Seaview WWTP

Assessment of Environmental Effects of Non-Compliant Wastewater discharges, 2023 - 2024

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1. Introduction

1.1 Purpose of this report

Over the last four years the Seaview Wastewater Treatment Plant (WWTP) has not consistently achieved the discharge quality standards specified by conditions of the consents which authorise discharges to the Coastal Marine Area. The purpose of this report is to provide a high-level assessment of the potential effects of non-compliance discharges on the receiving environment water quality and aquatic ecology.

1.2 Existing consents

The WWTP operates under three discharges permits which authorise:

- A continuous discharge of up to 286,000 cubic metres per day (peak wet weather flow) or 3,100 litres per second, of secondary biologically treated and UV disinfected wastewater from the Seaview Wastewater Treatment Plant to the coastal marine area from the outfall at Bluff Point, Pencarrow (WGN050359[24539]).
- Discharges during and/or immediately after heavy rain events (WGN120142 [33406]). If as a result of rainfall events the flow of treated wastewater through the Seaview WWTP exceeds the capacity of the main outfall pipeline (MOP), and the storm tank within the Seaview WWTP is full, treated wastewater is discharged via the outfall to the Waiwhetū Stream.
- Discharges that occur while repairs are undertaken on the MOP (WGN120142 [33408]). During such works treated wastewater from the Seaview WWTP is diverted from the MOP and discharged via the outfall to the Waiwhetū Stream.

Since January 2021, compliance has not been consistently achieved with **Condition 9** of the continuous discharge consent. Condition 9 specifies the following discharge standards:

(a) Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)

Compliance is based on daily 24-hour flow proportioned composite sampling, with a running geometric mean and eighty-percentile calculated each day using 90 consecutive daily test results.

The geometric mean of 90 consecutive daily $cBOD_5$ values shall not exceed 50 g/m^3 and no more than 20% of 90 consecutive daily values shall exceed 85 g/m^3.

(b) Total suspended solids (TSS)

Compliance is based on daily 24-hour flow proportioned composite sampling, with a running geometric mean and eighty-percentile calculated each day using 90 consecutive daily test results.

The geometric mean of 90 consecutive daily suspended solids values shall not exceed 50 g/m^3 and no more than 20% of 90 consecutive daily values shall exceed 85 g/m^3.

(c) Faecal coliforms

Compliance is based on daily grab samples to be taken between the hours of 10am and 4pm with a running geometric mean and eightieth percentile calculated each day using 90 consecutive daily test results.

The geometric mean of 90 consecutive daily faecal coliform values shall not exceed 1000 per 100ml and no more than 20% of 90 consecutive daily values shall exceed 5000 per 100ml.

Also relevant to this assessment is **Condition 11** of the consent states that:

Based on 24-hour flow proportioned composite samples collected and analysed once each month in accordance with conditions 6, 7, and 8, and Schedule I of this permit, all wastewater discharged through the outfall shall meet the following standards:

Analyte	*Unit*	*Standard: Over each 12-month period, from 1 July to 30 June, no more than 2 samples results shall exceed:*
Dissolved arsenic	*g/m³*	*0.115*
Dissolved cadmium	*g/m³*	*0.035*
Dissolved chromium	*g/m³*	*0.220*
Dissolved copper	*g/m³*	*0.065*
Dissolved nickel	*g/m³*	*0.350*
Dissolved lead	*g/m³*	*0.220*
Dissolved zinc	*g/m³*	*0.750*
Dissolved mercury	*g/m³*	*0.005*
Cyanide	*g/m³*	*0.200*
Phenol	*g/m³*	*0.500*

Condition 12 of the consent states:

"The discharge shall not result in any of the following effects beyond a 200m radius of the discharge point:

a) The production of any conspicuous oil or grease films, scums or foams or floatable or suspended materials

b) Any conspicuous change in colour or visual clarity

c) Any emission of objectionable odour, or

d) Any significant effects on aquatic life"

2. Recent performance of the WWTP

The compliance issue primarily concerns condition 9(c) of the continuous discharge consent, however for completeness this report assesses recent compliance with discharge standards specified in conditions 2, 9(a), 9(b), 9(c), 11, and 12 of the coastal discharge consent.

2.1 Wastewater flow rate

Condition 2 of the continuous discharge consent states that: *"The rate of discharge shall not exceed 3,100L/s or 268,000 m³/day (peak wet weather flow)".* Figure 2-1 shows that the maximum inlet flow is well inside the authorised peak flow, and that flow rates statistics have been relatively consistent over the last four years. The maximum recorded instantaneous flow over that period is 2,318L/s. Note, the statistics shown here are for inlet flows (m³/day).

