WATERCARE SERVICES SOUTHWEST MANUKAU

WATER QUALITY AND BENTHIC ECOLOGY BASELINE MONITORING 2024–2025

COAST & CATCHMENT

ENVIRONMENTAL CONSULTANTS

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Cover photo: Screenshot from underwater video footage from the 2025 biogenic habitat survey.

1 CONTENTS

2 EXECUTIVE SUMMARY

Watercare Services Ltd (Watercare) have consent for the construction of a new wastewater outfall in Waiuku Channel, Manukau Harbour, and for the discharge of treated wastewater. Watercare is required by the conditions of consent, to carry out baseline monitoring of the coastal receiving environment for at least two years prior to discharges from the new outfall commencing.

The first year of baseline monitoring, carried out in 2024–25, included:

- monthly sampling for general water quality at 10 sites, and phytoplankton at six sites;
- 24-hour monitoring of dissolved oxygen at a site below the newly consented outfall site in December 2024, March 2025 and May 2025;
- sampling and characterisation of intertidal benthic macroinvertebrate communities at nine intertidal sites on the western and eastern sides of Waiuku Channel;
- sampling and analysis of sediment characteristics and quality at the nine intertidal sites where ecological samples were collected;
- obtaining underwater video footage along 50, 200 m transects for the analysis of biogenic and physical features.

Water quality

Results show that water quality at the remote Whatapaka (WQ 8) site[1] was much poorer than in all the Waiuku Channel and Taihiki Creek sites. The Whatapaka (WQ 8) site had higher concentrations of ammoniacal-N, total nitrogen, total phosphorus, total suspended solids and turbidity. Occasionally, large spikes in total oxidised nitrogen, total inorganic nitrogen, chlorophyll *a*, enterococci, and faecal coliforms were also recorded at that site.

Total ammoniacal-N concentrations tended to be low at the Waiuku and Taihiki Creek sites. Total oxidised nitrogen concentrations were highest at the uppermost sites (Taihiki (WQ-10) and Upper Waiuku (WQ 9)), and declined toward the main body of the harbour. Total nitrogen concentrations tended to be less variable (spatially and temporally) than inorganic forms, with similar concentrations observed at all sites. All sites around the existing and consented future outfall had similar dissolved reactive phosphorus (DRP) concentrations and displayed comparable patterns of temporal variation – a declining trend between June and November, followed by an increasing trend though to April, then a subsequent decline. Concentrations and temporal variation in total phosphorus concentrations were also similar among sites, but temporal patterns were less pronounced and differed slightly from those displayed by DRP. The highest chlorophyll *a* concentration (0.0035 mg/L) was recorded in February, at the 3 km North (WQ 7) site in the main body of the harbour. However, little difference was apparent in chlorophyll *a* concentrations among the monitoring sites.

Little spatial or temporal variation was also apparent in total suspended solids concentrations, turbidity, pH, dissolved oxygen saturation or salinity. Enterococci concentrations were low at all sites and sampling occasions, and mostly below detection

[1] Situated at the mouth of the Kingseat tributary.

limits, while faecal coliform concentrations varied from below detection limits (33% of samples) to 64 cfu/100 mL. Sixteen samples (13.6%) had faecal coliform concentrations >10 cfu/100 mL, while 5 samples (4.3%) had concentrations of ≥ 20 cfu/100 mL.

Diurnal variation in dissolved oxygen

Diurnal variation in dissolved oxygen was much greater than depth variation. Lowest saturation and concentration levels occurred around dawn, with increasing levels through to mid to late afternoon/evening, and declining concentrations overnight. Dissolved oxygen levels were highest in early summer (December), intermediate in early autumn (March), and lowest in late autumn (May).

Phytoplankton

Overall, a total of 152 phytoplankton taxa from 11 phylum or other general high-order groups were identified. The dominant taxa groups were flagellates-unicells, and small flagellates-unicells which displayed strong seasonality in cell counts, with numbers increasing in late spring to peak in summer, and declining over autumn at all sites. Similar seasonal patterns were observed in pooled counts of the next 10 taxa groups ranked by mean numbers, and in total cell counts of all taxa throughout the year.

Low numbers of potentially toxic filamentous cyanobacteria were detected at the 250 m South (WQ 2) (6 cells per mL, 715 μm^3/mL), and 3 km North (WQ 7) (5 cells per mL, 650 μm^3/mL) water quality monitoring sites in July 2024. Other potentially toxic species obtained in phytoplankton samples, included: *Alexandrium ostenfeldii, Alexandrium pacificum, Gymnodinium catenatum*, *Azadinium* sp., and *Karenia* sp. Taxa from the potentially toxic *Prorocentrum* and *Pseudo-nitzschia* genera were also present, but were not identified to species levels.

Sediment quality

Sediments at the Ngahere site, on the eastern side of the main channel had the highest proportion of mud (48%). On that side of the channel, a clear demarcation in sediment characteristics occurred around the entrance to Waiuku River (between Tokaroa and Karaka Points), with sediment mud content decreasing in the northern sites in the main body of the harbour. A similar change occurred on the western side of the channel, with a marked difference occurring between the Rauau and Tokaroa North sites (Tokaroa North had the lowest proportion of mud of any site). However, mud content increased again between the Tokaroa North and Wairoa Point sites. All sites had moderate to high percentages of sand (51–99%), with the Tokaroa North and Clarks Beach sites having the highest percentage (95–96%).

Mud, total organic carbon content,phosphorus and total nitrogen concentrations were highly correlated, and therefore all four parameters displayed similar spatial patterns to those described above for mud content.

Intertidal benthic macrofauna

A diverse assemblage of intertidal macrofauna was identified, with 18,735 individuals and 90 taxa collected from the nine monitoring sites. The abundance of individual taxa and

results from four indicators of ecological diversity and abundance varied among sites. In summary:

- Cockles *Austrovenus stutchburyi* were the most abundant species by a large margin, followed by the nut shell *Linucula hartvigiana* and polychaete *Anoides trifida*, whose overall mean abundances were less than half that of cockles.
- Cockle and nut shell numbers on the western side of the main channel were markedly lower at sites north of Tokaroa and Karaka Points. On the eastern side of the channel, patterns in these species were more variable, with no clear distinction between sites above and below the transition zone.
- Other taxa, including the polycheate *A. trifida* and mysid shrimps (Mysida) occurred in high numbers at a limited number of sites.
- Variation in the total numbers of individuals largely mirrored the patterns described above for variation in cockle and nut shell numbers.
- The eastern channel sites generally had more taxa than the other sites.
- Patterns in Pielou's evenness and Shannon diversity were similar, and largely the inverse of patterns for the total numbers of individuals. This reflects the influence of high cockle and nut shell numbers on these indicators.
- Multivariate analysis indicated that macrofaunal communities from sites in the main body of the harbour were more variable than communities within Waiuku River, with a gradient observed between western and eastern sites. Three of the inner channel sites (Ohiku Creek, Waiau, and Rauau North) had very similar communities, but the community composition of the Ngahere site was distinct.
- Combined Health Scores of all sites, except Clarks Beach, were ranked as 'fair'. The Clarks Beach site was ranked as 'good'.

Shellfish

In total, 5258 cockles, 557 wedge shells *Macomona liliana* and four pipi *Paphies australis* were collected. The majority of cockles were very small, with 75% being less than 5 mm in length, and none considered a 'harvestable' size (>30 mm). Similarly, the majority (73%) of wedge shells were less than 5 mm long.

Subtidal habitats and biogenic features

Underwater video footage showed that hard substrates were the most widespread feature within the area surveyed, with reef, boulders and gravelly rubble observed. Overall, hard substrates were found in 88% of transects, whereas muddy and sandy substrates were only found in 24% and 22% of transects, respectively.

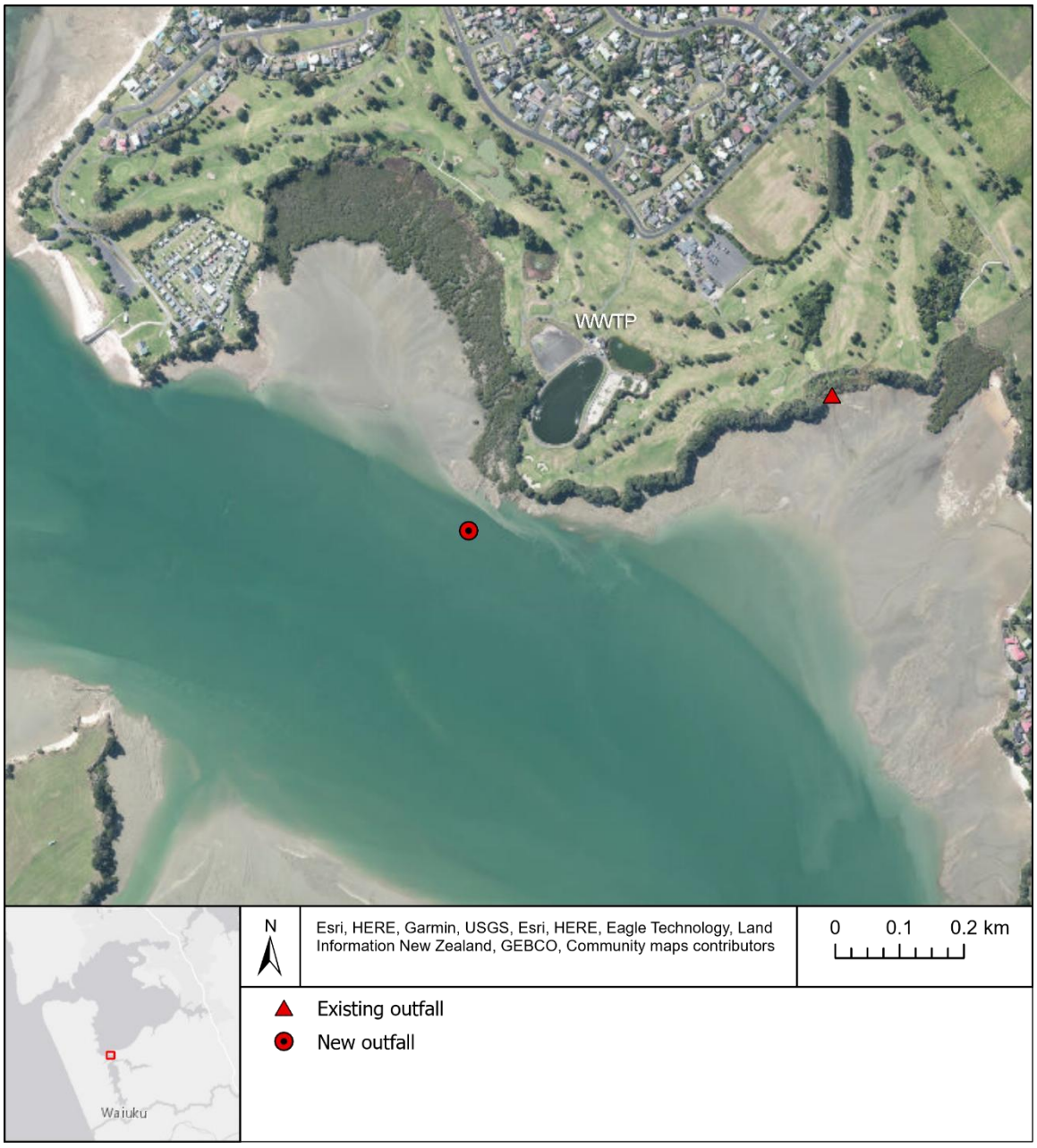
Biological features observed in the transect footage included sponges, bryozoans, macroalgae, and a variety of other taxa. Sponges were the most common and widespread group observed (occurring in 78% of the transects), followed by bryozoans (64%), ascidians (38%) and macroalgae (18%). Sponges were observed throughout the survey area, except for the southernmost section. Bryozoans and ascidians were generally limited to the northern half of the survey area, whereas macroalgae were generally only observed in the outermost

transects. Ecological complexity was typically low upstream of the outfall and moderate to high downstream of the outfall location, except for around Tokaroa Point, where it was low.

3 BACKGROUND

Treated wastewater from the Clarks Beach Wastewater Treatment Plant (WWTP) is currently discharged via a stormwater drain onto the Clarks Beach golf course where it runs through a series of reservoirs and wetlands before being discharged to the intertidal zone in Waiuku Channel (Figure 1). In 2018, Watercare Services Ltd (Watercare) obtained consent (CST60082600 & CST60082302) for the construction of a new wastewater outfall in Waiuku Channel, and for the discharge of treated wastewater. Watercare is required by the conditions of consent, to carry out baseline monitoring of the coastal receiving environment for at least two years prior to discharges from the new outfall commencing. This report presents the first year's monitoring results for water quality and marine benthic ecology as specified in the certified Receiving Environment Monitoring Plan (REMP; Watercare 2024).

Figure 1. Location of the Clarks Beach WWTP, the existing outfall, and the new outfall.



4 WATER QUALITY

4.1 METHODS

4.1.1 MONITORING PERIOD AND SITES

Ten sites were monitored for water quality on a monthly basis between June 2024 and June 2025 (Figure 2):

- 50 m south and north (upstream and downstream) of the outfall (WQ3 and WQ4);
- 250 m south and north (upstream and downstream) of the outfall (WQ2 and WQ5);
- 1 km south and north (upstream and downstream) of the outfall (WQ1 and WQ6);
- 3 km north (downstream) of the outfall (WQ7);
- Whatapaka (WQ8);
- Upper Waiuku (WQ9); and,
- Taihiki (WQ10).

Coordinates for the sites are given in Table 9 in the Appendices.

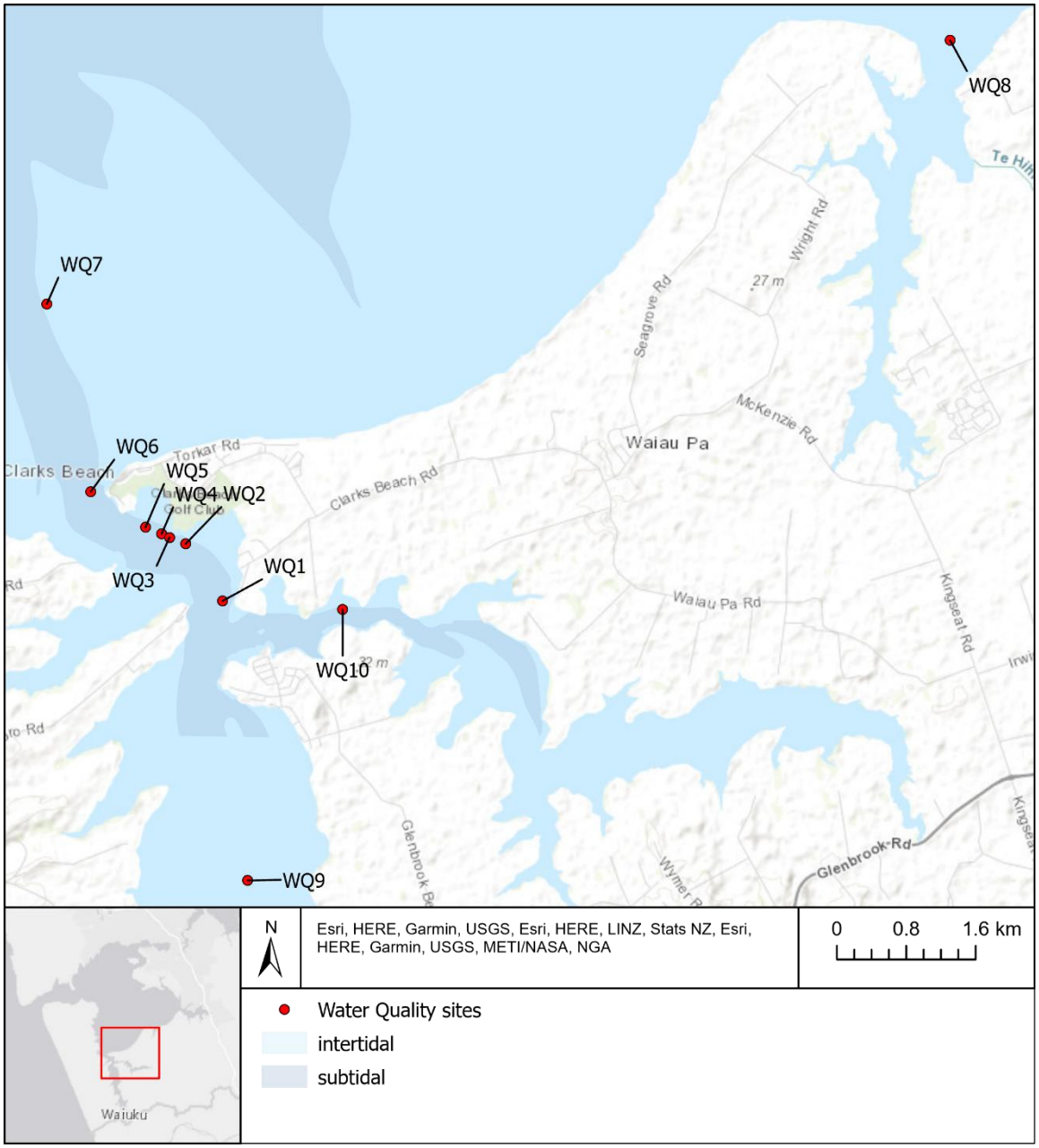
4.1.2 WATER QUALITY SAMPLING METHODS

All sites, except for WQ8, were sampled monthly by Coast and Catchment via boat. WQ8 was sampled by Auckland Council as part of their monthly helicopter run. Sampling was conducted within 1.5 hours of mid-tide, in accordance with the methods outlined in REMP. At each site:

- Field measurements were taken for salinity, conductivity, dissolved oxygen, water temperature, and pH using calibrated YSI ProSolo and Pro 10 field meters.
- Water samples were collected, transferred to cooler bins, and transported to Watercare Laboratories on the day of collection. Samples were analysed for ammoniacal-N (NH_x-N), total oxidised nitrogen (TON – alternatively referred to as nitrate-nitrite-nitrogen), total inorganic nitrogen (TIN), total nitrogen (TN), dissolved reactive phosphorus (DRP), total phosphorus (TP), chlorophyll-*a*, total suspended solids, turbidity, enterococci, and faecal coliforms. Laboratory measurements of pH, salinity and conductivity were also made.
- General observations were made on:
    - the presence of any conspicuous oil or grease films, foam scums, or floating/suspended materials;
    - weather and water conditions;
    - any sampling issues;
    - date and time of sampling and tide time.

As the data only covered a single year, statistical analyses of the data were not carried out. Rather, water quality data were simply plotted, with spatial and temporal patterns being visually assessed. Plotting and visual analysis of water quality results was carried out using RStudio and tidyverse package (Wickham et al. 2019).

Figure 2. Location of the water quality monitoring sites.



4.1.3 DISSOLVED OXYGEN SAMPLING

Dissolved oxygen measurements were taken every two hours over a 24-hour period at a site with a low tide depth of approximately 12 m (beside the 250 m North (WQ 5) water quality site; see Figure 2). Monitoring was carried out on three occasions: 3–4 December 2024, 11–12 March 2025 and 5–6 May 2025. The sampling periods were chosen to cover times when when chl-*a* concentrations are typically at their highest (Dec–Mar), and when they are typically at their lowest (May). Readings were taken using a hand-held YSI ProSolo dissolved oxygen meter with a 20 m sensor cable. The weighted sensor was clipped to, and fed down, a heavily weighted vertical line. Measurements were taken at every two metres of depth in December, and at every one metre of depth in March and May. Dissolved oxygen data were plotted and visually assessed.

4.1.4 PHYTOPLANKTON

Monthly phytoplankton sampling was conducted at six sites (WQ2, WQ5, WQ6, WQ7, WQ9, WQ10). A depth-integrated water sample was taken from the top 5 m of the water column. Samples were transferred to dark containers, chilled, and transported to Earth Sciences New Zealand Hamilton for analysis within 24 hours of collection. Samples were analysed for:

- harmful microalgae;
- cyanobacteria;
- numerically dominant phytoplankton species.

For each site, maximum cell counts (cells/mL) of potentially harmful microalgae listed in Table 2 of the Regulated Control Scheme for Bivalve Molluscan Shellfish for Human Consumption (Ministry for Primary Industries 2024) were converted to cells/L and compared against trigger values for flesh testing on marine farms. Counts of potentially toxic cyanobacteria were also provided, along with information on where and when they were detected.

Variation in taxa diversity and the total cell counts of all phytoplankton, and the 12 taxa with the highest mean cell counts were plotted to examine variation over time and among sites. Finally, non-metric multidimensional scaling (MDS) was used to examine variation in phytoplankton community composition.

4.2 WATER QUALITY RESULTS

4.2.1 GENERAL WATER QUALITY

Temporal and spatial variation in monitored indicators of general water quality are provided in Figure 3 to Figure 16. As the data only covered a single year, statistical analyses of the data were not carried out. However, preliminary observations show that water quality at the Whatapaka (WQ 8) site is much poorer than it is in all of the Waiuku Channel and Taihiki Creek sites. The Whatapaka (WQ 8) site had higher concentrations of ammoniacal-N, total nitrogen, total phosphorus, total suspended solids and turbidity. Occasional large spikes in total oxidised nitrogen, total inorganic nitrogen, chlorophyll *a*, enterococci, and faecal coliforms were also observed at that site.

For sites around the existing and consented future outfall, plots of nitrogen species indicate that total ammoniacal-N concentrations at all sites tend to be low, and were frequently below detection limits (Figure 3). Highest concentrations were recorded above the outfall, at the Taihiki (WQ-10 site). Highest total oxidised nitrogen concentrations occurred in the uppermost sites (Taihiki (WQ-10) and Upper Waiuku (WQ 9)), and declined toward the main body of the harbour (Figure 4). All sites displayed similar temporal patterns in TON. Total inorganic nitrogen concentrations displayed similar patterns to TON, reflecting the fact that TON was the dominant contributor to TIN (Figure 5). Total nitrogen concentrations tended to be less variable (spatially and temporally) than inorganic forms, with similar concentrations observed at all sites (Figure 6).

All sites around the existing and consented future outfall had similar DRP concentrations and displayed very similar patterns of temporal variation – a declining trend between June and November, followed by an increasing trend though to April, then a subsequent decline (Figure 7). Concentrations and temporal variation in TP concentrations were also similar

among sites, but the temporal patterns were less pronounced and differed slightly from those displayed by DRP. Total phosphorus concentrations declined between June and August, increased through to April–-May, and subsequently declined (Figure 8). The highest chlorophyll *a* concentration (0.0035 mg/L) was recorded in February at the 3 km North (WQ 7) site in the main body of the harbour. However, overall there was little difference in chlorophyll *a* concentrationsamong the monitoring sites (Figure 9).

There was also little difference among the sites around the existing and consented future outfall in TSS concentrations or turbidity. The highest TSS concentration measured was 23 mg/L at the 1 km North (WQ 6) site in November (Figure 10), while the highest turbidity level recorded was 11 NTU at the 1 km North (WQ 6) and 1 km South (WQ 1) sites in November (Figure 11).

Little difference was also observed in field measurements of:

- pH, which ranged between 7.9 and 8.4 (Figure 12);
- dissolved oxygen saturation, which ranged between 91% and 110% (Figure 13); and,
- salinity, which ranged between 27 ppt and 38 ppt (Figure 14).

Enterococci concentrations were low at all sites and sampling occasions, and mostly below detection limits (Figure 15). Faecal coliform concentrations varied from below detection limits (33% of samples) to 64 cfu/100 mL, which was recorded at the 50 m South (WQ 3) site in June 2025. Sixteen samples (13.6%) had faecal coliform concentrations >10 cfu/100 mL, while five samples (4.3%) had concentrations of ≥ 20 cfu/100 mL.

Figure 3: Temporal variation in total ammoniacal-N. Sites are ordered from up-river to down-river with those above the future outfall having green headers and those below having blue headers, and the Whatapaka site coloured khaki.

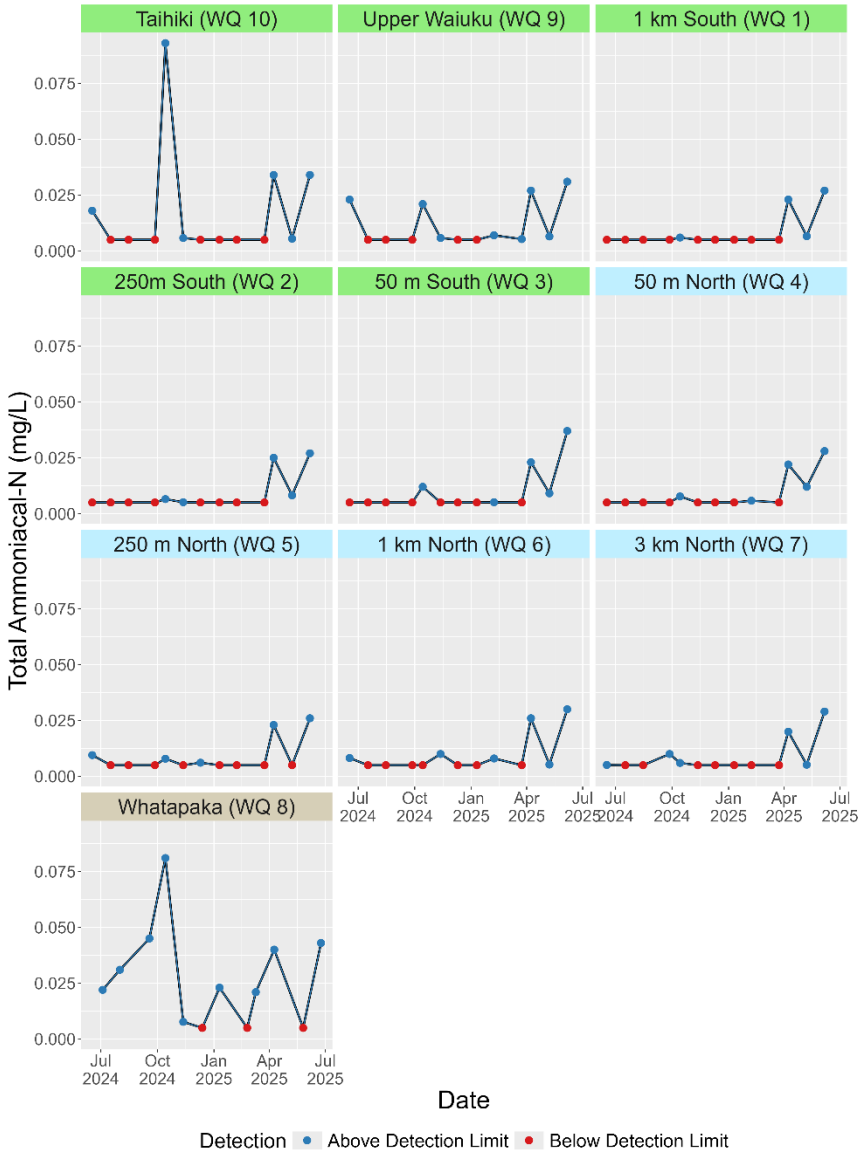


Figure 4: Temporal variation in total oxidised nitrogen. Sites are ordered from up-river to down-river with those above the future outfall having green headers and those below having blue headers, and the Whatapaka site coloured khaki.

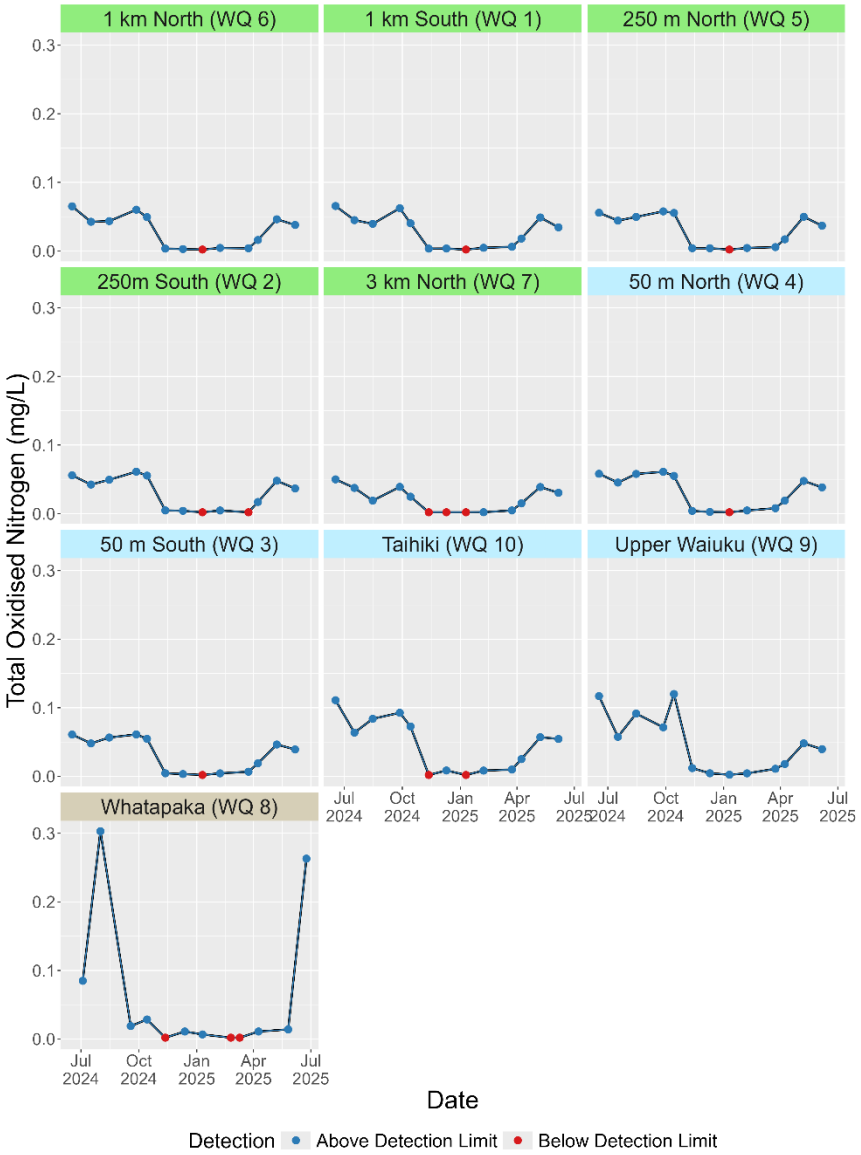


Figure 5: Temporal variation in total inorganic nitrogen. Sites are ordered from up-river to down-river with those above the future outfall having green headers and those below having blue headers, and the Whatapaka site coloured khaki.

