduction at both sites between 2010 and 2012. Compared with other NZ tidal river estuaries the abundances were relatively low.

The mud tolerance of the Hutt Estuary macroinvertebrate community was in the "moderate-high" category in 2012, a slight improvement from the previous two years (Figure 2-6). The results show that the community was dominated by species that prefer mud rather than those that prefer sand. Overall, the sediment results indicate that macroinvertebrate diversity and abundance is likely to be adversely affected by the sediment mud content, and that fine sediments are at levels where both sites and nearly all sensitive species are affected. However, there is evidence that some improvement occurred between 2010 and 2012.

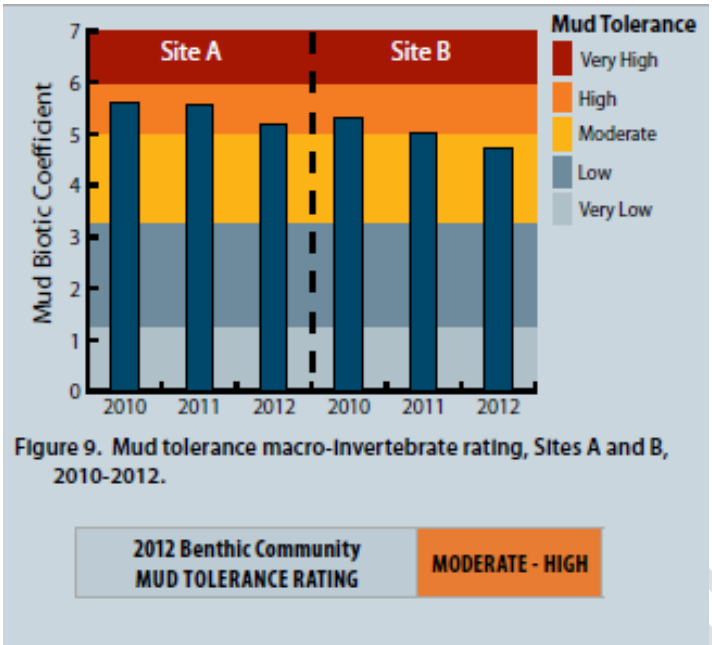

Figure 2-6: Mud tolerance macroinvertebrate rating, sites A and B, 2010-2012

Wear (2010) noted that the river mouth downstream of the Waione Street Bridge is regularly dredged to maintain flood capacity, and that the sediments of the extraction zone are essentially anoxic, while the benthic biota is described as depauperate and of low ecological value. Wear also observed that the south-western seawall consists of man-made materials positioned along the true left bank as protection from flooding and erosion, which forms intertidal habitat dominated by green algae (*Ulva)* and *Enteromorpha intestinalis* and the blue mussels *Mytilus galloprovincialis,* with patches of necklace seaweed (*Hormosira banksii*).

2.2.8 Fish

Migratory freshwater fish species recorded in the Hutt River, including the majority of fish species listed in Table 2-7, rely on the estuary zone to provide unimpeded access from the open harbour waters to the river (or *vice versa*) for the purposes of spawning. Additionally a number of marine species venture into the estuarine area to breed or feed, including yellow-eyed mullet (*Aldrichetta forsteri)*, sand flounder *(Rhombosolea plebia)* and kahawai *(Arripis trutta)*. The estuary is considered to be an important nursery area for juvenile sand flounder (Wear & Haddon, 1992; Wear, 2010).

Despite the general unsuitability of the main-stem for inanga spawning, there are records of inanga spawning in areas in the tidal reach where bank armouring is absent. These include observations near the Sladden Park boat ramp in Petone, at Te Mome Stream and Opahu Stream (Taylor & Kelly, 2001; Taylor & Marshall, 2016).

Table 2-7: Summary of the NZFFD records for the Hutt River as of June 2015 (n=93).

Scientific name	Common name	Migratory species	Threat status (Goodman *et al* 2014)
Anguilla australis	Shortfin eel	yes	Not threatened
Anguilla dieffenbachii	Longfin eel	yes	At risk (declining)
Galaxias argenteus	Giant kokopu	yes	At risk (declining)
Galaxias brevipinnis	Koaro	yes	At risk (declining)
Galaxias divergens	Dwarf galaxias	no	At risk (declining)
Galaxias maculatus	Inanga	yes	At risk (declining)
Galaxias fasciatus	Banded kokopu	yes	Not threatened
Geotria australis	Lamprey	yes	Threatened (Nationally Vulnerable)
Gobiomorphus basalis	Crans bully	No	Not threatened
Gobiomorphus cotidianus	Common bully	yes	Not threatened
Gobiomorphus gobioides	Giant bully	yes	Not threatened
Gobiomorphus hubbsi	Bluegill bully	yes	At risk (declining)
Gobiomorphus huttoni	Redfin bully	yes	At risk (declining)
Retropinna retropinna	Common smelt	yes	Not threatened
Salmo trutta	Brown trout	yes	Introduced/naturalised

*Not listed in the NZFFD but recorded by Perrie (2013)

2.2.9 Birds

The western arm tidal flat of the Hutt Estuary is an important roosting, wading and feeding area for a number of birds, including the variable oystercatcher, black shag, little black shag, royal spoonbill, reef heron, mallards and grey ducks, red-billed gulls, and terns (Wear & Haddon, 1992; McArthur, Robertson, Adams, & Small, 2015).

GWRC has identified the Hutt River reach from the river mouth to 1.3 km upstream of the mouth as a site of significance for indigenous birds (McArthur and Lawson, 2013). The ecological context is that "this site provides seasonal or core habitat for black shag, little black shag, royal spoonbill, variable oyster catcher and red-billed gull". Present threats identified in that report include disturbance caused by recreational users, dogs and vehicles, disturbance and habitat modification caused by flood protection activities.

2.2.10 Hutt River Mouth Sediment Extraction

GWRC, Flood Protection, holds consent to extract an average of 50,000 m^3 of sand and shingle annually from the bed of the Hutt River downstream of the Waione Street bridge for the purpose of flood mitigation. The extraction and disposal areas are shown in Figure 2-4. Extraction of sediment is by way of a mobile hydraulic excavator mounted on a barge and positioned by tugboat. The extraction digs the seabed to a maximum depth of about 4 m below the water level. When the barge has a full load of about 60 m^3 it is pushed to shore where the sediment is unloaded for processing. The by-product is barged to a designated 6 ha disposal area located about 700 m south of the Hutt River mouth.

Exclusion zones are identified in Figure 2-4 where no dredging is undertaken; at the mouth of the Waiwhetu Stream, at Waione Street Bridge, adjacent to Hikoikoi Pa and in the western mudflat embayment. GWRC, Flood Protection, has indicated that it would oppose construction of a new outfall into the middle of the Hutt River channel.

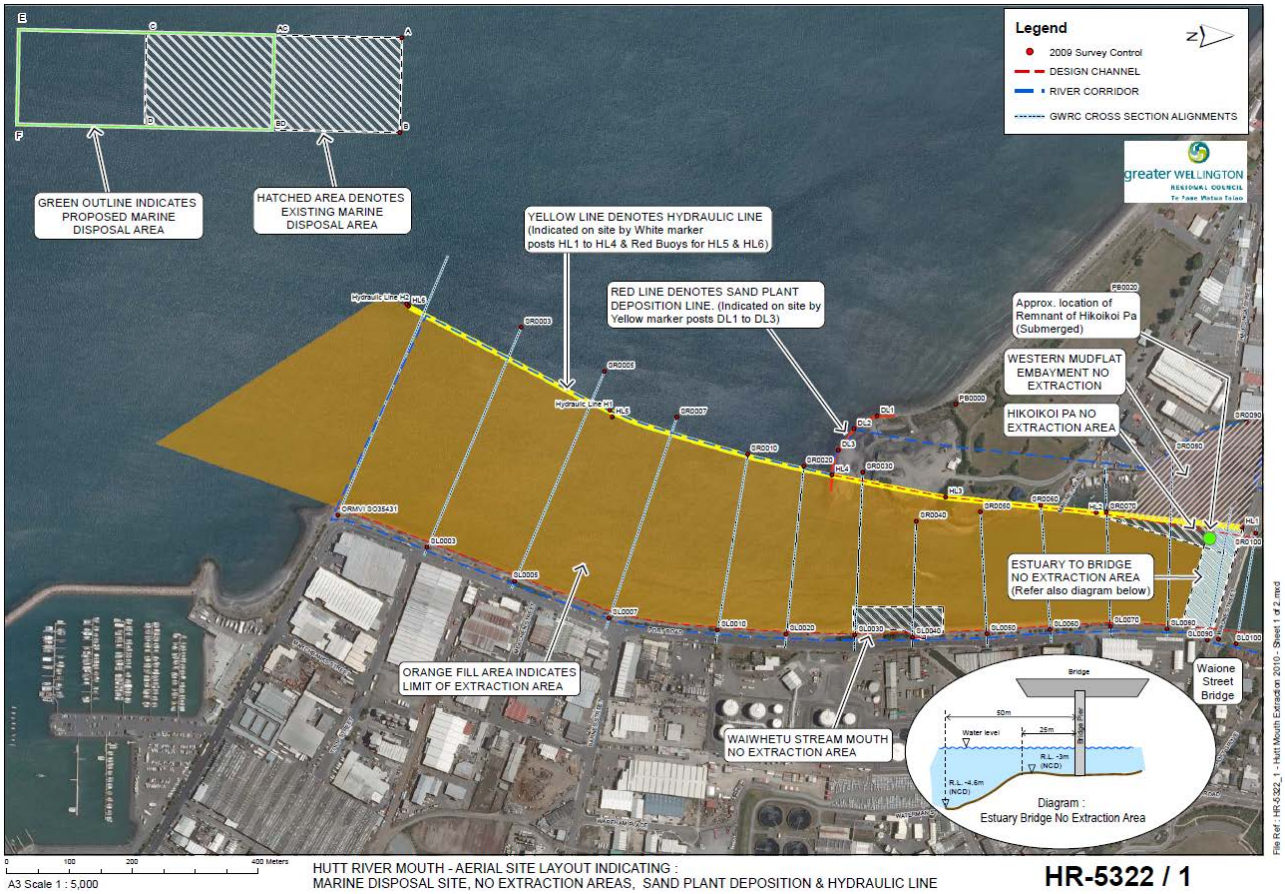

Figure 2-7: Hutt River Mouth sediment extraction area

2.3 Wellington Harbour

Intertidal habitats along the eastern side of Wellington Harbour include estuary, sand beaches and rocky shores. Moderately sheltered and sheltered rocky reef habitat is found on outcrops between Pt Howard and Eastbourne, with sandy beaches at Lowry Bay, York Bay, Mahina Bay, Days and Eastbourne. South of Eastbourne, the rocky reef is moderately exposed, becoming very exposed south of Inconstant Point (EHEA 1997). Detailed descriptions of habitat and ecology are given in Morton and Miller (1973) and Morton (2004).

A survey of edible shellfish beds in Wellington Harbour coastline (EHEA 1997) indicates that the green lipped mussel (*Perna canaliculus)* and the blue mussel (*Mytilus edulis*) are found on many of the rocky outcrops between Pencarrow Head and Point Arthur. Paua (*Haliotis iris),* kina (*Evechinus chloroticus)* and rock lobster (*Jasus edwardsii*) are found along the Pencarrow coast south of Eastbourne. Pipi (*Phaphies australis*) are found at Days Bay and Petone Beach while the cockle (*Austrovenus stutchbury*) is found at York Bay, Lowry Bay, Sorrento Bay and Point Howard. Scallops are found further offshore in waters of 5 to 15m depth between Point Howard and Eastbourne. The open scallop season for Wellington runs from 15 July to 14 February.

The Eastern Bays water quality can be strongly influenced by the Hutt River. At times of high flow the river causes surface water discolouration, reduced salinity and elevated bacteria concentrations. Local stormwater runoff from urban areas also contributes to the bacteriological contamination of these coastal waters.

3 Characterisation of Wastewater Discharges

3.1 Rate and duration of MOP Maintenance/repair Discharges

Over the last 12 years the duration of MOP maintenance treated wastewater discharges to Waiwhetu Stream (i.e. excluding wet weather overflow discharges) has averaged 158 hours per year, or around

seven days. The average rate of discharge was 480 L/s, the peak flow rate was1,360 L/s and the total discharge volume has averaged 401,453m^3 per year (Table 3-1).

Table 3-1: Record of discharges from Seaview WWTP to Waiwhetu Stream during MOP maintenance

Year (1 Apr – 31 Mar)	Mean discharge flow (L/s)	Peak discharge flow (L/s)	Total overflow Volume (m^3/yr)	Total duration (hours/yr)
2003-04	?	840	1,801,200	504
2004-05	0	0	0	0
2005-06	?	?	603,565	294
2006-07	431	1336	16,994	7
2007-08	301	1068	21,100	20
2008-09	469	520	1,068	1
2009-10	523	1368	394,028*	166*
2010-11	0	0	0	0
2011-12	439	1352	757,056	346
2012-13	0	0	0	0
2013-14	546	1758	483,577	246
2014-15	650	2640	738,855	316
Average	**480**	**1,360**	**401,453**	**158**

Note * - major outages 26 March to 13 May and 22 May to 25 July 2009 excluded from table as an outlier. Approximately 7,000,000m^3 of treated effluent was discharged to the Waiwhetu Stream during this period.

3.2 Rate and duration of Wet Weather Overflow Discharges

Wet weather treated wastewater discharges have occurred on average 4.2 times each year with an average duration of 13.6 hours per event and 61 hours per year (two and a half days). Wet weather discharges occur at an average flow rate of 386 L/s up to a maximum recorded rate of 922 L/s. The total discharge volume has averaged 94,262 m^3 per year (Table 3-2).

