



Stormwater Discharges to the Coastal Marine Area: RM11.313.01 – RM11.313.10

July 2025 to June 2026 Monitoring

Dunedin City Council

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Basis of Report

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Executive Summary

Monitoring of Dunedin’s stormwater discharges and receiving environments (Otago Harbour) was undertaken between July 2025 and June 2026, as required of Dunedin City Council by Otago Regional Council resource consents (RM11.313.01 - RM11.313.10).

Monitoring activities included dry-weather stormwater quality sampling and harbour sediment sampling. However, weather and tidal conditions prevented completion of several consent monitoring requirements, including wet-weather stormwater sampling and dry and wet weather harbour water quality sampling.

Dry-weather stormwater monitoring was completed in 4 of the 12 sampling months over the 2025 to 2026 monitoring period. Several outfalls had elevated concentrations of the faecal contaminant indicators *E. coli*, consistent with results from previous years. Investigations undertaken in earlier years have identified stormwater and wastewater cross-connections in some catchments. While sewage is a potential source of elevated *E. coli* concentration, contamination can also arise from animal faecal matter commonly present in urban stormwater environments. Wet-weather stormwater sampling was not completed as the required rainfall and tide conditions did not coincide for sampling to be undertaken during daylight hours.

The automated sampler was relocated to the Shore Street catchment in January 2026 but has not yet successfully captured a suitable rainfall event.

Harbour water quality monitoring was unable to be undertaken due to rainfall and tidal conditions not being met in daylight hours.

Harbour sediment monitoring in 2026 revealed concentrations were generally similar to or lower than results from recent years, with no indication of persistent patterns over time. While all measured concentrations remained below the consent trigger levels established in 2013, concentrations of PAH at Kitchener Street, Orari Street, and Shore Street and lead at Orari Street exceeded ANZECC (2000) ISQG-Low guideline values, which represents the potential for effects to occur. Further investigation would be worthwhile to determine potential sources for the increased PAH and lead. Given the dynamic nature of sediment processes, contaminant concentrations are expected to vary between years. Continued monitoring will be important to determine whether elevated concentrations at some sites represent an emerging trend or normal year-to-year variability.



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1.0 Introduction

Dunedin City Council (DCC) operates the Dunedin stormwater system, which comprises a network of gutters, open channels, pipes, mud tanks, and outfalls. The principal coastal receiving water environments for Dunedin's reticulated stormwater are the upper basin of Otago Harbour, Port Chalmers, and, on the open coast, Second Beach and St Clair Beach. Otago Regional Council (ORC) resource consents (RM11.313.01 – RM11.313.10) authorise the discharge of stormwater from ten stormwater catchments (St Clair, Shore Street, South Dunedin, Portsmouth Drive, Orari Street, Kitchener Street, Mason Street, Halsey Street, Ravensbourne, and Port Chalmers catchments) to these receiving environments (Figure 1). The consent conditions require monitoring of stormwater quality during dry and wet weather conditions, harbour water quality during dry and wet weather conditions, harbour sediments, and on a biennial basis, harbour biological communities.

DCC engaged SLR Consulting to undertake the required monitoring between July 2025 and June 2026. This report summarises the results of that monitoring.



Figure 1: Dunedin 3 Waters catchment boundaries. Modified from DCC Webpage.



2.0 Stormwater Outfall Locations

Monitoring of Dunedin’s stormwater quality is required at 14 large outfalls and many smaller outfalls (Figure 2; Appendix A). Many of Dunedin’s outfalls have long histories dating back to the early settlement of the city. A collection of the outfalls do not have outfall structures or are inaccessible for sampling, and it is therefore neither practical nor possible to sample all 33 outfalls at the discharge point (outfall) to the receiving environment. However, access at many sites is available via manholes a short distance upstream from the outfall.

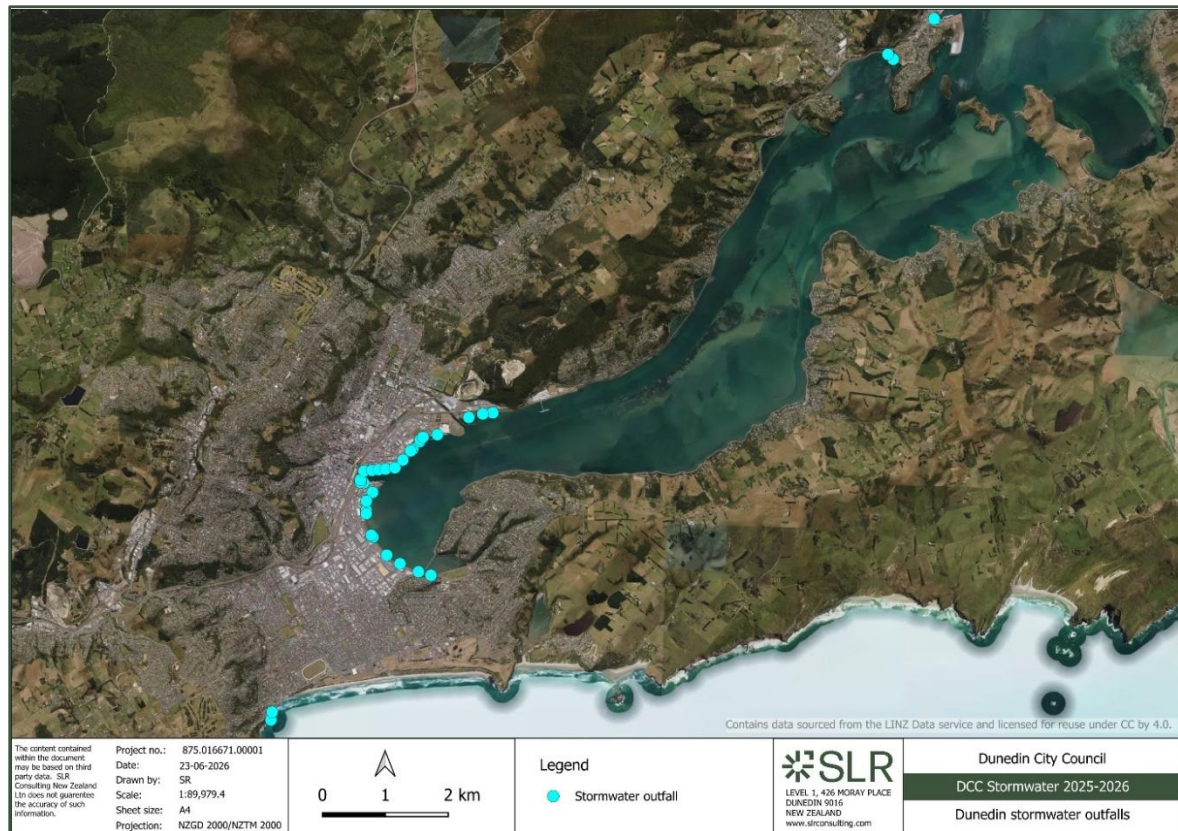


Figure 2: Dunedin stormwater outfalls.

3.0 Sampling Requirements and Methods

3.1 Stormwater Sampling - Dry Weather

Dry weather water sampling is undertaken to determine background contaminant levels entering the receiving environments via stormwater outfalls and it can indicate possible cross-connections between stormwater and wastewater systems. At some outfalls where indicators of human wastewater have not been detected or there is generally no flow, sampling is only required six-monthly, while sampling at other outfalls is required monthly (when all conditions for sampling are met) (Figure 3 and Figure 4; Appendix A). At many six-monthly sampling sites there is no access to the outfall. However, due to the small size of the receiving catchments for these outfalls, there is not expected to be any flow under dry conditions.



Dry weather water sampling is required at stormwater outfalls under low tide conditions, to avoid dilution by seawater. Dry weather is defined as a period of at least 72 hours with no more than 1 mm of measurable rainfall. If no dry weather conditions occur within a calendar month, no sampling is undertaken for that month.

When conditions are suitable, grab samples of water are collected in laboratory-provided containers from the end of the outfall pipe, or as near as practicable prior to the discharge mixing with seawater, for laboratory analysis (Eurofins) for *Escherichia coli* (*E. coli*). *E. coli* is a type of bacteria commonly found in the gut of humans and other warm-blooded animals and is used as an indicator of faecal contamination in freshwater. The indicator bacteria themselves do not necessarily pose a significant risk to human health, but rather indicate the likely presence of faecal material, which contains disease-causing pathogens, including a range of bacteria and viruses. Potential sources of *E. coli* in stormwater include sewage and faecal deposition by animals (e.g., birds, rodents, domestic pets). If the *E. coli* concentration in samples from three consecutive months is greater than 550 units per 100 millilitres, the consent requires investigation and remedial action, if required. The *E. coli* trigger level is based on Ministry for the Environment (MfE) (2003) action (red) level guidelines where water poses an unacceptable health risk from bathing.