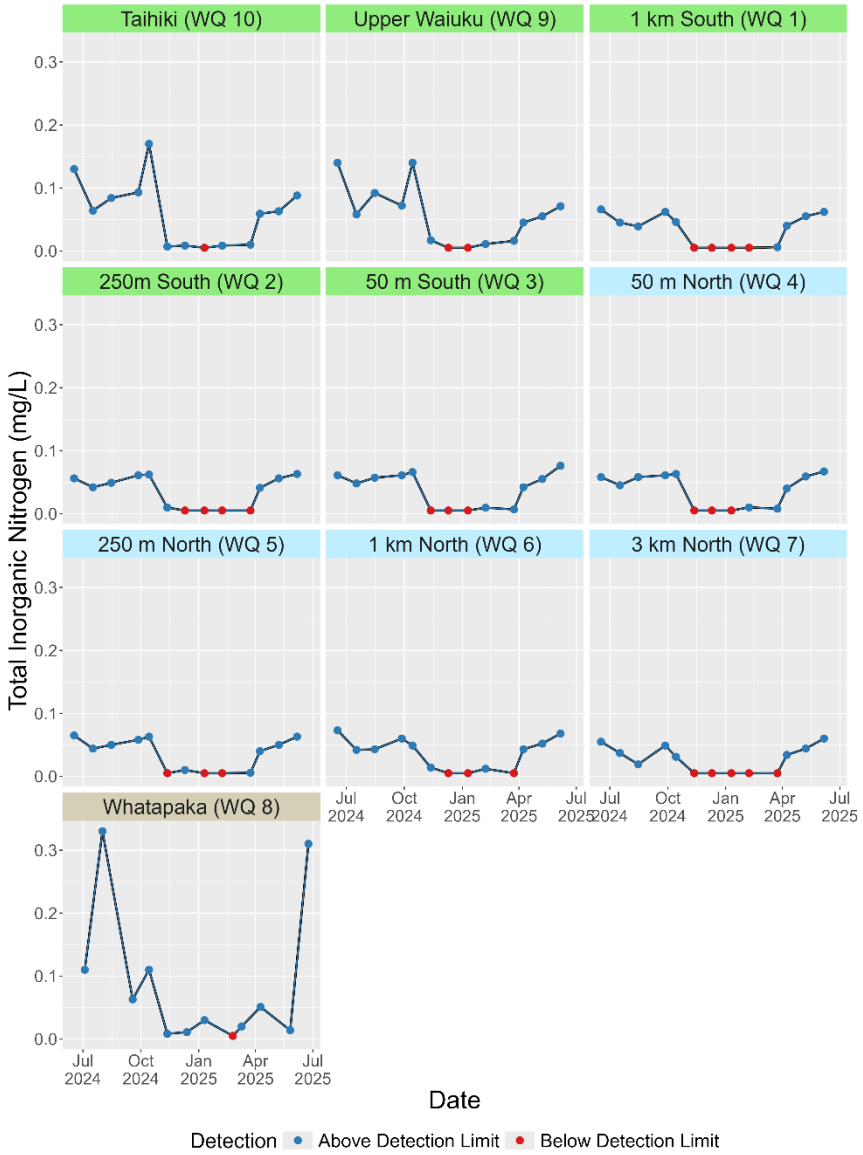


Figure 6: Temporal variation in total nitrogen. Sites are ordered from up-river to down-river with those above the future outfall having green headers and those below having blue headers, and the Whatapaka site coloured khaki.

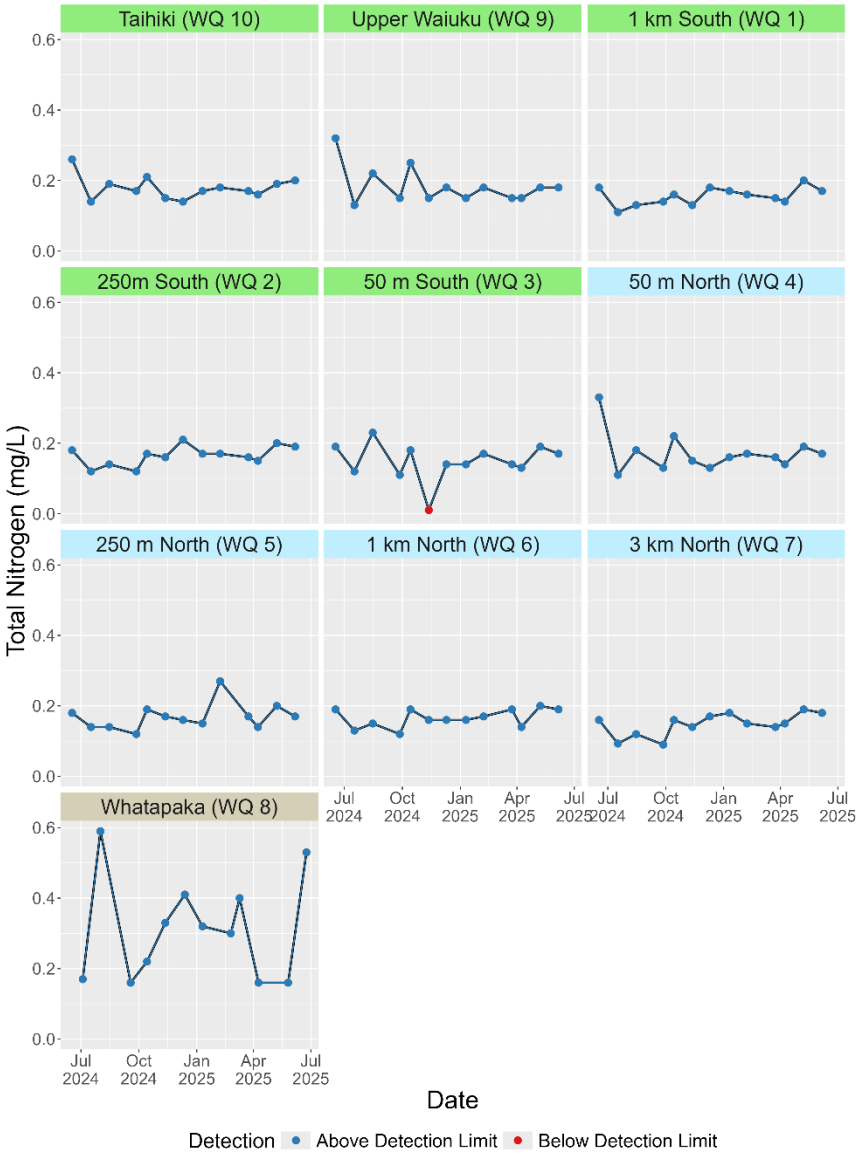


Figure 7: Temporal variation in dissolved reactive phosphorus. Sites are ordered from up-river to down-river with those above the future outfall having green headers and those below having blue headers, and the Whatapaka site coloured khaki.

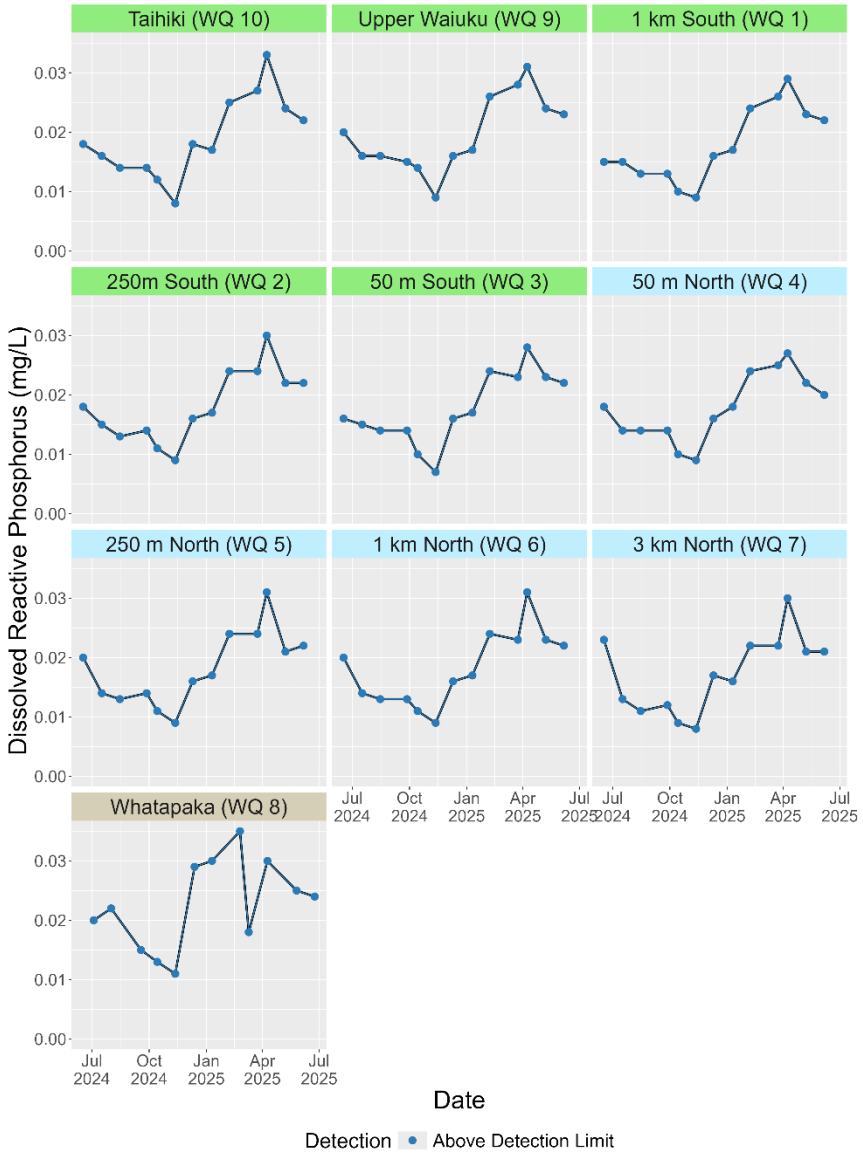


Figure 8: Temporal variation in total phosphorus. Sites are ordered from up-river to down-river with those above the future outfall having green headers and those below having blue headers, and the Whatapaka site coloured khaki.

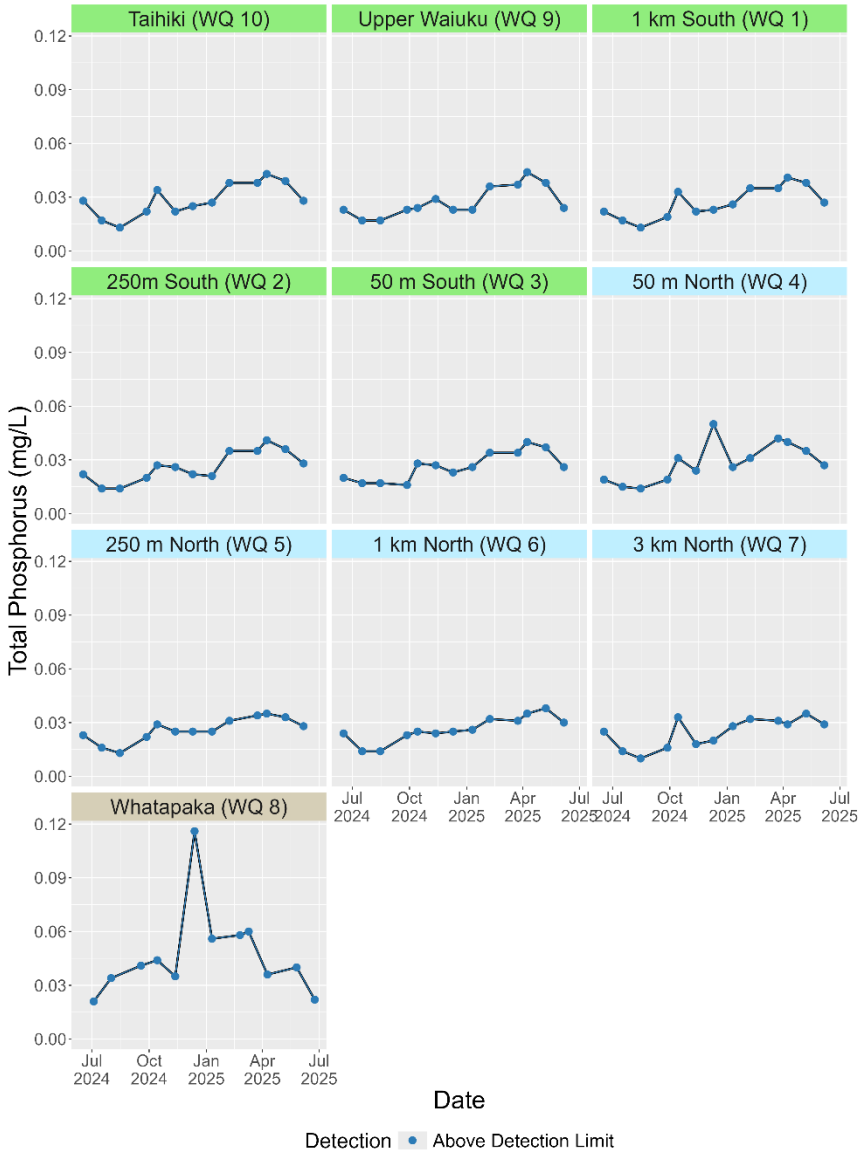


Figure 9: Temporal variation in chlorophyll *a*. Sites are ordered from up-river to down-river with those above the future outfall having green headers and those below having blue headers, and the Whatapaka site coloured khaki.

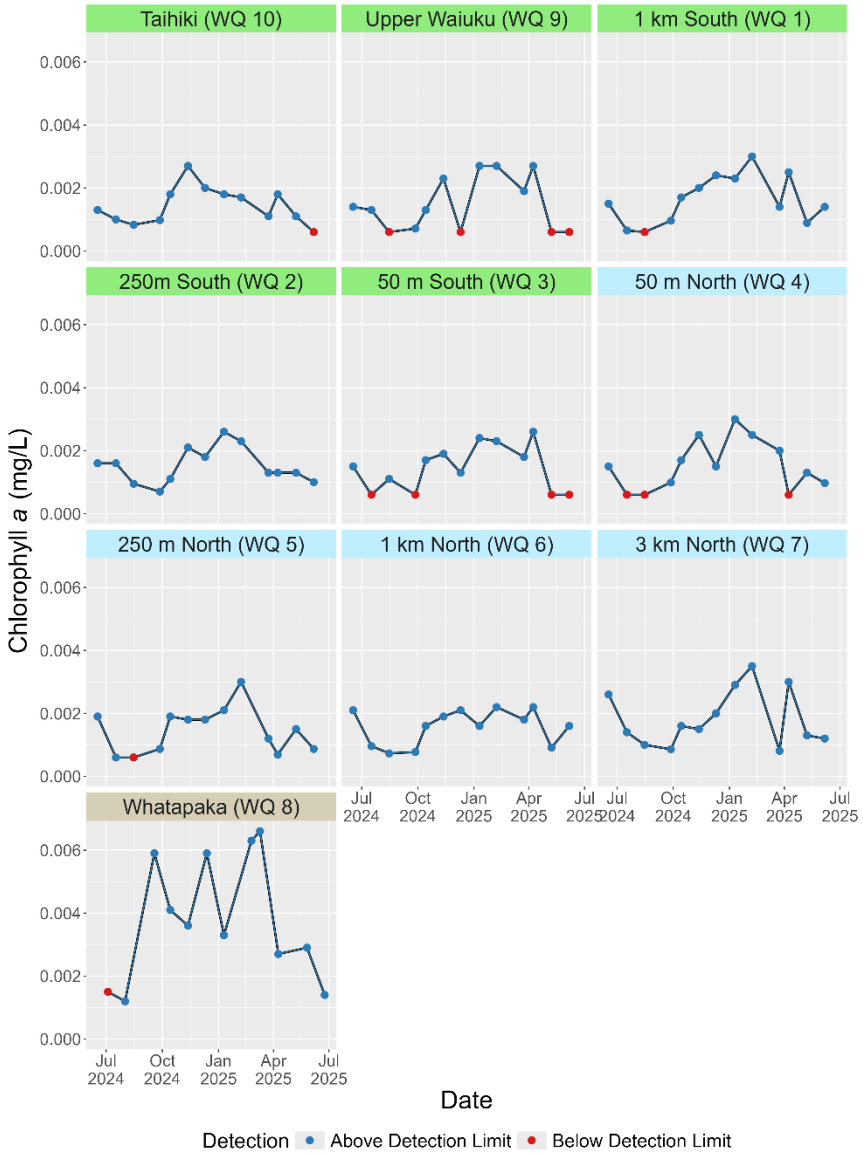


Figure 10: Temporal variation in total suspended solids. Sites are ordered from up-river to down-river with those above the future outfall having green headers and those below having blue headers, and the remote Whatapaka (WQ 8) site coloured khaki.

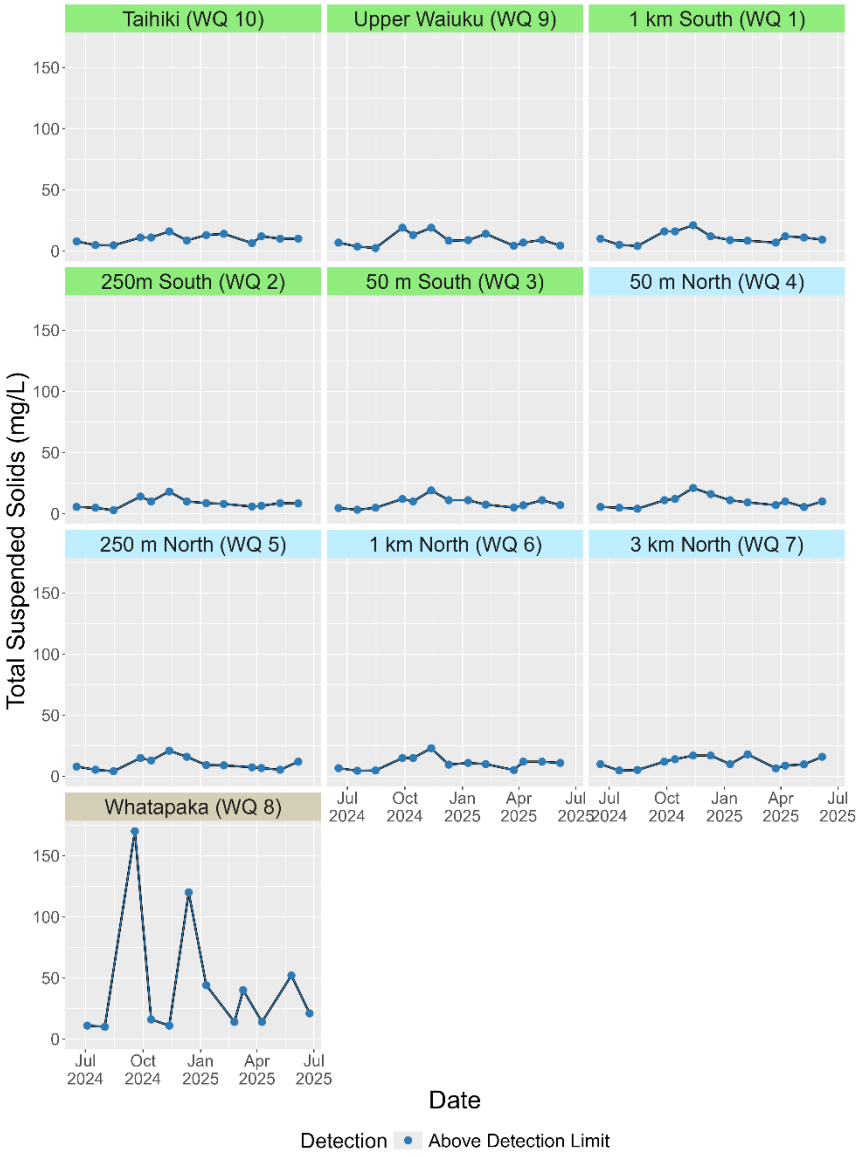


Figure 11: Temporal variation in turbidity. Sites are ordered from up-river to down-river with those above the future outfall having green headers and those below having blue headers, and the remote Whatapaka site (WQ 8) coloured khaki.

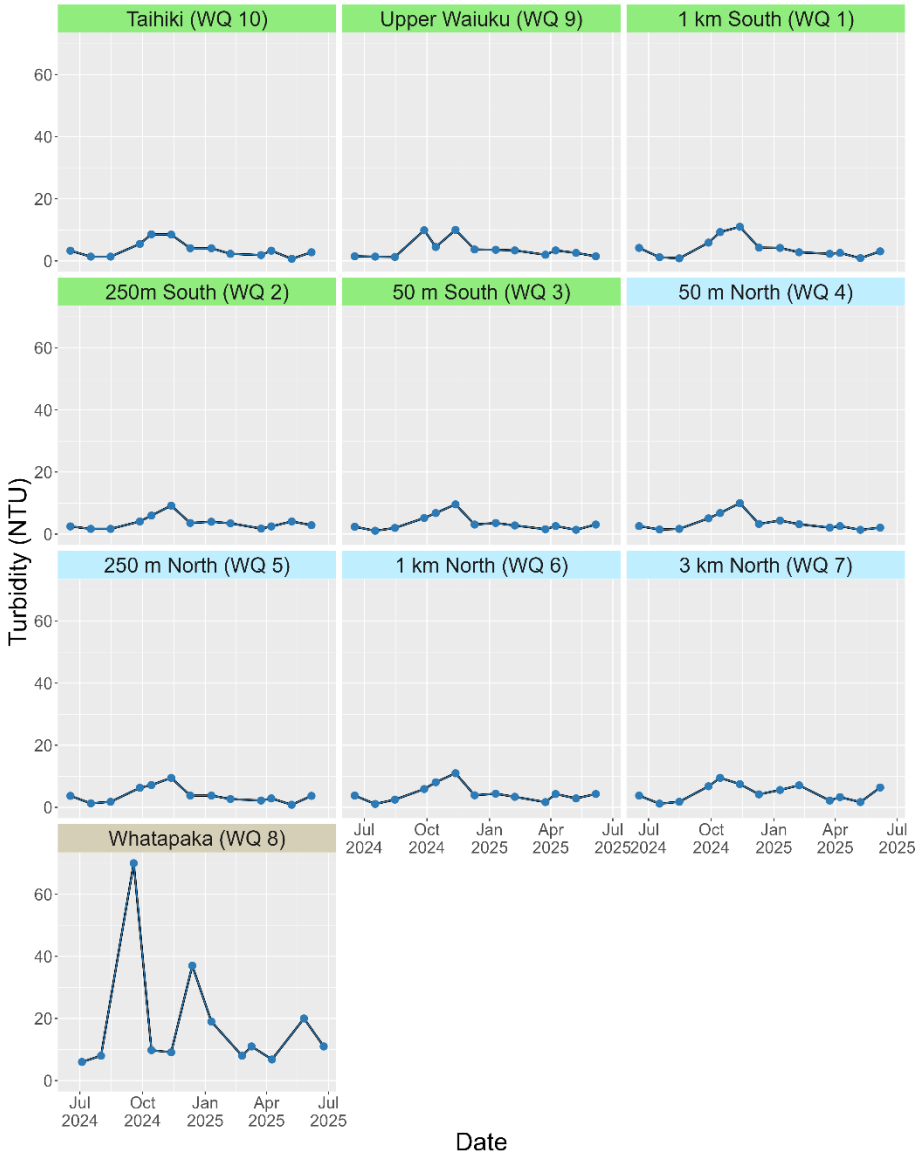


Figure 12: Temporal variation in pH. Sites are ordered from up-river to down-river with those above the future outfall having green headers and those below having blue headers, and the Whatapaka site coloured khaki.

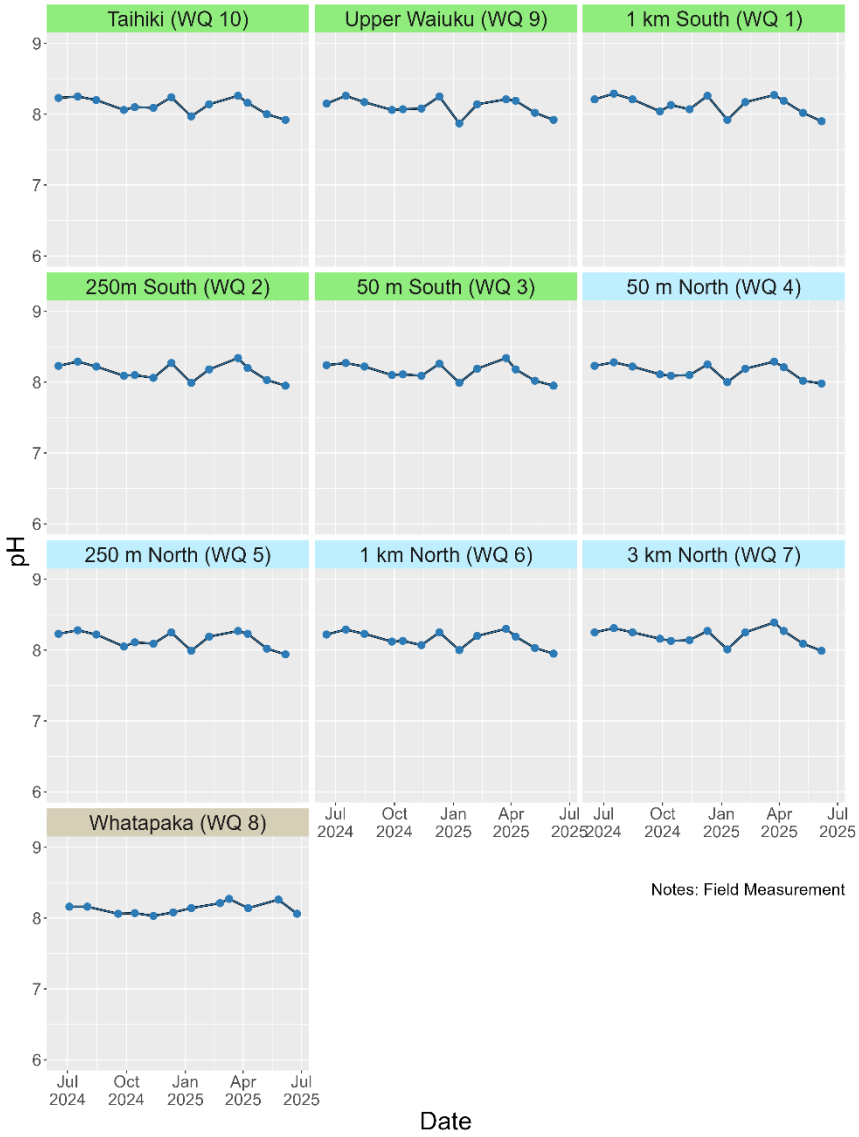


Figure 13: Temporal variation in dissolved oxygen saturation. Sites are ordered from up-river to down-river with those above the future outfall having green headers and those below having blue headers, and the Whatapaka site coloured khaki.