Table 3-2: Record of wet weather overflow discharges from Seaview WWTP to Waiwhetu Stream

Year (Apr – Mar)	Events per year	Average volume (m^3)	Maximum volume (m^3)	Average flow (L/s)	Maximum Flow (L/s)	Total overflow volume (m^3/yr)	Duration (hours/yr)	Average duration (hours/ event)
2003-04	6	11,017	19,900	317	500	66,103	60	10
2004-05	4	29,830	91,545	424	710	119,318	53	13.2
2005-06	1	8,649	8,649	353	360	8,649	6.8	5.7
2006-07	9	46,601	150,600	453	883	419,412	230	25.5
2007-08	1	44,100	44,100	670	821	44,100	15	15.4
2008-09	8	10,278	34,812	344	710	82,226	93	11.5
2009-10	4	6,183	12,254	255	592	24,732	37	9.2
2010-11	2	25,119	37,926	388	635	50,238	17	8.6
2011-12	?	?	?	?	?	??	?	?
2012-13	4	6,948	31,740	310	500	64,686	47	6.6
2013-14	5	6,540	13,680	232	922	32,702	38	7.5
2014-15	2	62,356	73,953	502	673	124,711	73	36.5
Average	**4.2**	**23,420**	**47,196**	**386**	**922**	**94,262**	**61**	**13.6**

3.3 Quality of MOP Maintenance/repair Discharges

The results of treated wastewater quality monitoring during maintenance discharges to Waiwhetu Stream in May 2013, and June, July and August 2014 (51 days in total) are summarised in Table 3-3.

Table 3-3: Treated wastewater quality from daily samples collected from dry weather discharges to Waiwhetu Stream during 2013 and 2014

Constituent	units	n. samples	Treated wastewater quality			
			minimum	median	95-percentile	maximum
pH	pH	51	7.0	7.40	7.59	7.60
Temperature	°C	15	14.6	17.2	18.1	18.3
Dissolved O_2	mg/L	15	2.2	3.2	5.6	6.3
$cBOD_5$	mg/L	51	3.0	6.0	13.9	19.0
Turbidity	mg/L	51	0.62	4.08	13.8	16.5
Faecal coliforms	/100ml	51	<4	100	4,895	10,800
E. coli	/100ml	51	<4	88	3,991	4,300
Enterococci	/100ml	51	<1	110	2,530	3,400
DRP	mg/L	51	0.865	2.070	2.737	2.990
Nitrite-N	mg/L	51	<0.01	<0.01	0.348	0.400
Nitrate-N	mg/L	51	<0.005	<0.005	0.119	0.320
Ammonia-N	mg/L	51	14.1	23.7	29.7	31.7
Copper (dissolved)	mg/L	51	<0.004	0.006	0.010	0.056
Zinc (dissolved)	mg/L	51	0.012	0.022	0.027	0.029

3.1 Quality of Wet Weather Overflow Discharges

The results of treated wastewater quality monitoring during wet weather overflow discharges to Waiwhetu Stream during 2013, 2014 and 2015 (17 days in total) are summarised in Table 3-4. The quality of treated wastewater during wet weather overflows typically has lower concentrations of nutrients but higher concentrations of indicator bacteria compared with dry weather discharges.

Table 3-4: Treated wastewater quality from daily samples collected from wet weather overflow discharges during 2013, 2014 and 2015

Constituent	units	n. samples	Treated wastewater quality			
			minimum	median	95-percentile	maximum
$cBOD_5$	mg/L	17	<1	5	19.7	20
Faecal coliforms	/100ml	17	<4	430	32,431	45,000
E. coli	/100ml	17	<2	381	26,392	36,000
Enterococci	/100ml	17	<1	700	16,255	20,000
DRP	mg/L	17	0.274	0.830	1.47	1.60
Nitrite-N	mg/L	17	0.040	0.260	0.653	0.660
Nitrate-N	mg/L	17	0.005	0.770	5.08	6.04
Ammonia-N	mg/L	17	2.240	9.090	18.96	20.60
Copper (dissolved)	mg/L	1	<0.005	-	-	-
Zinc (dissolved)	mg/L	1	0.030	-	-	-

3.2 Dilution and Dispersion

3.2.1 Investigations

Hutt City Council has commissioned a series of investigations in order to determine the dilution and dispersion characteristics of the discharge plume from the existing outfall and for the alternative outfall options currently under consideration. The investigations include:

- Dye dilution and dispersion from a planned maintenance wastewater discharge into Waiwhetu Stream (Barter, 2013);

- HCC Plume Dispersal Data Report (Stevens, Brewer, Elliot, Grant, & Rickard, 2013);
- HCC Plume Dispersal in the Near-Field: CORMIX Predictions (Palliser, 2014);
- HCC Plume Dispersal into the Far Field; Numerical Modelling Report (Rickard & Hadfield, 2015)
- HCC Plume Dispersal Summary Report (Rickard & Hadfield, HCC Plume Dispersal Summary Report, 2015)
- HCC Plume Dispersal in the Near-Field: CORMIX Predictions for options 4, 5 & 6 (Tuckey, 2016)

3.2.2 Dye Dilution Study

A dye dilution and dispersion study was undertaken to collect field data that could be used to validate and verify the three-dimensional numerical model. Data were collected during a neap ebb tide during a period of fine weather and light northerly winds. During the dye release the discharge flow from the Seaview WWTP varied between 570 L/s and 1,250 L/s, averaging around 944 L/s. These flows are higher than anticipated due to the study being undertaken during the peak diurnal flow and at a time when wastewater stored in the storm tank was being released on the outgoing tide, in accordance with consent conditions.

In general terms the effluent formed an elongated plume that hugged the eastern bank of the Hutt River as it made its way out into Wellington Harbour. As expected, the lowest observed dilutions were encountered directly adjacent to the outflow from Waiwhetu Stream with numerous observations of dilution values of 10:1 or lower. Dye was never detected on the western side of the Hutt River, and never crossed the midline of the river channel. When the ebb tide finished and the tide turned, dye (hence effluent) was no longer detected at the mouth of the Waiwhetu Stream and the effluent was observed flowing upstream (in Waiwhetu Stream) with the tide (Barter, 2013)

Overall dilution within the Hutt River was relatively low, with less than 5:1 dilution achieved up to 150m downstream of the Waiwhetu Stream mouth and subsequent dilutions of 10:1 and 25:1 taking place as far as 350 m and 1000 m downstream, respectively (refer Figure 3-1).

3.2.3 Hydrography Data Collection

NIWA conducted field observations of the hydrography in Hutt River and Wellington Harbour as the first phase of the plume dispersion study. The observations included three instrumented moorings that measured water column velocity structure, near bed temperature and salinity. These moorings were located (a) in the Hutt River up-stream of the Waiwhetu Stream, (b) in the Hutt River mouth, and (c) in Wellington Harbour south of Matiu/Somes Island. These three moorings were augmented by nine profiling transects designed to capture the spatial evolution of the river plume in the harbour.

The field observations show that flow speeds in the Hutt River were around 0.01 m/s except during storm-driven rain when the river flowed into the harbour at a rate of over 0.4 m/s for a period of up to three days. The data show upstream flow in the Hutt River both at depth and at the surface for some of the tidal cycle, but not at the same time (Figure 3-2). This curious behaviour may be either a local effect based on the river shape where the current profiler was located or it could be a stratified adjustment where the tides drive not only a change in water elevation but also an internal change (Craig Stevens pers comm.).

Salinity at the river mouth is bimodal, switching from coastal ocean to near-fresh over very short periods of time. The harbour mooring indicates that the tides are only a modest component of flow (<0.005 m/s) and that the currents are multi-directional. Predicted current speeds at outfall locations 4, 5 and 6 are summarised in Table 3-5.

The profile transects showed that the river plume layer remained less than 1 m thick along the line sampled. There is clear evidence of stratification within the harbour. A 25 minute harbour seiche was apparent both in the harbour and up-river (Stevens, et al, 2013).

Table 3-5: Simulation currents at potential outfall locations 4, 5 and 6 (from NIWA WH-ROMS)

Percentile	Current Speed (m/s)		
	Option 4	Option 5	Option 6
25th	0.03	0.03	0.04
50th	0.05	0.06	0.07

75th	0.07	0.12	0.11
90th	0.09	0.21	0.16

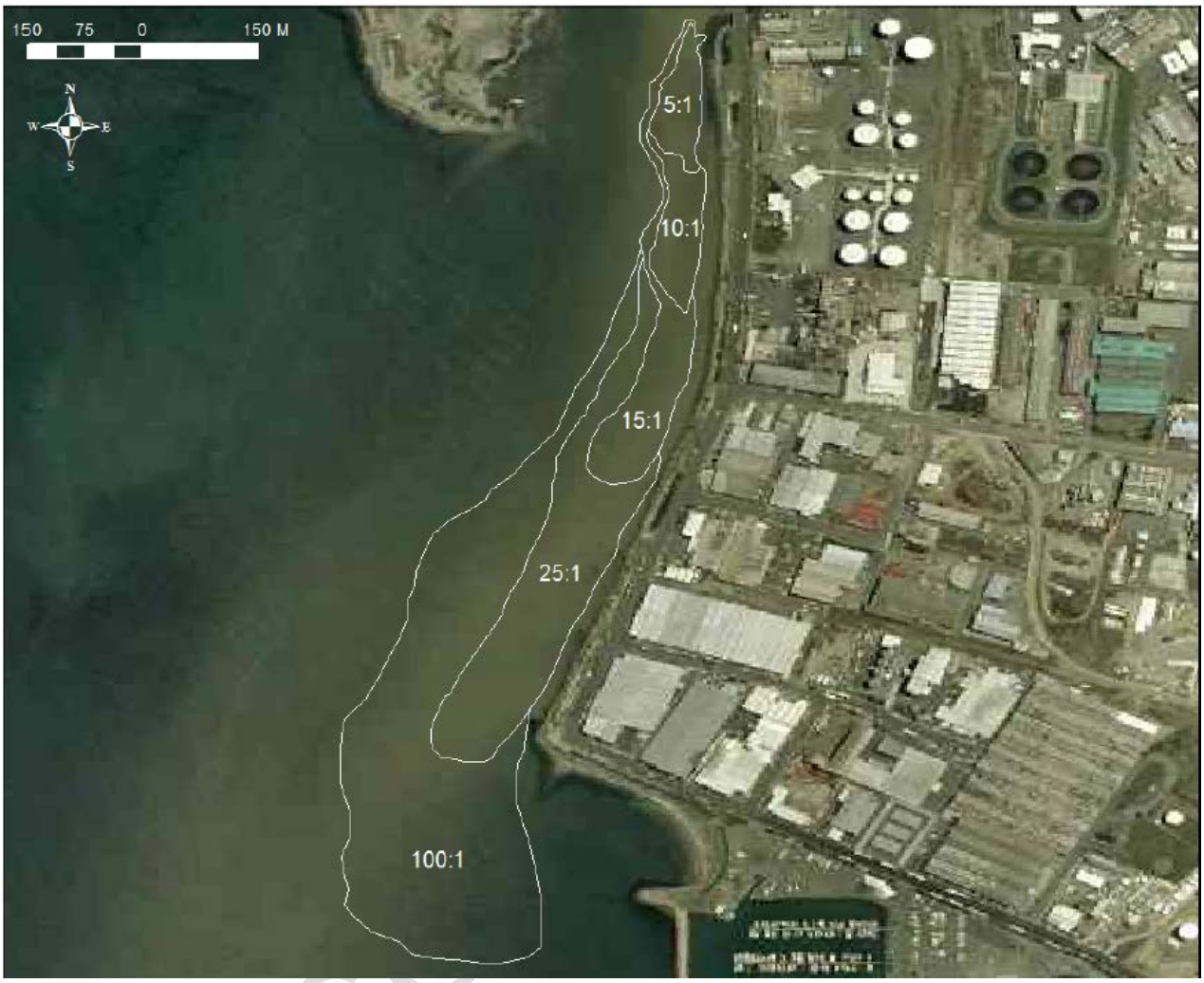

Figure 3-1: Effluent dilution contours in the Hutt River downstream of the Waiwhetu Stream (Barter, 2013).

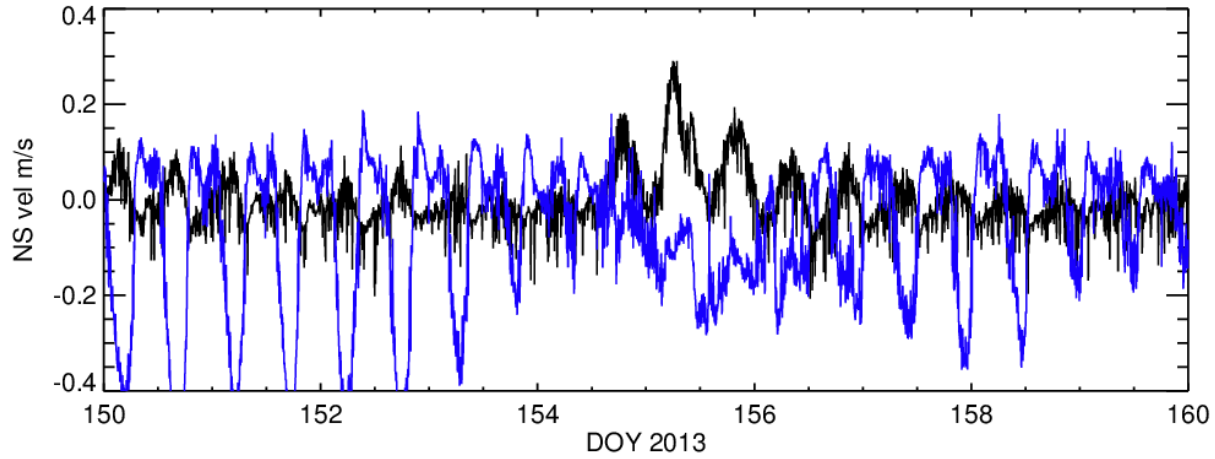

Figure 3-2: North-south flow velocities in surface water (blue) and deep water (black) at the Hutt River mooring. Negative values show flows south, out into the harbour (from Stevens *et al* 2013).

3.2.4 Near Field Mixing

The numerical modelling comprises two components, the first looking at the near-field dispersal, the second extrapolating and integrating the near-field solution into the wider flow field (far-field) in order to estimate the large scale plume dispersal characteristics.