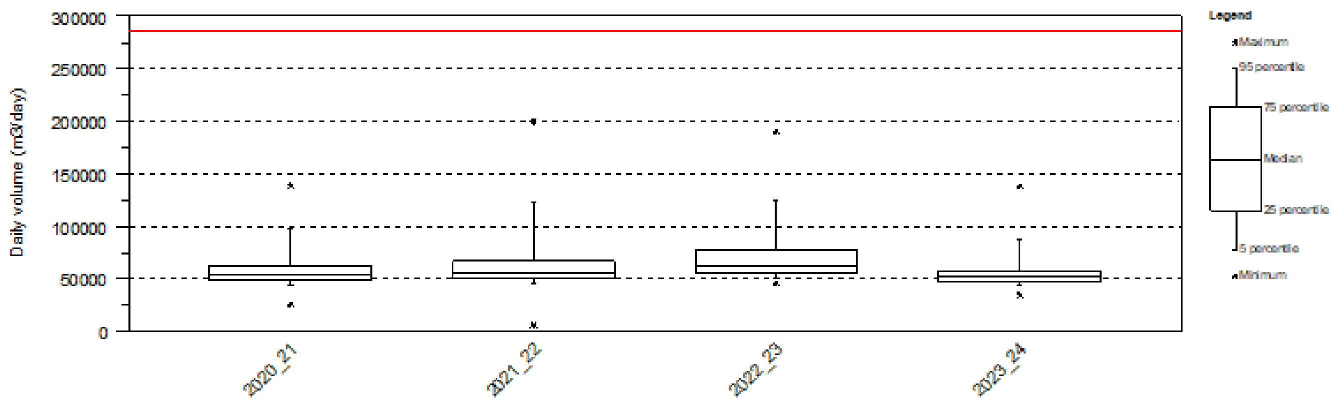

Figure 2-1: Total daily influent flow to Seaview WWTP, June 2020 to May 2024 (the maximum permitted discharge is indicated by red line)

2.2 Assessment against condition 9(a)

Figure 2-2 summarises the daily treated wastewater results for $cBOD_5$ from July 2019 to May 2024. There is little annual variation, except for a slight to moderate deterioration in the 2023_24 year. Nevertheless, the rolling 90-day geometric mean and 80th percentile BOD values illustrated in Figure 2-3 were fully compliant with their respective consent limits over that period.

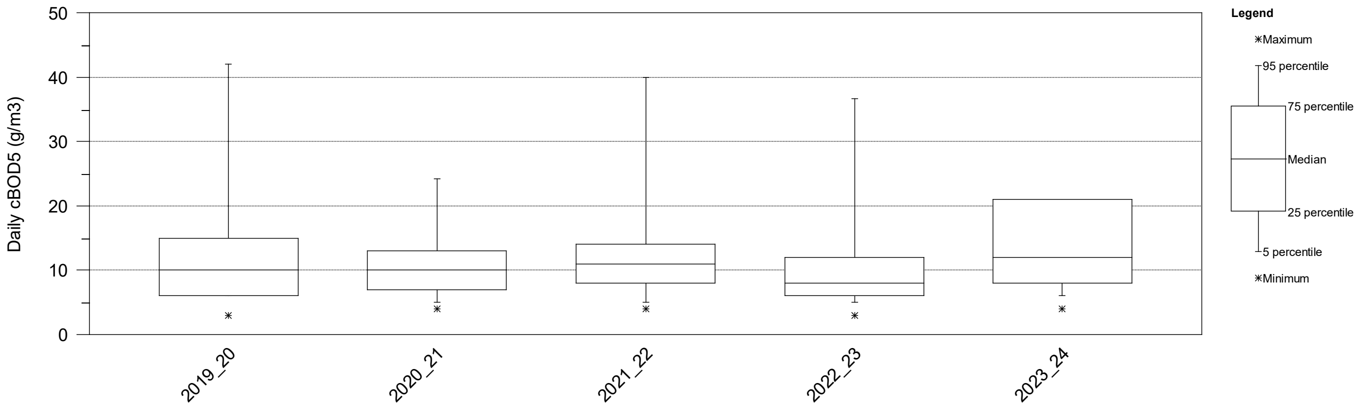

Figure 2-2: Boxplot summaries of daily treated wastewater $cBOD_5$ (g/m^3) by year