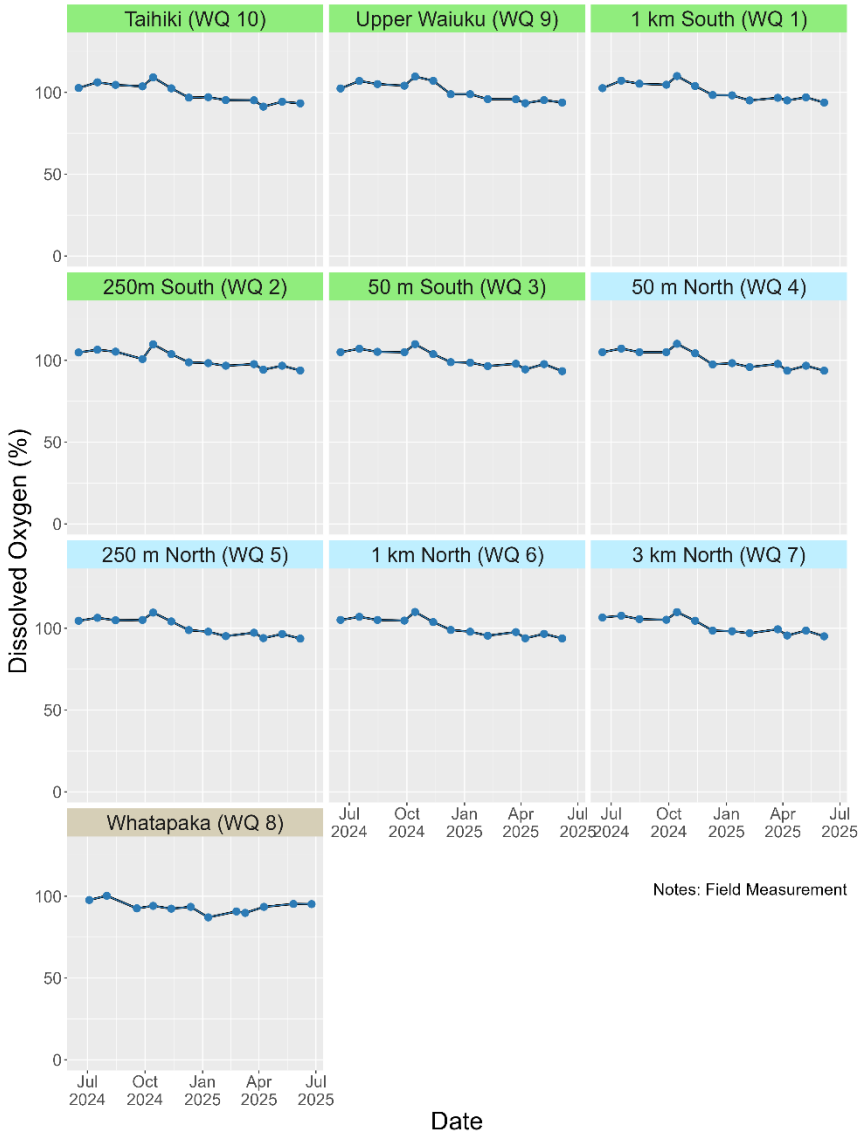


Figure 14: Temporal variation in salinity measured in the field. Sites are ordered from up-river to down-river with those above the future outfall having green headers and those below having blue headers, and the Whatapaka site coloured khaki.

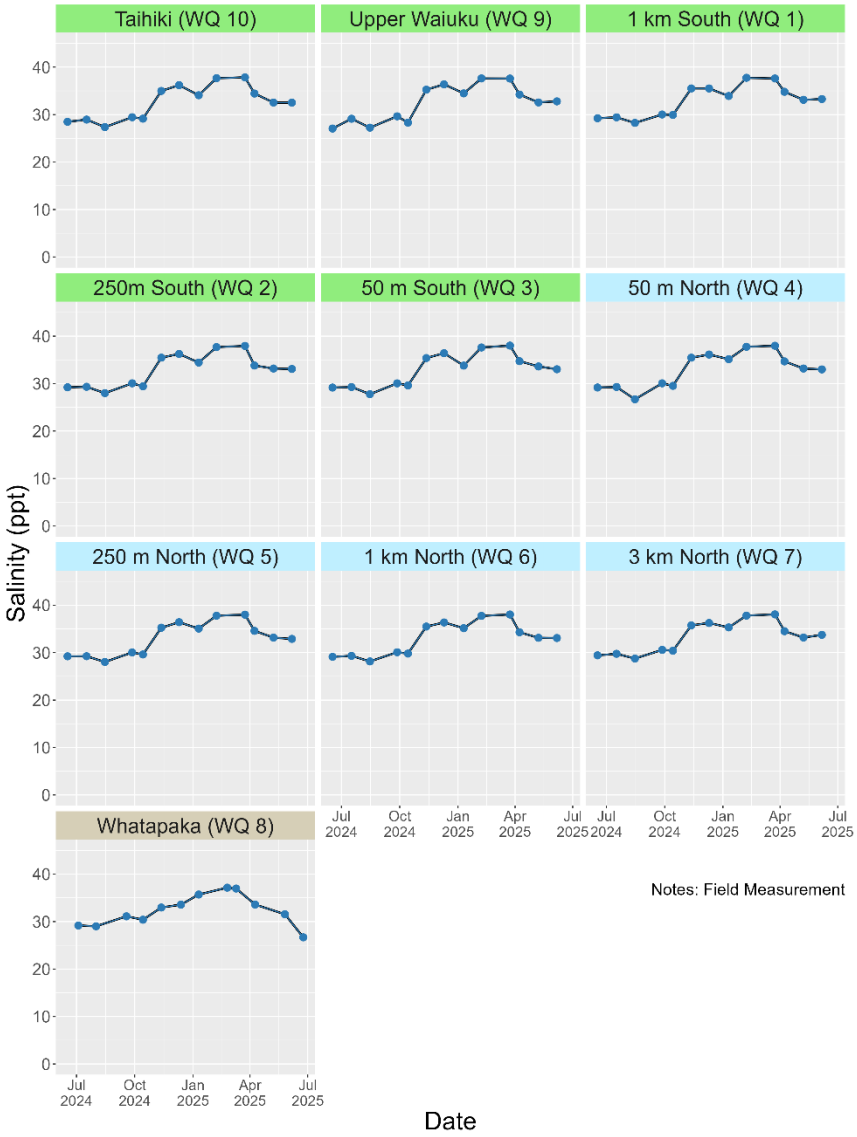


Figure 15: Temporal variation in enterococci. Sites are ordered from up-river to down-river with those above the future outfall having green headers and those below having blue headers, and the Whatapaka site coloured khaki.

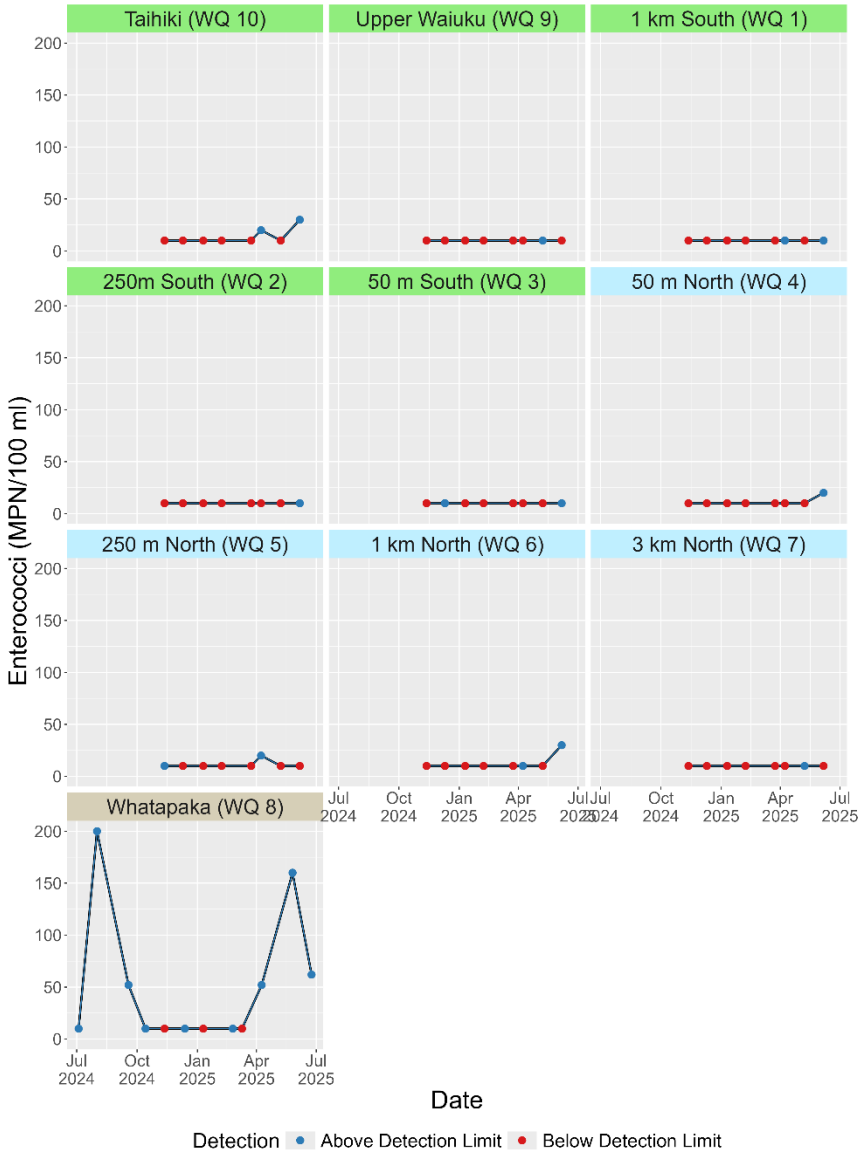
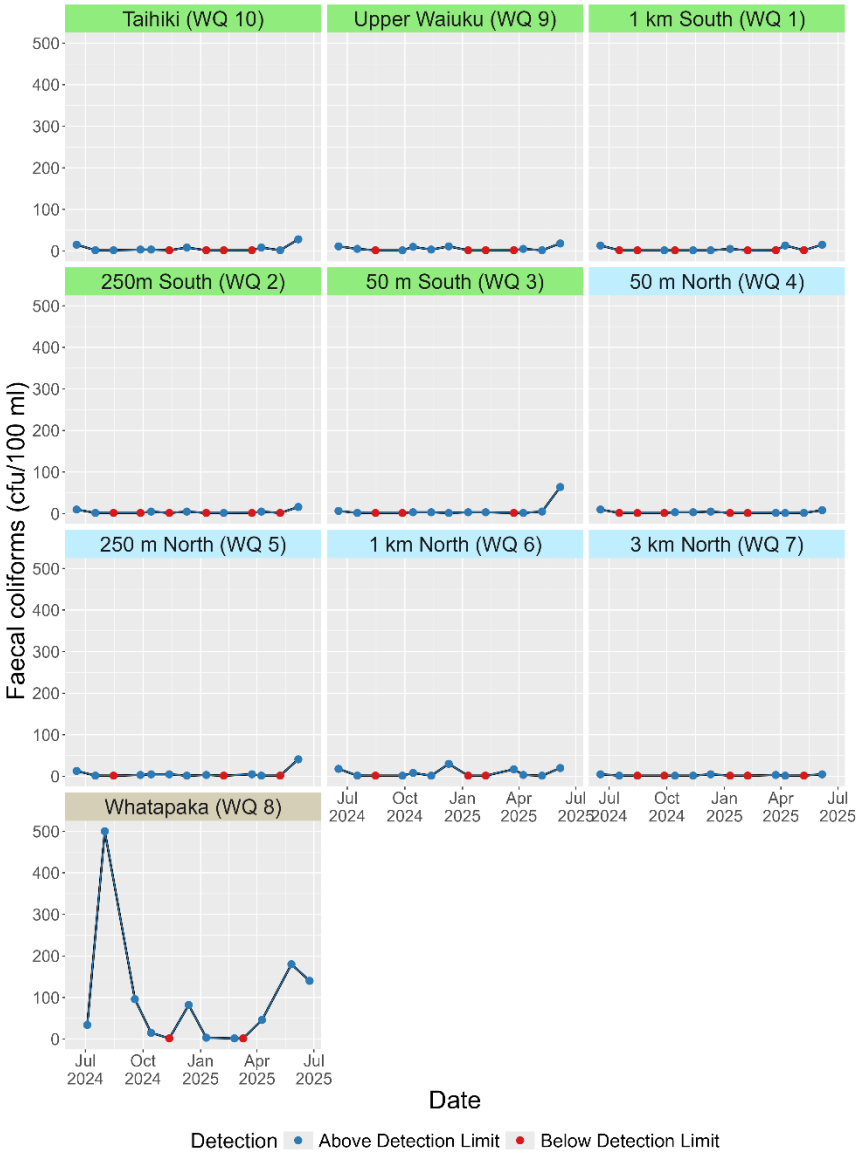


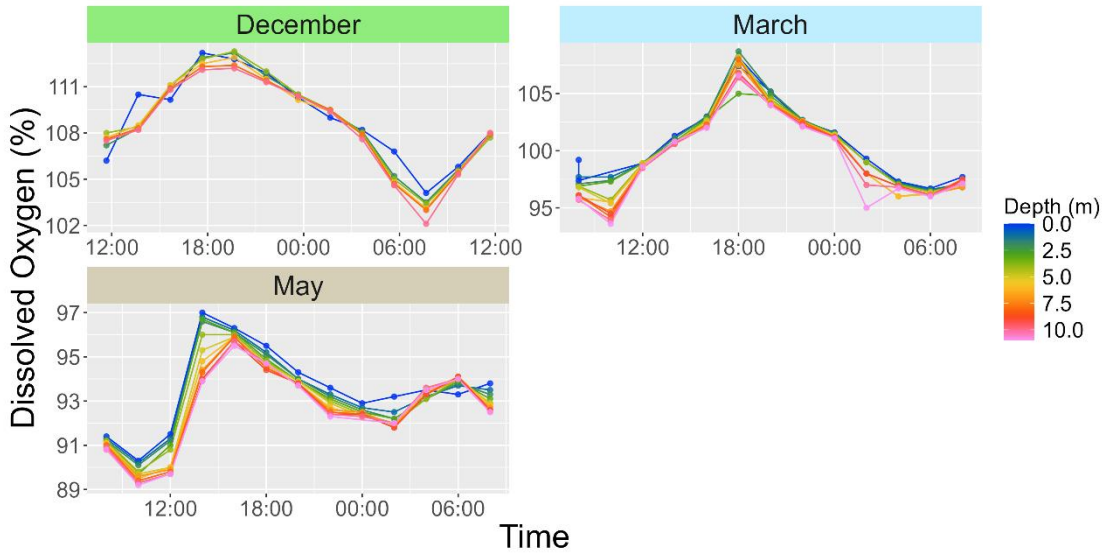
Figure 16: Temporal variation in faecal coliforms. Sites are ordered from up-river to down-river with those above the future outfall having green headers and those below having blue headers, and the Whatapaka site coloured khaki.



4.2.2 DISSOLVED OXYGEN

Depth profiles in dissolved oxygen saturation and concentrations were monitored for 24-hours in December 2024, March 2025, and May 2025. Patterns in dissolved oxygen saturation and concentration were very similar, with slight decreases observed with increasing depth over each 24-hour period. Temporal variation was much greater, with lowest saturation and concentration levels occurring around dawn, increasing levels through to mid to late afternoon/evening, and declining concentrations overnight. Dissolved oxygen levels were highest in early summer (December), intermediate in early autumn (March) and lowest in late autumn (May) (see Figure 17 for plots of dissolved oxygen saturation).

Figure 17: Twenty-four-hour depth profiles of dissolved oxygen from December 2024, March 2025, and May 2025. Note that the start time in December differs from those in March and May.



4.2.3 PHYTOPLANKTON

Low numbers of potentially toxic filamentous cyanobacteria were detected at the 250 m South (WQ 2) (6 cells per mL, 715 µm³/mL), and 3 km North (WQ 7) (5 cells per mL, 650 µm³/mL) in July 2024. Other potentially toxic species obtained in phytoplankton samples, included: *Alexandrium ostenfeldii, Alexandrium pacificum, Gymnodinium catenatum*, *Azadinium* sp., and *Karenia* sp. Taxa from the potentially toxic *Prorocentrum* and *Pseudo-nitzschia* genera were also present, but were not identified to species levels (Table 1).

Overall, a total of 152 phytoplankton taxa from 11 phylum or other general high-order groups[2] were identified. The two dominant taxa groups were flagellates-unicells, and small flagellates-unicells, which displayed strong seasonality in cell counts, with numbers increasing in late spring to peak in summer, and declining over autumn at all sites (Figure 18). Similar seasonal patterns were observed in pooled counts of the next 10 taxa groups

[2] Diatoms (Bacillariophyceae), Dinoflagellates (Dinoflagellata), Flagellates/Unicells, Autotrophic ciliate, Flagellates, Silicoflagellate, Raphidophytes, Blue greens (Cyanobacteria), Ciliophora (autotrophic), Eugleniods (Euglenozoa), Golden-brown algae (Chrysophyceae).

ranked by mean numbers[3] (Figure 19), and in total cell counts of all taxa throughout the year (Figure 20). However, numbers of taxa fluctuated throughout the year (Figure 21), leading to considerable variation in the relative contribution that individual taxa groups made to the phytoplankton community (e.g., see Figure 22). Multidimensional scaling showed that shifts in overall community composition occurred throughout the year at all sites (Figure 23).

[3] That is, taxa groups ranked 3rd to 12th for mean numbers.

Table 1: Potentially toxic phytoplankton taxa detected in water quality samples. Action levels for listed species are taken from the Regulated Control Scheme for Bivalve Molluscan Shellfish for Human Consumption (Ministry for Primary Industries 2024). Taxa that were identified to genus level have been included because they may be, or may include, a listed species.

Species/Group	Maximum count (cells/mL, adjusted to cells/L in brackets)	No. of samples	Action level (cells/L)	Sites where taxa detected	Notes
Alexandrium ostenfeldii	<0.1 (<100)	1	100	WQ 7	
Alexandrium pacificum	0.3 (300)	2	100	WQ 2	
Alexandrium **sp.**	0.6 (600)	1	100	WQ 2	Action level applicable to listed species
Alexandrium **spp.**	0.4 (400)	2	100	WQ 2, WQ 10	Action level applicable to listed species
Azadinium **sp.**	25	6	30,000	WQ 10, WQ 2, WQ 6	Level applies to *Azadinium* Group
Gymnodinium catenatum	0.4 (400)	2	100	WQ 2, WQ 6	
Karenia **sp.**	0.2 (200)	6	1,000– 250,000	WQ 5, WQ 6, WQ 9, WQ 10	Level varies among listed *Karenia* species and the general *Karina* Group
Prorocentrum **sp.**	<0.1 (<100)	2	500	WQ 6	
Prorocentrum **spp.**	<0.1 (<100)	2	500	WQ 6	Level only applicable to *Prorocentrum lima*
Pseudo-nitzschia **sp.**	9.88 (9,880)	22	100,000–1,000,000	All sites	Level varies between among listed species
Pseudo-nitzschia **spp.**	7 (7000)	8	100000–1,000,000	All sites	Level varies between among listed species

Figure 18: Stacked area plots showing temporal variation in cell counts of taxa groups ranked 1st and 2nd for mean numbers. Sites are ordered from up-river to down-river with those above the future outfall having green headers and those below having blue headers.

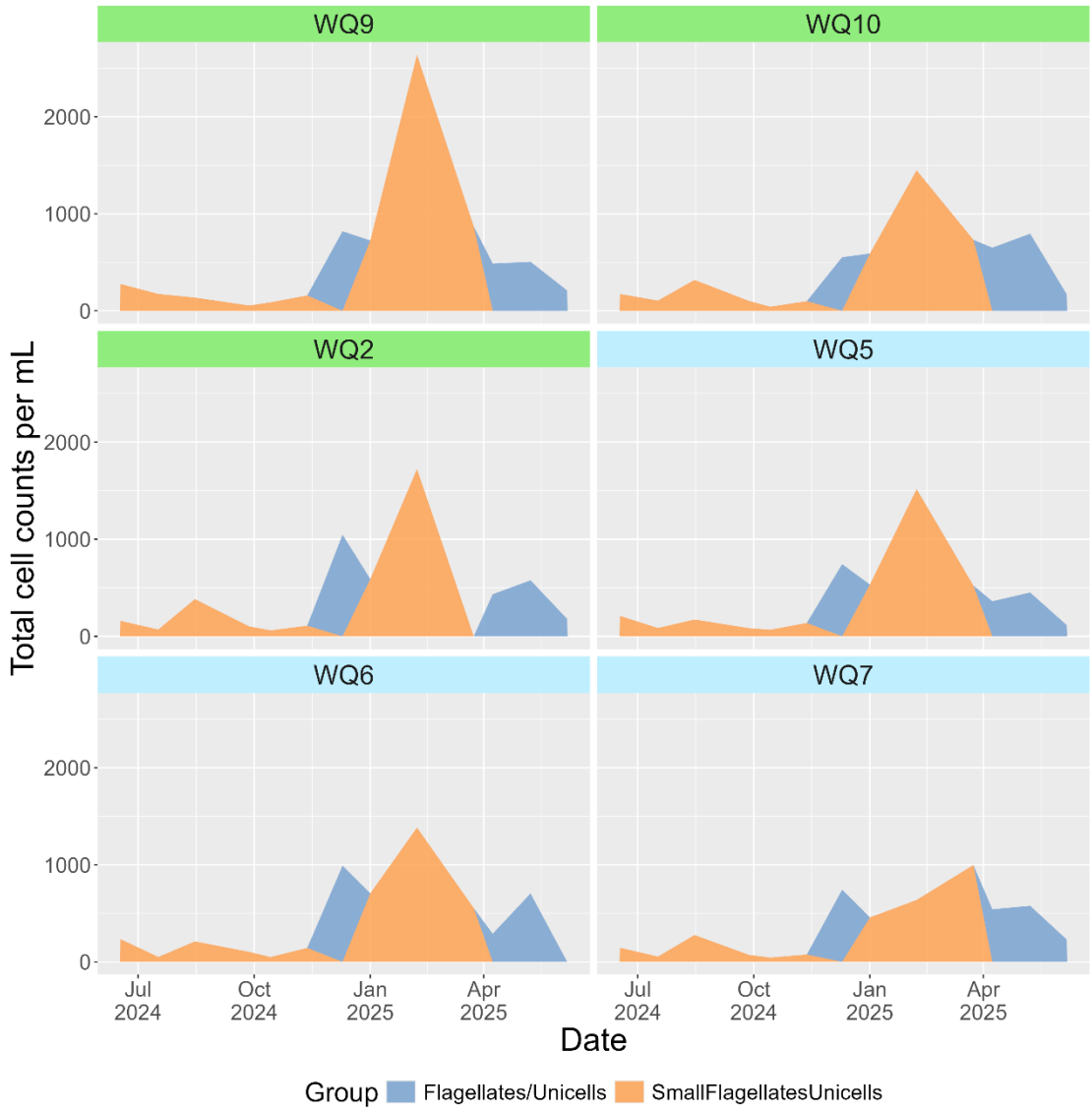
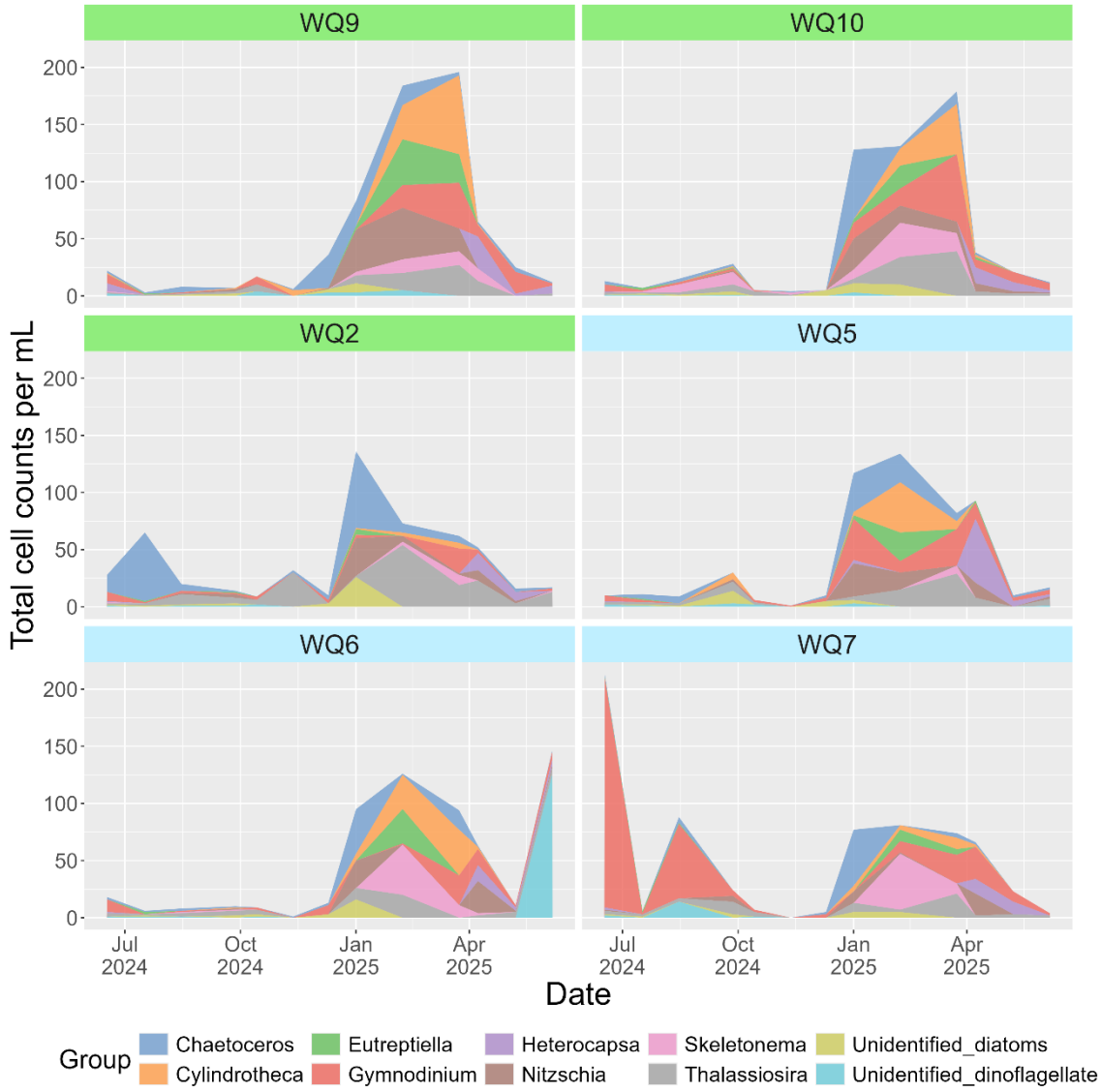


Figure 19: Stacked area plots showing variation among sites and over time in cell counts of taxa groups ranked 3rd to 12th for mean numbers[4]. Sites are ordered from up-river to down-river with those above the future outfall having green headers and those below having blue headers.



[4] behind “Small Flagellates/Unicells” and “Flagellates/Unicells”

Figure 20: Temporal variation in total counts of phytoplankton.

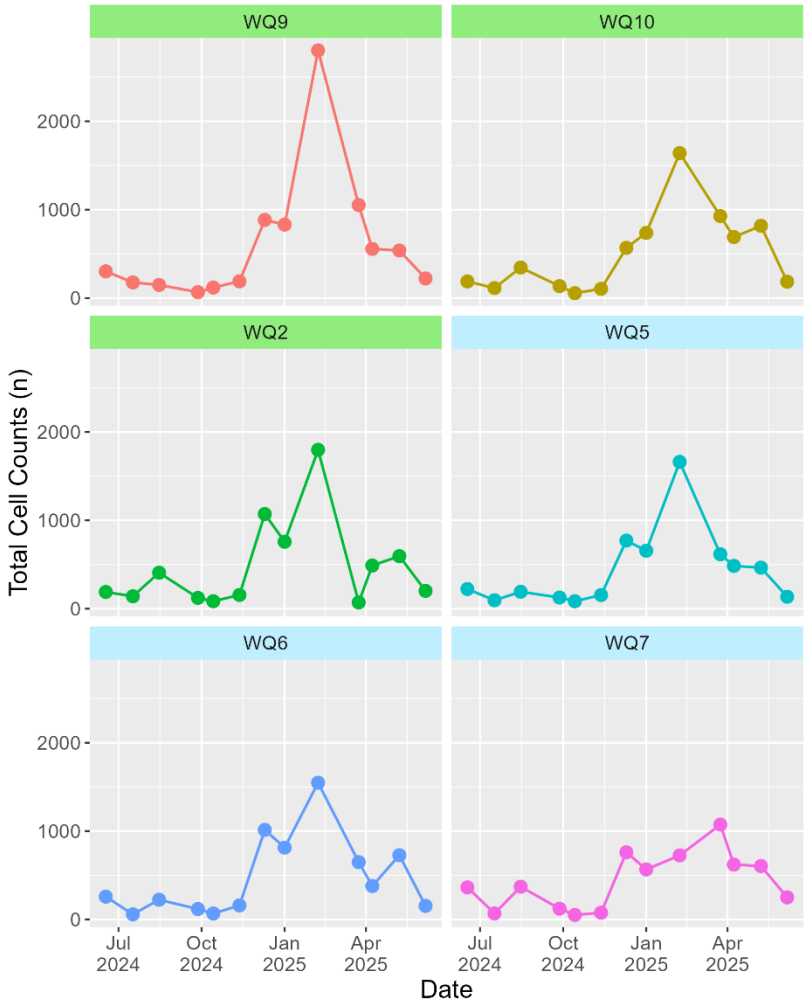


Figure 21: Temporal variation in the number of phytoplankton taxa.