A near field mixing assessment was conducted for the six outfall options using the CORMIX modelling system. The discharge of wastewater through the discharge pipe rises towards the surface of the ambient receiving water due to the buoyancy of the lighter density freshwater, entraining the receiving water with the plume leading to substantial dilution of the wastewater known as initial dilution. The momentum of the jet that exits the pipe creates shear stresses on the edge of the plume, also causing entrainment and mixing with ambient water.

The CORMIX assessment for the existing outfall (Option 1) was not able to obtain realistic wastewater behaviour for all discharge scenarios due to the constrained channel cross section and large wastewater discharge compared with the flow of the Waiwhetu Stream. Consequently only four sets of results were obtained (and no results were available for dilutions 50m and 100m downstream of the outfall). CORMIX was also constrained for Option 3 due to the pipe being too close to the water surface, resulting in a reduction being required to the pipe diameter in order to meet CORMIX criteria.

Notwithstanding these limitations the near-field mixing results summarised in Table 3-6 for options 1 and 2 are consistent with the dilution contour measurements made during the dye dispersion test (see Figure 3-1). That is, in the Hutt River 100m downstream of the Waiwhetu Stream mouth, a 5:1 dilution is likely to have occurred in dry weather conditions. Options 3 achieves a 12:1 dilution in dry weather. For options 4, 5 and 6 a conceptual diffuser design had to be incorporated into the assessment to provide realistic predictions, which resulted in dilutions at 100m of 215:1, 10:1 and 177:1, respectively, in dry weather conditions. Near-field dilution estimates used in mass balance calculations in this assessment are shown in bold brackets.

Table 3-6: Summary of near-field dilution results

Downstream distance from outfall	Effluent flow (m^3/s)	Option 1 Waiwhetu Stream	Option 2 Hutt River at Waiwhetu	Option 3 Hutt River at Barnes	Option 4 Harbour near Somes/Matiu	Option 5 Harbour Port Rd 100m	Option 6 Harbour Port Rd 600m
End of near-field	0.55	1.6 - 3.9	1.6 - 7.7	4.2 - 55.6	392 - 480	9 - 61	151 - 206
	0.80	7.3	11.1 - 12.9	19.3 - 21.5	289 - 350	7 - 42	120 - 148
50 m	0.55	-	1.6 - 5.3	5.9 – 11.6	91 - 130	3 - 65	85 - 201
	0.80	6.5	25.2 – 26.2	41.1 – 43.2	76 - 106	2 - 46	63 - 142
100 m	0.55	**(2.5)**	1.8 – 7.1 **(5)**	11.0 – 17.0 **(12)**	170 – 217 **(215)**	4 – 71 **(10)**	93 – 218 **(177)**
	0.80	8.0	32.5 – 39.4	52.9 – 54.2	142 - 175	3 - 50	68 - 155
	3.00	not assessed	not assessed	not assessed	64 - 78	7 - 17	34 - 49

3.2.5 Far Field Dilution

Following the initial dilution phase, a reasonably coherent surface plume moves away from the discharge site under the impetus of the coastal current. As it moves it continues to spread and dilute, but at a slower pace than in the initial dilution phase. In order to characterise the far field dilution NIWA ran a three-dimensional model using the Regional Ocean Modelling System (ROMS) configured for Wellington Harbour and through the Harbour into Cook Strait (so-called "WH_ROMS"). Results of the CORMIX near field analyses were translated to a set of distinct initial conditions (Cases) as inputs to the WH-ROMS in order to follow the evolution of the discharge material into the wider harbour (the far field).

As the discharges are not continuous but are relatively short term intermittent events, three operational cycles were applied per Case in order to simulate the likely operational range:

- Cycle A: 0.5 days ON and 11.5 days OFF,
- Cycle B: 5 days ON and 45 days OFF, and
- Cycle C: 30 days On and 70 days OFF.

Dilution predictions were run for specified "sensitive sites" as follows: (site 1) Petone Beach-west, (site 2) Petone Beach-east, (site 3) Hutt River at Waione Street Bridge, (site 4) Hutt River 100m downstream of

Waiwhetu Stream mouth, (site 5) Lowry Bay, and (site 6) Days Bay. However due to "blocky" resolution of near coastal waters the WH-ROMS was unable to separate sites (3) and (4). Consequently these sites are combined into a single site referred to as site 3+4.

Predicted 5th percentile dilution ranges at five sensitive sites for Cycles A, B and C are presented in Tables 3-7, 3-8 and 3-9, respectively. The lower and upper values of the range are associated with dry weather and wet weather conditions respectively, that is, dilutions are higher in wet weather when river flows are elevated. The 5th percentile value has been selected for use in the following assessment as it provides a realistic 'worst case' dilution, i.e., the actual dilution would be greater than this value for 95% of the time. The first thing to note is that the dilutions for each statistic tend to decrease progressively from Cycle A to C for all Options and at all sensitive sites. This is not surprising as Cycle A represents a discharge of only 12 hours duration, characteristic of a wet weather overflow, while at the other end of the spectrum Cycle C represents a discharge of 30 days duration, which may occur for a planned maintenance activity or emergency repairs for a major pipeline failure.

The WH-ROMS shows that for all options discharge material generally spreads to the whole harbour, including Lambton Harbour and Evans Bay, but at dilutions typically greater than 10,000-fold at those locations. For the Hutt River mouth discharges the 5th percentile distribution pattern has dilutions in the following order of magnitude: Hutt River<the Eastern Bays<Petone Beach<wider harbour. For the harbour discharge south of Somes/Matiu Island the lowest dilutions are around the outfall, with fairly uniform higher dilutions spreading across the entire harbour.

Table 3-7: Predicted 5th percentile dilution ranges (x-fold) at five sensitive sites for discharge Cycle A

Outfall Option	Sensitive Sites				
	Petone W (site 1)	Petone E (site 2)	Hutt River (sites 3+4)	Lowry Bay (site 5)	Days Bay (site 6)
Option 1 Waiwhetu	16307 - 23722	12549 - 18253	4103 - 5967	6664 - 9693	4289 - 6239
Option 2 Hutt@Waiwhetu	16307 - 24349	12549 - 19255	4104 - 17313	6664 - 10960	4289 - 6213
Option 3 Hutt@Barnes	16307 - 24576	12549 - 19189	4104 - 17340	6664 - 10720	4289 - 6103
Option 4 Harbour	14408 - 20956	13333 - 19392	14990 - 21802	12223 - 17777	11955 - 17388

Table 3-8: Predicted 5th percentile dilution ranges (x-fold) at five sensitive sites for discharge Cycle B

Outfall Option	Sensitive Sites				
	Petone W (site 1)	Petone E (site 2)	Hutt River (sites 3+4)	Lowry Bay (site 5)	Days Bay (site 6)
Option 1 Waiwhetu	3720 - 5411	3969 - 5773	64 - 93	1793 - 2608	1501 - 2183
Option 2 Hutt@Waiwhetu	3720 - 5478	3969 - 5798	64 - 1829	1793 - 2707	1501 - 2212
Option 3 Hutt@Barnes	3720 - 5474	3969 - 5804	64 - 2494	1793 - 2712	1501 - 2212
Option 4 Harbour	4089 - 5948	3965 - 5768	4584 - 6667	3988 - 5801	3851 - 5601

Table 3-9: Predicted 5th percentile dilution ranges (x-fold) at five sensitive sites for discharge Cycle C

Outfall Option	Sensitive Sites				
	Petone W (site 1)	Petone E (site 2)	Hutt River (sites 3+4)	Lowry Bay (site 5)	Days Bay (site 6)
Option 1 Waiwhetu	775 - 1127	1036 - 1506	37 - 54	522 - 760	421 - 613
Option 2 Hutt@Waiwhetu	775 - 1017	1035 - 1395	37 - 188	522 - 752	421 - 608
Option 3 Hutt@Barnes	775 - 995	1035 - 1356	37 - 201	522 - 741	421 - 602
Option 4 Harbour	1264 - 1839	1201 - 1747	1307 - 1901	1099 - 1599	1104 - 1607

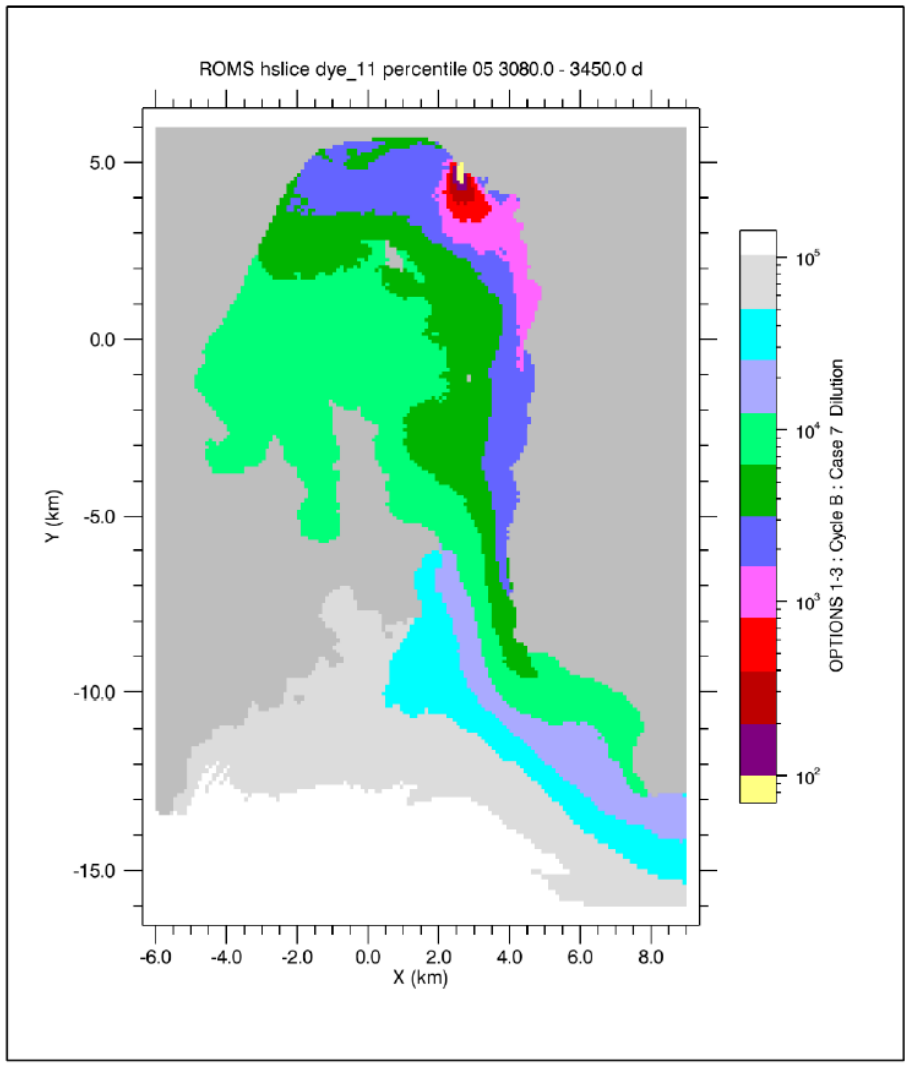

Figure 3-3: Fifth percentile dilutions, cycle B, for Options 1 to 3

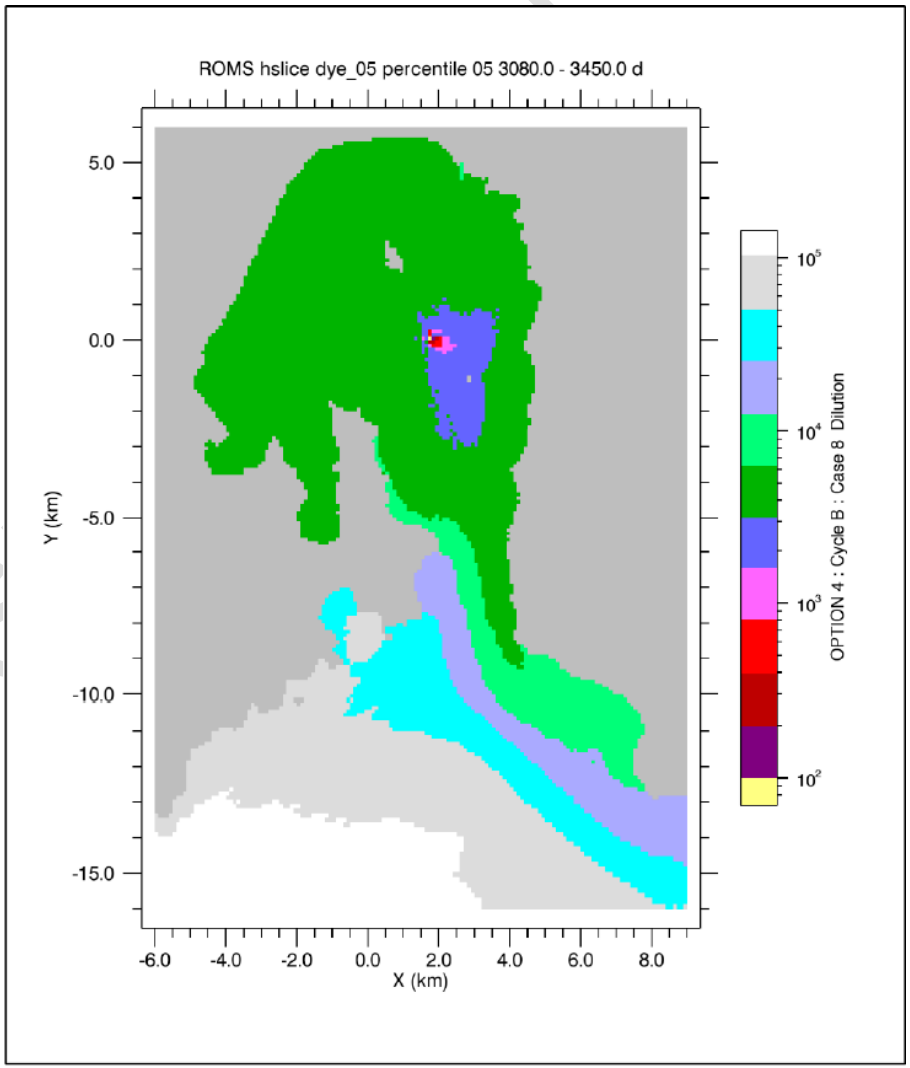

Figure 3-4: Fifth percentile dilutions, cycle B, for Option 4

4 Option Assessment

4.1 Existing discharge to Waiwhetu Stream: *Option 1*

4.1.1 Description

Gravity flow along an existing pipeline to the Seaview Outfall on Waiwhetu Stream. The existing arrangement accommodates wet weather overflows and MOP offline flows in all conditions.