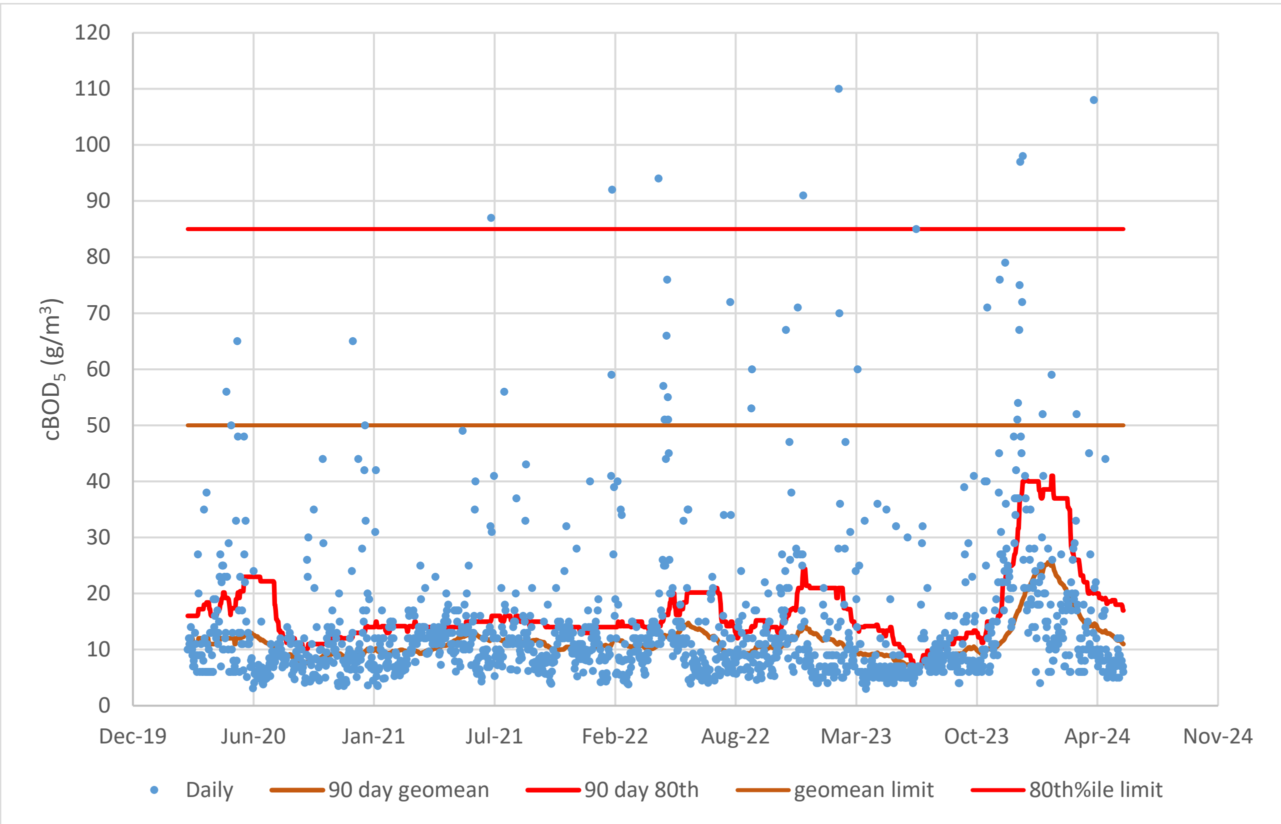

Figure 2-3: Daily treated wastewater $cBOD_5$ (g/m^3), 90-day geometric means and 90-day 80th percentiles

2.3 Assessment against condition 9(b)

Figure 2-4 summarises daily treated wastewater results for TSS from July 2019 to May 2024. The annual statistics suggest a slight deterioration in the 2023_24 year but the difference is not statistically significant and, as illustrated in Figure 2-5, the rolling 90-day geometric mean and 80th percentile TSS values were fully compliant with their respective consent limits over that period.