Grab samples of water are also collected and analysed on site for fluorescent whitening agents (FWAs) using an AquaFluor handheld fluorometer. Measurement of FWAs is not required by resource consents, however they provide a useful indicator of potential contamination. FWAs are used in laundry detergents and, as household plumbing mixes effluent from toilets with washing machine 'grey water', FWAs can be associated with human faecal contamination and indicate possible wastewater infiltration to the stormwater system. Detection of 0.1 ppb of FWA is suggestive of contamination from grey/wastewater and a level of 0.2 ppb is strongly indicative of contamination from grey/wastewater (Gilpin and Devane 2003). While samples with higher levels of FWAs generally also contain high levels of *E. coli*, a direct linear relationship between the two is not always evident as FWAs are chemicals that may have different movement and survival characteristics to microbial pathogens (Gilpin and Devane 2003).



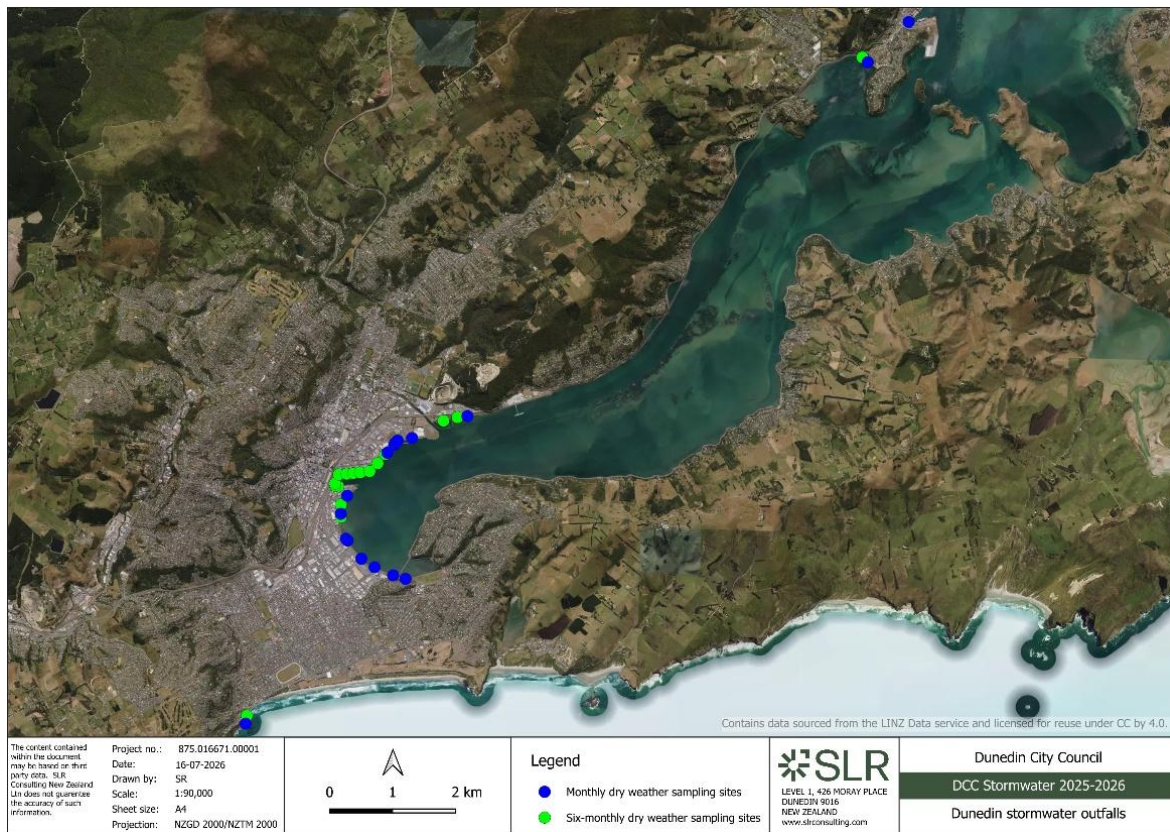


Figure 3: Dunedin stormwater outfalls - monthly and six-monthly dry weather sites (all sites).





Figure 4: Dunedin stormwater outfalls - monthly and six-monthly dry weather sites (upper harbour sites).

3.2 Stormwater Sampling - Wet Weather

Wet weather water sampling is undertaken in an endeavour to sample the first flush of stormwater, which typically contains the highest concentration of contaminants, into the receiving environment.

Wet weather water sampling is required annually at ten major stormwater outfalls (Figure 5 and Figure 6; Appendix A) at low tide within two hours of the commencement of a rain event (more than 2.5 mm of rain), following an antecedent dry period of at least 72 hours of no rainfall in the catchment.

When conditions are suitable, grab samples of water are collected in laboratory-provided containers from the end of the outfall pipe, or as near as practicable prior to the discharge mixing with seawater, for laboratory analysis (Hill Labs) for total arsenic, cadmium, chromium, copper, nickel, lead, and zinc, and oil and grease, suspended solids, pH, polycyclic aromatic hydrocarbons (PAH), and *E. coli*.



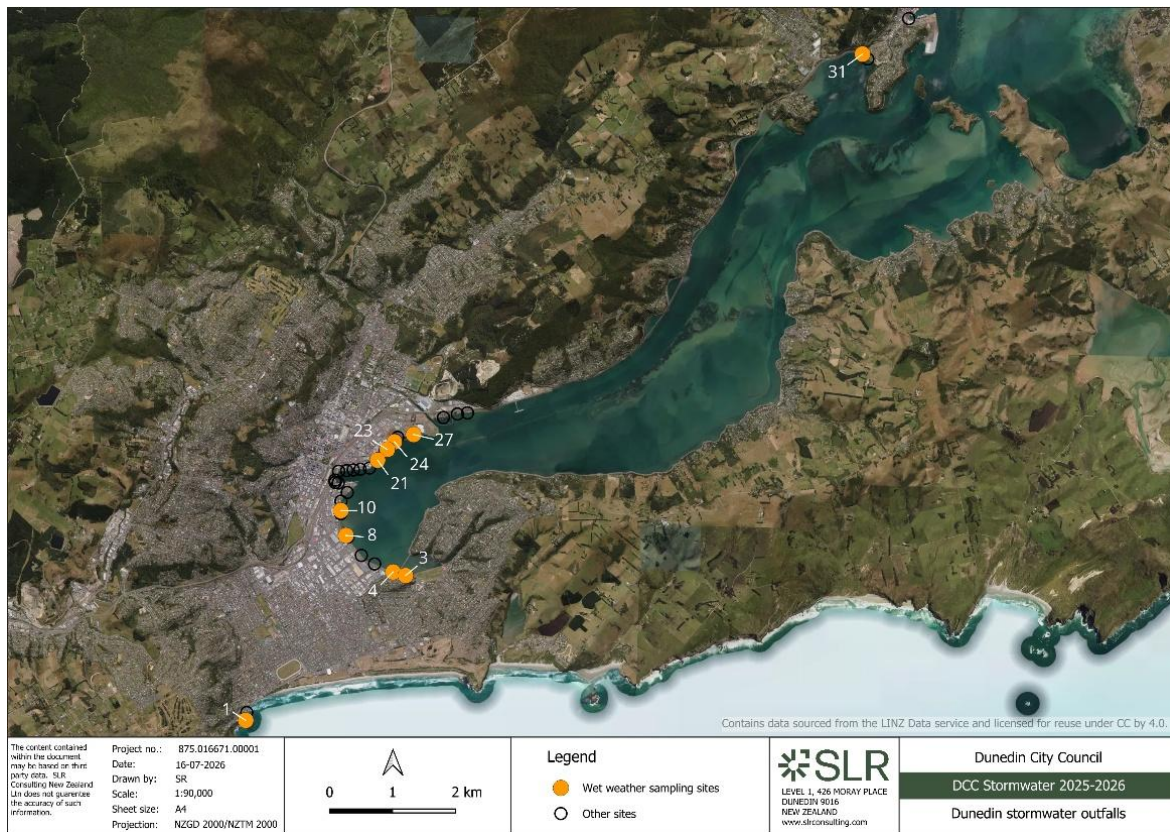


Figure 5: Dunedin stormwater outfalls - wet weather sampling sites (all sites).





Figure 6: Dunedin stormwater outfalls - wet weather sampling sites (upper harbour sites).

3.3 Stormwater Sampling - Wet Weather: Automated Sampler

An ISCO automated sampler is a sampling device used to remotely collect water samples. The sampler is installed next to an opening into the stormwater network (e.g., manhole), and a tube installed from the sampler into the stormwater pipe. When the required conditions are met, the sampler is triggered to collect water samples with a pump used to extract water from the stormwater pipe and fill bottles within the sampling device. Samples from these bottles can then be analysed to provide a contaminant profile through time.

The sampler can only be installed within one stormwater catchment at a time, so it is used to target specific outfalls within certain stormwater catchments (South Dunedin, Halsey Street, Shore Street, Kitchener Street, and Mason Street catchments), as required by resource consents. Consent conditions require sampling of three storm events per year, with the sampler to be moved yearly such that each catchment is sampled once every five years. However, the sampler has typically remained at a site longer than one year due to the difficulty in capturing three suitable events (that meet all required conditions) within this period.