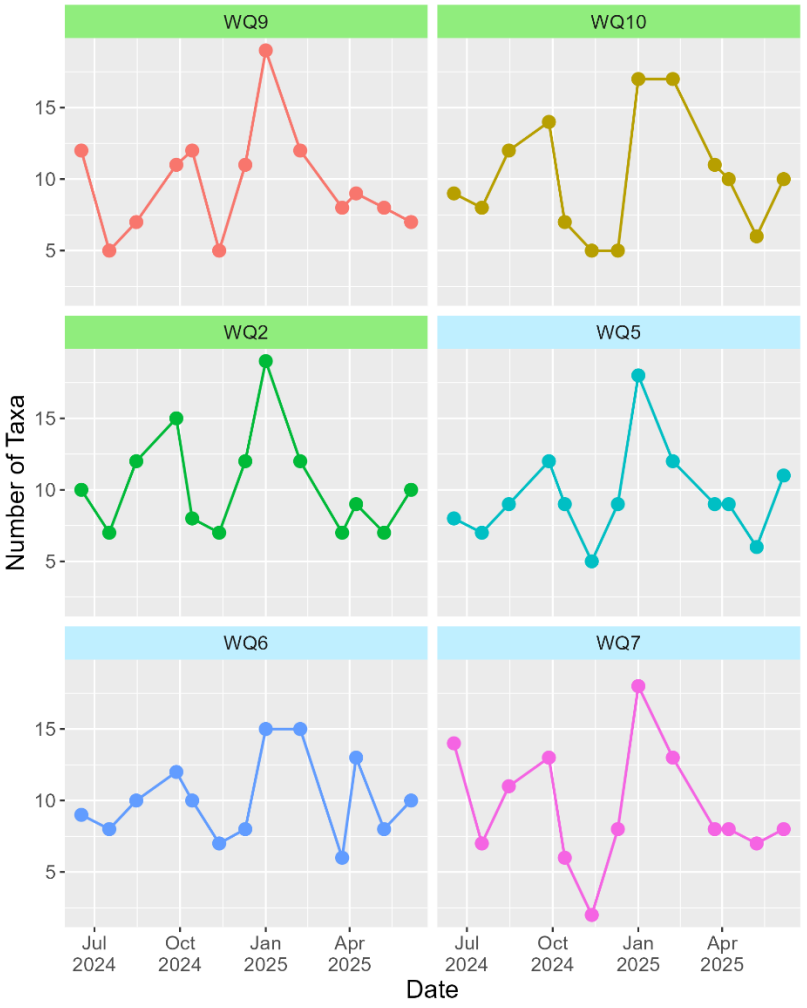
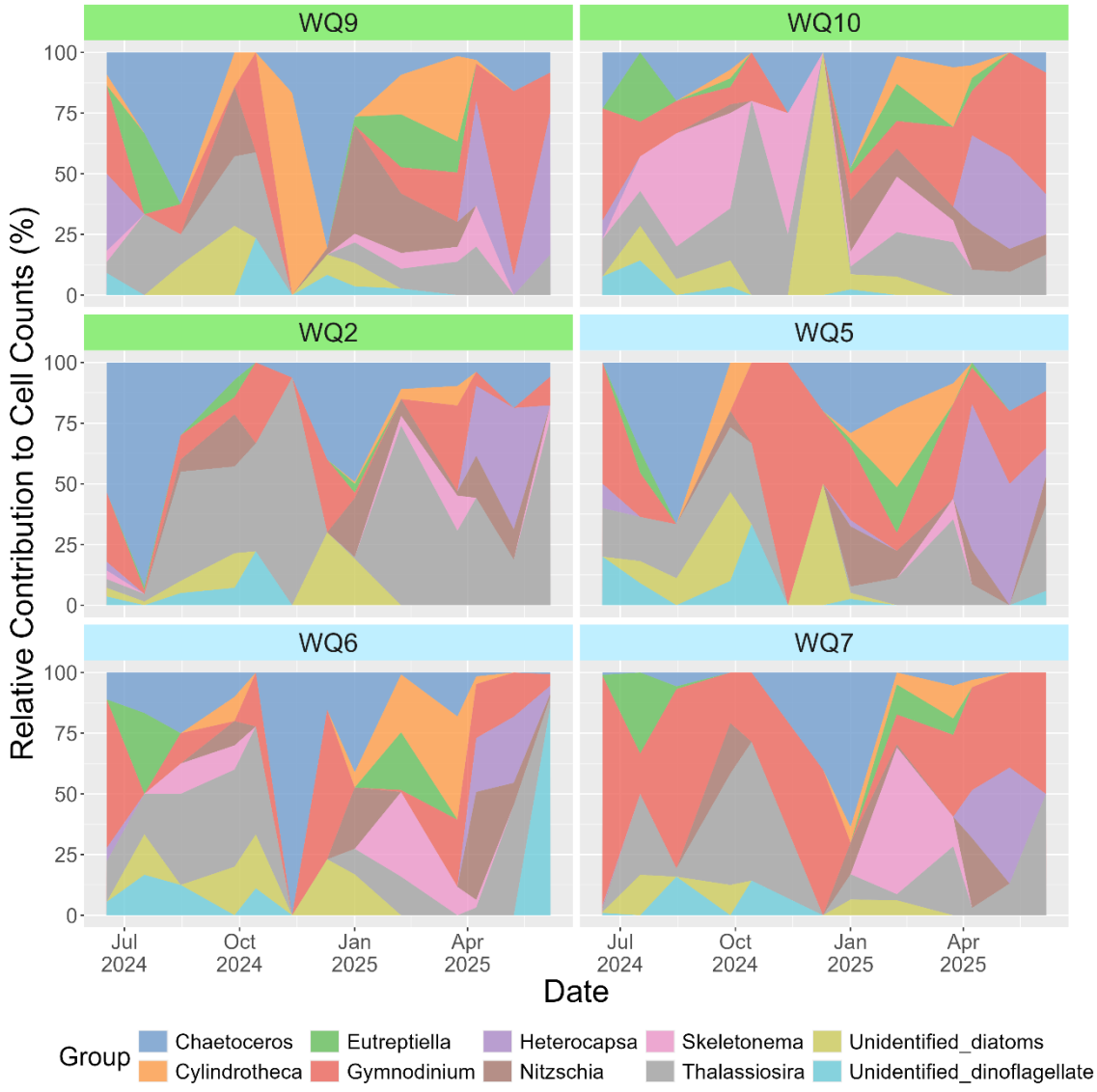
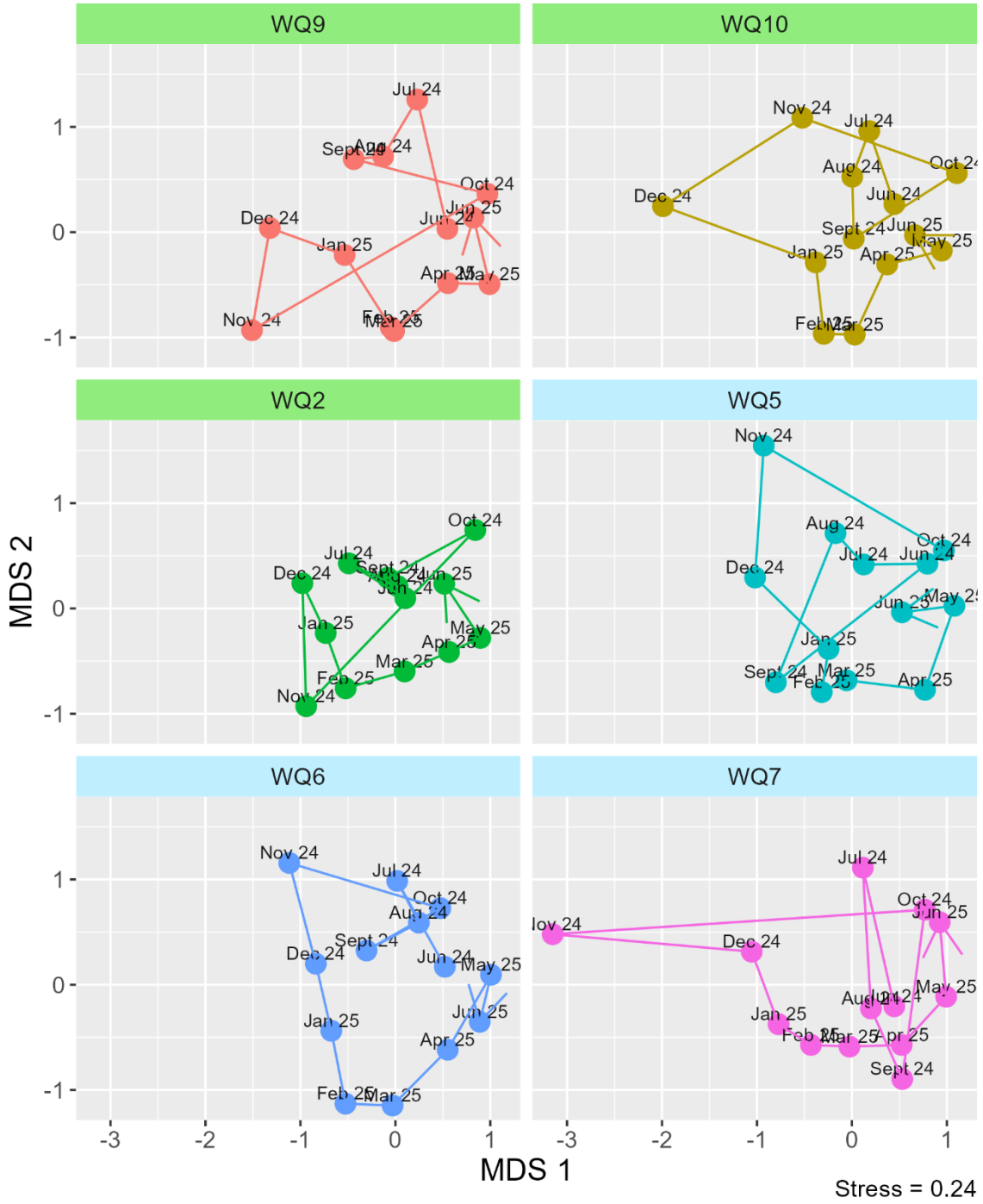


Figure 22: Stacked area plots showing variation among sites and over time in the relative contribution that each of the taxa groups ranked 3rd to 12th made towards overall cell counts within those groups[5]. Sites are ordered from up-river to down-river with those above the future outfall having green headers and those below having blue headers.



[5] behind "Small Flagellates/Unicells" and "Flagellates/Unicells"

Figure 23: MDS showing variation in microalgae community composition, based on monthly total microalgae counts per genus (cells/mL) at the six SW Manukau water quality monitoring sites. Note that the MDS was carried out on all sites combined, but sites have been plotted separately for clarity. Sites are ordered from up-river to down-river, with those above the future outfall having green headers and those below having blue headers.



5 BENTHIC ECOLOGY AND SEDIMENT QUALITY

5.1 METHODS

5.1.1 MONITORING SITES

Initial site checks were conducted around low tide on 18 September 2024 to confirm the suitability of each site, and if required, to make final adjustments to site locations or perimeters. This led to slight changes to the locations of the Clarks West and Ngahere sites to avoid areas of exposed or underlying reef, and changes in the proposed perimeter shapes of the Clarks West and Ohiku Creek sites to keep the sites within the mid-tide zone, while maintaining the size of the areas covered (Figure 24). Coordinates for the monitoring sites are provided in Table 9 in the Appendices. Images of each site are provided in Figure 25 and Figure 26.

Figure 24. Amendments to the originally proposed site locations and perimeter shapes.

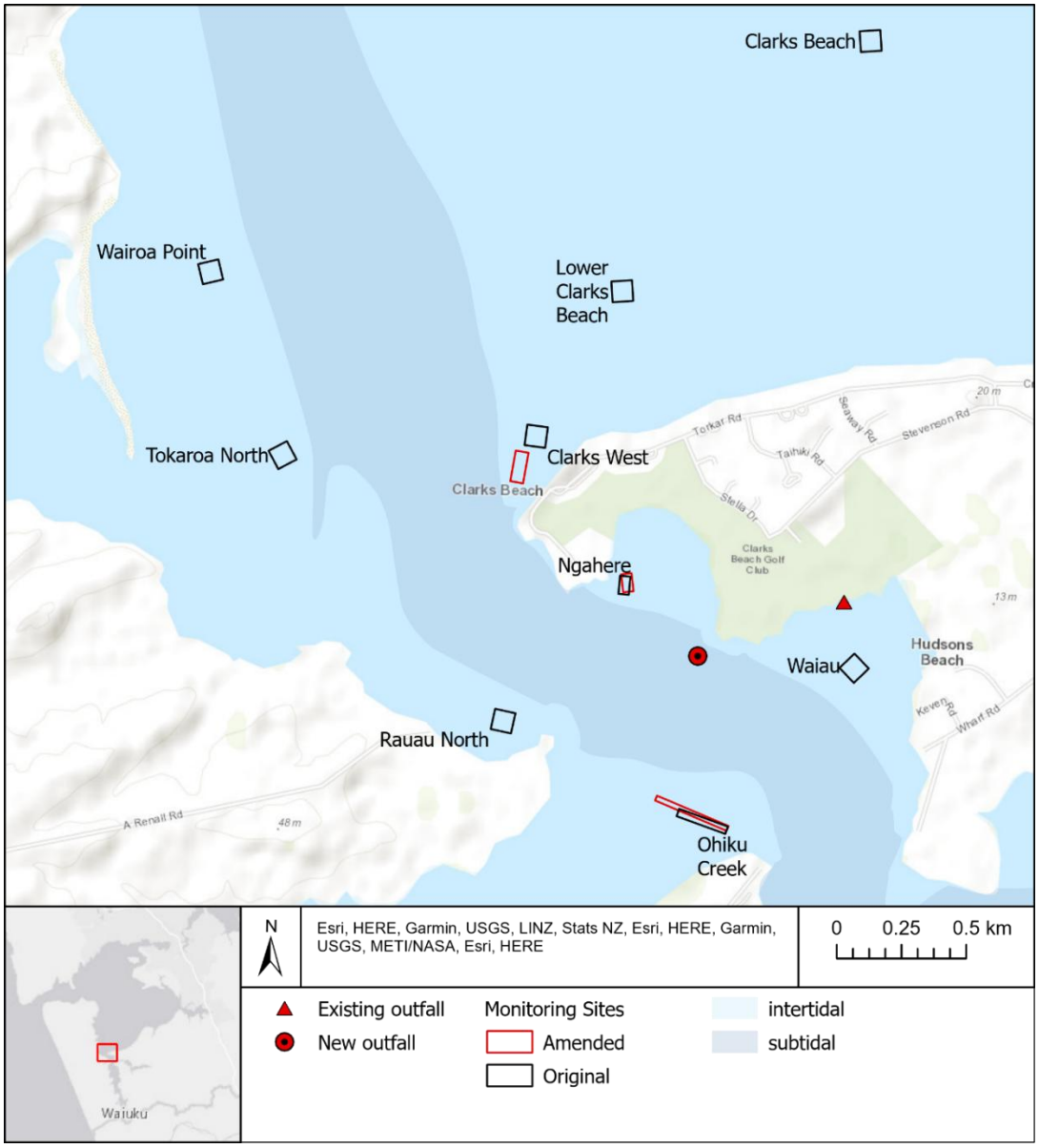


Figure 25: Images on benthic ecological monitoring sites on the western side of Waiuku Channel.

Ohiku Creek

Rauau North

Tokaroa North

Wairoa Point

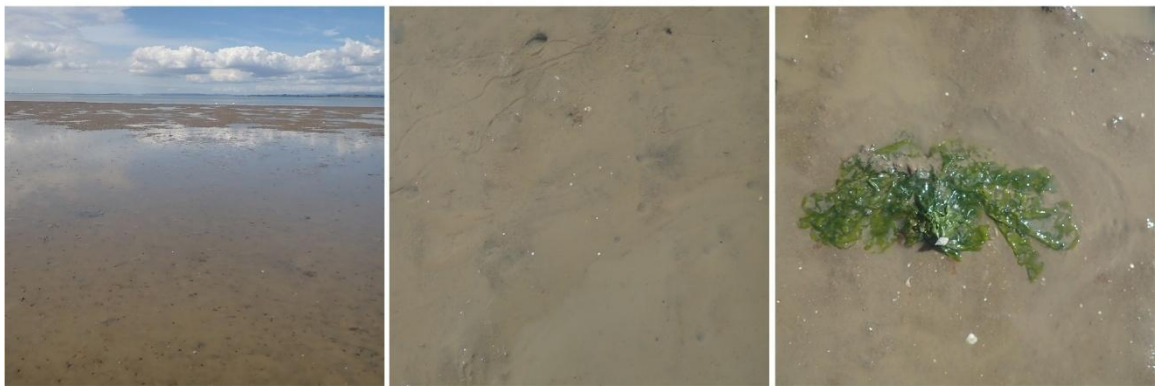


Figure 26: Images on benthic ecological monitoring sites on the eastern side of Waiuku Channel.

Waiau Bay

Ngahere

Clarks West

Lower Clarks

Clarks

5.1.2 RANDOMISATION OF SAMPLES

Randomised sample stations were generated for each site using QGIS. Each site was subdivided into 12 near-equal-sized areas, and one random station was generated within each of those areas. Briefly, the process involved:

1. Generating 100 random points within each sampling area (using the random point within polygons procedure).
2. Using K-means clustering to group those points into 12 clusters within each sampling area (using the K-means clustering procedure).
3. Aggregating the points within each cluster (using the aggregate procedure).
4. Producing centroids for each aggregation of cluster points (using the centroids procedure).
5. Producing Voronoi polygons around the centroids within each site (using the Voronoi polygons procedure).
6. Clipping the Voronoi polygons to the sites (using the intersection procedure).
7. Generating one random point within each of the Voronoi polygons, with a minimum distance of 20 m between those points (using the random point within polygons procedure).

5.1.3 ECOLOGICAL SAMPLING AND SAMPLE PROCESSING

Sampling was conducted on 15–16 October 2024, in accordance with the methods outlined in the REMP. That is:

- Each monitoring site was located on the mid to lower shore and contained relatively uniform habitat. Each site was divided into 12 equal sectors (see Section 5.1.2), with one macrofaunal core (13 cm diameter by 15 cm deep) collected from a random position within each sector.
- Adjacent to every second macrofaunal core:
    - two sediment cores (2 cm deep, 2 cm diameter) were collected, with one added to a composite sample for the determination of grain size and the analysis of organic content (matter), and the other added to a composite sample for the determination of chlorophyll-*a* concentrations (each 'final' sample is the composite of six pooled cores);
    - one surface sediment sample (2 cm deep) was collected using a plastic scoop for the analysis of heavy metals, polyaromatic hydrocarbons (PAH), total nitrogen, total phosphorus and total organic carbon;
- Macrofaunal cores were sieved through a 500 µm mesh, and the retained fauna was preserved with 100% isopropyl alcohol and sent to Earth Sciences New Zealand Hamilton for sample sorting, taxa identification, and enumeration in accordance with Auckland Council monitoring protocols.
- Sediment samples were obtained from the Clarks Beach site for the analysis of heavy metals, polyaromatic hydrocarbons (PAH), total nitrogen, total phosphorus and

total organic carbon, but macrofaunal and other sediment data was provided by Auckland Council.

- Common bivalves (cockles (*Austrovenus stutchburyi*), pipi (*Paphies australis*) and wedge shells (*Macomona liliana*)) were measured (longest shell dimension) and assigned to size classes (<5 mm, 5–10 mm, 10–15 mm, 15–20 mm, 20–30 mm, 30–40 mm, 40–50 mm and >50 mm).
- Photos and site notes were taken of each site, e.g., presence of birds, plants, benthic microalgae, and epifaunal species.

5.1.4 SEDIMENT QUALITY ANALYSIS

The refrigerated sediment samples were transported to Earth Sciences New Zealand within 24 hours of collection. Samples used for the analysis of total nitrogen, total phosphorus, heavy metals, PAHs, and total organic carbon were homogenised, freeze-dried, and sieved to 500 µm. The freeze-dried samples were then sent to Watercare Laboratory Services for chemical analysis. Three replicates per site were analysed by Watercare.

The analyses of sediment samples for total organic matter, grain size and chl-*a* concentration were carried out by Earth Sciences New Zealand, using Auckland Council's standard procedures, as outlined below:

- Total organic matter (as ash-free dry weight): approximately 5 g of sediment was placed in a dry, pre-weighed tray and dried at 60°C until a constant weight is achieved (sample weight is taken after~ 40 hours and then again after 48 hours). Samples were then ashed for 5.5 hours at 400°C (Mook & Hoskin 1982) and reweighed.
- Grain-size: samples were homogenised and a subsample of approximately 5 g of sediment taken. Subsamples were digested in 6% hydrogen peroxide until all organic matter was removed and sampled by wet sieving and pipette analysis (Gatehouse 1971). Pipette analysis was used to separate the sediment into seven size fractions: gravel (>2 mm), coarse sand (500–2000 µm), medium sand (250–500 µm), fine sand (125–250 µm), very fine sand (62.5–125 µm), silt (3.9–62.5 µm) and clay (<3.9 µm).
- Chlorophyll-*a*: sediment samples were freeze-dried, weighed, then homogenised and subsampled (~0.5 g) for analysis. Chlorophyll-*a* was extracted by boiling the sediment in 90% ethanol, and the extract was processed using a spectrophotometer (Sartory & Grobbelaar 1984).

5.1.5 DATA ANALYSES

5.1.5.1 SEDIMENT QUALITY

Sediment quality data were analysed in the following manner:

1. Data were plotted and visually assessed for spatial patterns;

2. Heavy metals and high molecular weight PAH (HMW-PAH) data were compared to the Threshold Effects Level (TEL) guidelines[6], and the ANZG (2018) low-level default guideline values (DGVs) (see Table 2). However, for arsenic, Allen (2024) notes that: *The application of more conservative guidelines (such as the TEL/PEL) for the metalloid arsenic are not deemed suitable for Auckland, as guideline values can sit below what is found to occur naturally or as 'background' concentrations in the region. As such, arsenic is compared with ANZG guidelines only*. For Auckland marine sediments, a background concentration of 12.06 mg/kg has been proposed (80th percentile probability; Allen 2023a).

Only four sediment samples from three sites had sediment samples with PAH concentrations that exceeded detection limits. For those sites (Clarks West, Ohiku Creek and Wairoa Point), the concentrations of High Molecular Weight (HW) PAH were calculated as the sum of benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, fluoranthene and pyrene concentrations (as defined in ANZECC 2000). Those concentrations were normalised to a sediment organic carbon content of 1% before being compared against sediment quality guidelines.

Table 2: Commonly used sediment quality guidelines. TEL and DVG guidelines are referred to in this report.

Metal/Metalloid	Guideline value (mg/kg)					
	Macdonald et al. (1996)		Long and Morgan		ANZG (2018)	
	TEL	PEL	ERL	ERM	DGV	DGV-High
Cadmium	0.68	1.2	1.2	9.6	1.5	10
Chromium	52	160	81	370	80	370
Copper	18.7	108	34	270	65	270
Lead	30.2	112	47	218	50	220
Nickel	15.9	43	21	52	21	52
Zinc	124	271	150	410	200	410
HMWPAH	0.66	6.7	1.7	9.6	1.7	9.6

5.1.5.2 BENTHIC ECOLOGY

Benthic macrofaunal data were plotted and analysed using a combination of univariate and multivariate analyses. Data plots were produced using ggplot in R Studio and Primer-E.

Four univariate indicators of ecological diversity and abundance were analysed:

- number of taxa;
- total counts of individuals;
- Shannon's Diversity;

[6] TEL guidelines are used as the Green-Amber threshold in Auckland Council's Environmental Response Criteria (ERC).

- Pielou's Evenness.

Shannon's Diversity takes into account both the number of species (or taxa) and how evenly individuals are spread among those species (or taxa). It is a measure of the uncertainty associated with correctly predicting which species a randomly selected specimen belongs to. That uncertainty decreases as the number of taxa and evenness decrease. If nearly all individuals belong to a single species, Shannon Diversity approaches zero (it equals zero if there is only one species). Conversely, Shannon Diversity increases as the number of taxa and evenness increases, with the maximum value achieved when each taxon has the same number of individuals (the maximum value possible equals the log of the number of species). Shannon Diversity values are sensitive to sampling effort and the logarithm base used. Therefore, results should only be compared among studies with similar sampling designs and for results using the same logarithm base (Clarke & Warwick 2001; Pla et al. 2012).

Pielou's Evenness is a measure of how even (i.e., similar) the abundances of individual species are at a site. Low index values indicate that the site is dominated by a single, or a few, species which occur in high abundance(s). The remaining species occur in relatively low abundances. In contrast, high index values indicate that the abundances of all species are similar. Pielou's Evenness is derived from the Shannon Diversity value of a sample divided by the maximum possible Shannon Diversity value of that sample (Clarke & Warwick, 2001; Pla *et al.*, 2012).

One way ANOVA and tests for Tukey's honestly significant differences (HSD) were used compare results for the indicators of ecological diversity among the monitoring sites. When necessary, data was $\log_{10}$ transformed[7] to meet assumptions of equal variance and normally distributed residuals prior to analysis. Those analyses were carried out in R Studio.

Multivariate analyses were carried out using Primer-E, tests performed included:

- Principal Component Analysis (PCA) of normalised environmental data (composite samples or means) to investigate the differences in environmental variables among sites.
- Non-metric multidimensional scaling (MDS) of square-root transformed count data using Bray-Curtis similarity to look for differences in community composition among sites. MDS plots provide an easily interpretable representation of community data, with the composition of samples close together on an MDS plot being more similar than those further apart.
- CLUSTER and SIMPROF analyses, which allow similarity (and dissimilarity) among samples to be estimated and presented in dendrograms, showing both statistically significant and non-significant clusters.
- Similarity Percentages (SIMPER), which examines which taxa contributes the most to the similarities and differences among sites (using a 90% cut-off for the cumulative contributions of individual taxa).

5.1.6 HEALTH INDICES

5.1.6.1 BENTHIC HEALTH MODELS

[7] $\log_{10}$ transformation was used for count data.

Benthic Health Models assess the health of macrofaunal communities relative to metal stormwater contaminants (BHM_{metals}; sediment copper, lead and zinc) and sediment mud content (BHM_{mud}). The models are based on data from 95 intertidal sites (estuaries, harbours and tidal creeks) that had a range of contaminant concentrations and mud. Multivariate canonical analysis of principal coordinates (CAP) was used to rank the health of macrofaunal communities, in accordance with Auckland Council's benthic health models. Health was ranked from 1 (very low impact) to 5 (very high impact – Table 3) (see Anderson et al. 2006; Hewitt & Ellis 2010 for more details).

Table 3. Conversion of BHM scores into health groups. The groups are given an assigned value for their combination into Combined Health Scores.

Group	Meaning	BHM_{mud} score	BHM_{metals} score	Value
1	Very low impact	≤-0.12	≤-0.134	0.2
2	Low impacts	≤-0.05	≤-0.067	0.4
3	Moderate impacts	≤0.02	≤0.023	0.6
4	High impacts	≤0.1	≤0.1	0.8
5	Very high impacts	>0.1	>0.1	1.0

5.1.6.2 TRAITS-BASED INDEX

This index uses macrofaunal characteristics/traits e.g., feeding mode, mobility, size, living habit, to categorise them into groups. The Traits-Based Index (TBI) is based on species richness that exhibits seven traits that are important for benthic ecosystem function:

1. Living in the top 2 cm of the sediment.
2. Having an erect structure or tube.
3. Moving sediment around within the tube.
4. Being sedentary or only moving within a fixed tube.
5. Being a suspension feeder.
6. Being medium-sized.
7. Being worm-shaped.

The index calculation accounts for the number of cores collected, with values ranging from 0–1. A site with a high level of functional redundancy is considered 'healthy' as the community is more resilient to environmental change (Table 4; Lohrer & Rodil 2011; Hewitt et al. 2012).

Table 4. Ranking criteria for Trait-Based Index groups.