4.1.2 Assessment Criteria

The immediate receiving waters of Waiwhetu Stream are managed under the Wellington Regional Freshwater Plan and Proposed Natural Resources Plan, as well as The National Policy Statement for Freshwater Management. The assessment criteria for discharges to freshwater are summarised in Appendix B.

It is assumed that the maximum duration of any discharge would be six weeks in the period between 5 May and 5 July, and no more than 2 weeks at any other time.

4.1.3 Outfall Location

Figure 4-1: Seaview wastewater outfall Option 1

4.1.4 Potential Effects of Wastewater Discharge to Waiwhetu Stream

Predicted contaminant concentrations in Waiwhetu Stream resulting from discharges via the existing Seaview Outfall are summarised in Table 4-1. The results align well with the monitoring results presented in the annual report for the year to June 2015 (MWH, 2015) with both sets of data indicating that ammonia toxicity is of primary concern, and that nutrient enrichment and microbiological water quality are secondary considerations.

Low dilutions result in predicted and measured ammonia concentrations in Waiwhetu Stream well in excess of the **NPS-Freshwater** national bottom line of 2.2 mg/L, indicating an unacceptably high risk of toxicity for benthic invertebrate and fish species, and potentially a barrier for migrating fish. Elevated ammonia concentrations are also predicted for the Hutt River near the true left bank immediately

downstream of the Waiwhetu Stream mouth, although this effect is relatively localised (dye testing results show that the discharge plume hugs the true left bank and does not extend past the river centre-line on the ebb tide).

Although exposure to ammonia would occur intermittently, typically for brief periods on five or six occasions over the course of a year, the duration of continuous exposure could, in the worst case, extend up to six weeks in the winter and up to two weeks in the summer. That order of exposure has the potential to adversely affect the structure and diversity of invertebrate and fish communities in the lower stream.

Nutrient concentrations are significantly increased in both Waiwhetu Stream and in the Hutt River near the true left bank as a result of the Seaview Outfall discharge. Short duration discharges of less than two weeks may not cause any noticeable increase in macroalgae cover. Longer-term discharges, particularly those that occur during the summer growth period, might potentially contribute to nuisance blooms within the intertidal zone. That risk could be appropriately mitigated by ensuring that all planned discharges were scheduled to occur between 5 May and 5 July, with a maximum duration of 6 weeks, and that any discharges occurring outside of this window were limited to a maximum duration of 2 weeks.

This assessment indicates that the potentially significant adverse effects associated with ammonia toxicity on benthic invertebrates and fish would be contrary to Sections 70 and 107 of the RMA (1991) which requires that "the discharge of contaminants are not likely to have any significant effects on aquatic life". On the face of it the continuation of intermittent discharges of treated wastewater to Waiwhetu Stream would not be consistent with the **Regional Freshwater Plan** requirement that the Waiwhetu Stream is managed "so that water quality is enhanced" or with Policy 22 of the Proposed **Natural Resources Plan** which requires that "Significant adverse effects on the ecosystems or values of estuaries, including their importance as habitat for indigenous birds and fish, including indigenous species, and as a nursery for fish stocks, shall be avoided".

Objective O24 of the **Proposed Natural Resources Plan** which seeks to ensure that coastal waters are suitable for contact recreation and Maori customary use, is largely achieved in terms of microbiological water quality at Petone Beach, Lowry Bay and Days Bay.

Objective O25 of the **Proposed Natural Resources Plan**, to safeguard aquatic ecosystem health and mahinga kai, is not met in the lower Waiwhetu Stream due to high ammonia concentrations. Policy P70 requires that for an existing point source discharge which contributes to the objective not being met, the discharge is only appropriate if:

- the application for resource consent includes a defined programme of work for upgrading the activity, in accordance with good management practice, within the term of the resource consent, and
- conditions of the resource consent require the reduction of adverse effects of the activity in order to improve water quality in relation to the objective within the term of the consent.

Table 4-1: Option 1: existing Seaview Outfall. Predicted contaminant concentrations in Waiwhetu Stream, Hutt River and at nearby bathing beaches during dry weather maintenance discharges; Cycle C (exceedance of recommended guideline values is indicated by pink shading; non-compliance with the NPS-freshwater national bottom line is indicated by red shading).

Constituent	*Treated wastewater concentration (95-percentile)*	*Background concentration at:*			*Predicted receiving water concentration at:*								*ANZECC (2000)*		*National Bottom Line*
		Waiwhetu Stream	*Hutt River*	*Wellington Harbour*	*Waiwhetu 100m DS outfall*	*Hutt River 100m DS Waiwhetu*	*Hutt River 100m DS Barnes S.*	*Hutt River at Waione St Bridge*	*Petone Beach west (site 1)*	*Petone Beach east (site 2)*	*Lowry Bay (site 5)*	*Days Bay (site 6)*			*Freshwater*
5%ile dilution	-	-	-	-	2.5	5	25	37	775	1036	522	421	Marine	Freshwater	*(Waiwhetu)*
BOD5	13.9	1	0.5	0.5	4.7	2.7	1.0	0.9	0.5	0.5	0.5	0.5			
TSS	13.8	9.5	9.0	9.0	10.7	9.8	9.2	9.1	9.0	9.0	9.0	9.0			
NNN*	0.467	0.185	0.160	0.005	0.266	0.211	0.172	0.168	0.006	0.005	0.006	0.006		0.444	Annual 95th%ile 9.8
Ammonia-N	30	0.075	0.01	0.01	8.625	5.01	1.163	0.799	0.049	0.039	0.067	0.081	0.910	0.900	Max 2.2
TP	7.29	0.041	0.009	0.015	2.11	1.22	0.289	0.201	0.024	0.022	0.029	0.032		0.033	
DRP	2.74	0.021	0.005	0.005	0.80	0.46	0.110	0.077	0.009	0.008	0.010	0.011		0.01	
E. coli	3991	240	100	10	1312	749	250	202	15	14	18	19	260	260	Annual median 1000
arsenic	0.003	0.0005	0.0005	0.0015	0.0012	0.0009	0.0006	0.0006	0.0015	0.0015	0.0015	0.0015	0.013	0.013	
cadmium	<0.001	0.0001	0.00025	0.00005	0.0004	0.0004	0.0003	0.0003	0.0001	0.0001	0.0001	0.0001	0.0007	0.0002	
chromium	0.01	0.0005	0.00025	0.0005	0.0032	0.0019	0.0006	0.0005	0.0005	0.0005	0.0005	0.0005	0.0044	0.0010	
copper	0.01	0.0013	0.0011	0.00005	0.0038	0.0026	0.0014	0.0013	0.0001	0.0001	0.0001	0.0001	0.0010	0.0014	
lead	0.012	0.00025	0.00005	0.00005	0.0036	0.0020	0.0005	0.0004	0.0001	0.0001	0.0001	0.0001	0.0044	0.0034	
mercury	0.0007	0.00025	0.0001	0.0000006	0.0004	0.0002	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0004	0.0006	
nickel	0.01	0.00025	0.00025	0.00033	0.0030	0.0019	0.0006	0.0005	0.0003	0.0003	0.0003	0.0004	0.007	0.011	
zinc	0.027	0.015	0.0018	0.000078	0.0184	0.0060	0.0028	0.0025	0.0001	0.0001	0.0001	0.0001	0.015	0.008	

*NNN = nitrate + nitrite nitrogen

Table 4-2: Assessment of Option 1 against PNRP Objective O25 criteria, Waiwhetu Estuary (low to medium adverse effects are indicated by pink shading, high adverse effects are shaded red)

Ecological component	O25 criteria (Table 3.8 – estuaries)	Current State Waiwhetu Stream	Significance of ecological effects
Macroalgae	The algae community is balanced with a low frequency of nuisance blooms	Relatively high cover but nuisance conditions not widespread	Low to medium for short duration discharges of less than two weeks, or for discharges of up to six weeks duration provided they avoid the spring and summer growth season.
Seagrass and saltmarsh	Seagrass, saltmarsh and brackish water submerged macrophytes are resilient and diverse and their cover is sufficient to support invertebrate and fish communities	Approximately 0.14 ha saltmarsh habitat is located downstream of the Seaview Road Bridge; low condition rating in 2012.	Not known
Invertebrates	Invertebrate communities are resilient and their structure, composition and diversity are balanced	The benthic invertebrate is dominated by tolerant species including gastropods, polychaetes and oligochaetes. Crustacean, nemerteans, nemotodes and fly larvae were also present but in low numbers. These species live predominantly in a relatively clean layer of oxygenated surface mud overlaying anoxic sediments.	High water column ammonia concentrations are potentially toxic to benthic invertebrates, especially those in the immediate vicinity of the outfall. Longer duration discharges of two to six weeks may adversely affect the composition and diversity of the benthic invertebrate community in the 100m stream reach extending from the outfall to the stream mouth.
Mahinga kai species	Mahinga kai species, including taonga species, are present in quantities, sizes and of a quality that is appropriate for the area	Mahinga kai species are sparsely distributed in the Waiwhetu Estuary and are not suitable for human consumption due to the presence of microbiological and other contaminants.	The discharge is likely to increase the risk of microbiological contamination in filter feeding shellfish, however due to very limited distribution of mahinga kai species in the vicinity the risk of adverse effects is low to moderate.
Fish	Indigenous fish communities are resilient and their structure, composition and diversity are balanced	Indigenous fish communities may be limited by a scarcity of suitable spawning and adult habitat.	High water column ammonia concentrations in the lower stream are potentially toxic to fish. Longer duration discharges of two to six weeks may adversely affect the composition and diversity of the fish community in the 100m stream reach extending from the outfall to the stream mouth.
Sedimentation rate	The sedimentation rate is within an acceptable range of that expected under natural conditions	Sediments are dominated by a mix of cobble, gravel and sand; very good condition rating in 2012	Negligible
Mud content	The mud content and areal extent of soft mud habitats is within a range of that found under natural conditions	Soft mud not present inter-tidally, but present sub-tidally	Negligible

4.2 Hutt River Near Waiwhetu Stream Mouth: *Option 2*

4.2.1 Description

Gravity flow along the existing pipeline to Waiwhetu Stream, then via new pipeline ending a further 180m to the Hutt River, as shown in Figure 4-1. The discharge point has nominally been assumed as 20m beyond the low tide mark to ensure flow is always discharged to water. This option accommodates wet weather overflows and MOP offline flows in all but extreme conditions. The outfall structure would be only partially submerged; it would be located within an area which is excluded from dredging by GWRC.

4.2.2 Assessment Criteria

The Coastal Marine Boundary at the Hutt River mouth is at the seaward edge of the Waione Street (Estuary) Bridge. Consequently outfall Option 2 is located within Coastal Marine Area (CMA) and is managed under the Wellington Regional Coastal Plan and the Proposed Natural Resources Plan for the Wellington Region, as well as The New Zealand Coastal Policy Statement (Appendix C).

It is assumed that the maximum duration of any discharge would be six weeks in the period between 5 May and 5 July, and no more than 2 weeks at any other time.

4.2.3 Outfall location

Figure 4-2: Seaview wastewater outfall option 2

4.2.4 Potential Effects of Discharge to Hutt River at Waiwhetu Mouth

Predicted receiving water contaminant concentrations from discharges via a new outfall located on the true left bank of the Hutt River immediately downstream of Waiwhetu Stream mouth (Option 2) are summarised in Table 4-4 and an assessment against PNRP Objective O25 criteria is provided in Table 4-3. While Option 2 would remove the point of discharge from Waiwhetu Stream, and prevent adverse effects in the stream on the ebb tide, it is anticipated that the discharge plume would be pushed back into Waiwhetu Stream on the flood tide. Consequently the worst case adverse effects of Option 2 would be similar those already described in the previous section for Option 1, but would only occur in Waiwhetu Stream on the flood tide.

Adverse effects within Waiwhetu Stream could be reduced by utilisation of additional storage to prevent the discharge plume from entering the stream on the flood tide, but this would result in a doubling of the

of the discharge rate to the Hutt River on the ebb tide, and a consequent doubling of ammonia and nutrient concentrations in the Hutt River near the left bank (above the values shown in Table 4-4). This would deliver little net benefit compared to the existing discharge regime, and in respect of the Hutt River, would not achieve the required reduction of adverse effects. It is concluded that the relocation of the discharge the Hutt River near the mouth of the Waiwhetu Stream would not deliver the required improvements.