The sampler was located within the South Dunedin catchment between December 2024 and May 2025, with the third rain event captured in that catchment in May 2025. The automated sampler was then moved to the Shore Street catchment, with installation completed in January 2026. The automated sampler is located in the Shore Street catchment approximately 100 m up-pipe of stormwater outfall 3 (Figure 7).



The sampler is programmed to collect 1 L water samples every five minutes over the first two-hour period of a rain event (more than 2.5 mm of rain within 2 hours), to provide a contaminant profile across the rain event including the first flush of stormwater. Consent conditions for sample analysis require an antecedent dry period of at least 72 hours of no rainfall in the catchment and no mixing with seawater (i.e., low tide).

When the automated sampler is triggered under suitable conditions, water samples are collected within the sampler's 24 internal 1 L bottles. These bottles need to be emptied within four hours of collection, to ensure the integrity of the samples. Due to the volume of water required for laboratory analysis, samples from two bottles are combined to make one 10-minute sample (12 samples in total over the two-hour rain event), and these samples are transferred into laboratory-provided containers. Following removal of the samples, the internal 1 L bottles are thoroughly rinsed with distilled water and replaced within the sampler, which is reset to prepare for further sampling. Samples are transferred to the laboratory (Hill Labs or Eurofins) and analysed for total arsenic, cadmium, chromium, copper, nickel, lead, and zinc, and oil and grease, suspended solids, pH, PAH, and *E. coli*. In addition, FWAs are measured using an AquaFluor handheld fluorometer.

The sampler sometimes triggers when not all the required conditions have been met, which results in 'false alarms'. False alarms can occur when the sampler triggers when the rain event does not continue with sufficient rainfall and the sample bottles do not get filled sufficiently, or (at sites where tidal conditions are relevant) at the time of a higher tide that could result in potential saltwater intrusion into the collected samples. Other causes for false alarms include malfunctions or maintenance issues with the sampler (e.g., perforated tubing within the sampler, flat battery, errors with communication between sampler and rain gauge). Following false alarms, the sampler is checked, bottles emptied (if required) and rinsed with distilled water, and the sampler reset.





Figure 7: The location of the ISCO automated sampler since January 2026, sampling the South Dunedin catchment.

3.4 Harbour Water Sampling - Dry and Wet Weather

Monitoring of harbour water quality is undertaken during both dry weather and wet weather (i.e., a rain event). Dry weather sampling allows the determination of background contaminant levels in harbour water, while wet weather sampling assesses the contribution of contaminants from high volume stormwater inputs. Ebb tides (outgoing tides) are likely to move stormwater contaminants down harbour while flood tides (incoming tides) may lead to higher concentrations of stormwater contaminants in the upper harbour. However, inputs from the Water of Leith can complicate contaminant levels, especially during flood tides. The upper harbour basin requires 4–6 tidal cycles to flush completely (Smith and Croot 1993, 1994) and therefore contaminants within the upper harbour basin may gradually increase in concentration throughout prolonged wet spells.

Harbour water sampling is required at six sites in the upper harbour (Figure 8) for one dry weather period and for one wet weather event each year. Dry sampling follows high tide and occurs three hours apart on the mid ebb tide and then mid flood tide during a period when there has been no measurable rainfall for at least 72 hours prior to sampling. Wet sampling occurs at the same state of tides as the dry round, no less than three hours after the commencement of a rain event that is likely to produce at least 2 mm of rainfall and that has had an antecedent dry period of at least 72 hours.

When conditions are suitable, grab samples of water are collected from approximately 20 cm below the water surface, in laboratory-provided containers for laboratory analysis (Eurofins) for total cadmium, copper, lead, and zinc and enterococci.



Results for heavy metals are assessed against 2013 trigger levels specified in the consents, which originate from ANZECC (2000) 95% protection trigger values for 'slightly to moderately disturbed' ecosystems, with 95% signifying the percentage of species expected to be protected. For marine systems, this ecosystem condition would typically have largely intact habitats and associated biological communities. Examples are marine ecosystems lying immediately adjacent to metropolitan areas, such as Otago Harbour. Trigger values are concentrations that, if exceeded, could indicate a potential environmental problem, and so 'trigger' a management response.

Enterococci is a type of bacteria commonly found in the gut of humans and other warm-blooded animals and is used as an indicator of faecal contamination in marine water. Enterococci have been identified as having the best relationship with health effects in marine waters (MfE 2003). The indicator bacteria themselves do not necessarily pose a significant risk to human health; instead, they indicate the presence of faecal material, which contains disease-causing pathogens. Potential sources of enterococci bacteria in Otago Harbour include sewage and faecal deposition by animals (e.g., birds, rodents, domestic pets, livestock). Results for enterococci are compared against MfE (2003) bacteriological 'trigger' values for bathing. In the consent, the trigger value has been set at the 'amber/alert' mode, where if a single sample has greater than 140 cfu/100 mL, a management response is triggered, which includes increased monitoring, investigation of source and risk assessment. Although the upper harbour basin is popular with wind surfers, paddle boarders, and other boat users when conditions permit, it is not a recognised swimming area. Consequently, the alert (amber) limit could be considered conservative and potentially not appropriate for much of the time.

Re-sampling of harbour water is required if trigger levels are exceeded, with re-sampling to be undertaken when the conditions are next suitable.



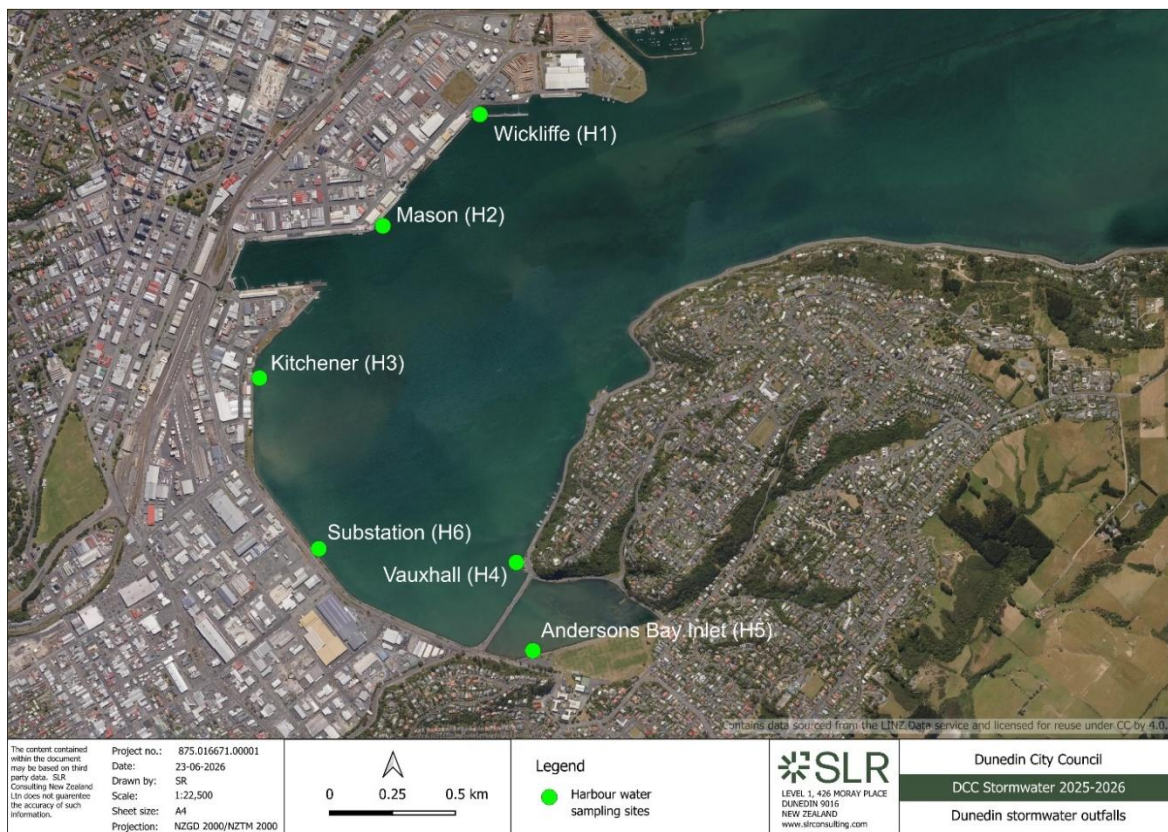


Figure 8: Otago Harbour water quality sampling sites.

3.5 Harbour Sediment Sampling

Monitoring of harbour sediment quality is undertaken as sediments are a potential source and sink for dissolved contaminants. Assessing sediment quality can identify where contaminant concentrations could result in adverse effects on ecological communities. Harbour sediment sampling is required once annually at four sites in the upper harbour (Figure 9).