Group	Meaning	Score	Value
1	Good health and high functional redundancy/resilience	>0.4 to 1	0.33
2	Intermediate health and resilience	0.3 to ≤0.4	0.67
3	Unhealthy and low functional redundancy/resilience	≤0.3	1.0

5.1.6.3 COMBINED HEALTH SCORE

BHM and TBI values are combined into a single index, the Combined Health Score (see Hewitt et al. 2012 for more details). The index ranges from 0–1, with an increase in score representing a degradation in health (Table 5). Note that the scores for a particular site cannot be generalised to a whole estuary (Drylie 2021). All Health indices were calculated by Earth Sciences New Zealand.

Table 5. Combined Health Scores.

Value	Meaning
≤0.2	Excellent
0.2 to ≤0.4	Good
>0.4 to ≤0.6	Fair
>0.6 to ≤0.8	Marginal
>0.8	Poor

5.2 RESULTS

5.2.1 SEDIMENT QUALITY

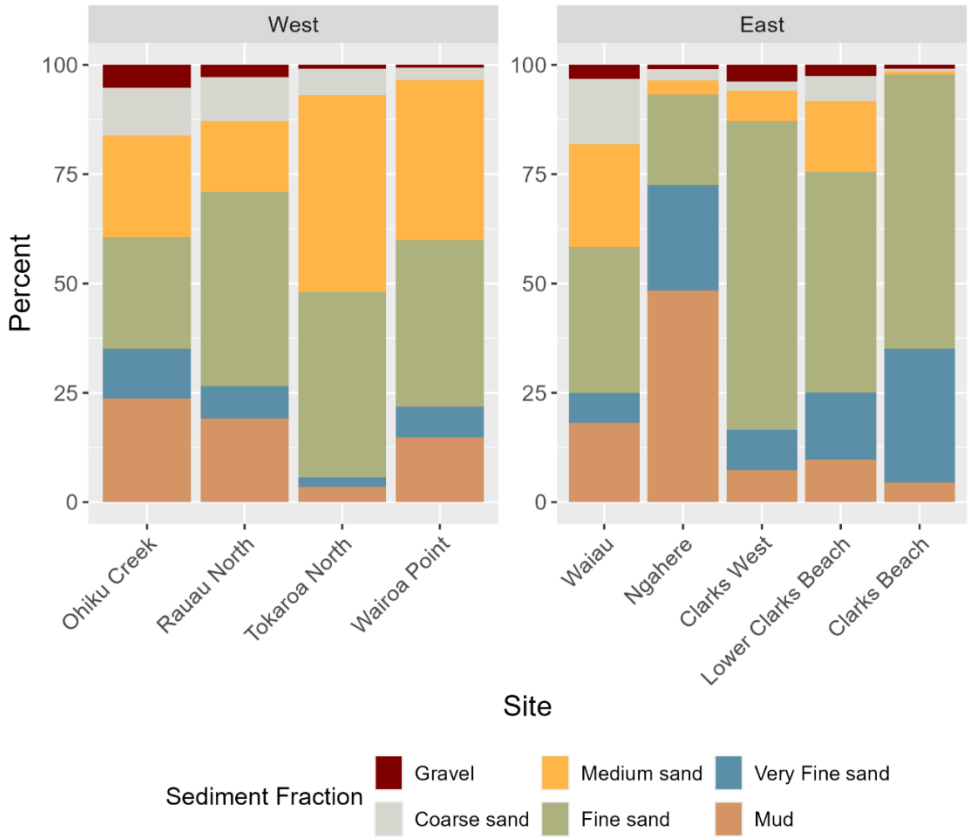
Overall, sediments at the Ngahere site, on the eastern side of the main channel had the highest proportion of mud (48%). On that side of the channel, a clear demarcation in sediment characteristics occurred around the entrance to Waiuku River (between Tokaroa and Karaka Points), with sediment mud content decreasing in the northern sites in the main body of the harbour. A similar change occurred on the western side of the channel, with a marked difference occurring between the Rauau and Tokaroa North sites (Tokaroa North had the lowest proportion of mud of any site). However, mud content increased again between the Tokaroa North and Wairoa Point sites (Figure 27). All sites had moderate to high percentages of sand (51–99%), with the Tokaroa North and Clarks Beach sites having the largest percentage (95–96%).

Mud, total organic carbon and total organic matter content, and phosphorus and total nitrogen concentrations were highly correlated (correlation coefficients ≥0.835, Figure 28), and therefore all five parameters displayed similar spatial patterns to those described above for mud content (Figure 28). Patterns in benthic chlorophyll *a* concentrations differed slightly from the other parameters, with a key difference being chlorophyll *a* concentrations on the western side of the channel were similar above and below the entrance to Waiuku River.

Mean arsenic concentrations were not compared to TEL guideline values, but were similar to, or less than, the majority of sites monitored by Auckland Council in the Auckland Region (Allen 2023b). All sites, except for Ngahere, had arsenic concentrations below the nominal background concentration of 12.06 mg/kg. All other heavy metals were well below the TEL guidelines at all monitored sites (Figure 30). Correlation analysis indicated that concentrations of chromium, copper, nickel and zinc were highly correlated (Figure 31). This potentially suggests that those metals may originate from a common source.

Ninety-five percent of the polycyclic aromatic hydrocarbons (PAH) tested[8] were below detection limits, therefore, mean concentrations for PAHs were not calculated (see Appendices for PAH results). Organic carbon normalised HMW-PAH concentrations in four sediment samples from Clarks West, Ohiku Creek and Wairoa Point, with PAH concentrations above detection limits, were all well below the TEL sediment quality guideline (maximum concentration of 0.1 mg/kg c.f. the TEL guideline value of 0.66 1 mg/kg).

Figure 27. Grainsize composition at monitoring sites on the western and eastern sides of Waiuku Channel.



[8] 476 PAH tests were conducted in total

Figure 28: Correlation matrix showing the strength of relationships between percent mud (Mud), total organic carbon (TOC), total phosphorus (TP) and total nitrogen (TN) concentrations. Correlations are provided for pooled data and for sites on the eastern and western sides of the channel.

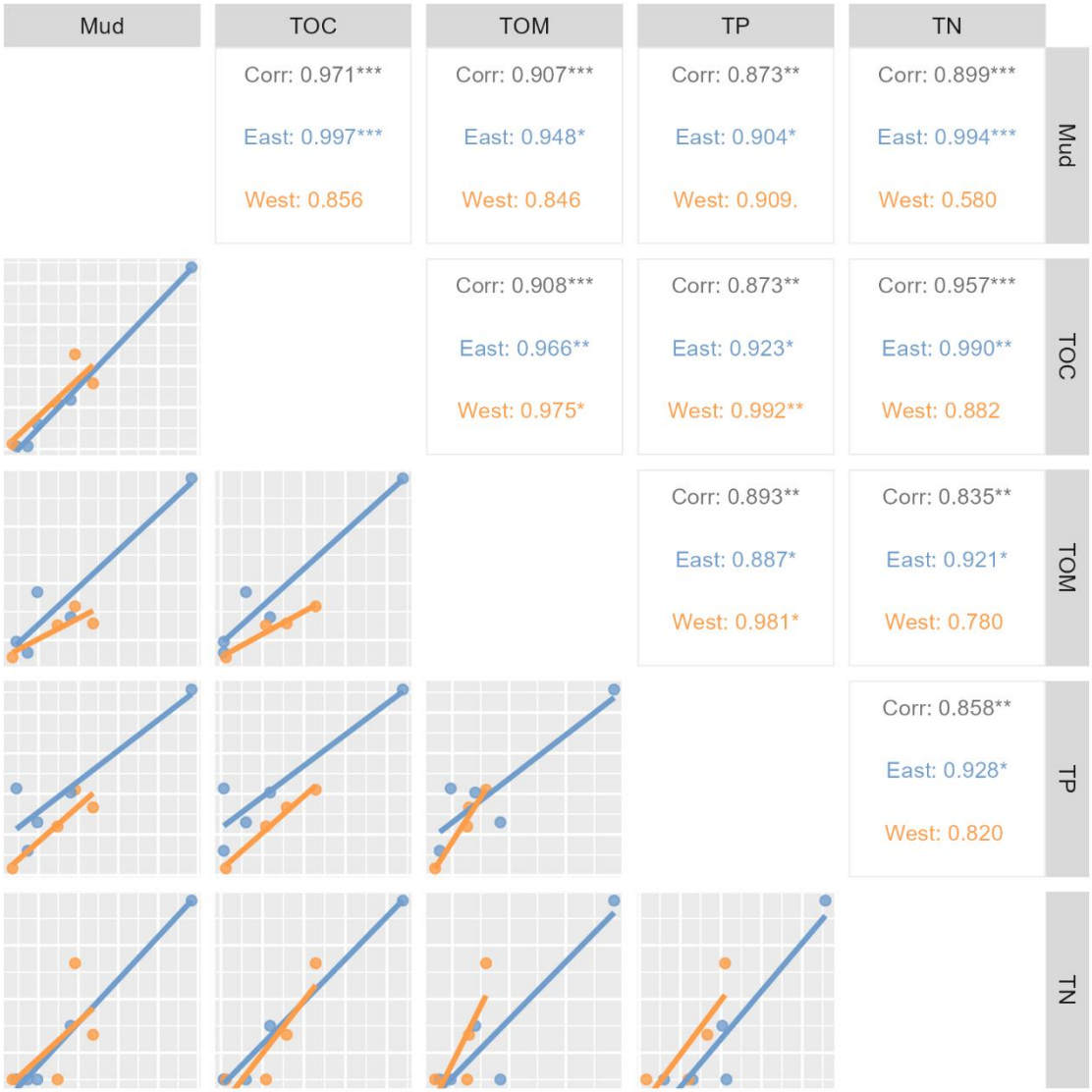


Figure 29. Total organic carbon, total organic matter; total nitrogen; total recoverable phosphorus; and benthic chlorophyll-*a* concentrations at the monitored sites. Total organic carbon; total nitrogen; and total phosphorus values are means ± S.E. Total organic matter and chlorophyll-*a* results are from a single composite sample per site. Sites are grouped by channel side, and ordered from inner to outer harbour.

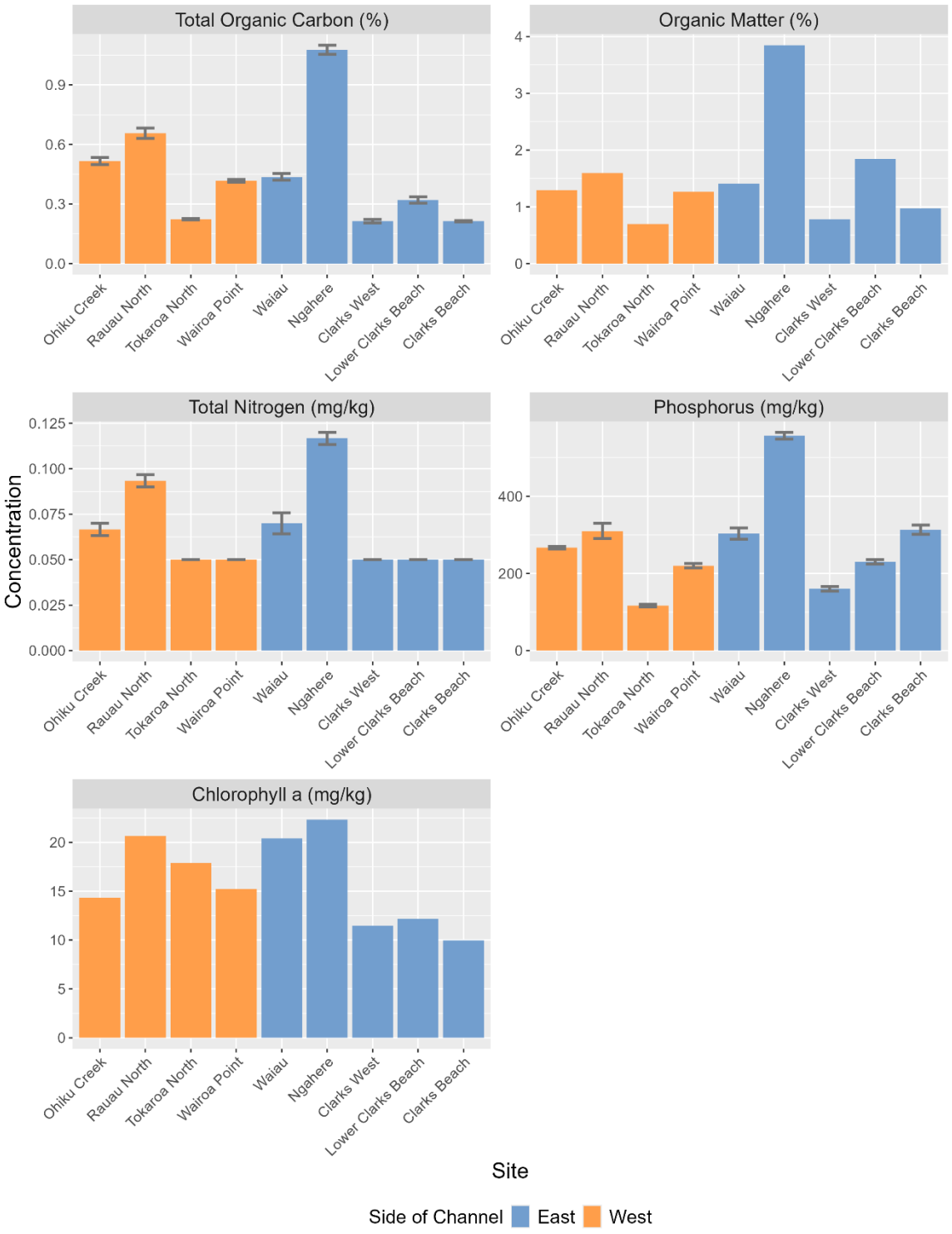


Figure 30. Mean ± S.E. heavy metal sediment concentrations in the monitored sites. The red dotted line shows the TEL guideline values. Sites are grouped by channel side, and ordered from inner to outer harbour.

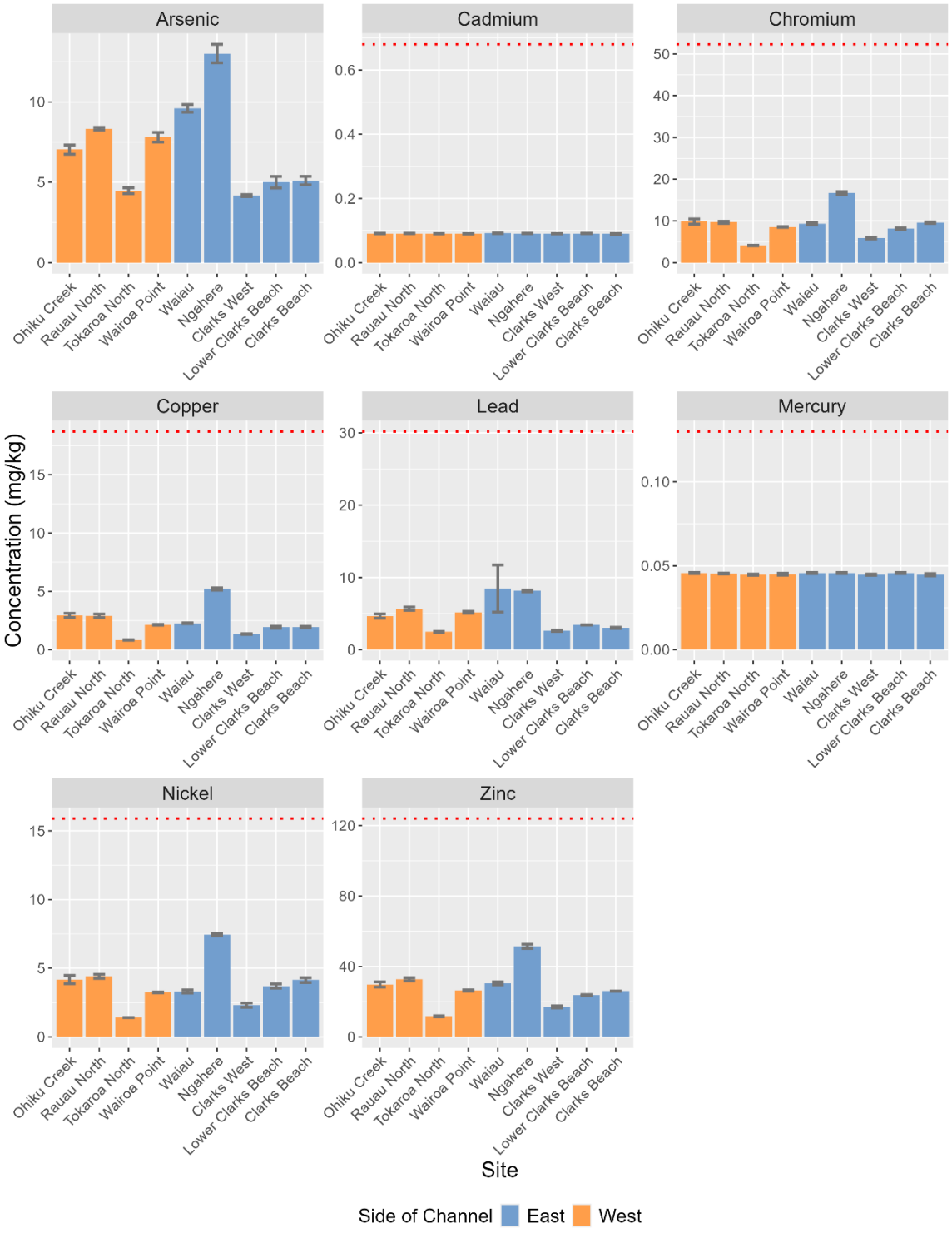
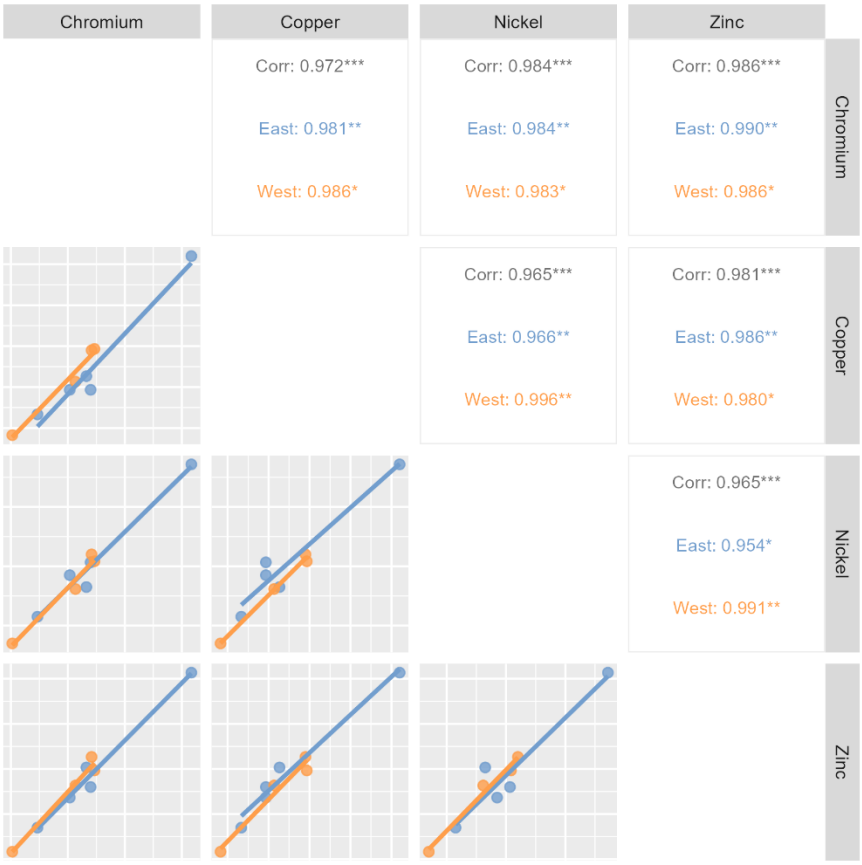


Figure 31: Correlation matrix showing the strength of relationships between heavy metal concentrations. Correlations are provided for pooled data, and for sites on the eastern and western sides of the channel.



5.2.2 MACROFAUNA

In total, 18,735 individuals and 90 taxa were collected from the benthic monitoring sites. Nine taxa comprised 77% of all individuals collected, with cockles (*Austrovenus stutchburyi*) being the most abundant taxa by a large margin, followed by the nut shell *Linucula hartvigiana* and polychaete *Anoides trifida*, whose overall mean abundances were less than half that of cockles.

However, numbers of individuals within each taxa varied considerably among sites (see Figure 32 & Figure 33 for variation in the 10–20 most abundant taxa). For instance, cockle and *L. hartvigiana* numbers on the western side of the main channel were markedly lower at sites north of Tokaroa and Karaka Points (where the Waiuku River enters the main body of the harbour). Conversely, wedge shell (*Macomona lilliana*) numbers on the western side of the main channel were markedly higher at sites north of the transition zone. On the eastern side of the channel, patterns in these species were more variable, with no clear distinction between sites above and below the transition zone.

Other taxa of note included the polychaete *A. trifida* and mysid shrimps (Mysida), which occurred in high numbers at a limited number of sites. Large numbers of: *A. trifida* were obtained from the Clarks West site; mysid shrimps from the Ngahere site; and, the

polychaete *Prionospio aucklandica* from the Rauau North site. Other species also occurred in relatively high (albeit lower) numbers at a limited number of sites (Figure 32 & Figure 33).

The mean, total number of individuals per core varied from 65 ± 8 at Wairoa Point to 270 ± 33 at Clarks West (Figure 33 A). One way ANOVA showed that $\log_{10}$ counts of individuals were significantly different ($p<0.001$) among sites, with Tukey's HSD tests showing that mean estimates at the:

- Wairoa Point site were significantly lower than numbers at all other sites;
- Clarks West site were significantly higher than mean counts at the Clarks Beach, Tokaroa North and Waiau sites; and,
- Ohiku Creek, Rauau North, Waiau, Ngahere andLower Clarks Beach sites overlapped.

The mean number of taxa per core varied from 17 ± 0.8 at Ngahere to 22 ± 1.2 at Clarks Beach (Figure 33B). One way ANOVA showed that $\log_{10}$ transformed numbers of taxa were significantly different ($p<0.001$) among sites. A Tukey's HSD test found that numbers of taxa at the Ohiku Creek and Ngahere sites were significantly ($p<0.05$) less than those at the Clarks Beach site. No significant differences were detected in the means from all other sites, although plotted data showed a general pattern of eastern channel sites in the main body of the harbour having more taxa than the other sites.

Mean Pielou's evenness per site varied from 0.54 ± 0.05 at Clarks West to 0.85 ± 0.04 at Wairoa Point (Figure 33C). One way ANOVA showed that evenness was significantly different ($p<0.001$) among sites, while a Tukey's HSD test showed that eveness at the:

- Wairoa Point site was significantly higher than at the Ohiku Creek, Rauau North, Waiau, Ngahere, Clarks West, and Lower Clarks Beach sites;
- Clarks West site was significantly less than at the Tokaroa North, Waiau, Clarks West, and Clarks Beach sites; and,
- Tokaroa North and Clarks Beach sites were significantly greater than at the Rauau North and Ngahere sites.

Mean Shannon's diversity per site varied from 1.7 ± 0.2 at Clarks West to 2.5 ± 0.1 at Clarks Beach. Spatial patterns in Shannon's diversity mirrored that of Pielou's evenness (Figure 33D).

Figure 32. Boxplots showing site variation in the number of individuals collected for the 10 most abundant taxa overall. Sites are grouped by side of channel, and ordered from inner to outer harbour.

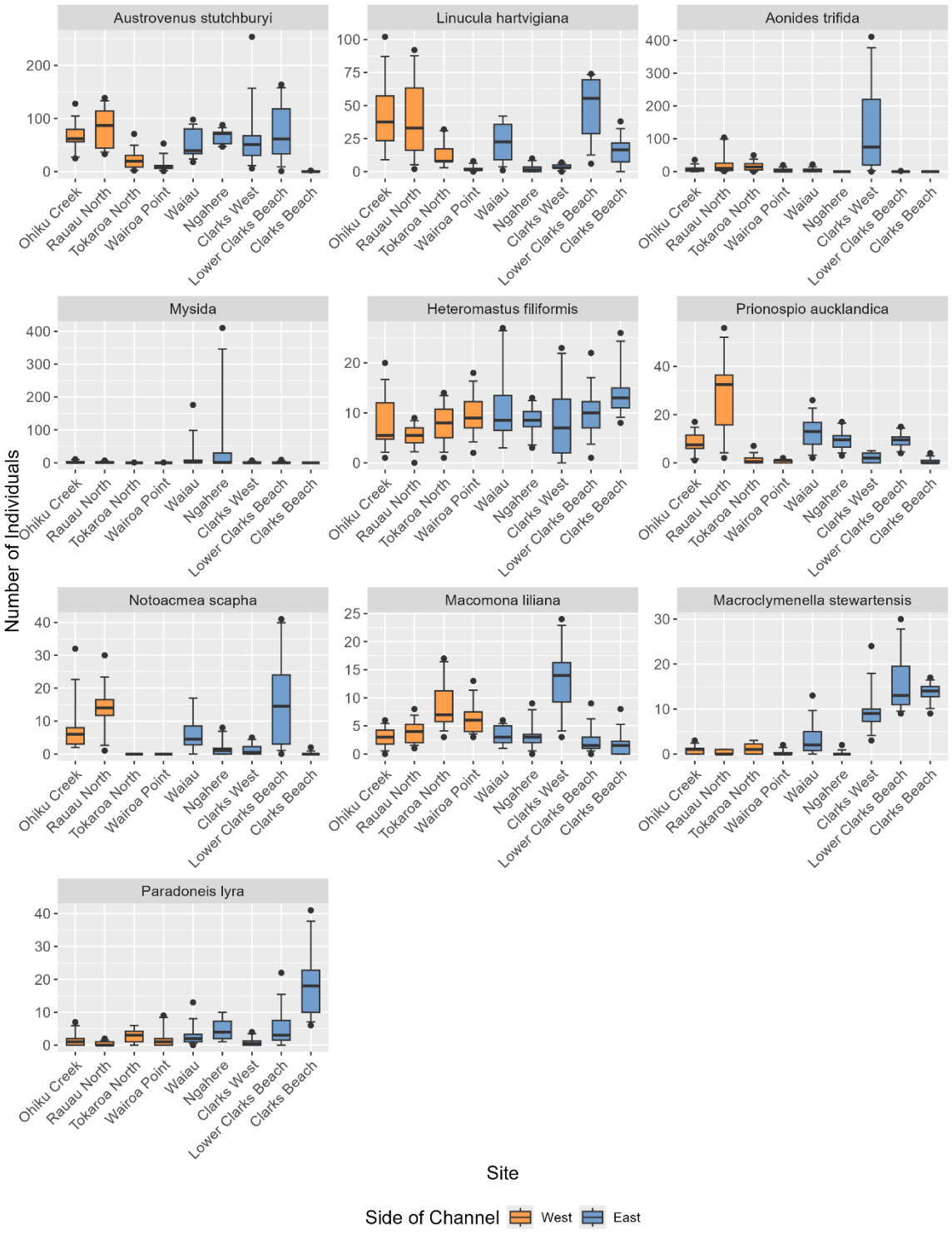


Figure 33. Stacked bar plot showing mean numbers of individuals collected from each site for the 20 most abundant taxa overall. Sites are grouped by side of channel, and ordered from inner to outer harbour.