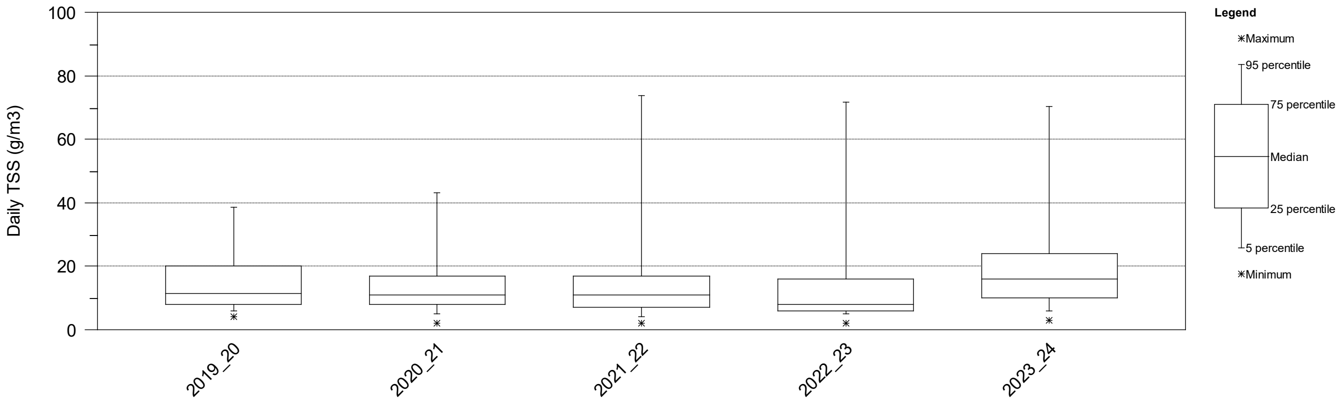

Figure 2-4: Boxplot summary of daily treated wastewater TSS by year

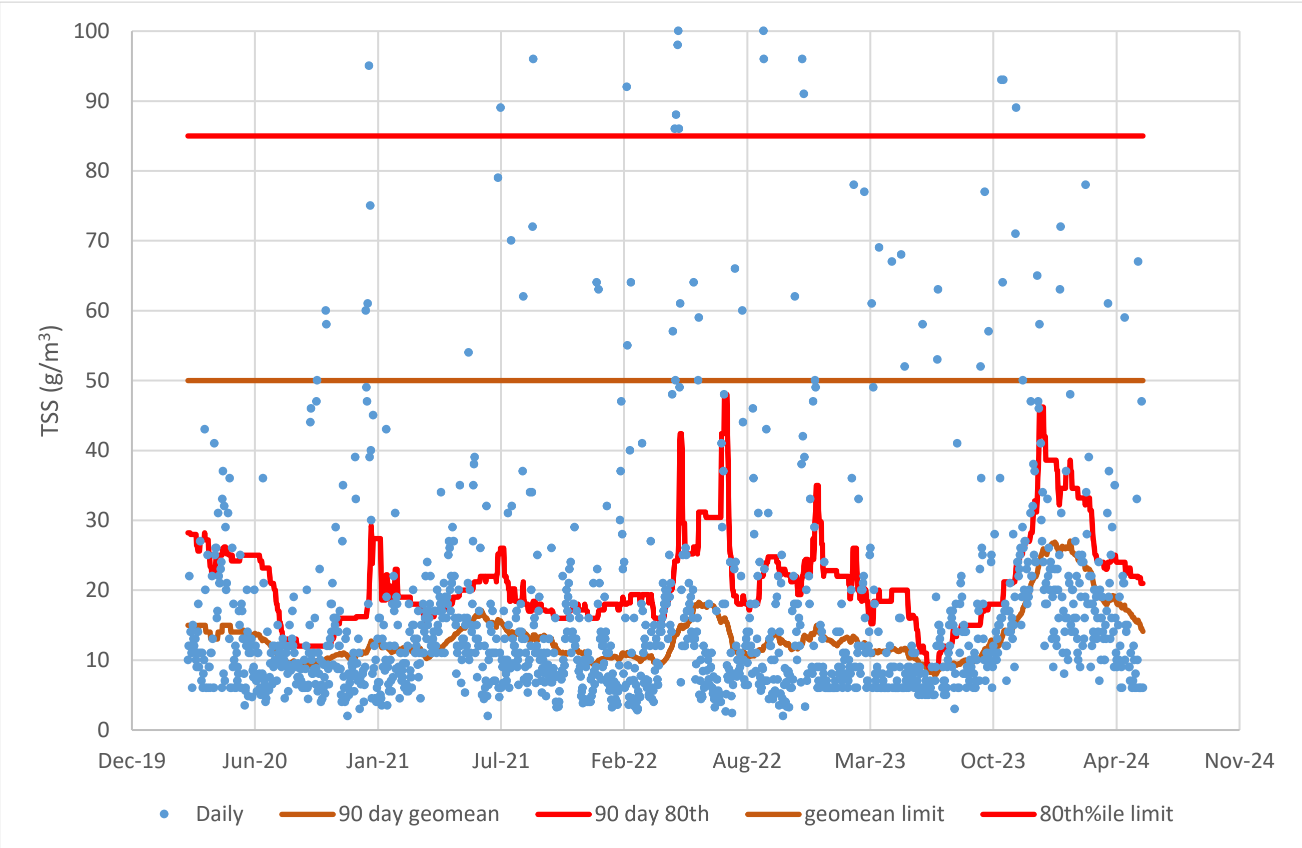

Figure 2-5: Daily treated wastewater TSS (g/m³), 90-day geometric means and 90-day 80th percentiles

2.4 Assessment against 9(c)

Figure 2-6 and Table 2-1 summarise the daily faecal coliform results from July 2019 to May 2024. The annual statistics show a deterioration in the 2020/2021 year and then a very pronounced deterioration in the 2023/2024 year. The rolling 90-day geometric mean and 80th percentile faecal coliform values were fully compliant in the 2019/2020 year but have exceeded consent limits by some margin in every summer period since 2020 (Figure 2-7).