Table 4-3: Assessment of Option 2 against PNRP Objective O25 criteria, Waiwhetu/Hutt Estuary (low to medium adverse effects are indicated by pink shading, high adverse effects are shaded red)

Ecological component	O25 criteria (Table 3.8 – estuaries)	Current State Waiwhetu/Hutt Estuary	Significance of ecological effects
Macroalgae	The algae community is balanced with a low frequency of nuisance blooms	Relatively high cover but nuisance conditions not widespread	Low to medium for short duration discharges of less than two weeks, or for discharges of up to six weeks duration provided they avoid the spring and summer growth season.
Seagrass and saltmarsh	Seagrass, saltmarsh and brackish water submerged macrophytes are resilient and diverse and their cover is sufficient to support invertebrate and fish communities	Approximately 0.14 ha saltmarsh habitat is located in the Waiwhetu downstream of the Seaview Road Bridge; low condition rating in 2012. Salt-marsh and sea-grass habitat in virtually absent in the Hutt River	Not known
Invertebrates	Invertebrate communities are resilient and their structure, composition and diversity are balanced	The benthic invertebrate fauna in the Waiwhetu Estuary is dominated by tolerant species including gastropods, polychaetes and oligochaetes. Crustacean, nemerteans, nemotodes and fly larvae were also present but in low numbers. These species live predominantly in a relatively clean layer of oxygenated surface mud overlaying anoxic sediments. Sub-tidal biota in the Hutt Estuary near the proposed outfall are sparsely distributed and of low ecological value due to frequent disturbance by flood flows, sediment deposition and dredging activity. Intertidal benthos along the seawall is typical of that occurring elsewhere in the Harbour.	High water column ammonia concentrations are potentially toxic to benthic invertebrates, especially those in the immediate vicinity of the outfall. Longer duration discharges of up to six weeks may adversely affect the composition and diversity of the benthic invertebrate community along the true right bank of the Hutt River near the Waiwhetu confluence.
Mahinga kai species	Mahinga kai species, including taonga species, are present in quantities, sizes and of a quality that is appropriate for the area	Mahinga kai species are sparsely distributed in the Waiwhetu & Hutt estuaries and are not suitable for human consumption due to the presence of microbiological and other contaminants.	The discharge is likely to increase the risk of microbiological contamination in filter feeding shellfish, however due to very limited distribution of mahinga kai species in the vicinity the risk of adverse effects is low to moderate.
Fish	Indigenous fish communities are resilient and their structure, composition and diversity are balanced	Indigenous fish communities may be limited In Waiwhetu Stream by a scarcity of suitable spawning and adult habitat. The Hutt River channel is important for fish passage between harbour and river. The western mudflat embayment is an important nursery area for juvenile sand flounder	High water column ammonia concentrations are potentially toxic to fish, especially those resident along true right bank of the Hutt River near the Waiwhetu confluence. Longer duration discharges of up to six weeks may adversely affect the composition and diversity of the fish community in this reach.
Sedimentation rate	The sedimentation rate is within an acceptable range of that expected under natural conditions	Sediments in Waiwhetu Stream are dominated by a mix of cobble, gravel and sand; very good condition rating in 2012. Sedimentation rate in the Hutt Estuary shows slight erosion (due to dredging)	Negligible
Mud content	The mud content and areal extent of soft mud habitats is within a range of that found under natural conditions	Soft mud not present inter-tidally, but present sub-tidally	Negligible

Table 4-4: Option 2: Discharge to Hutt River near Waiwhetu Stream mouth. Predicted contaminant concentrations in Waiwhetu Stream, Hutt River and at Wellington Harbour bathing beaches during dry weather maintenance discharges; Cycle C (exceedance of recommended guideline values is indicated by pink shading; non-compliance with the NPS-freshwater national bottom line is indicated by red shading).

Constituent	*Treated wastewater concentration (95%ile)*	*Background concentration at:*			*Predicted receiving water concentration at:*								*ANZECC (2000)*		*National Bottom Line*
		Waiwhetu Stream	*Hutt River*	*Wellington Harbour*	*Waiwhetu lower*	*Hutt River 100m DS Waiwhetu*	*Hutt River 100m DS Barnes S.*	*Hutt River at Waione St Bridge*	*Petone Beach west (site 1)*	*Petone Beach east (site 2)*	*Lowry Bay (site 5)*	*Days Bay (site 6)*	Marine	Freshwater	*Freshwater (Waiwhetu)*
5%ile dilution	-	-	-	-	5	5	25	37	775	1036	522	421			
BOD5	13.9	1	0.5	0.5	3.2	2.7	1.0	0.9	0.5	0.5	0.5	0.5			
TSS	13.8	9.5	9.0	9.0	10.2	9.8	9.2	9.1	9.006	9.005	9.009	9.011			
NNN	0.467	0.185	0.160	0.005	0.232	0.211	0.172	0.168	0.006	0.005	0.006	0.006		0.444	Annual 95th%ile <9.8
Ammonia-N	30	0.075	0.01	0.01	5.063	5.008	1.163	0.799	0.049	0.039	0.067	0.081	0.910	0.900	Max 2.2
TP	7.29	0.041	0.009	0.015	1.249	1.223	0.289	0.201	0.024	0.022	0.029	0.032		0.033	
DRP	2.74	0.021	0.005	0.005	0.474	0.461	0.110	0.077	0.009	0.008	0.010	0.011		0.01	
E. coli	3991	240	100	10	865	749	250	202	15	14	18	19	260	260	Annual median <1000
arsenic	0.003	0.0005	0.0005	0.0015	0.0009	0.0009	0.0006	0.0006	0.0015	0.0015	0.0015	0.0015	0.013	0.013	
cadmium	<0.001	0.0001	0.00025	0.00005	0.0002	0.0003	0.0003	0.0003	0.0001	0.0001	0.0001	0.0001	0.0007	0.0002	
chromium	0.01	0.0005	0.00025	0.0005	0.0021	0.0019	0.0006	0.0005	0.0005	0.0005	0.0005	0.0005	0.0044	0.0010	
copper	0.01	0.0013	0.0011	0.00005	0.0028	0.0026	0.0014	0.0013	0.0001	0.0001	0.0001	0.0001	0.0010	0.0014	
lead	0.012	0.00025	0.00005	0.00005	0.0022	0.0020	0.0005	0.0004	0.0001	0.0001	0.0001	0.0001	0.0044	0.0034	
mercury	0.0007	0.00025	0.0001	0.0000006	0.0003	0.0002	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0004	0.0006	
nickel	0.01	0.00025	0.00025	0.00033	0.0019	0.0019	0.0006	0.0005	0.0003	0.0003	0.0003	0.0004	0.007	0.011	
zinc	0.027	0.015	0.0018	0.000078	0.0170	0.0060	0.0028	0.0025	0.0001	0.0001	0.0001	0.0001	0.015	0.008	

4.3 Hutt River 100m off-shore of Barnes Street: *Option 3*

4.3.1 Description

Mabin et al (2016) considered a sub-option of connecting the Option 3 alternative outfall to the existing pump station, but concluded that it is not viable. Accordingly it is assumed that a new pump station is required, which would accommodate both MOP off-line flows and wet weather overflows.

The existing Waiwhetu Stream outfall would be retained for emergencies only.

4.3.2 Assessment Criteria

The Coastal Marine Boundary at the Hutt River mouth is at the seaward edge of the Waione Street (Estuary) Bridge. Outfall Option 3 is therefore located within the CMA and is managed under the Wellington Regional Coastal Plan and the Proposed Natural Resources Plan for the Wellington Region, as well as The New Zealand Coastal Policy Statement. The relevant assessment criteria are set out in Appendix C.

It is assumed that the maximum duration of any discharge would be six weeks in the period between 5 May and 5 July, and no more than 2 weeks at any other time.

4.3.3 Outfall Location

Figure 4-3: Location of Seaview wastewater outfall option 3

4.3.4 Potential Effects of Discharge to Hutt River off Barnes Street

Predicted receiving water contaminant concentrations from MOP offline discharges via a new outfall located at the mouth of the Hutt River 100m off-shore from the end of Barnes Street are summarised in Table 4-3. The outfall would be located at a water depth varying between 1.3m and 3m, depending on the tide. Being located 460m from the mouth of Waiwhetu Stream the discharge plume is unlikely to be pushed into the stream on the flood tide except in a very dilute form. Option 3 will not cause any exceedance of the national bottom line values specified in the **NPS-Freshwater**. The worst case prediction for the lower reaches of Waiwhetu Stream is for a marginal exceedance of ANZECC (2000) trigger values for ammonia and copper, as well as moderately elevated phosphorus and indicator bacteria concentrations, however such events are expected to be very infrequent and short-lived, occurring only when the discharge plume is carried into Waiwhetu Stream on the flood tide. Option 3 would represent a marked reduction in the risk of adverse effects within Waiwhetu Stream, such that occasional discharges via the Option 3 outfall are unlikely to contribute to Objective O25 of the **Proposed Natural Resources Plan** not being met within Waiwhetu Stream.

A 12-fold dilution is predicted in Hutt River at the edge of a 100m radius mixing zone, i.e., at the Port Road shoreline, during the mid-ebb tide, which is very similar to the 15-fold dilution measured at this location during the dye study. Minimum dilutions are expected to be lower at slack tide but modelling predictions could not be obtained for those conditions. The worst case assessment for the Hutt River intertidal zone near the end of Barnes Street is that trigger values for nitrate-N, TP, DRP, ammonia and copper would be exceeded when the plume moves towards the shore, however this may be an infrequent occurrence, limited to periods of slack tide, as the primary plume direction is expected to be along the river and parallel with the shoreline. Based on predicted dilutions, the effect of discharges on intertidal habitats of the Hutt River would be little different than those that occur under the current discharge regime. The assessment provided in Table 4-6 indicates that occasional discharges via outfall Option 3 would meet the management objectives of O25 most of the time.

This option would have a low to moderate effect on the microbiological water quality at Petone Beach, Lowry Bay and Days Bay and would largely be consistent with O24 of the **Proposed Natural Resources Plan** which seeks to ensure that coastal waters are suitable for contact recreation and Maori customary use.

GWRC, Flood Protection, following a preliminary discussion about the outfall options, has indicated that it would oppose construction of a new outfall into the middle of the Hutt River channel (specifically option 3) for the following reasons:

- The associated hydraulic problems with having a structure fixed in the bed at the mouth;
- The impact that it may have on the existing sediment extraction operation both in terms of it being an obstacle and also in terms of contamination of the sediment;
- The impact it would have on navigation (harbour operations);
- The impact it would have on the aspiration for the area to have a high amenity value (this is an ongoing consideration with future changes in the use of the area).

Table 4-3: Option 3: Discharge to Hutt River 100m off Barnes Street. Predicted contaminant concentrations in Waiwhetu Stream, Hutt River and at Wellington Harbour bathing beaches during dry weather maintenance discharges; Cycle C (exceedance of recommended guideline values is indicated by pink shading; non-compliance with the NPS-freshwater national bottom line is indicated by red shading)

Constituent	*Treated wastewater concentration (95%ile)*	*Background concentration at:*			*Predicted receiving water concentration at:*								*ANZECC (2000)*		*National Bottom Line*
		Waiwhetu Stream	*Hutt River*	*Wellington Harbour*	*Waiwhetu lower*	*Hutt River 100m DS Waiwhetu*	*Hutt River 100m DS Barnes S.*	*Hutt River at Waione St Bridge*	*Petone Beach west (site 1)*	*Petone Beach east (site 2)*	*Lowry Bay (site 5)*	*Days Bay (site 6)*			*Freshwater (Waiwhetu)*
5%ile dilution	-	-	-	-	35	25	12	37	775	1036	522	421	Marine	Freshwater	
BOD5	13.9	1	0.5	0.5	1.4	1.0	1.5	0.9	0.5	0.5	0.5	0.5			
TSS	13.8	9.5	9	9	9.6	9.2	9.4	9.1	9.006	9.005	9.009	9.011			
NNN*	0.467	0.185	0.160	0.005	0.193	0.172	0.184	0.168	0.006	0.005	0.006	0.006		0.444	Annual 95th%ile 9.8
Ammonia-N	30	0.075	0.01	0.01	0.906	1.163	2.317	0.799	0.049	0.039	0.067	0.081	0.910	0.900	Max 2.2
TP	7.29	0.041	0.009	0.015	0.242	0.289	0.569	0.201	0.024	0.022	0.029	0.032		0.033	
DRP	2.74	0.021	0.005	0.005	0.097	0.110	0.215	0.077	0.009	0.008	0.010	0.011		0.01	
E. coli	3991	240	100	10	344	250	399	202	15	14	18	19	260	260	Annual median 1000
arsenic	0.003	0.0005	0.0005	0.0015	0.0006	0.0006	0.0007	0.0006	0.0015	0.0015	0.0015	0.0015	0.013	0.013	
cadmium	0.0005	0.0001	0.00025	0.00005	0.0001	0.0003	0.0003	0.0003	0.0001	0.0001	0.0001	0.0001	0.0007	0.0002	
chromium	0.01	0.0005	0.00025	0.0005	0.0008	0.0006	0.0010	0.0005	0.0005	0.0005	0.0005	0.0005	0.0044	0.0010	
copper	0.01	0.0013	0.0011	0.00005	0.0015	0.0014	0.0018	0.0013	0.0001	0.0001	0.0001	0.0001	0.0010	0.0014	
lead	0.012	0.00025	0.00005	0.00005	0.0006	0.0005	0.0010	0.0004	0.0001	0.0001	0.0001	0.0001	0.0044	0.0034	
mercury	0.0007	0.00025	0.0001	0.0000006	0.0003	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0004	0.0006	
nickel	0.01	0.00025	0.00025	0.00033	0.0005	0.0006	0.0010	0.0005	0.0003	0.0003	0.0003	0.0004	0.007	0.011	
zinc	0.027	0.015	0.0018	0.000078	0.0153	0.0028	0.0037	0.0025	0.0001	0.0001	0.0001	0.0001	0.015	0.008	

Table 4-4: Assessment of Option 3 against PNRP Objective O25 criteria, Hutt Estuary (low to medium adverse effects are indicated by pink shading, high adverse effects are shaded red)

Ecological component	O25 criteria (Table 3.8 – estuaries)	Current State Hutt Estuary	Likely Effects
Macroalgae	The algae community is balanced with a low frequency of nuisance blooms	Nuisance conditions not widespread	Low to moderate for short duration discharges of less than two weeks, or for discharges of up to six weeks duration during the winter period.
Seagrass and saltmarsh	Seagrass, saltmarsh and brackish water submerged macrophytes are resilient and diverse and their cover is sufficient to support invertebrate and fish communities	No sea-grass or saltmarsh habitat in this area	Nil
Invertebrates	Invertebrate communities are resilient and their structure, composition and diversity are balanced	Sub-tidal biota are sparsely distributed at the proposed outfall location due to dredging activity. Intertidal benthos along the seawall is typical of that occurring elsewhere in Wellington Harbour	Slight increase in the risk of ammonia toxicity in intertidal habitats along the Port Road shoreline at slack tide and under onshore wind conditions.
Mahinga kai species	Mahinga kai species, including taonga species, are present in quantities, sizes and of a quality that is appropriate for the area	Mahinga kai species are sparsely distributed in the Hutt Estuary and are not suitable for human consumption due to the presence of microbiological and other contaminants.	The discharge is likely to increase the risk of microbiological contaminant in filter feeding shellfish, however due to very limited distribution in the vicinity the risk of adverse effects is low to moderate.
Fish	Indigenous fish communities are resilient and their structure, composition and diversity are balanced	The main river channel is important for fish passage between harbour and river. The western mudflat embayment is an important nursery area for juvenile sand flounder	Fish passage is not prevented while the discharge is operating (plume occupies only part of the channel). Negligible risk of adverse effects on nursery habitat within the western mudflat embayment which is well removed from the outfall location.
Sedimentation rate	The sedimentation rate is within an acceptable range of that expected under natural conditions	Sedimentation rate shows slight erosion (due to dredging)	Negligible
Mud content	The mud content and areal extent of soft mud habitats is within a range of that found under natural conditions	Sediments have >15-25% mud content indicating the estuary is susceptible to poor clarity and muddy intertidal substrates	Negligible

4.4 Wellington Harbour at Matiu/Somes: *Option 4*

4.4.1 Description

A new pumped overflow extending 4650m off Port Road into Wellington Harbour (2 km south of Matiu/Somes Island):

- accommodates MOP offline flows and wet weather overflows,
- existing Waiwhetu Stream outfall retained for emergencies only,
- requires a new pump station at Seaview WWTP,
- a possible MOP replacement in the future if the WWTP were upgraded to remove nutrients.