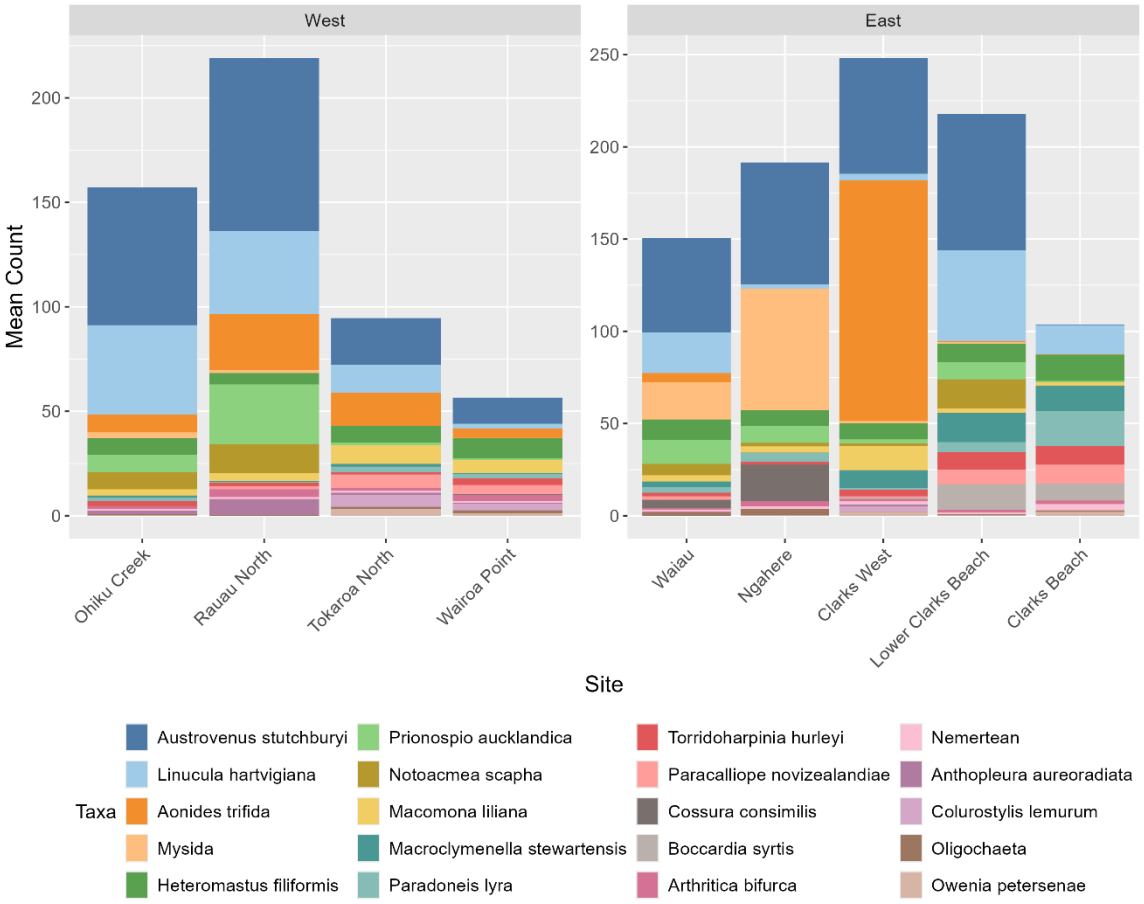
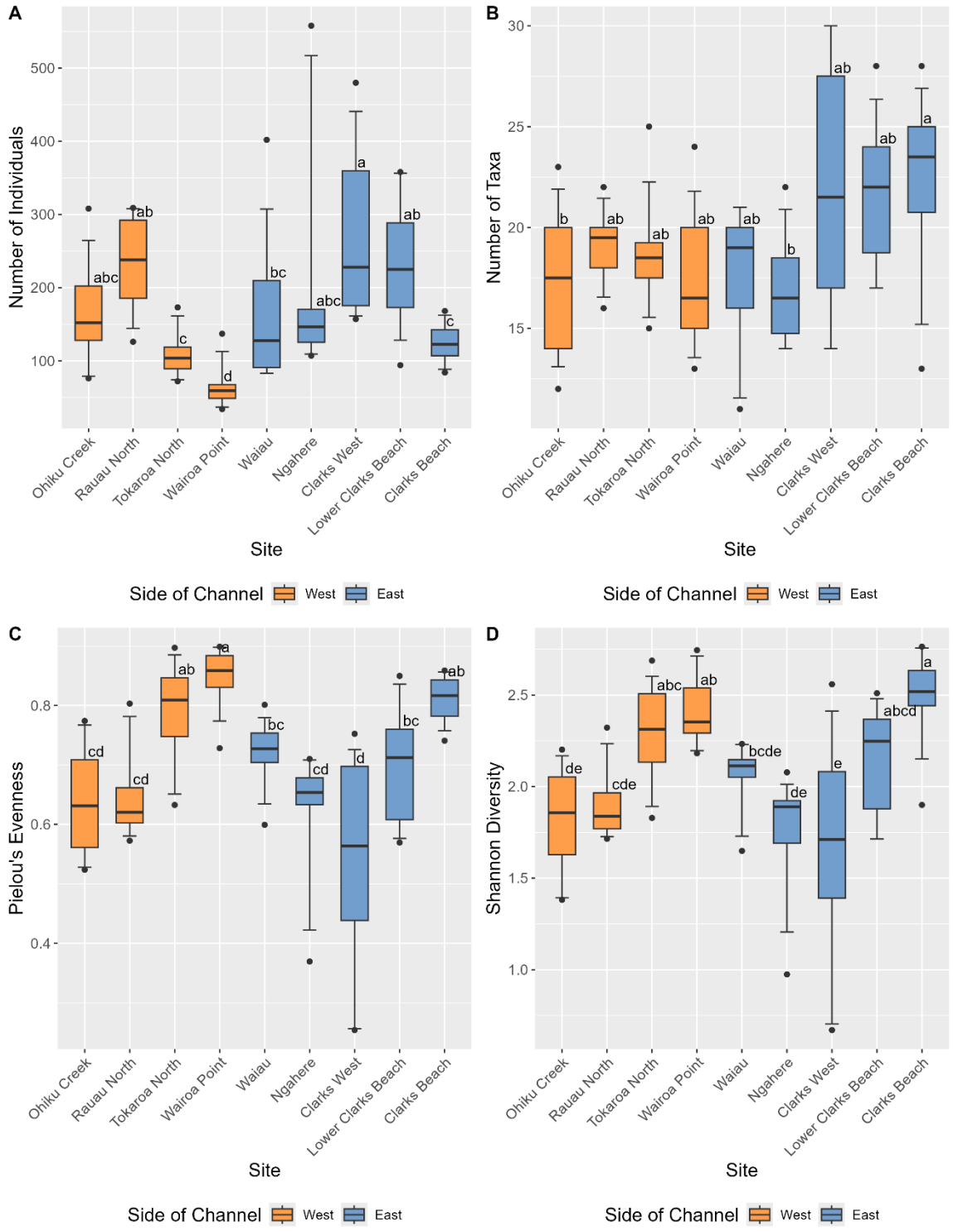


Figure 34. Boxplots showing the raw A) number of individuals; B) number of taxa; C) Pielou's evenness; and D) Shannon diversity at the monitored sites. Sites are grouped by side of channel, and ordered from inner to outer harbour. Letters indicate groupings obtained from Tukey's HSD tests of log_{10} transformed data for numbers of individuals and taxa, and raw results for Pielou's evenness and Shannon diversity.



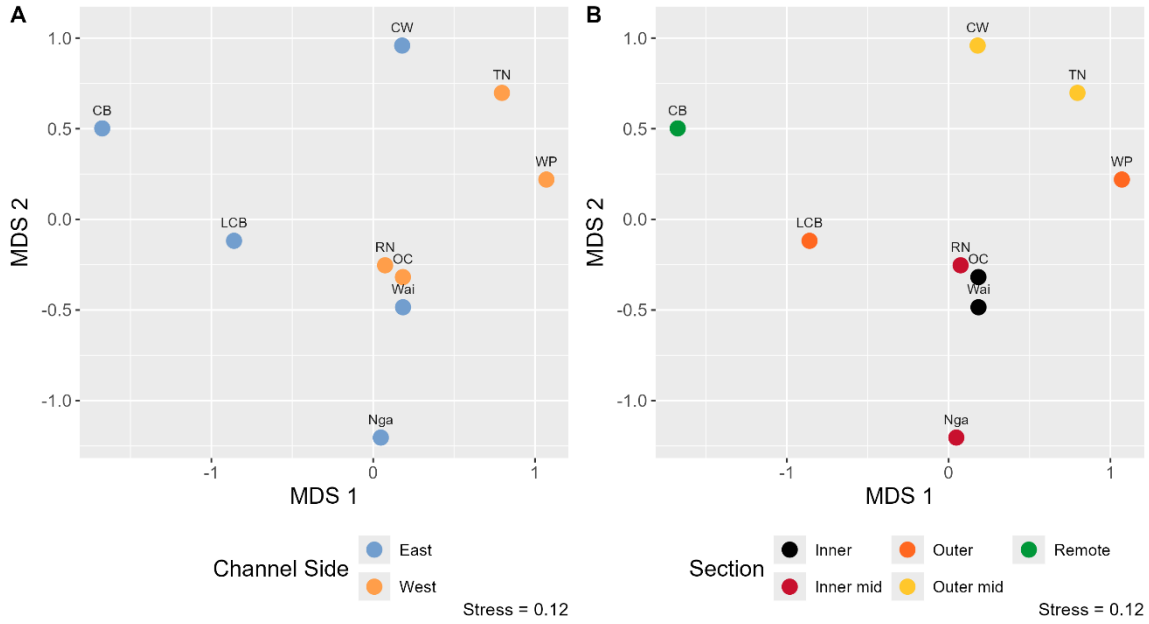
Multivariate analyses (nMDS) of the benthic community data showed that many of the sites could be differentiated from other sites based on their community composition (Figure 35). Communities from the outer sites on the western side of the main channel were plotted

toward the upper right of the MDS plot, with outer sites on the eastern side of the channel plotted on the left of those sites. Three of the inner channel sites (Ohiku Creek, Waiau and Rauau North) were grouped tightly together, slightly below and toward the left of the plots centre, indicating that they had similar communities, while Ngahere was situated below that group.

SIMPER analysis showed that the highest dissimilarity percentages between sites could be attributed to four taxa: the poychaete *Aonides trifida*, cockles, the nut shell (*Linucula hartvigiana*), and mysid shrimps. These differences were due to:

- a very high abundance of *Aonides trifida* at Clarks West, and low abundances elsewhere (Figure 32 and Figure 33);
- high abundances of cockles (*Austrovenus stutchburyi*) at Clarks West, Lower Clarks Beach, Ngahere, Ohiku Creek and Rauau North, intermediate abundance at Waiau, and low abundances at Tokaroa North, Wairoa Point and Clarks Beach (Figure 32 and Figure 33);
- high abundances of nut shells (*Linucula hartvigiana*) at Lower Clarks Beach, Ohiku Creek and Rauau North, low abundances at Ngahere, Wairoa Point and Clarks West, and intermediate abundances elsewhere (Figure 32 and Figure 33);
- a high abundance of mysid shrimps (Mysida) at Ngahere, an intermediate abundance at Waiau, and low abundances elsewhere (Figure 32 and Figure 33).

Figure 35. Non-metric multidimensional scaling plots of summed benthic macrofaunal data by site. Sites are coloured by A) side of Waiuku Channel, and B) the area along the channel running from inner to outer sections.



5.2.3 BIVALVES

In total, 5258 cockles, 557 wedge shells and four pipi were collected. The majority of cockles were very small, with 75% being less than 5 mm in length, and none considered a

'harvestable' size (>30 mm) (Figure 36). Similarly, the majority (73%) of wedge shells were less than 5 mm long (Figure 37).

Figure 36. Total number of cockles from each size class collected from the monitoring sites.

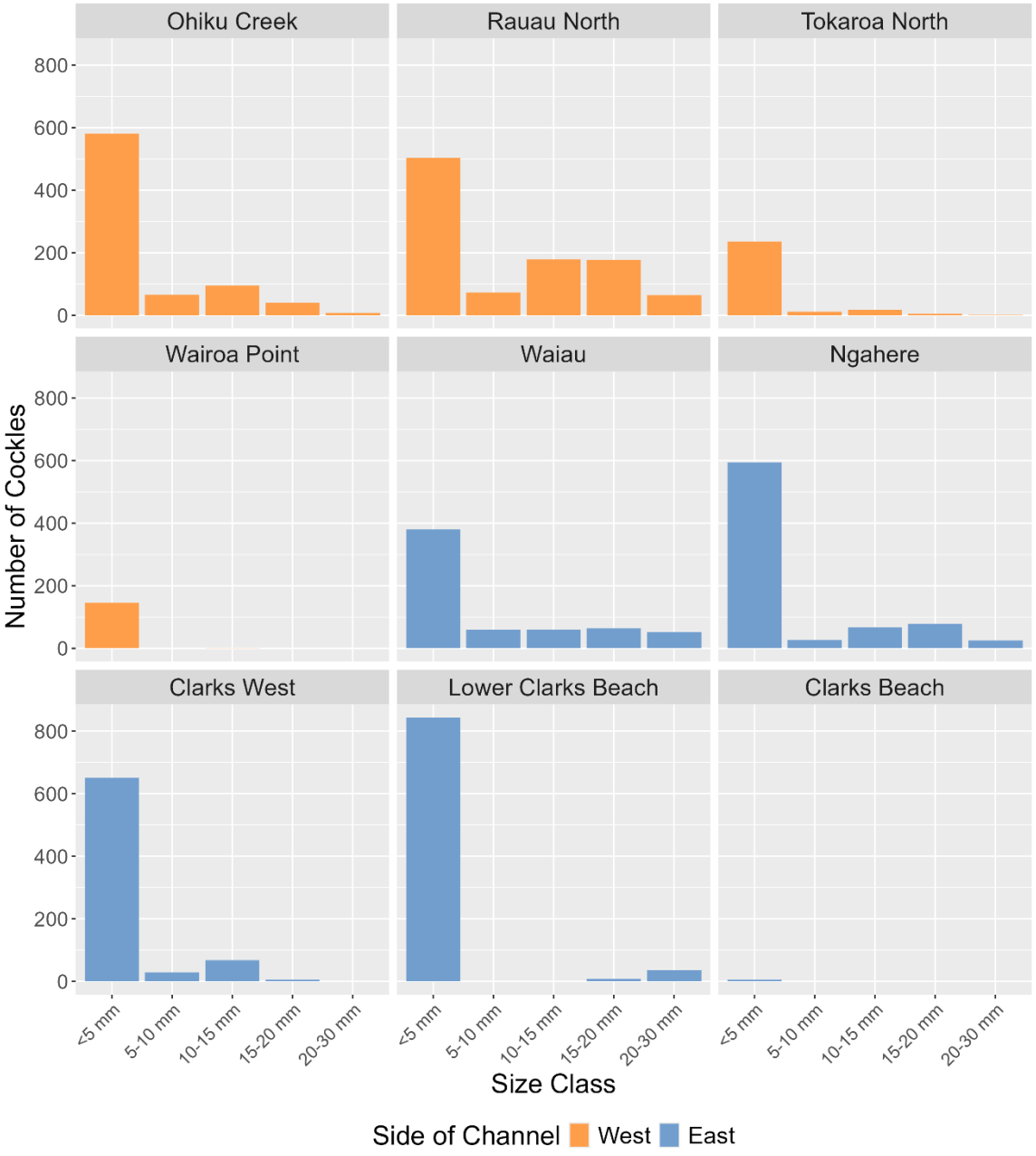
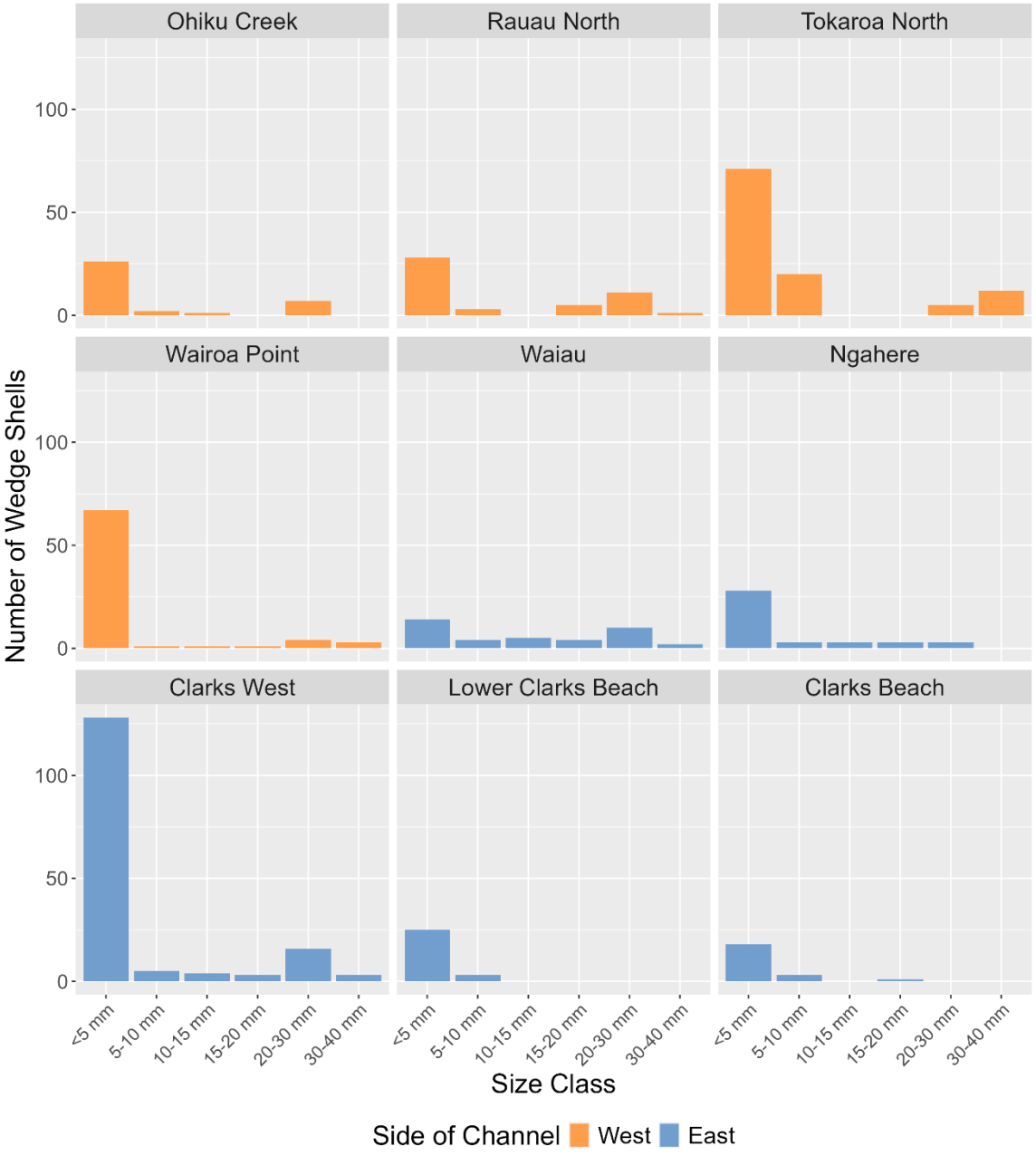


Figure 37. Total number of wedge shells from each size class collected from the monitoring sites.



5.2.4 BENTHIC HEALTH SCORES AND GENERAL SITE OBSERVATIONS

Groupings for Benthic Health Models (metals and mud), Trait-Based index, and the Combined Health Score for each site are given in Table 6. All sites had a 'fair' Combined Health Score, except for Clarks Beach site, which had a 'good' Combined Health Score.

General observations from each site are provided in Table 7.

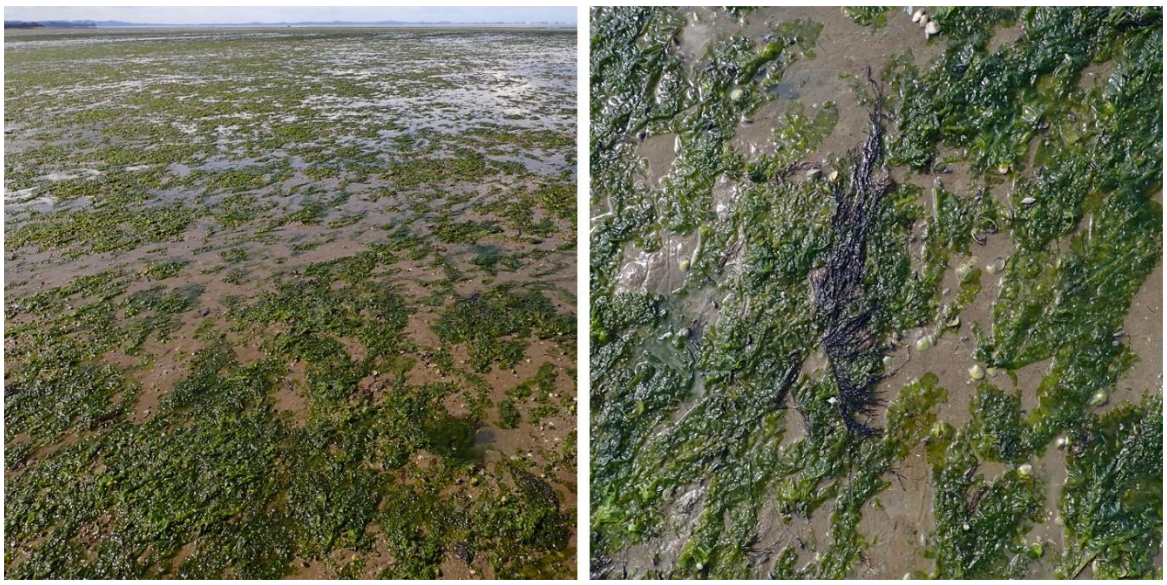
Table 6. Groupings for Benthic Health Models, Trait-Based Index and Combined Health Scores for the monitored sites. Blue = excellent, green = good, yellow = fair, orange = marginal, red = poor.

Site	BHM_{metal} group	BHM_{mud} group	TBI group	Combined Health Score
Waiau	4	3	1	0.58
Ohiku Creek	3	3	1	0.51
Ngahere	3	3	1	0.51
Rauau North	3	3	1	0.51
Clarks West	3	2	1	0.44
Tokaroa North	3	3	1	0.51
Wairoa Point	3	3	1	0.51
Lower Clarks Beach	3	3	1	0.51
Clarks Beach	2	2	1	0.377

Table 7: Summary of general observations about substrates and other key features recorded from the benthic ecological monitoring sites.

Site	General observations
Ohiku Creek	Substrate varied from soft mud to sand and dense cockle shell.
Rauau North	Substrate varied from soft mud to sand and dense cockle shell.
Tokaroa North	Substrate consisted of firm sand with *Ulva* sp. and scattered *Gracilaria* sp. scattered and patches of Asian date mussels (*Arcuatula senhousia*) present. An extensive area of dense *Ulva* was present west of the site (Figure 38).
Wairoa Point	Substrate varied from firm sand to soft, fluid mud, with some *Solieria* sp. and *Ulva* sp. present.
Waiau Bay	Substrate of muddy sand to sand with numerous cockles with patches of sparse seagrass and small red algae.
Ngahere	Substrate varied from soft mud to sand and dense cockle shell.
Clarks West	Substrate consisted of firm sand with patches of sparse to moderately dense seagrass (*Zostera muelleri*), and scattered *Solieria* sp.
Lower Clarks	Substrate consisted of firm sand to mud, with dense cockle shell and dense seagrass.
Clarks	Substrate consisted of firm sand with seagrass throughout.

Figure 38: Extensive bed of dense *Ulva* sp. with scattered *Gracilaria* sp. west of the Tokaroa North site.



6 BIOGENIC HABITATS

6.1 METHODS

Fifty, 200 m subtidal video transects were taken during February and March 2025 within 1 km of the outfall. Transect start locations were predetermined using a stratified random design, and the direction of the video tow was decided based on wind and current directions. The video camera was 'flown' above the seabed to minimise the disturbance of biogenic features. Visual contact between the video and the seabed was maintained using a live video feed. Footage was recorded on a GoPro Hero 11, while video tracks were recorded using a Garmin handheld 78scGPS, fitted with a GA38 GPS/GLONAS external aerial. The time on the GoPro and GPS were synchronised to allow the generation of location coordinates for observed features.

Post-survey, the GPS data were imprinted on the video footage using Telemetry Overlay software. Video footage was analysed carefully and:

- habitats observed along each transect were categorised into nine habitat types (bare mud, mud with burrows, Asian date mussels, sand, shelly sand, shell hash/gravel, gravelly rubble, boulders, and reef), with presence/absence recorded (Figure 39);
- ecological complexity was subjectively ranked from one (low complexity) to six (high complexity) based on the abundance and diversity of large epibenthic species, and the physical complexity and diversity of habitats observed along each transect (Table 8);
- the presence of large epibenthic species and taxa groups was recorded (scallops, green-lipped or blue mussels, oysters, Asian date mussels, sponges, bryozoans, ascidians, anemones, macroalgae, cushion stars, snapper, trevally, rays).

Images of the key features observed were saved from video stills.

Table 8. Criteria used to rank ecological complexity.

Complexity Ranking	Complexity Description
1	Single substrate with a low diversity of biota, low relief or few physical structures, and no or scattered large biological features.
2	Multiple substrates with a low diversity of biota, low relief or few physical structures, and no or scattered large biological features.
3	Single substrate type, with moderately diverse biota, and moderate coverage of large and complex physical and/or biological structures.
4	Multiple substrates with moderately diverse biota, and moderate coverage of large and complex physical and/or biological structures.
5	Single substrate type with diverse biota with pronounced and complex variation in physical and/or biological structures throughout the transect.
6	Multiple substrates and diverse biota with pronounced and complex variation in physical and/or biological structures throughout the transect.

6.2 RESULTS

Visibility varied from exceptionally poor to reasonable, despite calm conditions and extended periods of dry weather prior to the February and March survey dates. However, the video footage was sufficient to identify key substrates and large biological features.

Hard substrates were the most frequently observed substrate, with boulders observed in 58% of the transects, reef observed in 52% of the transects, and gravelly rubble observed in 34% of the transects. Asian date mussels and bare mud were the most infrequently observed substrates, being present in 2% and 4% of the transects, respectively (Figure 41). Overall, hard substrates were found in 88% of transects, whereas muddy and sandy substrates were only found in 24% and 22% of transects, respectively. Soft substrates were generally found at either end of the survey area, whereas hard substrates were found throughout the survey area (Figure 40).

Various biological features were observed in the transect footage, including sponges (Figure 42), bryozoans (Figure 43), macroalgae (Figure 44), and a variety of other species and taxa (Figure 46). Sponges were the most common and widespread group observed, with moderate levels of sponge diversity and abundance apparent. Sponges were observed in 78% of the transects, followed by bryozoans (64%), ascidians (38%) and macroalgae (18%) (Figure 45). Sponges were observed throughout the survey area, except for the southernmost section. Bryozoans and ascidians were generally limited to the outer half of the survey area, whereas macroalgae were generally only observed in the outermost transects (Figure 47).

Ecological complexity was typically low upstream of the outfall and moderate to high downstream of the outfall location, except for around Tokaroa Point, where it was low. No large biological features were observed in seven of the 50 transects. Empty transects were mostly located in the south-eastern part of the survey area (around the Waiau Pa boat ramp) (Figure 48).

Figure 39. Examples of the different substrates observed in the video transects: a) bare mud; b) mud with burrows; c) sand; d) shelly sand; e) shell hash/gravel; f) gravelly rubble; g) boulders; h) reef.

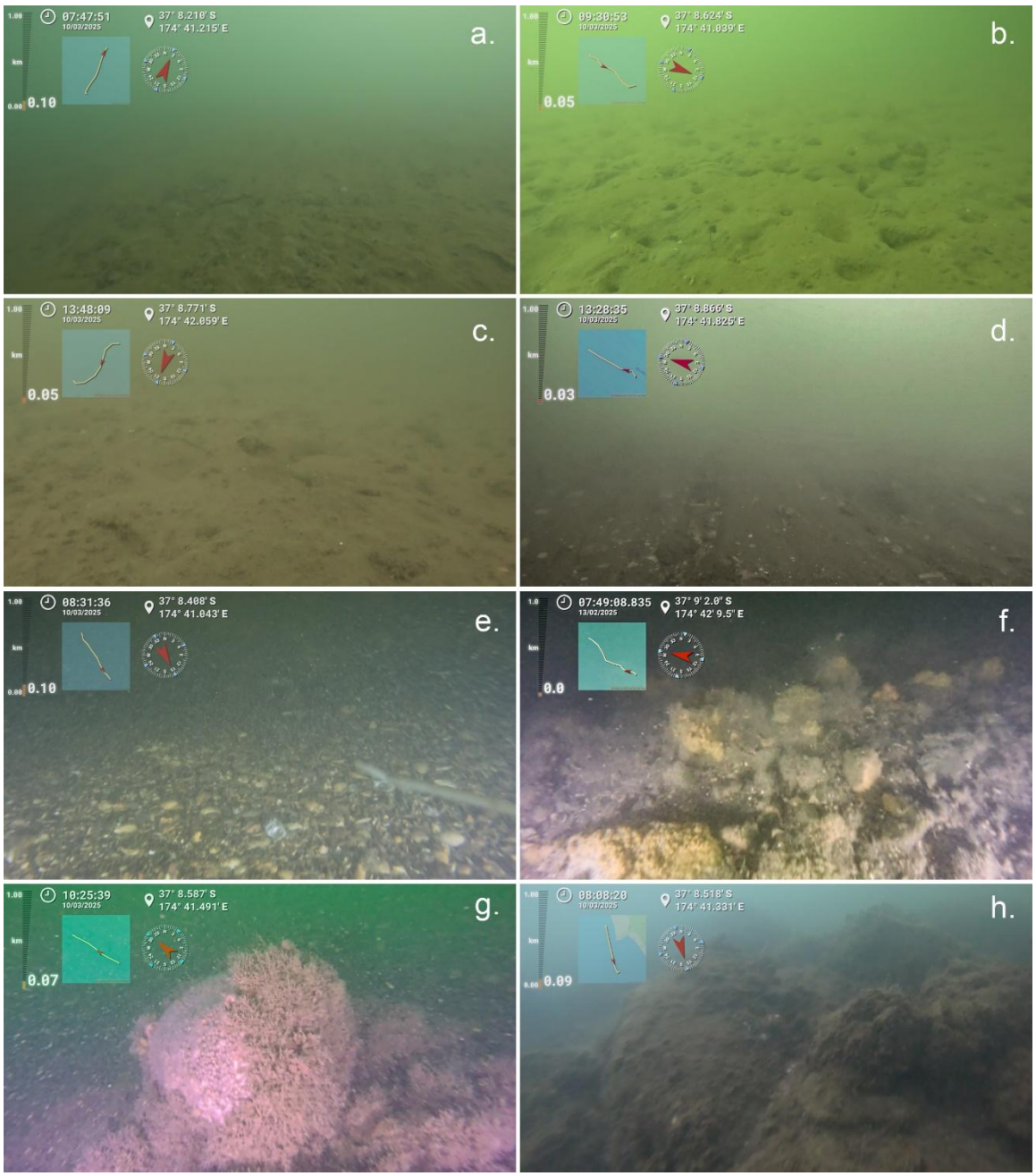


Figure 40. Distribution of substrate types within the survey area. Substrates have been grouped by type: A) muddy substrates (bare mud and mud with burrows); B) sandy substrates (sand and shelly sand; C) hard substrates (shell hash/gravel, gravelly rubble, boulders, and reef). More than one substrate type may occur within each video transect.