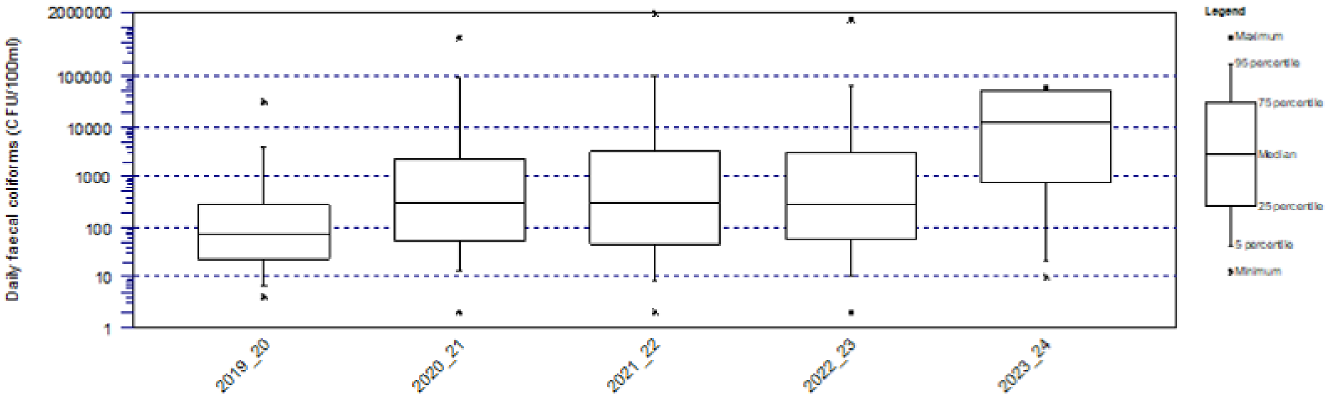

Figure 2-6: Boxplot summary of daily treated wastewater faecal coliforms (CFU/100ml) by year (Log scale)

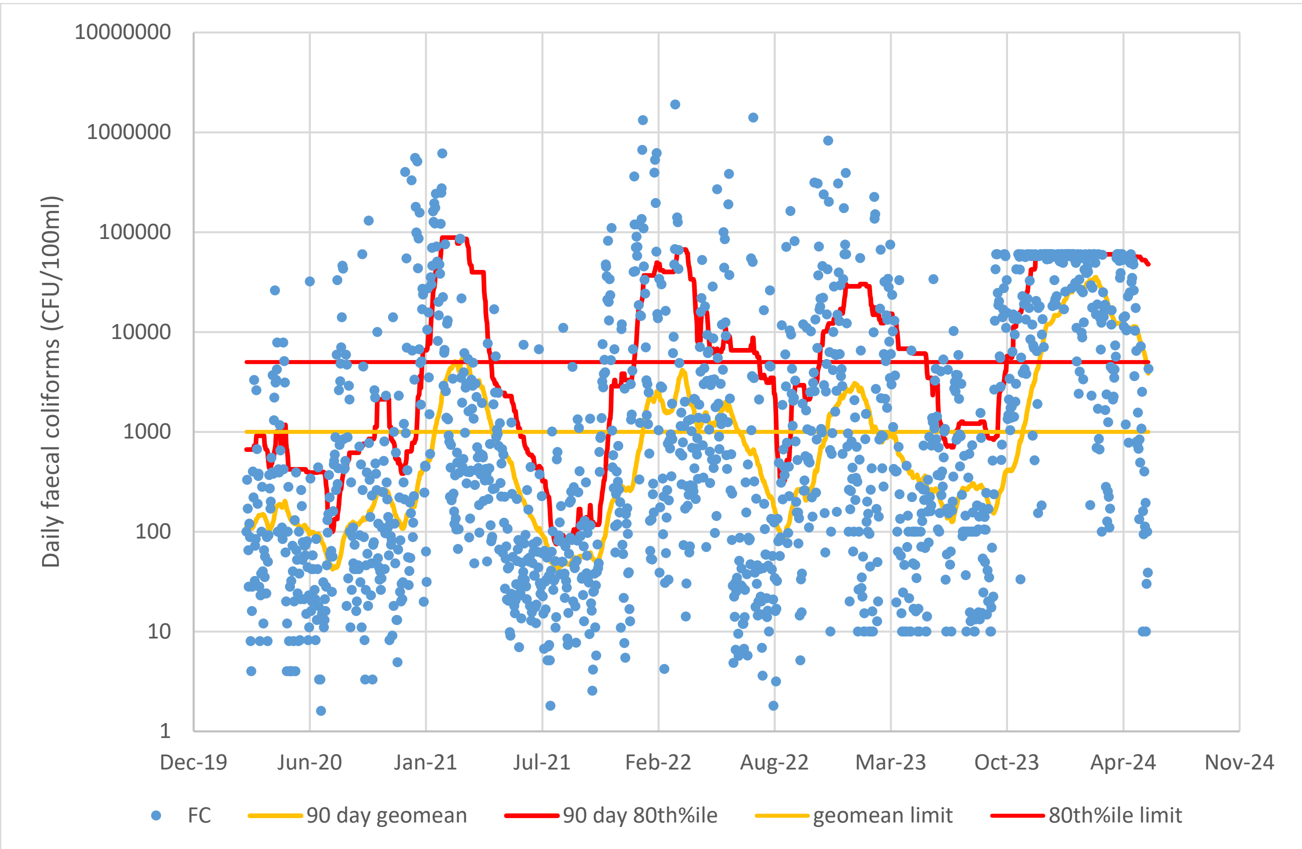

Figure 2-7: Treated wastewater faecal coliforms (CFU/100ml), 90-day geometric means and 90-day 80th percentiles[1] (log scale)

[1] The maximum faecal coliform concentration recorded from September 2023 onwards appears to plateau artificially at 60,000 cfu/100ml, presumably because of the analytical method applied, but earlier results suggest a maximum >1,000,000 cfu/100ml is likely.