4.4.2 Assessment Criteria

Outfall Option 4 is located within the Coastal Marine Area (CMA) and is managed under the Wellington Regional Coastal Plan and the Proposed Natural Resources Plan for the Wellington Region, as well as The New Zealand Coastal Policy Statement. Relevant assessment criteria are set out in Appendix C.

It is assumed that the maximum duration of any discharge would be six weeks in the period between 5 May and 5 July, and no more than 2 weeks at any other time.

4.4.3 Location of Outfall

The location of Option 4 is shown in Figure 1-2.

4.4.4 Potential Effects of Discharge to Wellington Harbour

Predicted receiving water contaminant concentrations from discharges via a Wellington Harbour outfall located approximately 2000m south of Matiu/Somes Island (Option 4) are summarised in Table 4-7.

Option 4 discharges at a water depth of 20m approximately 3,200m west of Days Bay, 4,500m south-west of Lowry Bay and 5,500m south of Petone Beach. A 191-fold minimum dilution is predicted at the edge of a 100m radius mixing zone, increasing to 215-fold at median current speeds. Minimum dilutions exceed 1000-fold at Days Bay, Lowry Bay and Petone Beach. The worst case prediction for the edge of 100m mixing zone is for no exceedance of ANZECC (2000) toxicity trigger values but moderately elevated nutrient concentrations. The assessment provided in Table 4-8 indicates that both occasional short duration discharges and longer duration discharges would be consistent with the objective O25 of the **Proposed Natural Resources Plan.**

This option would have minimal effect on the microbiological water quality at Petone Beach, Lowry Bay and Days Bay and would therefore be consistent with O24 of the **Proposed Natural Resources Plan** which seeks to ensure that coastal waters are suitable for contact recreation and Maori customary use.

Table 4-5: Option 4: Discharge to Wellington Harbour. Predicted contaminant concentrations in Waiwhetu Stream, Hutt River and at Wellington Harbour bathing beaches during dry weather maintenance discharges; Cycle C (exceedance of recommended guideline values is indicated by pink shading; non-compliance with the NPS-freshwater national bottom line is indicated by red shading).

Constituent	*Treated wastewater concentration (95%ile)*	*Background concentration at:*			*Predicted receiving water concentration at:*								*ANZECC (2000)*		*National Bottom Line*
		Waiwhetu Stream	*Hutt River*	*Wellington Harbour*	*Waiwhetu 100m DS outfall*	*Hutt River 100m DS Waiwhetu*	*Hutt River 100m DS Barnes S.*	*Wellington Harbour 100m from outfall*	*Petone Beach west (site 1)*	*Petone Beach east (site 2)*	*Lowry Bay (site 5)*	*Days Bay (site 6)*			*Freshwater (Waiwhetu)*
5%ile dilution	-	-	-	-	1307	1307	1307	215	1264	1201	1099	1104	Marine	Freshwater	
BOD5	13.9	1	0.5	0.5	1.0	0.5	0.5	0.6	0.5	0.5	0.5	0.5			
TSS	13.8	9.5	9	9	9.5	9.0	9.0	9.0	9.0	9.0	9.0	9.0			
NNN	0.467	0.185	0.160	0.005	0.185	0.160	0.160	0.007	0.005	0.005	0.005	0.005		0.444	Annual 95th%ile 9.8
Ammonia-N	30	0.075	0.01	0.01	0.098	0.033	0.033	0.149	0.034	0.035	0.037	0.037	0.910	0.900	Max 2.2
TP	7.29	0.041	0.009	0.015	0.047	0.015	0.015	0.049	0.021	0.021	0.022	0.022		0.033	
DRP	2.74	0.021	0.005	0.005	0.023	0.007	0.007	0.018	0.007	0.007	0.007	0.007		0.01	
E. coli	3991	240	100	10	243	103	103	28	13	13	14	14	260	260	Annual median 1000
arsenic	0.003	0.0005	0.0005	0.0015	0.0005	0.0005	0.0005	0.0015	0.0015	0.0015	0.0015	0.0015	0.013	0.013	
cadmium	0.0005	0.0001	0.00025	0.00005	0.0001	0.0003	0.0003	0.0001	0.0001	0.0001	0.0001	0.0001	0.0007	0.0002	
chromium	0.01	0.0005	0.00025	0.0005	0.0005	0.0003	0.0003	0.0005	0.0005	0.0005	0.0005	0.0005	0.0044	0.001	
copper	0.01	0.0013	0.0011	0.00005	0.0013	0.0011	0.0011	0.0001	0.0001	0.0001	0.0001	0.0001	0.0010	0.0014	
lead	0.012	0.00025	0.00005	0.00005	0.0003	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0044	0.0034	
mercury	0.0007	0.00025	0.0001	0.0000006	0.0003	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0004	0.0006	
nickel	0.01	0.00025	0.00025	0.00033	0.0003	0.0003	0.0003	0.0004	0.0003	0.0003	0.0003	0.0003	0.007	0.011	
zinc	0.027	0.015	0.0018	0.000078	0.0150	0.0018	0.0018	0.0002	0.0001	0.0001	0.0001	0.0001	0.015	0.008	

*Note, as ANZECC (2000) does not provide nutrient trigger values for New Zealand estuarine or marine ecosystems the values shown are for south-east Australian estuarine waters.

Table 4-6: Assessment of Option 4 against PNRP Objective O25 criteria, Wellington Harbour

Ecological component	O25 criteria (Table 3.8 – coastal)	Current State Wellington Harbour	Likely Effects
Macroalgae	The algae community is balanced with a low frequency of nuisance blooms	Nuisance conditions not widespread	Negligible
Seagrass and saltmarsh	Seagrass, saltmarsh and brackish water submerged macrophytes are resilient and diverse and their cover is sufficient to support invertebrate and fish communities	No sea-grass or saltmarsh habitat in this area	Nil
Invertebrates	Invertebrate communities are resilient and their structure, composition and diversity are balanced	The distribution of sub-tidal benthic biota at the proposed outfall location in Wellington Harbour is not known.	Negligible
Mahinga kai species	Mahinga kai species, including taonga species, are present in quantities, sizes and of a quality that is appropriate for the area	Mahinga kai species are present along the rocky reefs along the eastern bays and around Somes/Matiu Island	Negligible
Fish	Indigenous fish communities are resilient and their structure, composition and diversity are balanced	Not known	Negligible
Sedimentation rate	The sedimentation rate is within an acceptable range of that expected under natural conditions	Not known	Negligible
Mud content	The mud content and areal extent of soft mud habitats is within a range of that found under natural conditions	Not known	Negligible

4.5 Wellington Harbour 100m off Port Road Corner: *Option 5*

4.5.1 Description

A new pumped pipeline, extending approximately 100m from the Port Road corner into Wellington Harbour, west of the Point Howard Wharf, at a water depth of approximately 2-4m. This option:

- accommodates MOP offline flows and wet weather overflows
- would result in the existing Waiwhetu Stream outfall being retained for emergencies only
- requires a new pump station at Seaview WWTP and 1,380m of pumped pipeline
- could be the first stage of a replacement MOP pipeline to Bluff Point in Cook Strait.

4.5.2 Assessment Criteria

Outfall Option 5 is located within Coastal Marine Area (CMA) and is managed under the Wellington Regional Coastal Plan and the Proposed Natural Resources Plan for the Wellington Region, as well as The New Zealand Coastal Policy Statement. Relevant assessment criteria are set out in Appendix C.

It is assumed that the maximum duration of any discharge would be six weeks in the period between 5 May and 5 July, and no more than 2 weeks at any other time.

4.5.3 Outfall Location

Figure 4-4: Location of Seaview wastewater outfall option 5

4.5.4 Potential Effects of Discharge at mouth of the Hutt River

Predicted receiving water contaminant concentrations from MOP offline discharges via a new outfall located at the mouth of the Hutt River, extending 100m off-shore from the Port Road corner are summarised in Table 4-7. The outfall would be located at a water depth varying between approximately 2 and 4m depending on the tide. Being located 1,100m from the mouth of Waiwhetu Stream the discharge plume is unlikely to enter the stream except in a very dilute form and is therefore unlikely to have any effect on stream water quality, or cause an exceedance of the national bottom line values specified in the **NPS-Freshwater,** or contribute to Objective O25 of the **Proposed Natural Resources Plan** not being met within Waiwhetu Stream (Table 4-8).

A 3-fold minimum dilution is predicted at the edge of a 100m radius mixing zone increasing to 10-fold at median current speeds. The poor mixing efficiency at this location is due to the combination of shallow water and low current velocities. The worst case assessment for the Port Road shoreline is under southerly conditions at slack water when the plume is pushed towards the shore, resulting in elevated

nutrient concentrations (nitrate-N, ammonia-N, TP, DRP) in intertidal habitats. On those occasions ammonia may also exceed toxicity guidelines at the Port Road shoreline, however this would be an infrequent occurrence as the primary plume direction is out into the harbour and away from the shoreline. The assessment provided in Table 4-10 indicates that occasional discharges via outfall Option 5 would meet the management objectives of O25 most of the time.

This option would have a low to moderate effect on the microbiological water quality at Petone Beach, Lowry Bay and Days Bay and would largely be consistent with O24 of the **Proposed Natural Resources Plan** which seeks to ensure that coastal waters are suitable for contact recreation and Maori customary use.

Table 4-7: Option 5: Discharge to Wellington Harbour at the Hutt River mouth. Predicted contaminant concentrations in Waiwhetu Stream, Hutt River and at Wellington Harbour bathing beaches during dry weather maintenance discharges; Cycle C (exceedance of recommended guideline values is indicated by pink shading; non-compliance with the NPS-freshwater national bottom line is indicated by red shading).

Constituent	*Treated wastewater concentration (95%ile)*	*Background concentration at:*			*Predicted receiving water concentration at:*								*ANZECC (2000)*		*National Bottom Line Freshwater (Waiwhetu)*
		Waiwhetu Stream	*Hutt River*	*Wellington Harbour*	*Waiwhetu lower*	*Hutt River 100m DS Waiwhetu*	*Hutt River 100m DS Barnes S.*	*Wellington Harbour off Port Rd Corner 100m from outfall*	*Petone Beach west (site 1)*	*Petone Beach east (site 2)*	*Lowry Bay (site 5)*	*Days Bay (site 6)*			
5%ile dilution**	-				671	666	660	10	1020	1201	810	763	Marine	Freshwater	
BOD5	13.9	1	0.5	0.5	1.0	0.5	0.5	1.7	0.5	0.5	0.5	0.5			
TSS	13.8	9.5	9	9	9.5	9.0	9.0	9.4	9.0	9.0	9.0	9.0			
NNN	0.467	0.185	0.160	0.005	0.185	0.160	0.160	0.047	0.005	0.005	0.006	0.006		0.444	Annual 95th%ile 9.8
Ammonia-N	30	0.075	0.01	0.01	0.120	0.055	0.055	2.736	0.039	0.035	0.047	0.049	0.910	0.900	Max 2.2
TP	7.29	0.041	0.009	0.015	0.052	0.020	0.020	0.676	0.022	0.021	0.024	0.025		0.033	
DRP	2.74	0.021	0.005	0.005	0.025	0.009	0.009	0.254	0.008	0.007	0.008	0.009		0.01	
E. coli	3991	240	100	10	246	106	106	372	14	13	15	15	260	260	Annual median 1000
arsenic	0.003	0.0005	0.0005	0.0015	0.0005	0.0005	0.0005	0.0016	0.0015	0.0015	0.0015	0.0015	0.013	0.013	
cadmium	0.0005	0.0001	0.00025	0.00005	0.0001	0.0003	0.0003	0.0001	0.0001	0.0001	0.0001	0.0001	0.0007	0.0002	
chromium	0.01	0.0005	0.00025	0.0005	0.0005	0.0003	0.0003	0.0014	0.0005	0.0005	0.0005	0.0005	0.0044	0.001	
copper	0.01	0.0013	0.0011	0.00005	0.0013	0.0011	0.0011	0.0010	0.0001	0.0001	0.0001	0.0001	0.0010	0.0014	
lead	0.012	0.00025	0.00005	0.00005	0.0003	0.0001	0.0001	0.0011	0.0001	0.0001	0.0001	0.0001	0.0044	0.0034	
mercury	0.0007	0.00025	0.0001	0.0000006	0.0003	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0004	0.0006	
nickel	0.01	0.00025	0.00025	0.00033	0.0003	0.0003	0.0003	0.0012	0.0003	0.0003	0.0003	0.0003	0.007	0.011	
zinc	0.027	0.015	0.0018	0.000078	0.0150	0.0018	0.0018	0.0025	0.0001	0.0001	0.0001	0.0001	0.015	0.008	

Note, as far field modelling has not yet been undertaken for Option 5, interim 5%ile values are taken as the average of the 5%ile values Options 3 and 4.