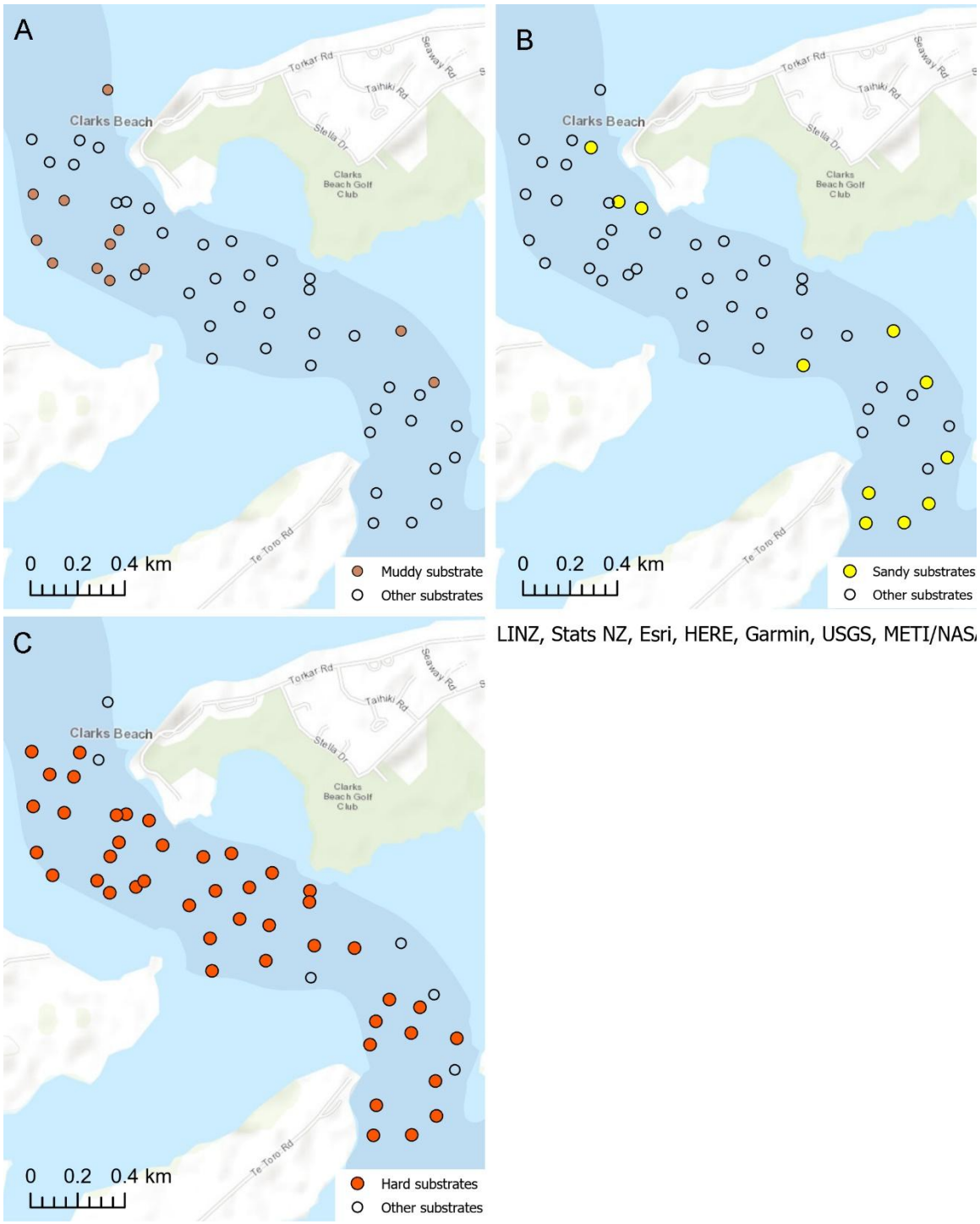


Figure 41. The percentage of transects in which each substrate type occurred.

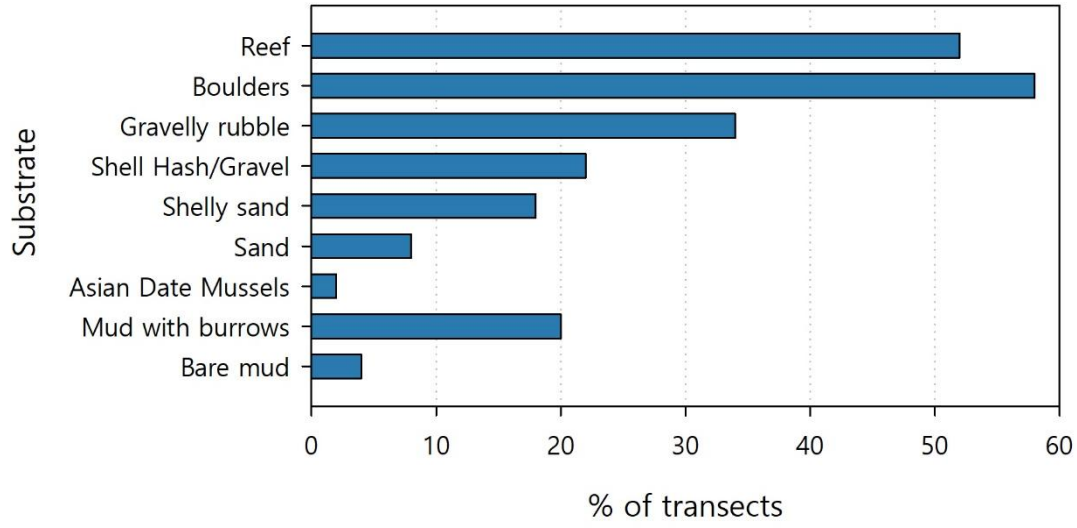


Figure 42. Examples of unidentified sponges observed in video footage (a to d) and screenshots illustrating the diversity of sponges on some reefs (d and e).

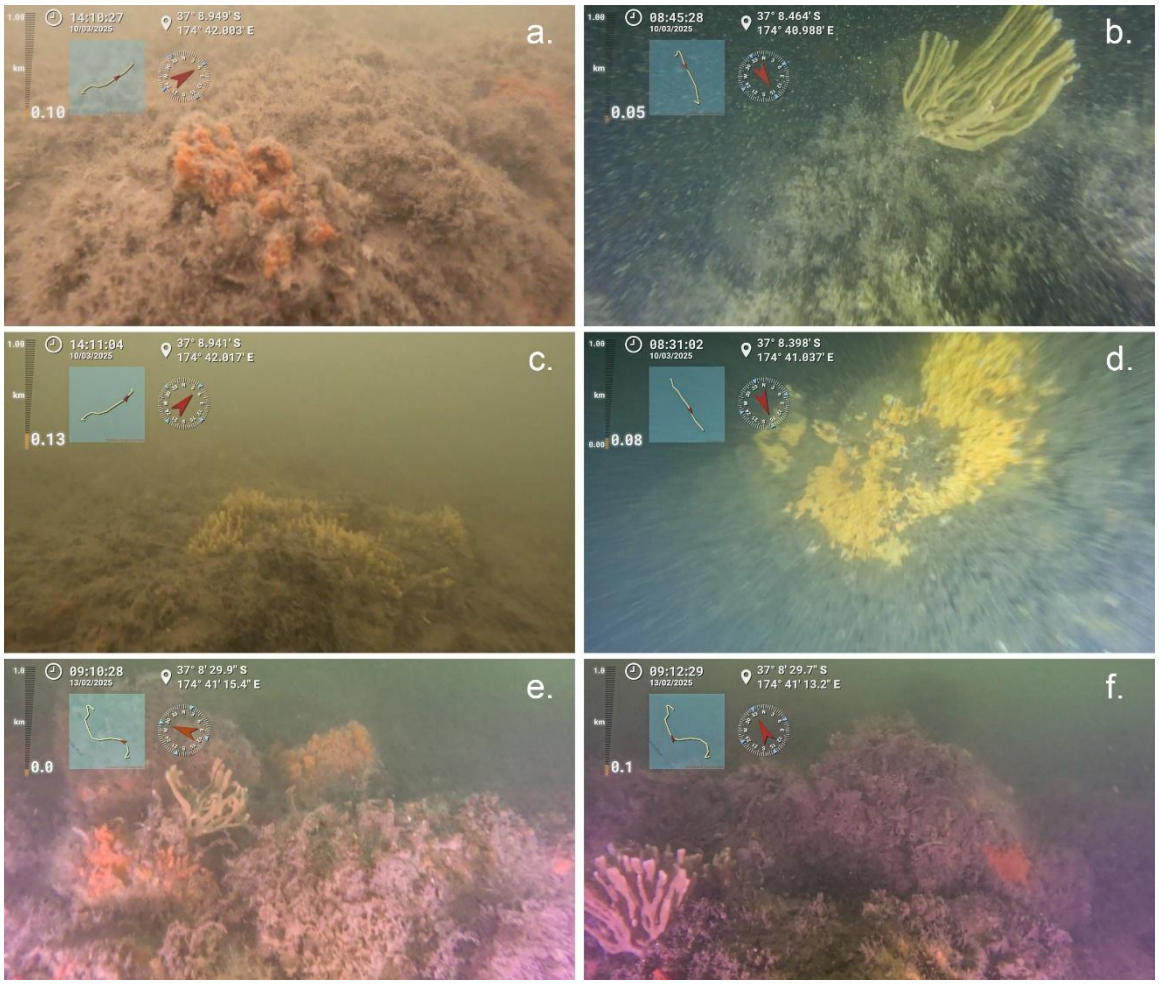


Figure 43. Examples of unidentified bryozoans observed in video footage (a to c) and screenshots showing their presence on sandy and rubble habitats (d and e).

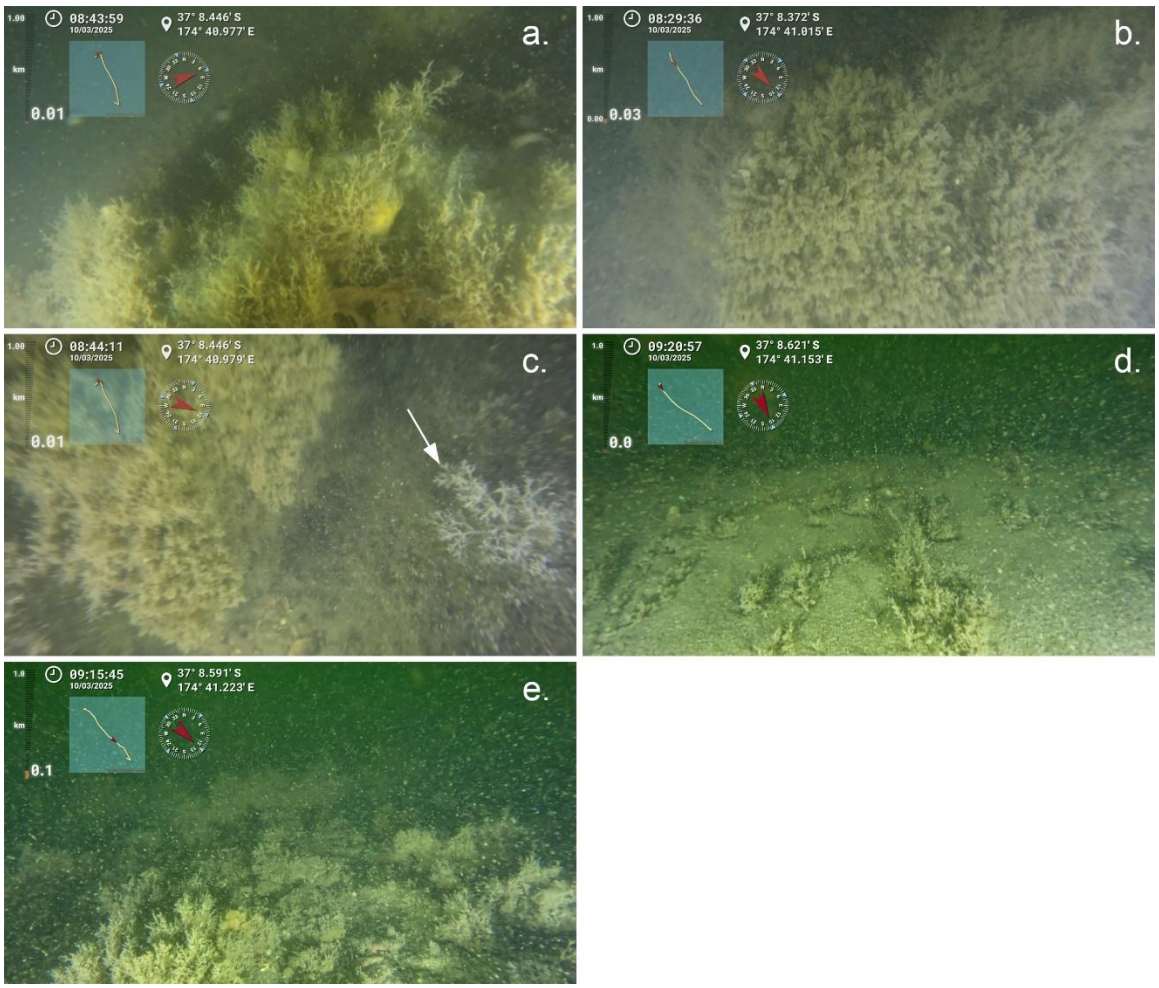


Figure 44. Examples of macroalgae observed in video footage: a) *Carpophyllum* sp. and *Ecklonia radiata* (front left); b) an unidentified brown macroalgae in the foreground; and, c); an unidentified red macroalgae (possibly *Solieria* sp.).

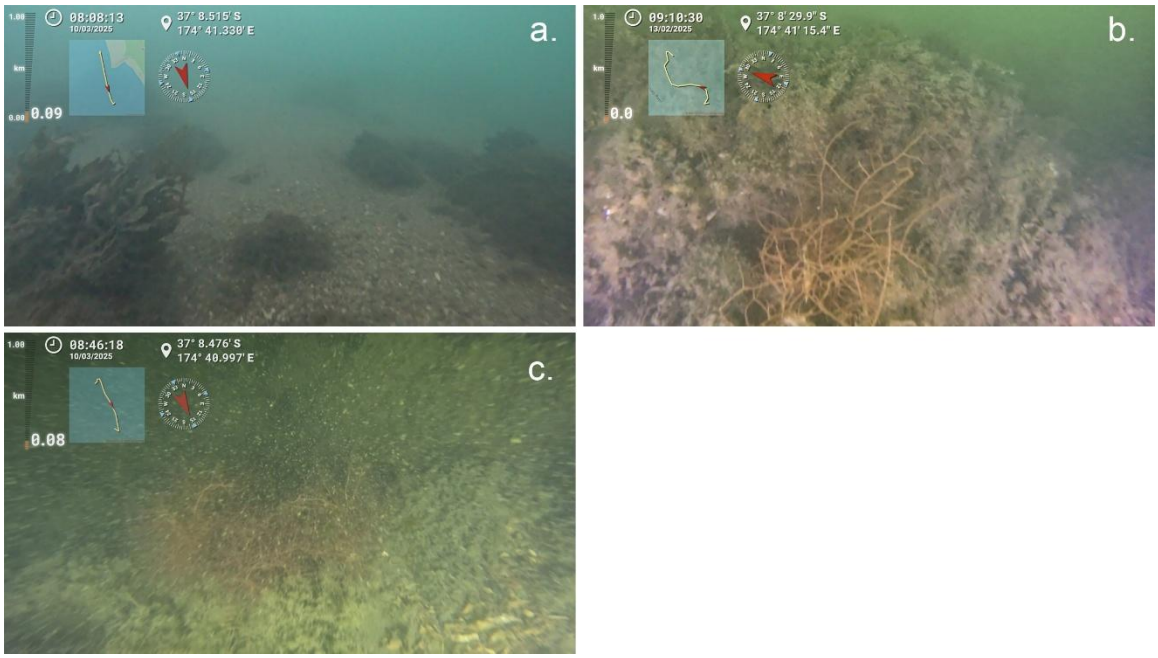


Figure 45. The percentage of transects in which each taxa/taxa group occurred.

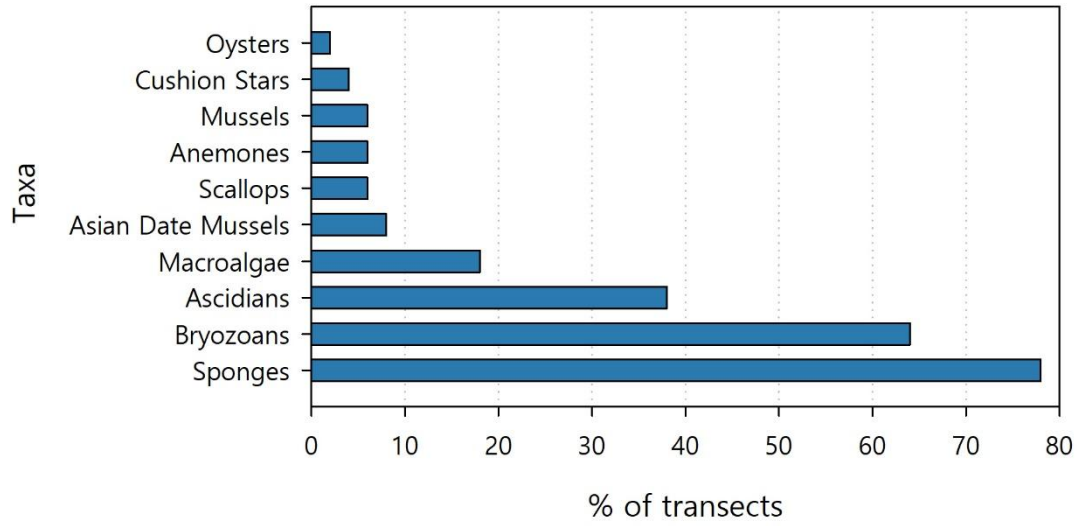


Figure 46. Examples of other biota observed in video footage: a) oysters; b) scallops; c) mussels; d) colonial ascidians; e) tube worms; f) anemones; g) cushion star (arrow) on a bed of Asian date mussels; h) juvenile snapper; i) trevally; and j) disturbed ray.

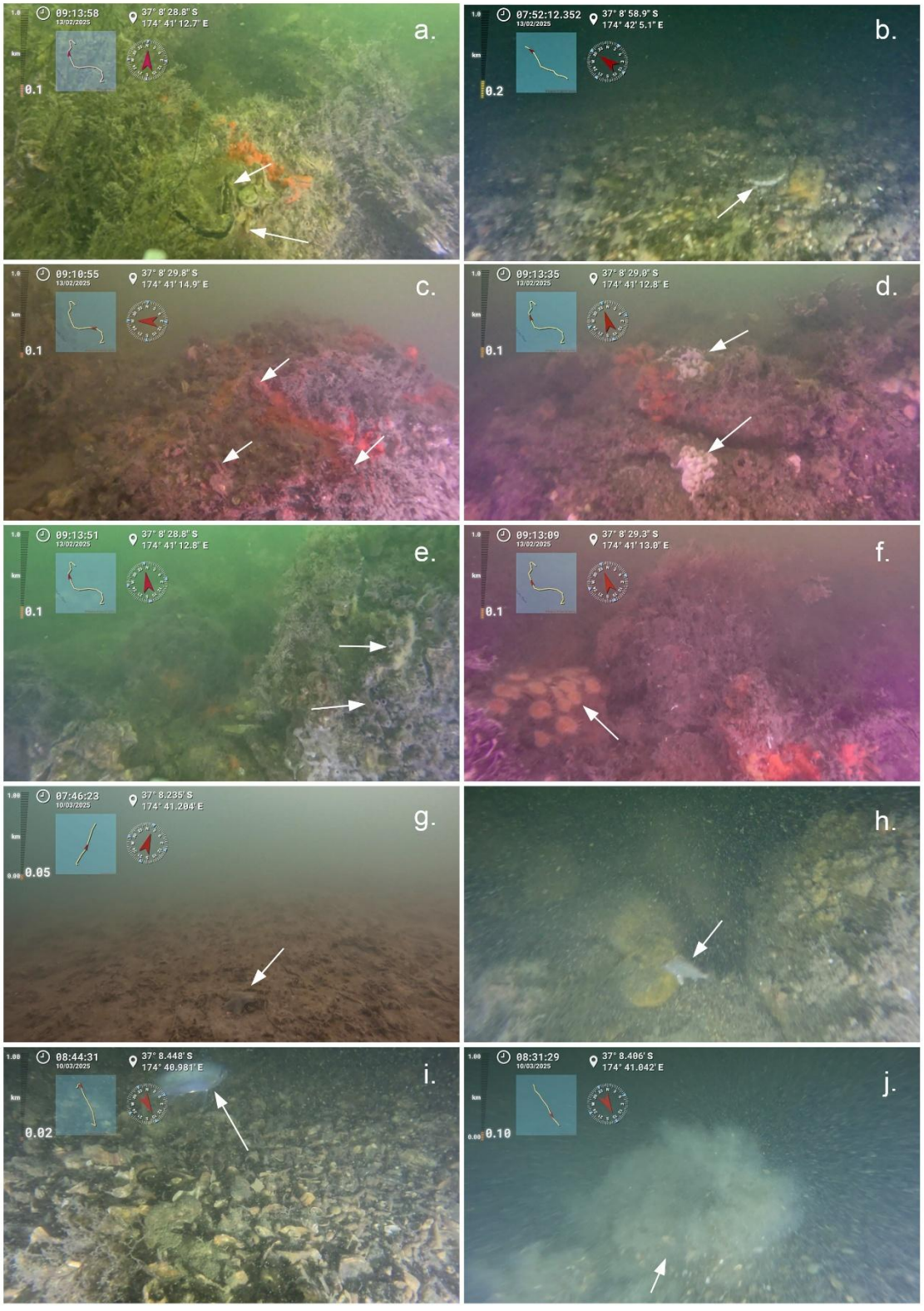


Figure 47. Distribution of the four most abundant taxa groups within the survey area. More than one taxa group may occur in the same video transect.

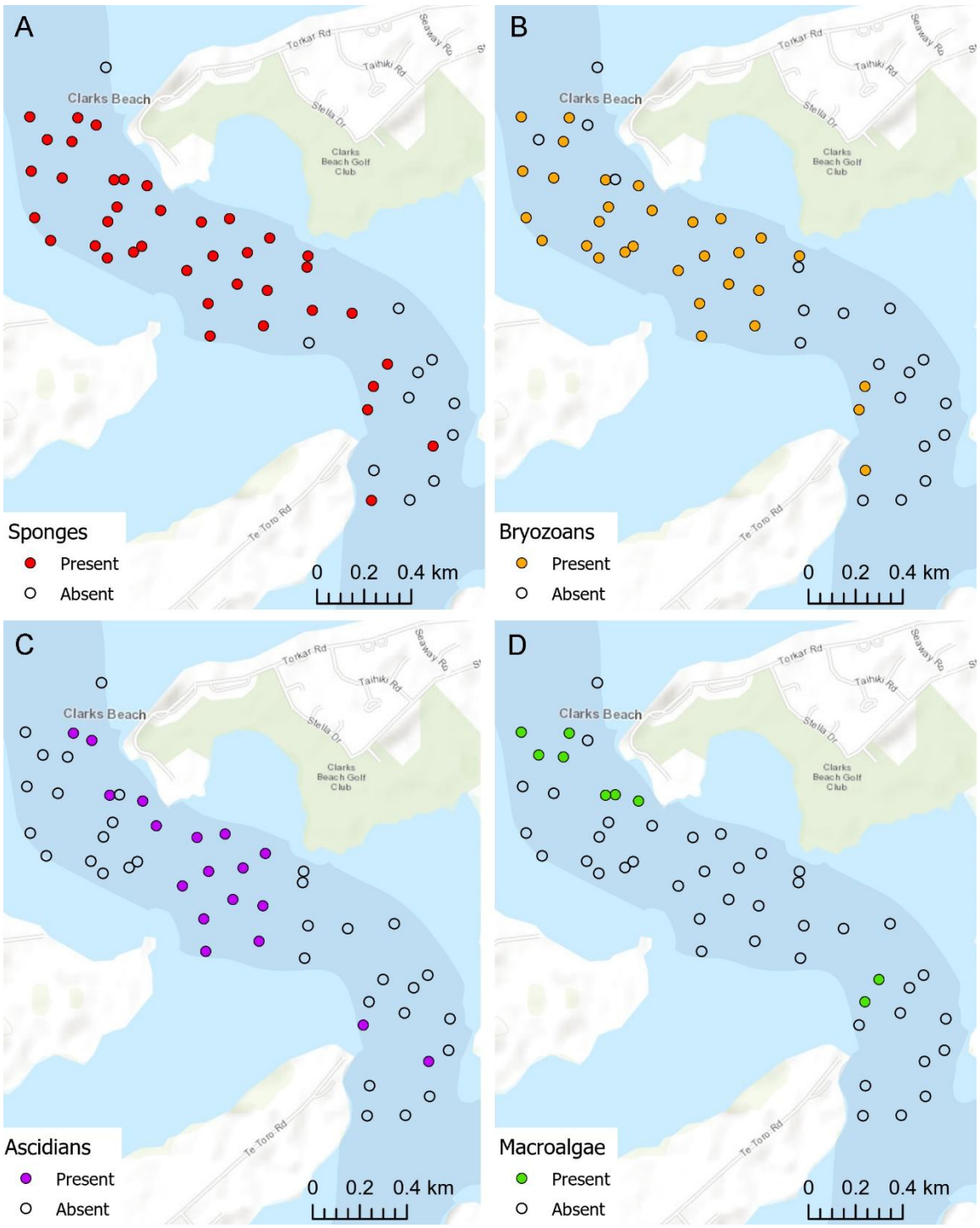
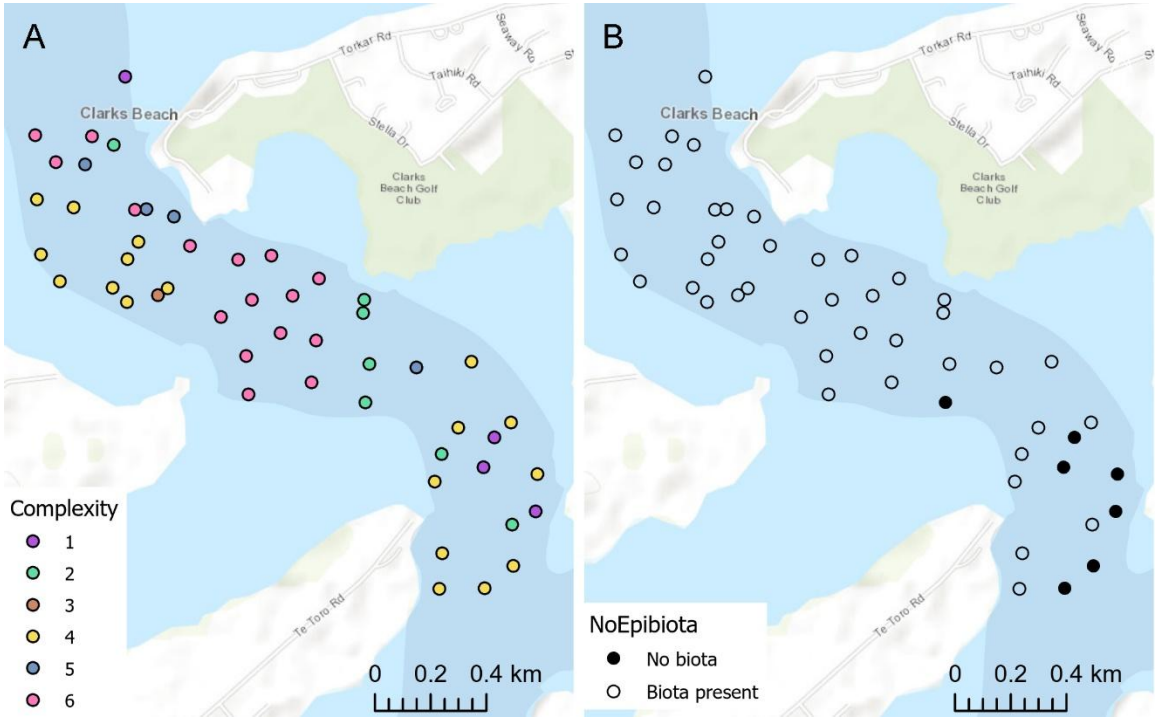


Figure 48. A) Ecological complexity rankings within the survey area from low (1) to high (6), and B) location of transects where no large epibiota was observed.