Table 2-1: Faecal coliform (CFU/100ml) summary statistics by year

Year	Sample size	Minimum	Median	95-percentile	Standard deviation
2019_20	122	<4	72	3,900	3,880
2020_21	365	<2	294	97,316	66,284
2021_22	363	<2	297	103,292	138,969
2022_23	365	<2	283	67,641	94,866
2023_24	336	<10	11,832	60,000 (1,000,000)[1]	24,638

2.5 Assessment against condition 11

Table 2-2 summarises the results of monthly monitoring from 2020 to May 2024 for the contaminants listed in condition 11. It also includes the maximum concentrations permitted by condition 11, and the ANZG (2018) 99% species protection level multiplied by the predicted 50-fold minimum initial dilution at a distance of 400m from the outfall. The latter is not a consent requirement but is included here to update the ANZECC (2000) guidelines used for the 2006 coastal permit to the current ANZG (2018) to provide a more robust indication of actual risk. None of the consent limits were exceeded during this period. However, the ANZG (2018) based trigger value for ammonia was marginally exceeded. As illustrated in Figure 2-8, treated wastewater concentrations of ammonia appear to have increased slightly during the 2022/23 year.

Table 2-2: Summary statistic from monthly final wastewater monitoring (2020 to 2024)

Variable	Units	N. samples	Minimum	Median	95th percentile	Maximum	Consent limit	ANZG (2018) 99%*50
Dissolved arsenic	g/m^3	45	<0.0001	0.0014	0.0020	0.0030	0.115	0.04
Dissolved cadmium	g/m^3	47	<0.0001	0.0001	0.0003	0.0005	0.035	0.035
Dissolved chromium	g/m^3	47	<0.0005	0.0010	0.0050	0.0056	0.220	0.385
Dissolved copper	g/m^3	47	<0.0005	0.0030	0.0040	0.0092	0.065	0.015
Dissolved lead	g/m^3	47	<0.0001	0.0002	0.0009	0.0050	0.220	0.11
Dissolved mercury	g/m^3	47	<0.00001	0.0001	0.0005	0.0005	0.005	0.005
Dissolved nickel	g/m^3	47	0.0008	0.0014	0.0039	0.0052	0.350	0.35
Dissolved zinc	g/m^3	47	0.0067	0.0150	0.0271	0.0320	0.750	0.165
Phenol	g/m^3	47	<0.0020	0.0100	0.0200	0.0800	0.5	13,500
Cyanide as CD	g/m^3	47	<0.0050	<0.0050	0.0240	0.0340	0.2	0.2400
Total phosphorus	g/m^3	31	0.76	1.88	3.49	8.80	not specified	not specified
Total nitrogen	g/m^3	31	17	26	29.9	30	not specified	not specified
Ammoniacal N	g/m^3	149	6.14	21.7	28.6	31.6	not specified	25
Oil & Grease	g/m^3	47	<4.0	5.0	9.8	19	not specified	not specified
pH	-	84	6.6	7.4	7.8	8.0	not specified	not specified

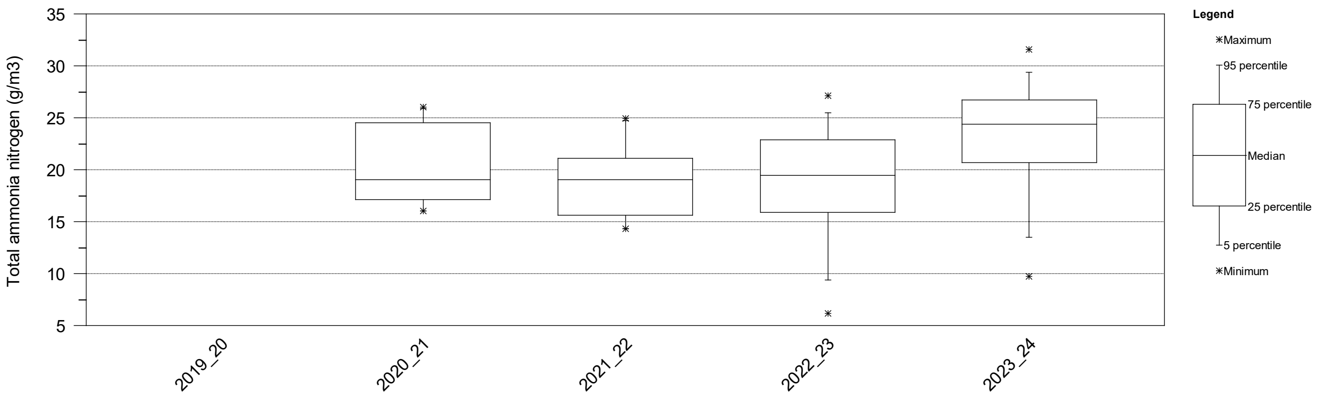

Figure 2-8: Boxplot summary of daily treated wastewater total ammonia nitrogen concentrations (g/m^3) by year

2.6 Assessment against condition 12

Condition 12 of the consent states: *"The discharge shall not result in any of the following effects beyond a 200m radius of the discharge point:*

a) The production of any conspicuous oil or grease films, scums or foams or floatable or suspended materials
b) Any conspicuous change in colour or visual clarity
c) Any emission of objectionable odour, or
d) Any significant effects on aquatic life"