Table 4-8: Assessment of Option 5 against PNRP Objective O25 criteria, Hutt River Mouth

Ecological component	O25 criteria (Table 3.8 – coastal)	Current State Hutt River Mouth	Likely Effects
Macroalgae	The algae community is balanced with a low frequency of nuisance blooms	Nuisance conditions not widespread	Low to moderate for short duration discharges of less than two weeks, or for discharges of up to six weeks duration provided they avoid the spring and summer growth season.
Seagrass and saltmarsh	Seagrass, saltmarsh and brackish water submerged macrophytes are resilient and diverse and their cover is sufficient to support invertebrate and fish communities	No sea-grass or saltmarsh habitat in this area	Nil
Invertebrates	Invertebrate communities are resilient and their structure, composition and diversity are balanced	Sub-tidal biota are sparsely distributed at the Hutt River mouth due to sediment deposition and dredging activity. Intertidal benthos along the seawall is typical of that occurring elsewhere in Wellington Harbour	Low to moderate increase in the risk of ammonia toxicity in intertidal habitats along the Port Road shoreline under some weather conditions.
Mahinga kai species	Mahinga kai species, including taonga species, are present in quantities, sizes and of a quality that is appropriate for the area	Mahinga kai species are sparsely distributed in the Hutt Estuary and are not suitable for human consumption due to the presence of microbiological and other contaminants.	Risk of microbiological contamination in filter feeding shellfish may be increased slightly, however the impact on Mahinga kai species is low due to the very limited resource in the vicinity.
Fish	Indigenous fish communities are resilient and their structure, composition and diversity are balanced	The main river channel is important for fish passage between harbour and river. The western mudflat embayment is an important nursery area for juvenile sand flounder	Negligible risk of adverse effects on fish migrations into the Hutt River or on nursery habitat within the western mudflat embayment which is well removed from the outfall location.
Sedimentation rate	The sedimentation rate is within an acceptable range of that expected under natural conditions	Sedimentation rate shows slight erosion (due to dredging)	Negligible
Mud content	The mud content and areal extent of soft mud habitats is within a range of that found under natural conditions	Sediments have >15-25% mud content indicating the estuary is susceptible to poor clarity and muddy intertidal substrates	Negligible

4.6 Wellington Harbour 600m off Port Road Corner: *Option 6*

4.6.1 Description

A new pumped pipeline, extending approximately 600m from the Port Road corner into Wellington Harbour, west of the Point Howard Wharf, at a water depth of approximately 10m. This option:

- accommodates MOP offline flows and wet weather overflows,
- would result in the existing Waiwhetu Stream outfall being retained for emergencies only,
- requires a new pump station at Seaview WWTP and 1880m of pumped pipeline, and
- could be the first stage of a replacement MOP pipeline to Bluff Point in Cook Strait.

4.6.2 Assessment Criteria

Outfall Option 6 is located within Coastal Marine Area (CMA) and is managed under the Wellington Regional Coastal Plan and the Proposed Natural Resources Plan for the Wellington Region, as well as The New Zealand Coastal Policy Statement. Relevant assessment criteria are set out in Appendix C.

It is assumed that the maximum duration of any discharge would be six weeks in the period between 5 May and 5 July, and no more than 2 weeks at any other time.

4.6.3 Outfall Location

Figure 4-5: Location of Seaview wastewater outfall option 6

4.6.4 Potential Effects of Discharge near mouth of the Hutt River

Predicted receiving water contaminant concentrations from MOP offline discharges via a new outfall located in Wellington Harbour and extending 600m off-shore from the Port Road corner are summarised in Table 4-9. The outfall would be located at a water depth of 10m, approximately 1,600m south of the Waiwhetu Stream mouth, 400m west of the entrance to the Seaview Marina and 330m north-west of the Point Howard Wharf. The discharge plume would be unlikely to have any influence on water quality or aquatic ecology of Waiwhetu Stream, or to cause any exceedance of the national bottom line values specified in the **NPS-Freshwater.** Nor would it contribute to Objective O25 of the **Proposed Natural Resources Plan** not being met within Waiwhetu Stream.

A 93-fold minimum dilution is predicted at the edge of a 100m radius mixing zone in Wellington Harbour, increasing to 177-fold at median current speeds. This represents significantly improved mixing efficiency compared with Option 5. The worst case assessment for the edge of a 100m radius mixing zone around the outfall diffuser is for moderately elevated nutrient concentrations (nitrate-N, ammonia-N, TP, DRP) locally, but with a low risk of adverse effects in intertidal habitats on the Port Road shoreline, the Seaview Marina seawall or Point Howard Wharf due to the separation achieved by the longer outfall length. The assessment provided in Table 4-10 indicates that both occasional short

duration discharges and longer duration discharges would be consistent with the management objectives of O25.

This option would have minimal effect on the microbiological water quality at Petone Beach, Lowry Bay and Days Bay and would therefore be consistent with O24 of the **Proposed Natural Resources Plan** which seeks to ensure that coastal waters are suitable for contact recreation and Maori customary use.

Table 4-9: Option 6: Discharge to Wellington Harbour 600m off Port Road Corner. Predicted contaminant concentrations in Waiwhetu Stream, Hutt River and at Wellington Harbour bathing beaches during dry weather maintenance discharges; Cycle C (exceedance of recommended guideline values is indicated by pink shading; non-compliance with the NPS-freshwater national bottom line is indicated by red shading).

Constituent	*Treated wastewater concentration (95%ile)*	*Background concentration at:*			*Predicted receiving water concentration at:*								*ANZECC (2000)*		*National Bottom Line NPS-Freshwater (Waiwhetu)*
		Waiwhetu Stream	*Hutt River*	*Wellington Harbour*	*Waiwhetu lower*	*Hutt River 100m DS Waiwhetu*	*Hutt River 100m DS Barnes S.*	*Wellington Harbour at Hutt River mouth 100m from outfall*	*Petone Beach west (site 1)*	*Petone Beach east (site 2)*	*Lowry Bay (site 5)*	*Days Bay (site 6)*			
5%ile dilution**	-				671	666	660	177	1020	1201	810	763	Marine	Freshwater	
BOD5	13.9	1	0.5	0.5	1.0	0.5	0.5	0.6	0.5	0.5	0.5	0.5			
TSS	13.8	9.5	9	9	9.5	9.0	9.0	9.03	9.0	9.0	9.0	9.0			
NNN	0.467	0.185	0.160	0.005	0.185	0.160	0.160	0.008	0.005	0.005	0.006	0.006		0.444	Annual 95th%ile 9.8
Ammonia-N	30	0.075	0.01	0.01	0.120	0.055	0.055	0.179	0.039	0.035	0.047	0.049	0.910	0.900	Max 2.2
TP	7.29	0.041	0.009	0.015	0.052	0.020	0.020	0.056	0.022	0.021	0.024	0.025		0.033	
DRP	2.74	0.021	0.005	0.005	0.025	0.009	0.009	0.020	0.008	0.007	0.008	0.009		0.01	
E. coli	3991	240	100	10	246	106	106	32	14	13	15	15	260	260	Annual median 1000
arsenic	0.003	0.0005	0.0005	0.0015	0.0005	0.0005	0.0005	0.0015	0.0015	0.0015	0.0015	0.0015	0.013	0.013	
cadmium	0.0005	0.0001	0.00025	0.00005	0.0001	0.0003	0.0003	0.0001	0.0001	0.0001	0.0001	0.0001	0.0007	0.0002	
chromium	0.01	0.0005	0.00025	0.0005	0.0005	0.0003	0.0003	0.0006	0.0005	0.0005	0.0005	0.0005	0.0044	0.001	
copper	0.01	0.0013	0.0011	0.00005	0.0013	0.0011	0.0011	0.0001	0.0001	0.0001	0.0001	0.0001	0.0010	0.0014	
lead	0.012	0.00025	0.00005	0.00005	0.0003	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0044	0.0034	
mercury	0.0007	0.00025	0.0001	0.0000006	0.0003	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0004	0.0006	
nickel	0.01	0.00025	0.00025	0.00033	0.0003	0.0003	0.0003	0.0004	0.0003	0.0003	0.0003	0.0003	0.007	0.011	
zinc	0.027	0.015	0.0018	0.000078	0.0150	0.0018	0.0018	0.0002	0.0001	0.0001	0.0001	0.0001	0.015	0.008	

Note, as far field modelling has not yet been undertaken for Option 6, interim 5%ile values are taken as the average of the 5%ile values Options 3 and 4.

Table 4-10: Assessment of Option 6 against PNRP Objective O25 criteria, Wellington Harbour

Ecological component	O25 criteria (Table 3.8 – coastal)	Current State Hutt River Mouth/Wellington Harbour	Likely Effects
Macroalgae	The algae community is balanced with a low frequency of nuisance blooms	Nuisance conditions not widespread	Negligible
Seagrass and saltmarsh	Seagrass, saltmarsh and brackish water submerged macrophytes are resilient and diverse and their cover is sufficient to support invertebrate and fish communities	No sea-grass or saltmarsh habitat in this area	Nil
Invertebrates	Invertebrate communities are resilient and their structure, composition and diversity are balanced	Sub-tidal biota are sparsely distributed at the Hutt River mouth due to sediment deposition and dredging activity. Intertidal benthos along the seawall is typical of that occurring elsewhere in Wellington Harbour	Negligible
Mahinga kai species	Mahinga kai species, including taonga species, are present in quantities, sizes and of a quality that is appropriate for the area	Mahinga kai species are sparsely distributed in the Hutt Estuary and are not suitable for human consumption due to the presence of microbiological and other contaminants.	Negligible
Fish	Indigenous fish communities are resilient and their structure, composition and diversity are balanced	The main river channel is important for fish passage between harbour and river. The western mudflat embayment is an important nursery area for juvenile sand flounder	Negligible
Sedimentation rate	The sedimentation rate is within an acceptable range of that expected under natural conditions	Sedimentation rate shows slight erosion (due to dredging)	Negligible
Mud content	The mud content and areal extent of soft mud habitats is within a range of that found under natural conditions	Sediments have >15-25% mud content indicating the estuary is susceptible to poor clarity and muddy intertidal substrates	Negligible

5 Summary and Conclusion

Neither Option 1 nor 2 would meet the NPS-Freshwater 'national bottom line' in respect of ammonia, and both would contribute to Objective O25 of the Proposed Natural Resources Plan not being achieved. Our conclusion is that neither option is sustainable beyond the short term.

Options 3 and 5 have a low to moderate risk of causing adverse effects in the receiving environment. Both would largely comply with relevant environmental assessment criteria, provided that the maximum duration of any discharge does not exceeds six weeks in the period between 5 May and 5 July, or 2 weeks at any other time. A significant constraint for option 3 is that it would be located within the GWRC dredging area, and GWRC have indicated they would oppose a new structure at this location.

Options 4 and 6 would both comfortably achieve the assessment criteria and have a low risk of causing adverse effects. Option 4 is the highest cost option with the largest construction footprint, requiring a new pump station and 5700m of new pumped pipeline. Option 6 has a lower cost and smaller footprint than Option 4, with the additional benefit that it could be designed as the first stage of a replacement MOP to Bluff Point in Cook Strait.

Table 5-1: Option assessment summary

Option	Location	Engineering Issues	Environmental Effects/Assessment Criteria	Cost estimates
1	Waiwhetu Stream (existing outfall)	None	Contrary to NPS-freshwater and Regional Plan (existing and proposed) criteria. Not sustainable beyond short term.	N/A
2	Hutt River near Waiwhetu	Accommodates MOP offline flows and wet weather overflows. Outfall structure only partly submerged	Contrary to NPS-freshwater and Regional Plan (existing and proposed) criteria. Not sustainable beyond short term.	$3.2M
3	Hutt River 100m offshore of Barnes St	Accommodates all flows but requires a new pump station and 1050m pumped pipeline. Outfall structure would be located within the GWRC FP dredging area. GWRC are opposed to a new structure at this location.	Meets assessment criteria most of the time and has a low to moderate risk of causing adverse effects in the receiving environment.	$18M
4	Wellington Harbour near Matiu/ Somes	Requires new pump station and 5700m pumped pipeline. Not on ideal alignment for replacement of MOP pipeline to Bluff Point, but could potentially provide an alternative outfall location to Bluff Point (i.e., a harbour outfall, if WWTP were upgraded).	Meets all assessment criteria and has low risk of causing adverse effects in the receiving environment.	$59.3M – $68.7M
5	Wellington Harbour at Hutt River mouth, 100m offshore of Port Road	Requires new pump station and 1380m pumped pipeline but is located outside of the GWRC FP dredging area and could potentially form the first stage of a future replacement MOP pipeline to Bluff Point	Meets assessment criteria most of the time and has a low to moderate risk of causing adverse effects in the receiving environment.	$23.5M
6	Wellington Harbour at Hutt River mouth, 600m offshore of Port Road	Requires new pump station and 1880m pumped pipeline but is located outside of the GWRC FP dredging area and could potentially form the first stage of a future replacement MOP pipeline to Bluff Point	Meets all assessment criteria and has a low risk of causing adverse effects in the receiving environment.	$31M