Samples are collected from the uppermost 20 mm of sediment from the area within approximately 20 m from the nearest stormwater outfall. At the Orari Street, Shore Street, and Kitchener Street sites, samples are collected by scooping the top 20 mm of the harbour bed sediment and transferring the sediments into laboratory-provided containers. At the Halsey Street site, sampling is required in deep water (approximately 3-7 m deep). Sediment at Halsey Street is therefore collected using a petit ponar grab, with a subsample obtained from the uppermost 20 mm of the contents of the grab and transferred into laboratory-provided containers. Samples are collected for laboratory analysis (Hill Labs) for total arsenic, cadmium, chromium, copper, nickel, mercury, lead, and zinc, and weak-acid extractable (WAE) copper, total petroleum hydrocarbons (TPH), organochlorine pesticides (OCP), and PAH.

Concentrations of contaminants in each sediment sample are assessed against 2013 trigger levels specified in the consents. Total arsenic, cadmium, copper, lead and zinc, and PAH trigger levels were determined from the 80th percentile of samples collected to that date. Total chromium and nickel trigger levels originate from ANZECC (2000) interim sediment quality guidelines (ISQG). Trigger values for TPH, OCP and WAE copper are yet to be



determined, but TPH can be compared with 2018 sediment quality default guideline values (ANZG 2018). ANZECC (2000) ISQG-Low values indicate concentrations at which there could be a possible biological effect and is intended as an alert for further investigation, whereas ISQG-High values indicate concentrations at which toxic-related adverse effects are expected.



Figure 9: Otago Harbour sediment sampling sites.

3.6 Sampling Overview

Table 1 provides an overview of the sampling requirements, parameters, and relevant guidelines, as specified by the consents.



Table 1: Dunedin stormwater sampling requirements.

Sampling type	Requirements	Locations	Parameters	Guidelines (from consents)
Dry weather sampling: outfalls	Monthly/six-monthly: Low tide 72 hours dry weather	33 outfalls	<i>E. coli</i> , FWA	MfE (2003): <i>E. coli</i> : 550 cfu/100 mL
Wet weather sampling: outfalls	One rain event per year: Low tide 72 hours dry weather >2.5 mm rain in first 2 hours	10 outfalls	Total arsenic, cadmium, chromium, copper, nickel, lead, zinc, oil and grease, suspended solids, pH, PAH, <i>E. coli</i>	–
Wet weather sampling: automated sampler	Three rain events per year: Low tide 72 hours dry weather >2.5 mm rain in first 2 hours	Currently in the Shore Street catchment	Total arsenic, cadmium, chromium, copper, nickel, lead, zinc, oil and grease, suspended solids, pH, PAH, <i>E. coli</i>	–
Harbour water	One rain event and one dry weather period per year: 72 hours dry weather Incoming and outgoing tide Rain event: >2 mm rain	6 sites	Total cadmium, copper, lead, zinc, enterococci	2013 trigger levels (from ANZECC 2000): Cadmium: 0.0055 g/m ³ Copper: 0.0013 g/m ³ Lead: 0.0044 g/m ³ Zinc: 0.015 g/m ³ MfE (2003): Enterococci: 140 cfu/100 mL
Harbour sediments	Once per year (between January and June): Low tide (required for access)	4 sites	Total arsenic, cadmium, chromium, copper, nickel, mercury, lead, zinc, WAE copper, TPH, OCP, PAH	2013 trigger levels (from 80th percentile of previous samples): Arsenic: 19 mg/kg Cadmium: 1.7 mg/kg Copper: 122 mg/kg Lead: 209 mg/kg Zinc: 902 mg/kg PAH: 183 mg/kg ANZECC (2000) ISQG-Low: Chromium: 80 mg/kg Mercury: 0.15 mg/kg Nickel: 21 mg/kg
Harbour biological	Once every two years (between January and June): Low tide (required for access)	5 sites	Infauna, epifauna, macroflora, cockles	–



4.0 Results and Discussion

4.1 Stormwater - Dry Weather

4.1.1 Sampling Results

Dry weather sampling of stormwater outfalls was undertaken under the required weather and tidal conditions during 4 of the 12 months between July 2025 and June 2026: July, August and November 2025 and May 2026 (Appendix B). Dry weather sampling could not be undertaken in other months due to weather not being suitable (e.g., no antecedent dry period of at least 72 hours) and/or tides not being suitable (e.g., low tide in the middle of the night, or low tides not suitable for accessing outfalls).

Sixteen of the stormwater outfalls accessible for sampling (23 in total) had concentrations of *E. coli* that exceeded the consented trigger level (550 cfu/100 mL) on at least one occasion during the monitoring period (Table 2). Four outfalls were sampled that did not exceed the trigger levels: outfalls 11, 12 (Kitchener Street), 29 (Ravensbourne) and 30 (Port Chalmers). Of these outfalls, 11 and 29 are only sampled on a six-monthly basis, and six-monthly sampling was only completed once. Similarly, outfalls 13-22 are to be sampled on a six-monthly basis, but there is no access to these outfalls. However, due to the small size of the catchments for these outfalls, there is not expected to be any flow under dry conditions.

Outfalls 8, 9, 11, 28, 29 and 31 were only sampled once, with outfalls 2, 10, and 26 not sampled. Of these outfalls, outfalls 8, 10 and 26 are monthly sampling sites, with the other sites to be sampled on a six-monthly basis. However, Outfalls 2 and 26 were not sampled as there was no flowing water, while outfalls 8 and 10 were not sampled due to restricted access to the outfalls because of tide limitations; when sampling was attempted at low tide, the outfalls could not be accessed to sample water discharging from the outfalls due to the harbour water level, even at low tide.

Due to the timing of the monthly sampling, with several months without suitable conditions for sampling, there were no three consecutive months of sampling over the twelve-month period. However, outfalls 1 (St Clair catchment), 3 (Shore Street catchment), 5 and 6 (Portsmouth Drive catchment), 23, 24, 25 and 27 (Halsey Street catchment), and 33 (Port Chalmers) all had *E. coli* concentrations that exceeded the trigger level on at least three sampling occasions (Table 2).

FWA concentrations were variable at the stormwater outfalls, with outfalls 5 and 6 (Portsmouth Drive catchment) and 32 (Port Chalmers catchment) having elevated FWA concentrations on more than one occasion during the 2025-2026 monitoring period. Elevated FWA results did not consistently coincide with elevated *E. coli* concentrations, which indicates that possible cross-connections between stormwater and wastewater systems are unlikely.

Overall, over the 2025-2026 monitoring period, dry weather sampling at stormwater outfalls revealed several outfalls with elevated *E. coli* concentrations on multiple occasions. According to the consent conditions, if the *E. coli* concentration in samples from three consecutive months is greater than the trigger level, the consent requires investigation and remedial action, if required.

4.1.2 Future

The *E. coli* trigger level for this dry weather sampling is based on MfE guidelines for recreation, with results above the trigger level indicating water is considered unsafe for swimming. The dry weather sampling is useful to assist with determining whether there are



any cross-connections between stormwater and wastewater systems, however as recreation/bathing would not be undertaken within the stormwater pipes, it is arguable whether this sampling is useful for determining whether the water poses a health risk for bathing; harbour water quality sampling would be more useful for determining any health risks for bathing associated with any dry-weather discharges from the stormwater outfalls.

As indicated in previous reports, reviewing the sampling regime for dry weather monitoring, to remove the sampling of some outfalls, could be worthwhile. These could be outfalls where there has consistently been no indicators of wastewater in previous sampling or those which frequently contain no flowing water (e.g., Outfalls 12 and 26) or are sampled six-monthly (due to previously been found to have no indicators of wastewater or be frequently dry) and are consistently dry during dry weather (e.g., Outfall 2, 9, 11, and outfalls 13-22 which are also inaccessible).

Table 2: *E. coli* dry weather sampling results between July 2025 and June 2026, compared with the *E. coli* trigger level of 550 cfu/100 mL (MfE (2003) action (red) limit). Grey cells: no sampling or no access or no flow. Green cells: results below trigger levels. Red cells: results above trigger levels.

Outfall	Location	Frequency	July 2025	August 2025	November 2025	May 2026
1	Second Beach	Monthly				
2	St Clair Beach	Six-monthly				
3	Shore Street	Monthly				
4	Portobello Road	Monthly				
5	Teviot Street	Monthly				
6	Midland Street	Monthly				
7	Orari Street	Monthly				
8	Orari Street	Monthly				
9	Kitchener Street	Six-monthly				
10	Kitchener Street	Monthly				
11	French Street	Six-monthly				
12	Kitchener Street	Monthly				
13-22	Birch, Wharf, Fryatt, Mason, Bauchop Streets	Six-monthly				
23	Bauchop Street	Monthly				
24	Halsey Street	Monthly				
25	Halsey Street	Monthly				
26	Halsey Street	Monthly				
27	Wickliffe Street	Monthly				
28	Magnet Street	Six-monthly				
29	Magnet Street	Six-monthly				
30	Ravensbourne Road	Monthly				
31	George Street /SH88	Six-monthly				
32	Sawyers Bay, Watson Park	Monthly				
33	George Street (Port Otago)	Monthly				



4.2 Stormwater - Wet Weather

Between July 2025 and June 2026, the conditions required to undertake wet weather sampling at stormwater outfalls (i.e., at low tide, within two hours of the commencement of a rain event (more than 2.5 mm of rain) and following an antecedent dry period of at least 72 hours of no rainfall in the catchment), were not met within daylight hours (required for safety reasons). There were therefore no suitable occasions for wet weather sampling to be completed in the 2025 to 2026 monitoring period.