2.6.1 Suspended solids, colour, clarity, oil, grease and adour

As discussed in Section 2.3 the TSS monitoring results for the 2023/24 year suggest a slight increase compared with the previous three years, but the difference is not statistically significant and TSS remained fully complaint with condition 9(b). There is no evidence that after initial mixing in coastal water the discharge would result in any of the effects listed in in 12(a), (b), (c) or (d) above. This assessment is supported by photographs taken as part of the monthly shoreline monitoring programme over the summer months, reported in the Seaview WWTP quarterly reports prepared by Veolia

2.6.2 Aquatic life

The treated wastewater content of potential toxicants including ammonia, metals, and phenol is determined from 24-hour flow proportioned composite samples one each month. As described in Section 2.5 none of the consent limits specified for these contaminants were exceeded. An additional trigger based on ANZG (2018) 99% species protection guidelines included in Section 2.5 was not exceeded for metals or phenol but was marginally exceeded for ammonia. However, ammonia is not of great concern in the high energy coastal waters at Bluff Point because of its reactive characteristics; reacting with water to form ammonium followed by conversion to ammonia gas which rapidly disperses rapidly to the atmosphere. For that reason, total ammonia nitrogen does not accumulate in coastal waters.

A series of marine ecology surveys have been conducted around the short ocean outfall at Pencarrow, including prior to commissioning of the Seaview WWTP (Anderlini & Wear, 1989; Anderlini, 1998) and after commissioning (Barter, Sneddon, & Keeley, 2004; Dunmore & Peacock, 2015). Dunemore and Peacock, reporting on the most recent survey, noted that the discernable variation in species diversity with distance from the outfall reported in 1998 was no longer discernable in the 2004 or 2014 surveys. Transects located 30m northwest and 70m southeast of the outfall had a similar species diversity to a control transect located 800m to the southest. These result indicate that in 2004 and 2014 the treated wastewater was not having any descernable impact on aquatic life. There is nothing identified in the current review to suggest that the risk to aquatic life is any greater in 2024 than it was in 2004 or 2014.

It is noted that the next marine ecology survey is scheduled for later in 2024.

3. Assessment of effects

The preceding section confirms that faecal coliform concentrations have been significantly elevated and non-compliant during each summer since 2020, but that compliance has been achieved with other discharge standards over that period.

3.1 Discharges to Fitzroy Bay

Faecal coliform bacteria are monitored in the discharge to indicate the level of public health risk associated with water contact activities near the point of discharge. Dilution and dispersion studies conducted on the WWTP discharge via the ocean outfall at Bluff Point indicate that a minimum 50-fold dilution occurs at the point where the discharge plume first contacts the shoreline and where there is a realistic possibility that a recreational user of the area might encounter faecal contamination (Barter, Sneddon, & Keeley, 2004).

The effects of the Seaview WWTP discharge on receiving water concentrations of faecal indicator bacteria can be determined by mass balance calculation. The predicted receiving water contaminant concentration (*Cx*) at any location *x* is given by equation 1:

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

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

The wastewater faecal coliform concentration is from Table 3-1, the background seawater concentration is the median value from monthly monitoring, and the dilution is as described above. Predicted faecal coliform concentrations in coastal water at a distance of 400m from the outfall resulting from median and 95th percentile wastewater concentrations (typical and worst case) are summarised in Table 3-1.

Table 3-1: Predicted faecal coliform concentrations after initial mixing (in coastal waters 400m from the Bluff Point outfall)

Year	Statistic	Wastewater concentration (CFU/100ml)	Background seawater concentration (CFU/100ml)	Minimum dilution (x-fold)	Predicted concentration after initial dilution (CFU/100l)	Predicted increase (CFU/100ml)
2019_20	Median	72	2	50	3.4	1.4
	95-percentile	3,900	2	50	80	78
2023_24	Median	11,800	2	50	239	237
	95-percentile	1,000,000	2	50	20,002	20,000

The treated wastewater quality achieved during the 2019/20 year had a relatively low faecal indicator bacteria content and is unlikely to have caused any more than a negligible increase in faecal coliform concentrations at the point where the discharge plume contacts the shore (1 to 78 CFU/100ml). By comparison the poor quality wastewater achieved during the 2023/24 year is expected to have increased seawater concentrations at the same location by between 239 (typical) and 20,000 CFU/100ml (worst case) which represents a substantial decrease in receiving water quality. Shoreline faecal coliform monitoring results reported in the October to December 2023 quarterly report (Veolia, January 2024) range between <10 and 1400 cfu/100ml, which is consistent with the predictions in Table 3-1.

Recreational users of the Fitzroy Bay area near the outfall would have been at increased risk of infection if they had engaged in full contact activities such as bathing or diving during the 2023/24 year. The likelihood of that occurring is reduced to some extent because full contact recreation is rare in Fitzroy Bay due to its isolation, its highly exposed aspect, and signage warning of the risks.

The risks associated with consumption of shellfish collected from the vicinity of the outfall are probably low because, in addition to the reasons outlined above, filter feeding shellfish such as mussels are very sparsely distributed and do not constitute a recognised seafood resource in the area.