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Appendices

Appendix A Overflow Option Comparison 2012

Option	Description	Outcome	Engineering		Rough Order Cost (2012)
			New Assets	Comments/Issues – hydraulic complexity, engineering constructability, future proof compatibility	
1	Extend outfall to Hutt River bank	- Accommodates wet weather overflow and Main Outfall Pipeline (MOP) off-line flows in all but extreme conditions (e.g. Q20 storm)	- 380m x 375mm dia stormwater pipe - 160m x 1350mm dia overflow extension - Diversion chamber and manual valve - Headwall structure	- Separate stormwater from overflow - Pressurise existing overflow pipe - Manual valve for emergency or extreme wet weather discharge to Waiwhetu Stream when MOP off-line - High groundwater table during construction - Outlet headwall only partially submerged. Treated effluent would flow across river flat at low tide - Within area GWRC do not dredge (but are consented to)	$1.7M
2a	Extend outfall 20m into Hutt River	- Accommodates wet weather overflow and MOP off-line flows in all but extreme conditions (e.g. Q20 storm)	- 380m x 375mm dia stormwater pipe - 190m x 1600mm dia overflow extension - Diversion chamber and automatic valve - Outfall structure	- Separate stormwater from overflow - Pressurise existing overflow pipeline - Automated valve for emergency or extreme wet weather discharge to Waiwhetu Stream when MOP off-line - High groundwater table during construction - 30m of construction in estuary environment - Outfall structure only partially submerged - Within area GWRC do not dredge (but are consented to)	$2.6M
2b	New pipeline from Main Pump Station (MPS) and extend outfall 20m into Hutt River	- Accommodates wet weather overflow and MOP off-line flows	- 330m x 1350mm dia overflow duplication - 170m x 1600mm dia overflow extension - Outfall structure	- Existing pipeline would remain for stormwater - Some construction through private property - High groundwater table during construction - 30m of construction in estuary environment - Outfall structure around pipe only partially submerged - Within area GWRC do not dredge (but are consented to)	$3.6M
3	Diversion from existing MOP along Barnes Street into Hutt River	- Accommodates MOP off-line flows only - Wet weather overflow would remain in Waiwhetu Stream	- 810m x 1350mm dia pumped overflow - Diversion chamber on MOP including fittings - Air break structure	- Could not be sized for full $3m^3/s$ flow without major upgrade to existing MPS - Overflow into Waiwhetu Stream required while construction of diversion on the MOP - Conflicts with GWRC flood protection dredging area	$7.4M

Option	Description	Outcome	Engineering		Rough Order Cost (2012)
			New Assets	Comments/Issues – hydraulic complexity, engineering constructability, future proof compatibility	
4a	New pumped overflow extended 100m off Barnes Street into Hutt River	- Accommodates wet weather overflow and MOP off-line flows	- New pump station - 1050m pumped overflow pipe - Air break structure	- Would be used for wet weather overflows - Existing Waiwhetu overflow to remain for emergency use only - New pump station at WWTP - Would allow for upgrade works to MOP - Conflicts with GWRC flood protection dredging area	$14.9M
4c	New pumped overflow extended 4650m off Port Road into harbour (2km south of Matiu Island)	- Suitable for wet weather overflows and planned discharge	- New pump station - 5700m pumped overflow pipe - Air break structure	- Would be used for wet weather overflows - Existing Waiwhetu overflow to remain for emergency use only - New pump station at WWTP - Possible MOP replacement if additional treatment undertaken at WWTP	$56.2M
5	Additional 5,000m^3 storage at Seaview site (total 10ML)	- Would reduce frequency and volume of wet weather overflows - Would allow additional flow to be released on the outgoing tide	- New 5ML storm tank - New pump station	- Ground remediation works required - New pump station at WWTP	$6.8M
6	Further 5,000m^3 storage at Seaview site (total 15ML)	- Would reduce frequency and volume of wet weather overflows - Would allow all dry weather flow to be released on the outgoing tide	- New 5ML storm tank - New pump station	- Ground remediation works required - New pump station at WWTP	$3M
7	Do Nothing				

Appendix B Assessment Criteria - Freshwater

Assessment Criteria - Freshwater

The Wellington Regional Freshwater Plan (WRFP) states that the Waiwhetu Stream is to be managed "so that water quality is enhanced" for aquatic ecosystem purposes. The following guidelines apply (from Appendix 8 of the WRFP):

A8.1 The following guidelines reflect the minimum water quality standards established in sections 70 and 107 of the Act.

After reasonable mixing, the contaminant, either by itself or in combination with other contaminants, is not likely to cause any of the following effects:

(1) The production of conspicuous oil or grease films, scums or foams, or floatable or suspended materials.

(2) Any conspicuous change in the colour or visual clarity.

(3) Any emission of objectionable odour.

(4) The rendering of freshwater unsuitable for consumption by farm animals.

(5) Any significant adverse effects on aquatic life.

The Proposed Natural Resources Plan for the Wellington Region (31.07.2015) includes the following relevant Objectives and Policies:

Objective O25 COASTAL

To safeguard **aquatic ecosystem health** and **mahinga kai** in fresh water bodies and coastal marine area:

(a) water quality, flows, water levels and aquatic and coastal habitats are managed to maintain **aquatic ecosystem health** and **mahinga kai**, and

(b) **restoration** of **aquatic ecosystem health** and **mahinga kai** is encouraged, and

(c) where an objective in Tables 3.4, 3.5, 3.6, 3.7 or 3.8 is not met, a fresh water body or coastal marine area is improved over time to meet that objective.

Aquatic ecosystem health and mahinga kai objectives

Table 3.4 Rivers and streams

River class		Macrophytes	Periphyton mg/m² chlorophyll *a*		Invertebrates Macroinvertebrate Community Index		Fish	Mahinga kai species
			All rivers	Significant rivers	All rivers	Significant rivers		
1	Steep, hard sedimentary	Indigenous macrophyte communities are resilient and their structure, composition and diversity are balanced	≤ 50	≤ 50	≥ 120	≥ 130	Indigenous fish communities are resilient and their structure composition and diversity are balanced	Mahinga kai species, including taonga species, are present in quantities, size and of a quality that is appropriate for the area
2	Mid-gradient, coastal and hard sedimentary		≤ 120	≤ 50	≥ 105	≥ 130		
3	Mid-gradient, soft sedimentary		≤ 120*	≤ 50*	≥ 105	≥ 130		
4	Lowland, large, draining ranges		≤ 120	≤ 50	≥ 110	≥ 130		
5	Lowland, large, draining plains and eastern Wairarapa		≤ 120*	≤ 50*	≥ 100	≥ 120		
6	Lowland, small		≤ 120*	≤ 50*	≥ 100	≥ 120		

Policy P70: Managing point source discharges for aquatic ecosystem health and mahinga kai COASTAL

Where an objective in Table 3.4, Table 3.5, Table 3.6 or Table 3.8 of Objective O25 is not met, **point source discharges** to water shall be managed in the following way:

(a) for an existing activity that contributes to the objective not being met, the discharge is only appropriate if:

(i) the application for resource consent includes a defined programme of work for upgrading the activity, in accordance with **good management practice**, within the term of the resource consent, and

(ii) conditions on the resource consent require the reduction of adverse effects of the activity in order to improve water quality in relation to the objective within the term of the consent, and

(b) for a new activity, the discharge is only appropriate if the activity would not cause the affected fresh water body or area of coastal water to become any worse in relation to the objective.

In assessing the appropriateness of a new or existing discharge, the ability to **offset residual adverse effects** may be considered.

Policy P71: Quality of discharges

The adverse effects of **point source discharges** to rivers shall be minimised by the use of measures that result in the discharge meeting the following water quality standards in the receiving water after the **zone of reasonable mixing**:

(a) below the discharge point compared to above the discharge point:

(i) a decrease in the Quantitative Macroinvertebrate Community Index of no more than 20%, and

(ii) a change in pH of no more than ±0.5, and

(iii) a decrease in water clarity of no more than:

1. 20% in **River class** 1, or
2. 33% in **River classes** 2 to 6, and

(iv) a change in temperature of no more than:

3. 2°C in **River classes** 1 or 2, or
4. 2°C in any river identified as having high macroinvertebrate community health in Schedule F1 (rivers/lakes), or
5. 3°C in any other river, and

(b) a 7-day mean minimum dissolved oxygen concentration of no lower than 5mg/L, and

(c) a daily minimum dissolved oxygen concentration of no lower than 4mg/L.

All water quality standards apply at all flows except (a)(iii) which applies at less than **median flows**, (a) applies at all times of the year, (b) and (c) apply only between 1 November and 30 April each year.

Policy P72: Zone of reasonable mixing

Where not otherwise permitted by a rule, 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 Nationally Policy Statement for Freshwater Management (NPS) includes water quality attribute tables for ecosystem health which specify four levels for each attribute, including a national bottom line. The national bottom lines for those attributes of relevance to discharges to the Waiwhetu Stream or Hutt River are summarised in Table 4-1.

Table 5-2: National bottom lines specified in the NPS for Freshwater Management

Attribute	Numeric Attribute State		Narrative Attribute State
Nitrate-N (mg/L)	Annual median	Annual 95th Percentile	Growth effects on up to 20% of species (mainly sensitive species such as fish). No acute effects
	6.9	9.8	
Ammonia-N (mg/L)	Annual Median*	Annual maximum*	80% species protection level: starts impacting regularly on the 20% most sensitive species (reduced survival of most sensitive species)
	1.30	2.20 (max)	
Dissolved oxygen (mg/L)	7-day mean minimum (summer period: 1 Nov. – 30th April)	1-day mean minimum (summer period: 1 Nov. – 30th April)	Moderate stress on a number of aquatic organisms caused by dissolved oxygen levels exceeding preference levels for periods of several hours each day. Risk of sensitive fish and invertebrate species being lost.
	5.0	4.0	
E. coli	Annual median		People are exposed to a moderate risk of infection (less than 5% risk) from contact with water during activities with occasional immersion and some ingestion of water (such as wading and boating). People are exposed to a high risk of infection (greater than 5% risk) from contact with water during activities likely to involve immersion.
	1000		

*Based on pH 8 and temperature 20^{0}C

Appendix C Assessment Criteria - CMA

Assessment Criteria - CMA

Wellington Regional Coastal Plan (RCP)

Policy 10.2.3
To have particular regard to the criteria in Appendix 6 in order to determine, when considering applications for resource consent, if a discharge is able to comply with policies 10.2.1 and 10.2.2.

Appendix 6 of the Regional Coastal Plan states the following criteria for minimum water quality standards, contact recreation and shellfish gathering:

The following criteria reflect the minimum water quality standards set down in sections 70 and 107 of the Act:

After reasonable mixing, the contaminant, either by itself or in combination with other contaminants, is not likely to cause any of the following effects:

(1) The production of any conspicuous oil or grease films, scums or foams, or floatable or suspended material:
(2) Any conspicuous change in the colour:
(3) Any emission of objectionable odour:
(4) …
(5) Any significant impact on aquatic life.

The following criteria reflect the water quality required for water which is managed for contact recreation:

After reasonable mixing the contaminant, either by itself or in combination with other contaminants, is not likely to cause any of the following effects:

(6) All those effects detailed in 1-5 above;
(7) The rendering of water unsuitable for bathing by the presence of contaminants;
(8) The median bacterial content in samples of water taken over the bathing season to exceed
- *either 150 faecal coliforms per 100ml (minimum of five samples taken at regular intervals not exceeding one month, with four out of five samples containing less than 600 faecal coliforms per 100 ml); or*
- *35 enterocci per 100ml over the bathing season (any individual sample should not exceed 153 enterococci per 100ml)*

(9) Undesirable biological standards

The following criteria reflect the water quality required for water which is managed for shellfish gathering:

After reasonable mixing, the contaminant, either by itself or in combination with other contaminants, is not likely to cause any of the following effects:

(10) All those effects detailed in 1-9 above except effect 8 (bacterial content);
(11) The natural temperature of the water to be changed by more than 3˚C;
(12) The concentration of dissolved oxygen to be less than 80 percent of the saturation concentration;
(13) The median bacterial content in samples of water taken over the gathering season to exceed 14 MPN faecal coliforms per 100ml (nine out of ten samples containing less than 42 MPN faecal coliforms per 100 ml).
(14) Aquatic organisms to be rendered unsuitable for human consumption by the presence of contaminants.

Proposed Natural Resources Plan

Objective O25 GWRC COASTAL

To safeguard **aquatic ecosystem health** and **mahinga kai** in fresh water bodies and coastal marine area:

(a) water quality, flows, water levels and aquatic and coastal habitats are managed to maintain **aquatic ecosystem health** and **mahinga kai**, and

(b) **restoration** of **aquatic ecosystem health** and **mahinga kai** is encouraged, and

(c) where an objective in Tables 3.4, 3.5, 3.6, 3.7 or 3.8 is not met, a fresh water body or coastal marine area is improved over time to meet that objective.

Table 3.8 Coastal waters

Coastal water type	Macroalgae	Seagrass and saltmarsh	Invertebrates	Mahinga kai species	Fish	Sedimentation rate	Mud content
Open coast	The algae community is balanced with a low frequency of nuisance blooms	NA	Invertebrate communities are resilient and their structure, composition and diversity are balanced	Mahinga kai species, including taonga species, are present in quantities, sizes and of a quality that is appropriate for the area	NA		
Estuaries and harbours[2]		Seagrass, saltmarsh and brackish water submerged macrophytes are resilient and diverse and their cover is sufficient to support invertebrate and fish communities			Indigenous fish communities are resilient and their structure, composition and diversity are balanced	The sedimentation rate is within an acceptable range of that expected under natural conditions	The mud content and areal extent of soft mud habitats is within a range of that found under natural conditions

Policy P70: Managing point source discharges for aquatic ecosystem health and mahinga kai COASTAL

Where an objective in Table 3.4, Table 3.5, Table 3.6 or Table 3.8 of Objective O25 is not met, **point source discharges** to water shall be managed in the following way:

(a) for an existing activity that contributes to the objective not being met, the discharge is only appropriate if:

(i) the application for resource consent includes a defined programme of work for upgrading the activity, in accordance with **good management practice**, within the term of the resource consent, and

(ii) conditions on the resource consent require the reduction of adverse effects of the activity in order to improve water quality in relation to the objective within the term of the consent, and

(b) for a new activity, the discharge is only appropriate if the activity would not cause the affected fresh water body or area of coastal water to become any worse in relation to the objective.

In assessing the appropriateness of a new or existing discharge, the ability to **offset residual adverse effects** may be considered.

Policy P72: Zone of reasonable mixing COASTAL

Where not otherwise permitted by a rule, 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

[2] Intermittently closed and open lakes or lagoons (ICOLLs), such as Lake Onoke, should be treated as an estuary when they are in an open state. When closed to the coast, they should be managed as a lake, in which case Table 3.2 applies.

(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**.

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