There have not been suitable conditions for sampling for several years, given the difficulty in having all conditions coinciding within daylight hours to allow safe sampling of the outfalls. There are also difficulties associated with predicting when heavy rain events will occur, based on weather forecasting as forecasts can be very changeable over short time frames (e.g., over a period of 1-2 hours); such changeable forecasts can lead to 'false starts' for sampling rain events, but can also lead to missed opportunities when rainfall is heavier than forecast but timing and/or tide restrictions do not allow for sampling to be undertaken. Given the difficulty in meeting the required conditions, consideration is given later in the monitoring period (e.g., between March and June) to reducing the length of the antecedent dry period in an effort to capture a rain event, however this is outside the consent requirements.

4.3 Stormwater - Wet Weather: Automated Sampler

4.3.1 Sampling Results

The ISCO automated sampler has not yet successfully captured a rain event since being installed in the Shore Street catchment site in January 2026.

4.3.2 False Alarms

Monitoring of the automated sampler includes monitoring for 'false alarms', which occur when the sampler is triggered when a rainfall event starts but the event ends up not being suitable for sampling as the required conditions have not all been met. This often occurs when rainfall intensity is high at the start of an event, but then rain stops after only a short period of time, and also when rainfall starts at high tide and thus the sampler would collect harbour water that had entered the stormwater pipes (for sites where seawater inputs to the stormwater system at higher tide levels).

Between July 2025 and June 2026 there were seven occasions when the sampler was incorrectly triggered.

4.3.3 Future

The ISCO automated sampler has been located within the Shore Street catchment since January 2026. Consent conditions require sampling of three rain events per year, with the sampler to be moved yearly such that each of the specified catchments is sampled once every five years. As no rain events have yet been captured, the automated sampler will remain in the Shore Street catchment until three events have been captured.

Previous deployments of the automated sampler in the specified catchments have been at the Shore Street (2015 to 2016), Kitchener Street (2016 to 2018), Mason Street (2018 to 2021), Halsey Street (2021 to 2024), and South Dunedin (2024-2025) catchments. When the deployment at the Shore Street catchment is complete, the automated sampler will be re-deployed to Kitchener Street (to retain the same order as previous deployments).



4.4 Harbour Water

4.4.1 Sampling Results

Between July 2025 and June 2026, the conditions required to undertake wet or dry weather sampling of harbour water were not met within daylight hours (required for safety reasons).

4.5 Harbour Sediment

4.5.1 Sampling Results

Sampling of harbour sediment was undertaken at the four upper harbour sites on 19 May 2026. See Appendix C for tabulated results from this sampling.

Contaminant concentrations in harbour sediments at all sites were below the 2013 trigger levels listed in the resource consent (where applicable; Appendix C) and all concentrations were within the range of results from previous years (Figure 10 to Figure 12).

Contaminant concentrations exceeded the ANZECC (2000) ISQG-Low guidelines for lead at Orari Street and PAH at Kitchener Street, Orari Street and Shore Street. Contaminant concentrations were below the ISQG-High levels at all sites except for PAH at Kitchener Street (100.713 mg/kg). The ISQG-Low represents the threshold for potential effects to occur, while the ISQG-High represents a point where a high probability of effects is possible.

ANZECC (2000) guidelines, specified in the consents, do not provide guideline values for WAE copper, OCP and TPH. However, 2018 sediment quality default guideline values (DGV) (ANZG 2018) are available for TPH (DGV 280 mg/kg, DGV-high 550 mg/kg) and individual OCPs (DGV range from 0.0009 – 0.0045 mg/kg). TPH concentrations were below laboratory detection limits at all sites except Shore Street (133 mg/kg) where concentrations were well below the ANZG (2018) DGV. Individual OCP concentrations were generally lower than laboratory detection limits at all sites (<0.001 mg/kg), while concentrations of some individual OCPs (DDT isomers) were detected.

Overall, sampling in 2026 found containment concentrations at all sites were generally similar to or lower than results from recent years, with no indication of persistent patterns over time. However, in 2026 there was a notably high PAH concentration at the Kitchener Street site and the lead concentration at the Orari Street site was among the highest found at this site. Previous sediment sampling has also found increased contaminant concentrations at some sites, such as increased TPH and metals (e.g., copper) concentrations at Kitchener Street in 2024, however sampling in subsequent years has found lower concentrations. Such variation could result from disturbance and re-distribution of sediments with higher concentrations of contaminants, rather than from new inputs of contaminants to the harbour. An example of this is DDT, which was historically used (e.g., anti-fouling of boats) until being banned in New Zealand in 1989. Given DDT is no longer used, there should be no further inputs of DDT contaminants to the harbour. However, as DDT is persistent in the environment, disturbance and resuspension of sediments can result in variable concentrations of DDT isomers. Similarly, the Kitchener Street catchment has historically included a scrap metal yard and sandblasting operation, with high metal contaminants, while other sites have historically been influenced by the old gas works, which contributed high PAH concentrations to stormwater. The cessation of many industrial activities has reduced many sources of contaminant inputs to the harbour.

Further sampling in 2027 will be useful to help understand if any previously observed patterns of increasing, or decreasing, concentrations continue, or if concentrations continue to be variable between sites and years.



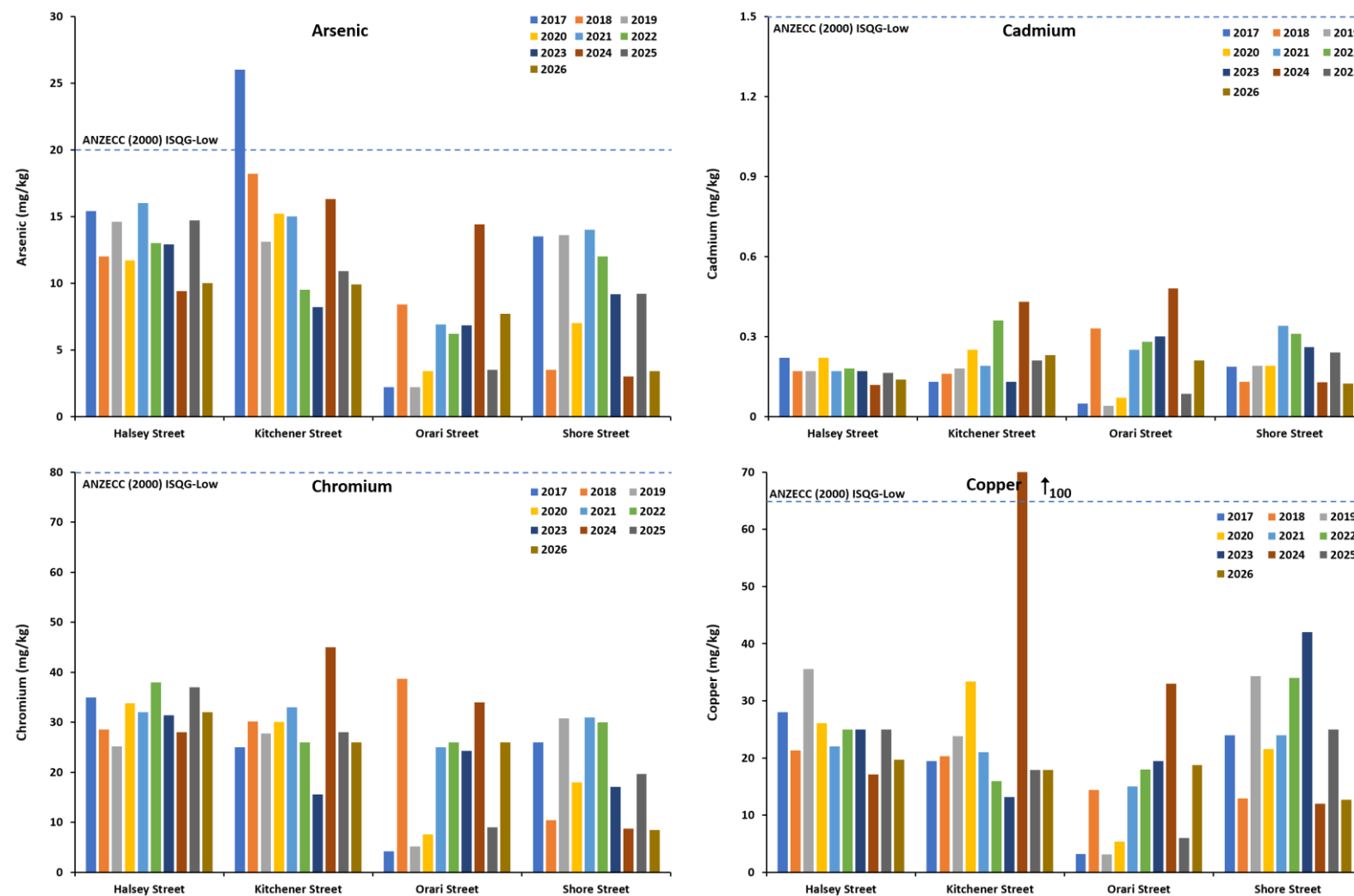


Figure 10: Contaminant concentrations in harbour sediments, 2017 to 2026. Dashed lines indicate ANZECC (2000) ISQG levels.