3.2 Occasional discharges to Waiwhetū Stream

The primary discharge of treated wastewater from the Seaview WWTP is to Fitzroy Bay via a short ocean outfall at Bluff Point. However, during periods of sustained wet weather when the flow of treated wastewater through the Seaview WWTP exceeds the capacity of the MOP, and the storm tank within the WWTP is full, treated wastewater is discharged via a constructed outfall to Waiwhetū Stream. Over the last five years a discharge to Waiwhetū Stream has occurred 15 times each year on average.

A quantitative dye dilution study undertaken by the Cawthron Institute during 2013 (Barter P, 2013) indicates that a WWTP discharge from the Seaview outfall in dry weather on the ebb tide would receive a minimum 5-fold dilution in the Hutt River 150m downstream of the Hutt/Waiwhetū confluence. Near field dilutions achieved in wet weather conditions were determined by CORMIX modelling to be in order of 35-fold at the same location (Palliser, 2014).

The effects of the Seaview WWTP discharge on concentrations of faecal indicator bacteria in Waiwhetū Stream be determined by mass balance calculation given above as equation 1. Calculated faecal coliform concentrations in Hutt River water 150m downstream of the Waiwhetu confluence resulting from median and 95th percentile wastewater concentrations (typical and worst case) are summarised in Table 3-2.

Table 3-2: Predicted faecal coliform concentrations 150m downstream of the Hutt/Waiwhetū confluence during a wet weather discharge wastewater from Seaview WWTP

Year	Statistic	Wastewater concentration (CFU/100ml)	Background seawater concentration (CFU/100ml)	Minimum dilution (x-fold)	Predicted concentration 150m downstream (CFU/100l)	Predicted change (CFU/100ml)
2019_20	Median	72	500	35	488	-12
	95-percentile	3,900	500	35	597	97
2023_24	Median	11,800	500	35	824	324
	95-percentile	1,000,000	500	35	29,057	28,557

The treated wastewater quality achieved during the 2019/20 year had a relatively low faecal indicator bacteria content and consequently the impact of wet weather discharges on the water quality of the Hutt River was low, increasing the receiving water concentration in the worst case by approximately 100 CFU/100ml after reasonable mixing.

By comparison the poor quality wastewater discharged in wet weather during the 2023/24 year is expected to have increased river water concentrations at the same location by between 324 (typical) and 28,557 CFU/100ml (worst case), representing a very substantial reduction in water quality.

During the 2023/24 year recreational users of the Hutt River Estuary area near the confluence of the Waiwhetū Stream would have been at increased risk of infection if they engaged in contact activities such as bathing, paddle boarding, windsurfing, or fishing during a wet weather WWTP discharge. The likelihood of that occurring is relatively low however because the storm conditions which produce high wastewater inflows (>20mm of rainfall in the catchment (Stantec, 2024)) would also cause the Waiwhetū Stream and Hutt River to be running at high flow or in flood, preventing most recreational activities.

The Hutt River in flood can influence water quality along the eastern bays from Lowry Bay through to Robinson Bay in Eastbourne and beyond. Filter feeding shellfish found in these waters including cockles, mussels and scallops are all susceptible to faecal contamination as they can accumulate faecal bacteria at higher concentrations than in the surrounding seawater. While the WWTP discharge may have a maximum duration of one or two days, the shellfish may take three to four weeks to purge themselves of faecal material. These shellfish, if collected for human consumption and eaten raw, would constitute a significant risk of gastrointestinal infection.

4. Conclusion

Faecal indicator bacteria concentrations in the Seaview WWTP treated wastewater have been significantly elevated over the last four years, and this assessment confirms that the discharge of poor quality wastewater to the coastal waters at Fitzroy Bay has substantially reduced the quality of nearshore waters close to the outfall during that period.

Recreational users of the coastal area near the outfall would have been at increased risk of gastrointestinal infection if they had engaged in full contact activities such as bathing or diving during the 2023/24 year. The likelihood of that occurring is low because full contact recreation is rare in Fitzroy Bay due to its isolation, its highly exposed aspect, and signage warning of the risks. The risks associated with consumption of shellfish collected from the vicinity of the outfall are also low because, in addition to the reasons outlined above, filter feeding shellfish such as mussels are very sparsely distributed and do not constitute a recognised seafood resource in the area.

Wet weather discharges of treated wastewater to Waiwhetū Stream have occurred 15 times per year on average over the last four years, and these discharges have caused a substantial but temporary reduction in water quality in the Stream and downstream in the Hutt River. While the likelihood of recreational use of Waiwhetū Stream or the Hutt River is low at such times because of high river flows, the discharges would contribute to faecal contamination of filter feeding shellfish along the Eastern Bays for up to four weeks after each discharge event.

A major component renewal is currently underway to provide a short-term improvement to disinfection performance. In addition, WWL is planning to replace the aged and deteriorating UV treated system which will provide a long-term solution for the microbiological quality issues identified here.

5. References

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