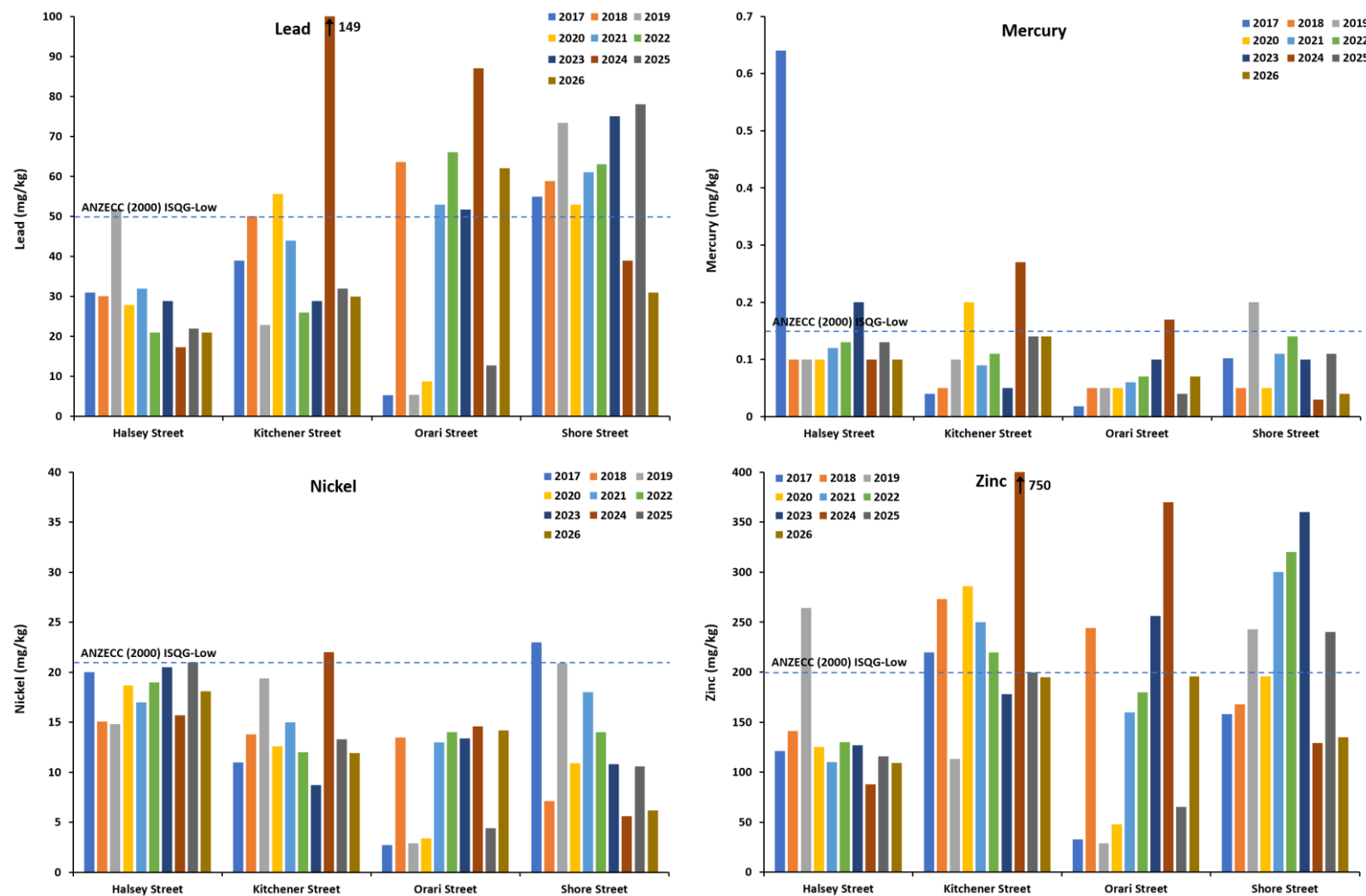


Figure 11: Contaminant concentrations in harbour sediments, 2017 to 2026. Dashed lines indicate ANZECC (2000) ISQG levels.



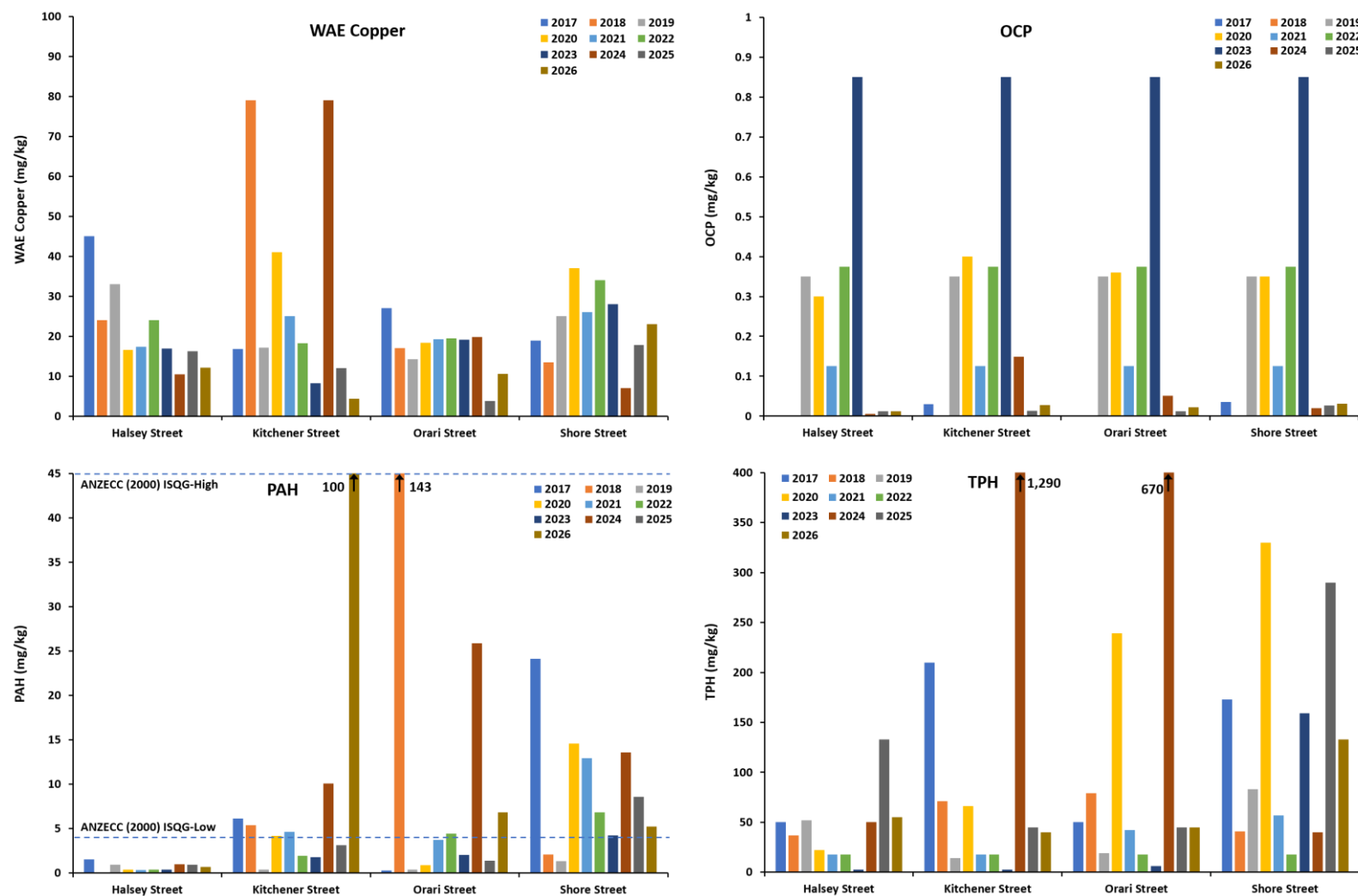


Figure 12: Contaminant concentrations in harbour sediments, 2017 to 2026. Dashed lines indicate ANZECC (2000) ISQG levels.



5.0 Summary and Conclusion

Monitoring of Dunedin's stormwater discharges and receiving environments (Otago Harbour) was undertaken between July 2025 and June 2026, as required of DCC by ORC resource consents (RM11.313.01 - RM11.313.10). Sampling included stormwater quality during dry weather conditions and sampling of harbour sediments. Further sampling was restricted by weather/tidal conditions not being met (i.e., stormwater quality during wet weather conditions, harbour water during dry and wet conditions).

Results from dry weather sampling of stormwater identified several stormwater outfalls with elevated faecal contaminant indicators, which has been seen in previous years. Previous investigations in some catchments, triggered by elevated results, identified cross-connections between the stormwater and wastewater networks. While sewage can be a source of *E. coli* in stormwater, contamination may also result from faecal matter deposited by animals such as birds, rodents, and domestic pets, which is common within stormwater.

Sampling of stormwater at outfalls during a wet weather event was not undertaken between July 2025 and June 2026 as the required conditions were not met.

The ISCO automated sampler was installed in the Shore Street catchment in January 2026 but has not yet successfully captured a rain event since being installed.

Harbour water quality sampling was not undertaken during dry and wet weather conditions between July 2025 and June 2026 as the required conditions were not met.

Sampling of contaminants in harbour sediments revealed concentrations were generally similar to or lower than results from recent years, with no indication of persistent patterns over time. Concentrations in 2026 were all below the 2013 trigger levels listed in the consents, however concentrations of PAH and lead at some sites were above the ANZECC (2000) ISQG-Low levels, which represent the threshold for potential effects to occur. Further investigation to determine if there are any new potential sources for the increased PAH and lead concentrations would be worthwhile. Some sites have historically had high concentrations of some contaminants (e.g., PAH at Portobello Road) however the cessation of some industrial activities (e.g., gas works) have reduced many sources of contaminant inputs to the harbour. Contaminant concentrations are expected to be variable year to year as contaminated sediment is buried or disturbed, and further monitoring will help determine if patterns of increasing concentrations at some sites continue, or if the lower concentrations in 2026 were reflective of ongoing variation.

6.0 References

- ANZECC. 2000. Australian and New Zealand guidelines for fresh and marine water quality. National Water Quality Management Strategy. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand.
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- Gilpin, B. and Devane, M. 2003. Advanced indicators for the identification of faecal pollution sources. Auckland Regional Council Technical Publication Number 338. 73p.
- Ministry for the Environment. 2003. Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas. Ministry for the Environment, Wellington. Ref. ME474.



Smith, A.M. and Croot, P.L. 1993. A flushing time for Anderson's Bay Inlet, Dunedin, New Zealand. Department of Marine Science, University of Otago. Report prepared for the Otago Regional Council.

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7.0 Closure

Sincerely,

SLR Consulting New Zealand

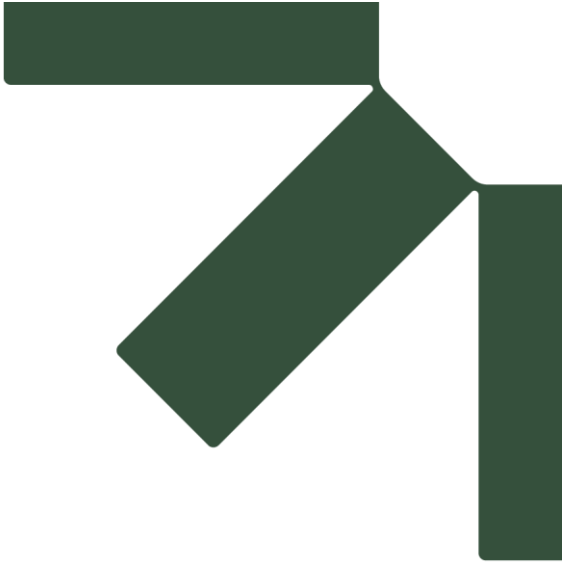


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Appendix A Stormwater Outfalls

**Stormwater Discharges to the Coastal Marine Area:
RM11.313.01 – RM11.313.10**

July 2025 to June 2026 Monitoring

Dunedin City Council

SLR Project No.: 875.016671.00001

30 July 2026

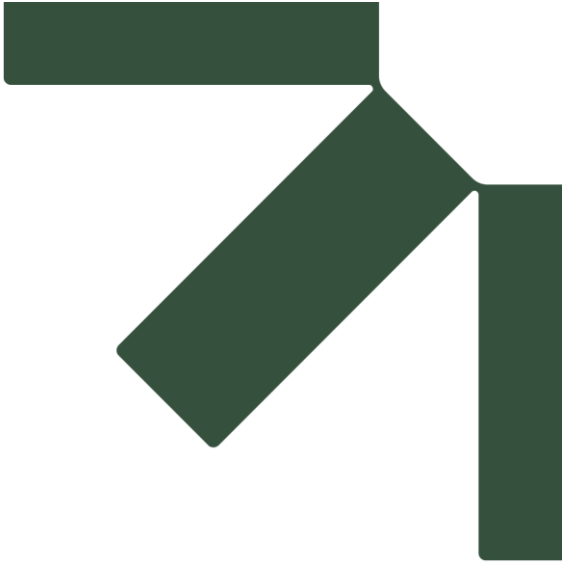
Table A-1: Dunedin stormwater outfall information.

Outfall	DCC reference	Resource consent	Location	Catchment	Frequency of dry weather sampling	Wet weather sampling?
1	SWX03979	RM11.313.10	Second Beach	St Clair	Monthly	Yes
2	SWX00011 & SWX00012	RM11.313.10	St Clair Beach	St Clair	Six-monthly	-
3	SWX04625	RM11.313.04	Shore Street	Shore Street	Monthly	Yes
4	SWX03649	RM11.313.09	Portobello Road	South Dunedin	Monthly	Yes
5	SWX03644	RM11.313.07	Teviot Street	Portsmouth Drive	Monthly	-
6	SWX03640	RM11.313.07	Midland Street	Portsmouth Drive	Monthly	-
7	SWX03631	RM11.313.07	Orari Street	Portsmouth Drive	Monthly	-
8	SWX03635 & SWX70740	RM11.313.08	Orari Street	Orari Street	Monthly	Yes
9	SWX03579	RM11.313.07	Kitchener Street	Portsmouth Drive	Six-monthly	-
10	SWX03568	RM11.313.06	Kitchener Street	Kitchener Street	Monthly	Yes
11	SWX70102	RM11.313.06	French Street	Kitchener Street	Six-monthly	-
12	SWX03547	RM11.313.06	Kitchener Street	Kitchener Street	Monthly	-
13	SWX03562	RM11.313.06	Birch Street	Kitchener Street	Six-monthly	-
14	SWX03556	RM11.313.06	Birch Street	Kitchener Street	Six-monthly	-
15	SWX03559	RM11.313.06	Wharf Street	Kitchener Street	Six-monthly	-
16	SWZ70569	RM11.313.06	Fryatt Street	Kitchener Street	Six-monthly	-
17	SWX03540	RM11.313.06	Fryatt Street	Kitchener Street	Six-monthly	-
18	SWX03536	RM11.313.06	Fryatt Street	Kitchener Street	Six-monthly	-
19	SWX03532	RM11.313.06	Fryatt Street	Kitchener Street	Six-monthly	-
20	SWX70370	RM11.313.06	Fryatt Street	Kitchener Street	Six-monthly	-
21	SWX03489	RM11.313.05	Mason Street	Mason Street	Six-monthly	Yes
22	SWX03506	RM11.313.03	Bauchop Street	Halsey Street	Six-monthly	-



Outfall	DCC reference	Resource consent	Location	Catchment	Frequency of dry weather sampling	Wet weather sampling?
23	SWX03466	RM11.313.03	Bauchop Street	Halsey Street	Monthly	Yes
24	SWX03455	RM11.313.03	Halsey Street	Halsey Street	Monthly	Yes
25	SWX03450	RM11.313.03	Halsey Street	Halsey Street	Monthly	-
26	SWX03472	RM11.313.03	Halsey Street	Halsey Street	Monthly	-
27	SWX03718	RM11.313.03	Wickliffe Street	Halsey Street	Monthly	Yes
28	SWX02628	RM11.313.02	Magnet Street	Ravensbourne	Six-monthly	-
29	SWX02623	RM11.313.02	Magnet Street	Ravensbourne	Six-monthly	-
30	SPN02502	RM11.313.02	Ravensbourne Road	Ravensbourne	Monthly	-
31	SWX12941	RM11.313.01	George Street / SH88	Port Chalmers	Six-monthly	Yes
32	SWX12994	RM11.313.01	Sawyers Bay, Watson Park	Port Chalmers	Monthly	-
33	SWX12879	RM11.313.01	George Street (Port Otago)	Port Chalmers	Monthly	-





Appendix B Stormwater - Dry Weather - Sampling Results, 2025-2026

**Stormwater Discharges to the Coastal Marine Area:
RM11.313.01 – RM11.313.10**

July 2025 to June 2026 Monitoring

Dunedin City Council

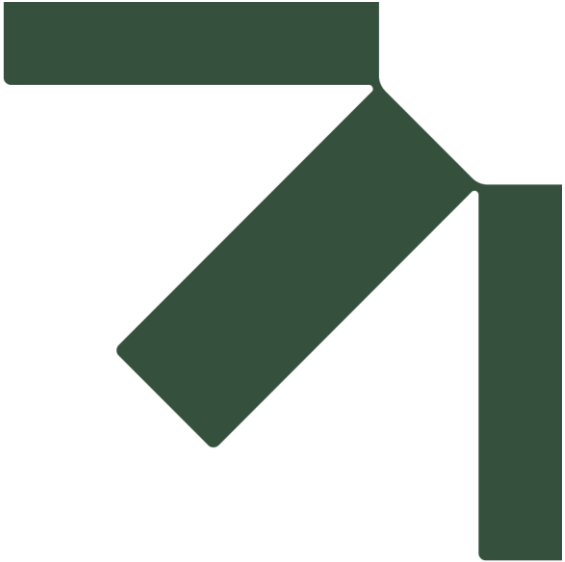
SLR Project No.: 875.016671.00001

30 July 2026

Table B-1: Contaminant concentrations in water from dry weather sampling between July 2025 and June 2026. Outfalls marked with grey cells are sampled six-monthly. Blue cells indicate values exceed trigger levels. FWA level 0.1 ppb is suggestive of human faecal pollution (Gilpin and Devane 2003). *E. coli* trigger level of 550 cfu/100 mL (MfE (2003) action (red) limit).

	29 July 2025		27 August 2025		20 November 2025		5 May 2026	
Outfall	FWA	<i>E. coli</i> (cfu/100 mL)	FWA	<i>E. coli</i> (cfu/100 mL)	FWA	<i>E. coli</i> (cfu/100 mL)	FWA	<i>E. coli</i> (cfu/100 mL)
1	0.050	640	0.055	500	0.047	1,600	0.052	670
2							No Flow	
3	0.083	1,700	0.084	4,500	0.062	27,000	0.068	65,000
4	0.028	<10	0.144	2,500	No Access (tide conditions)		No Access (tide conditions)	
5	0.127	<10	0.116	1,000	0.117	1,800	0.145	3,400
6	0.112	30	0.134	620	0.072	3,700	0.150	29,000
7	0.089	60	0.082	3,300	0.014	20	0.479	>800,000
8	No Access (tide conditions)		0.064	1,900	No Access (tide conditions)		No Access (tide conditions)	
9							0.119	3,700
10	No Access (tide conditions)		No Access (tide conditions)		No Access (tide conditions)		No Access (tide conditions)	
11							0.022	<10
12	0.010	<10	0.018	<10	0.014	10	0.051	70
13-22	No Access							
23	0.027	180	0.028	3,700	0.027	35,000	0.027	170,000
24	0.025	23,000	0.004	3,700	0.016	4,600	0.019	7,700
25	0.043	50,000	0.054	52,000	0.033	15,000	0.047	37,000
26	No Flow							
27	0.056	500	0.088	10,000	0.059	12,000	0.034	730
28							0.052	1,400
29							0.120	90
30	0.128	<10	0.079	<10	0.081	<10	0.077	<10
31							0.052	1,100
32	0.139	<10	0.143	40	0.118	10,000	0.073	10
33	0.088	23,000	0.070	14,000	0.073	5,300	0.084	50,000





Appendix C Harbour Sediments - Sampling Results, 2025-2026

**Stormwater Discharges to the Coastal Marine Area:
RM11.313.01 – RM11.313.10**

July 2025 to June 2026 Monitoring

Dunedin City Council

SLR Project No.: 875.016671.00001

30 July 2026

Table C-1: Harbour sediment contaminant concentrations, 19 May 2026. Trigger and guideline values are specified in resource consents.

	Arsenic (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	WAE copper ¹ (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Zinc (mg/kg)	PAH ² (mg/kg)	TPH ³ (mg/kg)	OCP ⁴ (mg/kg)
<i>2013 trigger levels</i>	19	1.7	80	-	122	209	-	21	902	183	-	-
<i>ANZECC (2000) ISQG-Low⁵</i>	20	1.5	80	-	65	50	0.15	21	200	4	-	-
<i>ANZECC (2000) ISQG-High⁵</i>	70	10	370	-	270	220	1	52	410	45	-	-
Halsey Street	10	0.138	32	12.1	19.7	21	0.1	18.1	109	0.669- 0.704	< 110	0.0012- 0.024
Kitchener Street	9.9	0.23	26	4.4	17.9	30	0.14	11.9	195	100.713	< 80	0.0165- 0.038
Orari Street	7.7	0.21	26	10.6	18.8	62	0.07	14.2	196	6.831	< 90	0.0123- 0.032
Shore Street	3.4	0.124	8.5	23	12.7	31	0.04	6.2	135	5.226	133	0.0052- 0.026

1. WAE copper = Weak-acid extractable copper.

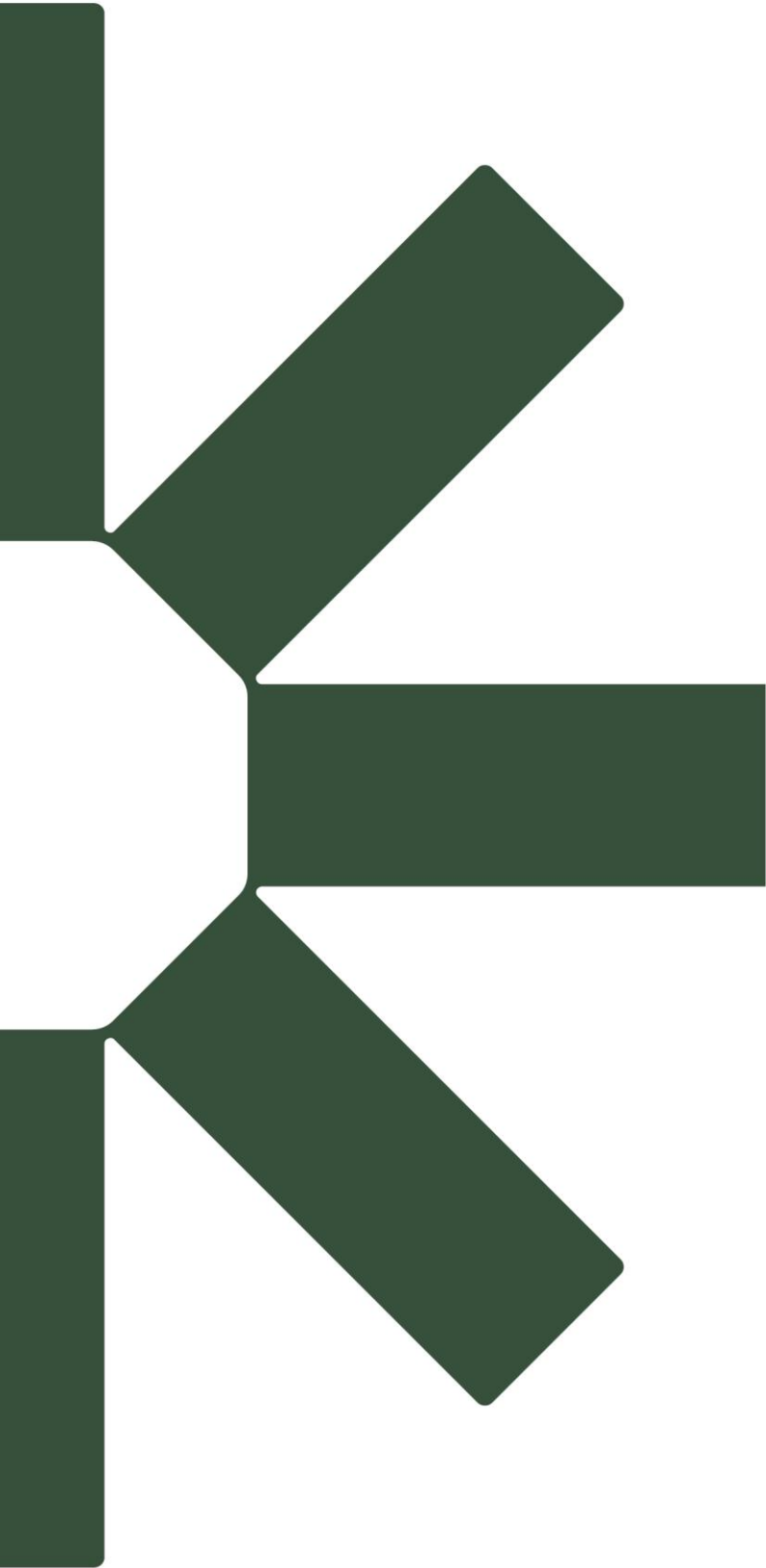
2. PAH = polycyclic aromatic hydrocarbons. Concentration ranges are between known concentrations and the maximum possible concentrations (as some samples below laboratory detection limits). '< value' indicates all concentrations below laboratory detection limits.

3. TPH = total petroleum hydrocarbons – maximum content. '< value' indicates all concentrations below laboratory detection limits.

4. OCP = organochlorine pesticides. Concentration ranges are between known concentrations and the maximum possible concentrations (as some samples below laboratory detection limits). '< value' indicates all concentrations below laboratory detection limits.

5. ANZECC (2000) interim sediment quality (ISQG) guideline values, as listed in the resource consent.





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