7 CONCLUSIONS

Baseline monitoring carried out in 2024–25 included:

- monthly sampling for general water quality and phytoplankton;
- 24-hour monitoring of dissolved oxygen at a site below the newly consented outfall site in December 2024, March 2025 and May 2025;
- sampling and characterisation of intertidal benthic macroinvertebrate communities at nine intertidal sites on the western and eastern sides of Waiuku Channel;
- sampling and analysis of sediment characteristics and quality at the nine intertidal sites where ecological samples were collected;
- obtaining underwater video footage along 50, 200 m transects for the analysis of biogenic and physical features.

Water quality

Results show that water quality at the remote Whatapaka (WQ 8) site[9] was much poorer than in all the Waiuku Channel and Taihiki Creek sites. The Whatapaka (WQ 8) site had higher concentrations of ammoniacal-N, total nitrogen, total phosphorus, total suspended solids and turbidity. Occasionally, large spikes in total oxidised nitrogen, total inorganic nitrogen, chlorophyll *a*, enterococci, and faecal coliforms were also recorded at that site.

[9] Situated at the mouth of the Kingseat tributary.

Total ammoniacal-N concentrations tended to be low at the Waiuku and Taihiki Creek sites. Total oxidised nitrogen concentrations were highest at the uppermost sites (Taihiki (WQ-10) and Upper Waiuku (WQ 9)) and declined toward the main body of the harbour. Total nitrogen concentrations tended to be less variable (spatially and temporally) than inorganic forms, with similar concentrations observed at all sites. All sites around the existing and consented future outfall had similar dissolved reactive phosphorus (DRP) concentrations and displayed comparable patterns of temporal variation – a declining trend between June and November, followed by an increasing trend though to April, and a subsequent decline. Concentrations and temporal variation in total phosphorus concentrations were also similar among sites, but temporal patterns were less pronounced and differed slightly from those displayed by DRP. The highest chlorophyll *a* concentration (0.0035 mg/L) was recorded in February, at the 3 km North (WQ 7) site in the main body of the harbour. However, overall there was little difference in chlorophyll *a* concentrations among the monitoring sites.

Little spatial or temporal variation were apparent in total suspended solids concentrations, turbidity, pH, dissolved oxygen saturation or salinity. Enterococci concentrations were low at all sites and sampling occasions, and mostly below detection limits, while faecal coliform concentrations varied from below detection limits (33% of samples) to 64 cfu/100 mL. Sixteen samples (13.6%) had faecal coliform concentrations >10 cfu/100 mL, while five samples (4.3%) had concentrations of ≥ 20 cfu/100 mL.

Diurnal variation in dissolved oxygen

Diurnal variation in dissolved oxygen was much greater than depth variation. Lowest saturation and concentration levels occurred around dawn, with increasing levels through to mid to late afternoon/evening, and declining concentrations overnight. Dissolved oxygen levels were highest in early summer (December), intermediate in early autumn (March), and lowest in late autumn (May).

Phytoplankton

Overall, a total of 152 phytoplankton taxa from 11 phylum or other general high-order groups were identified. The dominant taxa groups were flagellates-unicells, and small flagellates-unicells, which displayed strong seasonality in cell counts, with numbers increasing in late spring to peak in summer, and declining over autumn at all sites. Similar seasonal patterns were observed in pooled counts of the next 10 taxa groups ranked by mean numbers, and in total cell counts of all taxa throughout the year.

Low numbers of potentially toxic filamentous cyanobacteria were detected at the 250 m South (WQ 2) (6 cells per mL, 715 μm^3/mL), and 3 km North (WQ 7) (5 cells per mL, 650 μm^3/mL) water quality monitoring sites in July 2024. Other potentially toxic species obtained in phytoplankton samples, included: *Alexandrium ostenfeldii, Alexandrium pacificum, Gymnodinium catenatum*, *Azadinium* sp., and *Karenia* sp. Potentially toxic taxa from the *Prorocentrum* and *Pseudo-nitzschia* genera were also present, but were not identified to species levels.

Sediment quality

Sediments at the Ngahere site, on the eastern side of the main channel had the highest proportion of mud (48%). On that side of the channel, a clear demarcation in sediment characteristics occurred around the entrance to Waiuku River (between Tokaroa and Karaka

points), with sediment mud content decreasing in the northern sites in the main body of the harbour. A similar change occurred on the western side of the channel, with a marked difference occurring between the Rauau and Tokaroa North sites (Tokaroa North had the lowest proportion of mud of any site). However, mud content increased again between the Tokaroa North and Wairoa Point sites. All sites had moderate to high percentages of sand (51–99%), with the Tokaroa North and Clarks Beach sites having the largest percentage (95–96%).

Mud, total organic carbon, total organic matter content, total phosphorus, and total nitrogen concentrations were highly correlated, and therefore all four parameters displayed similar spatial patterns to those described above for mud content.

Intertidal benthic macrofauna

A diverse assemblage of intertidal macrofauna was identified, with 18,735 individuals and 90 taxa collected from the nine monitoring sites. The abundance of individual taxa and results from four indicators of ecological diversity and abundance varied among sites. In summary:

- Cockles *Austrovenus stutchburyi* were the most abundant species by a large margin, followed by the nut shell *Linucula hartvigiana* and polychaete *Anoides trifida*, whose overall mean abundances were less than half that of cockles.
- Cockle and nut shell numbers on the western side of the main channel were markedly lower at sites north of Tokaroa and Karaka Points. On the eastern side of the channel, patterns in these species were more variable, with no clear distinction between sites above and below the transition zone.
- Other taxa, including the polycheate *A. trifida* and mysid shrimps (Mysida) occurred in high numbers at a limited number of sites.
- Variation in the total numbers of individuals largely mirrored the patterns described above for variation in cockle and nut shell numbers.
- The eastern channel sites generally had more taxa than the other sites.
- Patterns in Pielou's evenness and Shannon diversity were similar, and largely the inverse of patterns for the total numbers of individuals. This reflects the influence of high cockle and nut shell numbers on these indicators.
- Multivariate analysis indicated that macrofaunal communities from sites in the main body of the harbour were more variable than communities within Waiuku River, with a gradient observed between western and eastern sites. Three of the inner channel sites (Ohiku Creek, Waiau, and Rauau North) had very similar communities, but the community composition of the Ngahere site was distinct.
- Combined Health Scores of all sites, except Clarks Beach, were ranked as 'fair'. The Clarks Beach site was ranked as 'good'.

Shellfish

In total, 5258 cockles, 557 wedge shells and four pipi were collected. The majority of cockles were very small, with 75% being less than 5 mm in length, and none considered a

'harvestable' size (>30 mm). Similarly, the majority (73%) of wedge shells were less than 5 mm long.

Subtidal habitats and biogenic features

Underwater video footage showed that hard substrates were the most widespread feature within the area surveyed with reef, boulders and gravelly rubble observed. Overall, hard substrates were found in 88% of transects, whereas muddy and sandy substrates were only found in 24% and 22% of transects, respectively.

Biological features observed in the transect footage included sponges, bryozoans, macroalgae, and a variety of other taxa. Sponges were the most common and widespread group observed (occurring in 78% of the transects), followed by bryozoans (64%), ascidians (38%) and macroalgae (18%). Sponges were observed throughout the survey area, except for the southernmost section. Bryozoans and ascidians were generally limited to the northern half of the survey area, whereas macroalgae were generally only observed in the outermost transects. Ecological complexity was typically low upstream of the outfall and moderate to high downstream of the outfall location, except for around Tokaroa Point, where it was low.

8 ACKNOWLEDGEMENTS

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10 APPENDICES

10.1 SITE COORDINATES

Table 9. Coordinates of the water quality monitoring sites.

Site	NZTM X	NZTM Y
WQ1	1751258	5887047
WQ2	1750831	5887704
WQ3	1750645	5887778
WQ4	1750555	5887821
WQ5	1750369	5887895
WQ6	1749736	5888304
WQ7	1748849	5890413
WQ8	1759646	5893505
WQ9	1751204	5885465
WQ10	1753220	5886897

Table 10. Corner coordinates for ecological and sediment quality monitoring sites.

Site Name	Site Number	Corner	NZTM X	NZTM Y
Waiau (WAI)	1	a	1751203	5887697
		b	1751261	5887752
		c	1751205	5887810
		d	1751148	5887754
Ngahere (NGA)	2	a	1750352	5888051
		b	1750344	5888120
		c	1750304	5888116
		d	1750312	5888046
Ohiku Creek (OC)	3	a	1750719	5887143
		b	1750711	5887125
		c	1750435	5887242
		d	1750443	5887261
Rauau North (RN)	4	a	1749896	5887579
		b	1749878	5887501
		c	1749800	5887518
		d	1749818	5887596
Clarks West (CW)	5	a	1749876	5888476
		b	1749925	5888467
		c	1749946	5888585
		d	1749897	5888594
Lower Clarks Beach (LCB)	6	a	1750271	5889167
		b	1750351	5889172
		c	1750346	5889252
		d	1750266	5889247
Tokaroa North (TN)	7	a	1749050	5888560
		b	1748980	5888522
		c	1748942	5888593
		d	1749013	5888631
Wairoa Point (WP)	8	a	1748766	5889255
		b	1748688	5889237
		c	1748670	5889314
		d	1748748	5889333
Clarks Beach (CB)	9	a	1751310	5890139
		b	1751305	5890219
		c	1751225	5890214
		d	1751230	5890134

10.2 GENERAL WATER QUALITY DATA

Date	Site	NH_3NH_4 (mg/L)	TON (mg/L)	TIN (mg/L)	TN (mg/L)	DRP (mg/L)	TP (mg/L)	Chl a (mg/L)	TSS (mg/L)	Turbidity (NTU)	DO (mg/L)	DO (%)	Salinity (ppt)	pH	Temp (°C)	F coliforms (cfu/100 mL)	Entero (MPN/100 mL)
17/06/2024	1 km North (WQ6)	0.0082	0.065	0.073	0.19	0.02	0.024	0.0021	6.7	3.8	8.96	105.1	29	8.2	14	18	
17/06/2024	1 km South (WQ1)	<0.005	0.0655	0.066	0.18	0.015	0.022	0.0015	10	4.2	8.73	102.6	29	8.2	14	13	
17/06/2024	250 m North (WQ5)	0.0095	0.0557	0.065	0.18	0.02	0.023	0.0019	8	3.7	8.9	104.6	29	8.2	14	13	
17/06/2024	250m South (WQ2)	<0.005	0.0559	0.056	0.18	0.018	0.022	0.0016	5.5	2.5	8.9	104.8	29	8.2	14	9.8	
17/06/2024	3 km North (WQ7)	0.0051	0.05	0.055	0.16	0.023	0.025	0.0026	10	3.8	9.05	106.6	29	8.2	14.1	4.9	
17/06/2024	50 m North (WQ4)	<0.005	0.0581	0.058	0.33	0.018	0.019	0.0015	5.5	2.6	8.94	105	29	8.2	14	9.8	
17/06/2024	50 m South (WQ3)	<0.005	0.061	0.061	0.19	0.016	0.02	0.0015	4.6	2.4	8.94	105	29	8.2	14	6.5	
17/06/2024	Taihiki (WQ10)	0.018	0.111	0.13	0.26	0.018	0.028	0.0013	7.8	3.3	8.79	102.7	28	8.2	13.9	15	
17/06/2024	Upper Waiuku (WQ9)	0.023	0.117	0.14	0.32	0.02	0.023	0.0014	6.8	1.5	8.86	102.4	27	8.2	13.8	11	
4/07/2024	Whatapaka (WQ8)	0.022	0.0849	0.11	0.17	0.02	0.021	<0.0015	11	6	8.91	97.7	29	8.2	11.2	34	10
17/07/2024	1 km North (WQ6)	<0.005	0.0425	0.042	0.13	0.014	0.014	0.00096	4.6	1.1	9.51	107	29	8.3	12	1.7	
17/07/2024	1 km South (WQ1)	<0.005	0.0449	0.045	0.11	0.015	0.017	0.00065	5	1.2	9.53	107.2	29	8.3	12	<1.7	
17/07/2024	250 m North (WQ5)	<0.005	0.0442	0.044	0.14	0.014	0.016	0.0006	5.4	1.3	9.45	106.4	29	8.3	12.1	1.7	
17/07/2024	250m South (WQ2)	<0.005	0.0424	0.042	0.12	0.015	0.014	0.0016	4.8	1.7	9.47	106.5	29	8.3	12	1.7	
17/07/2024	3 km North (WQ7)	<0.005	0.0375	0.037	0.093	0.013	0.014	0.0014	4.8	1.2	9.51	107.7	30	8.3	12.2	1.7	
17/07/2024	50 m North (WQ4)	<0.005	0.0453	0.045	0.11	0.014	0.015	<0.0006	4.8	1.5	9.53	107.2	29	8.3	12	<1.7	
17/07/2024	50 m South (WQ3)	<0.005	0.048	0.048	0.12	0.015	0.017	<0.0006	3.2	1.1	9.53	107.1	29	8.3	12	1.7	
17/07/2024	Taihiki (WQ10)	<0.005	0.0637	0.064	0.14	0.016	0.017	0.001	4.8	1.4	9.48	106.2	29	8.2	11.9	1.7	
17/07/2024	Upper Waiuku (WQ9)	<0.005	0.0576	0.058	0.13	0.016	0.017	0.0013	3.6	1.4	9.54	107	29	8.3	11.9	5	
1/08/2024	Whatapaka (WQ8)	0.031	0.303	0.33	0.59	0.022	0.034	0.0012	10	8	8.63	100.3	29	8.2	14.1	500	200
15/08/2024	1 km North (WQ6)	<0.005	0.0435	0.043	0.15	0.013	0.014	0.00073	4.8	2.5	9.46	105.1	28	8.2	12.9	<1.6	
15/08/2024	1 km South (WQ1)	<0.005	0.0395	0.039	0.13	0.013	0.013	<0.0006	4	0.85	9.49	105.3	28	8.2	12.8	<1.6	

Date	Site	NH_3NH_4 (mg/L)	TON (mg/L)	TIN (mg/L)	TN (mg/L)	DRP (mg/L)	TP (mg/L)	Chl a (mg/L)	TSS (mg/L)	Turbidity (NTU)	DO (mg/L)	DO (%)	Salinity (ppt)	pH	Temp (°C)	F coliforms (cfu/100 mL)	Entero (MPN/100 mL)
15/08/2024	250 m North (WQ5)	<0.005	0.0496	0.05	0.14	0.013	0.013	<0.0006	4.2	1.8	9.46	104.9	28	8.2	12.9	<1.6	
15/08/2024	250m South (WQ2)	<0.005	0.0494	0.049	0.14	0.013	0.014	0.00095	2.8	1.7	9.5	105.3	28	8.2	12.8	<1.6	
15/08/2024	3 km North (WQ7)	<0.005	0.019	0.019	0.12	0.011	0.01	0.001	5.2	1.8	9.45	105.6	29	8.2	13	<1.6	
15/08/2024	50 m North (WQ4)	<0.005	0.0579	0.058	0.18	0.014	0.014	<0.0006	4	1.7	9.49	105	27	8.2	12.8	<1.6	
15/08/2024	50 m South (WQ3)	<0.005	0.0566	0.057	0.23	0.014	0.017	0.0011	4.8	2	9.51	105.2	28	8.2	12.7	<1.6	
15/08/2024	Taihiki (WQ10)	<0.005	0.0839	0.084	0.19	0.014	0.013	0.00083	4.6	1.4	9.5	104.6	27	8.2	12.6	1.6	
15/08/2024	Upper Waiuku (WQ9)	<0.005	0.0915	0.092	0.22	0.016	0.017	<0.0006	2.4	1.3	9.62	105.1	27	8.2	12.3	<1.6	
18/09/2024	Whatapaka (WQ8)	0.045	0.019	0.063	0.16	0.015	0.041	0.0059	170	70	8.29	92.6	31	8.1	11.5	96	52
27/09/2024	1 km North (WQ6)	<0.005	0.0601	0.06	0.12	0.013	0.023	0.00077	15	5.9	8.73	104.7	30	8.1	15.3	1.6	
27/09/2024	1 km South (WQ1)	<0.005	0.0623	0.062	0.14	0.013	0.019	0.00096	16	5.9	8.73	104.7	30	8	15.3	1.6	
27/09/2024	250 m North (WQ5)	<0.005	0.0577	0.058	0.12	0.014	0.022	0.00087	15	6.3	8.77	105.1	30	8.1	15.2	3.3	
27/09/2024	250m South (WQ2)	<0.005	0.0612	0.061	0.12	0.014	0.02	0.0007	14	4.1	8.4	100.8	30	8.1	15.3	<1.6	
27/09/2024	3 km North (WQ7)	0.01	0.039	0.049	0.09	0.012	0.016	0.00086	12	6.8	8.75	105.2	31	8.2	15.3	<1.6	
27/09/2024	50 m North (WQ4)	<0.005	0.061	0.061	0.13	0.014	0.019	0.00099	11	5.1	8.76	105	30	8.1	15.3	<1.6	
27/09/2024	50 m South (WQ3)	<0.005	0.0611	0.061	0.11	0.014	0.016	<0.0006	12	5.2	8.75	105	30	8.1	15.3	<1.6	
27/09/2024	Taihiki (WQ10)	<0.005	0.0927	0.093	0.17	0.014	0.022	0.00098	11	5.5	8.66	103.7	29	8.1	15.3	3.3	
27/09/2024	Upper Waiuku (WQ9)	<0.005	0.0715	0.072	0.15	0.015	0.023	0.00071	19	9.9	8.71	104.1	30	8.1	15.2	1.6	
14/10/2024	1 km North (WQ6)	<0.005	0.0493	0.049	0.19	0.011	0.025	0.0016	15	8.1	8.95	110	30	8.1	16.5	8.2	
14/10/2024	1 km South (WQ1)	0.006	0.0403	0.046	0.16	0.01	0.033	0.0017	16	9.3	8.96	110	30	8.1	16.3	<1.6	
14/10/2024	250 m North (WQ5)	0.0079	0.0554	0.063	0.19	0.011	0.029	0.0019	13	7.2	8.91	109.6	30	8.1	16.6	4.9	
14/10/2024	250m South (WQ2)	0.0065	0.0554	0.062	0.17	0.011	0.027	0.0011	10	6	8.96	109.8	29	8.1	16.4	4.9	
14/10/2024	3 km North (WQ7)	0.006	0.0247	0.031	0.16	0.009	0.033	0.0016	14	9.5	8.89	109.9	30	8.1	16.6	1.6	
14/10/2024	50 m North (WQ4)	0.0077	0.055	0.063	0.22	0.01	0.031	0.0017	12	6.8	8.98	110.1	30	8.1	16.4	3.3	
14/10/2024	50 m South (WQ3)	0.012	0.0547	0.066	0.18	0.01	0.028	0.0017	10	6.8	8.95	109.9	30	8.1	16.5	3.3	
14/10/2024	Taihiki (WQ10)	0.093	0.0727	0.17	0.21	0.012	0.034	0.0018	11	8.6	8.91	109.2	29	8.1	16.5	3.3	
14/10/2024	Upper Waiuku (WQ9)	0.021	0.12	0.14	0.25	0.014	0.024	0.0013	13	4.5	9.01	109.7	28	8.1	16.4	9.8	

Date	Site	NH_3NH_4 (mg/L)	TON (mg/L)	TIN (mg/L)	TN (mg/L)	DRP (mg/L)	TP (mg/L)	Chl a (mg/L)	TSS (mg/L)	Turbidity (NTU)	DO (mg/L)	DO (%)	Salinity (ppt)	pH	Temp (°C)	F coliforms (cfu/100 mL)	Entero (MPN/100 mL)
14/10/2024	Whatapaka (WQ8)	0.081	0.0285	0.11	0.22	0.013	0.044	0.0041	16	9.8	7.72	94.1	30	8.1	16	15	10
12/11/2024	1 km North (WQ6)	0.01	0.0034	0.014	0.16	0.009	0.024	0.0019	23	11	7.77	103.8	35	8.1	19.9	1.6	<10
12/11/2024	1 km South (WQ1)	<0.005	0.0034	<0.005	0.13	0.009	0.022	0.002	21	11	7.77	103.9	36	8.1	19.8	1.6	<10
12/11/2024	250 m North (WQ5)	<0.005	0.004	<0.005	0.17	0.009	0.025	0.0018	21	9.5	7.81	104.2	35	8.1	19.9	4.9	10
12/11/2024	250m South (WQ2)	0.0051	0.0047	0.0097	0.16	0.009	0.026	0.0021	18	9.2	7.76	103.8	35	8.1	19.9	<1.6	<10
12/11/2024	3 km North (WQ7)	<0.005	<0.002	<0.005	0.14	0.008	0.018	0.0015	17	7.5	7.84	104.6	36	8.1	19.8	1.6	<10
12/11/2024	50 m North (WQ4)	<0.005	0.004	<0.005	0.15	0.009	0.024	0.0025	21	10	7.81	104.3	35	8.1	19.8	3.3	<10
12/11/2024	50 m South (WQ3)	<0.005	0.0045	<0.005	<0.01	0.007	0.027	0.0019	19	9.6	7.76	103.8	35	8.1	19.9	3.3	<10
12/11/2024	Taihiki (WQ10)	0.0058	<0.002	0.0069	0.15	0.008	0.022	0.0027	16	8.5	7.67	102.5	35	8.1	20	<1.6	<10
12/11/2024	Upper Waiuku (WQ9)	0.0058	0.012	0.017	0.15	0.009	0.029	0.0023	19	10	8	107.1	35	8.1	20	3.3	<10
12/11/2024	Whatapaka (WQ8)	0.0077	<0.002	0.0083	0.33	0.011	0.035	0.0036	11	9.1	6.9	92.4	33	8	20.1	<1.6	<10
10/12/2024	1 km North (WQ6)	<0.005	0.0027	<0.005	0.16	0.016	0.025	0.0021	9.6	3.9	7.1	99	36	8.2	21.3	30	<10
10/12/2024	1 km South (WQ1)	<0.005	0.0035	<0.005	0.18	0.016	0.023	0.0024	12	4.3	7.09	98.4	36	8.3	21.2	1.6	<10
10/12/2024	250 m North (WQ5)	0.0061	0.0039	0.01	0.16	0.016	0.025	0.0018	16	3.8	7.08	98.9	36	8.2	21.3	1.6	<10
10/12/2024	250m South (WQ2)	<0.005	0.0041	<0.005	0.21	0.016	0.022	0.0018	10	3.6	7.08	98.8	36	8.3	21.3	4.9	<10
10/12/2024	3 km North (WQ7)	<0.005	<0.002	<0.005	0.17	0.017	0.02	0.002	17	4.2	7.06	98.6	36	8.3	21.4	4.9	<10
10/12/2024	50 m North (WQ4)	<0.005	0.0025	<0.005	0.13	0.016	0.05	0.0015	16	3.3	7	97.5	36	8.2	21.2	4.9	<10
10/12/2024	50 m South (WQ3)	<0.005	0.0034	<0.005	0.14	0.016	0.023	0.0013	11	3.1	7.08	98.9	36	8.3	21.3	1.6	10
10/12/2024	Taihiki (WQ10)	<0.005	0.0085	0.0085	0.14	0.018	0.025	0.002	8.6	4.1	6.94	96.8	36	8.2	21.3	8.2	<10
10/12/2024	Upper Waiuku (WQ9)	<0.005	0.0045	<0.005	0.18	0.016	0.023	<0.0006	8.4	3.7	7.09	98.9	36	8.2	21.2	11	<10
13/12/2024	Whatapaka (WQ8)	<0.005	0.011	0.011	0.41	0.029	0.116	0.0059	120	37	6.82	93.5	34	8.1	21.3	82	10
10/01/2025	1 km North (WQ6)	<0.005	<0.002	<0.005	0.16	0.017	0.026	0.0016	11	4.4	7.16	97.9	35	8	20.8	<1.6	<10
10/01/2025	1 km South (WQ1)	<0.005	<0.002	<0.005	0.17	0.017	0.026	0.0023	8.8	4.2	7.23	98.2	34	7.9	20.8	4.9	<10
10/01/2025	250 m North (WQ5)	<0.005	<0.002	<0.005	0.15	0.017	0.025	0.0021	9.2	3.8	7.17	97.9	35	8	20.8	3.3	<10
10/01/2025	250m South (WQ2)	<0.005	<0.002	<0.005	0.17	0.017	0.021	0.0026	8.6	4	7.22	98.3	34	8	20.7	<1.6	<10
10/01/2025	3 km North (WQ7)	<0.005	<0.002	<0.005	0.18	0.016	0.028	0.0029	10	5.6	7.21	98.2	35	8	20.5	<1.6	<10

Date	Site	NH_3NH_4 (mg/L)	TON (mg/L)	TIN (mg/L)	TN (mg/L)	DRP (mg/L)	TP (mg/L)	Chl a (mg/L)	TSS (mg/L)	Turbidity (NTU)	DO (mg/L)	DO (%)	Salinity (ppt)	pH	Temp (°C)	F coliforms (cfu/100 mL)	Entero (MPN/100 mL)
10/01/2025	50 m North (WQ4)	<0.005	<0.002	<0.005	0.16	0.018	0.026	0.003	11	4.4	7.18	98.3	35	8	20.8	<1.6	<10
10/01/2025	50 m South (WQ3)	<0.005	<0.002	<0.005	0.14	0.017	0.026	0.0024	11	3.6	7.26	98.6	34	8	20.8	3.3	<10
10/01/2025	Taihiki (WQ10)	<0.005	<0.002	<0.005	0.17	0.017	0.027	0.0018	13	4.1	7.11	97.1	34	8	21	<1.6	<10
10/01/2025	Upper Waiuku (WQ9)	<0.005	0.0024	<0.005	0.15	0.017	0.023	0.0027	8.8	3.6	7.18	98.9	34	7.9	21.5	<1.6	<10
10/01/2025	Whatapaka (WQ8)	0.023	0.0067	0.03	0.32	0.03	0.056	0.0033	44	19	6.22	87.1	36	8.1	21.8	3.3	<10
7/02/2025	1 km North (WQ6)	0.008	0.0044	0.012	0.17	0.024	0.032	0.0022	10	3.4	6.54	95.5	38	8.2	23.5	<1.6	<10
7/02/2025	1 km South (WQ1)	<0.005	0.0046	<0.005	0.16	0.024	0.035	0.003	8.4	2.8	6.53	95.1	38	8.2	23.3	<1.6	<10
7/02/2025	250 m North (WQ5)	<0.005	0.0043	<0.005	0.27	0.024	0.031	0.003	9	2.7	6.51	95.2	38	8.2	23.6	<1.6	<10
7/02/2025	250m South (WQ2)	<0.005	0.0046	<0.005	0.17	0.024	0.035	0.0023	8	3.5	6.62	96.7	38	8.2	23.5	1.6	<10
7/02/2025	3 km North (WQ7)	<0.005	0.0021	<0.005	0.15	0.022	0.032	0.0035	18	7.1	6.67	97	38	8.2	23.2	<1.6	<10
7/02/2025	50 m North (WQ4)	0.0058	0.0046	0.01	0.17	0.024	0.031	0.0025	9.2	3.2	6.56	95.9	38	8.2	23.5	<1.6	<10
7/02/2025	50 m South (WQ3)	0.0051	0.0044	0.0095	0.17	0.024	0.034	0.0023	7.4	2.8	6.62	96.5	38	8.2	23.4	3.3	<10
7/02/2025	Taihiki (WQ10)	<0.005	0.0084	0.0084	0.18	0.025	0.038	0.0017	14	2.3	6.53	95.3	38	8.1	23.4	<1.6	<10
7/02/2025	Upper Waiuku (WQ9)	0.007	0.0044	0.011	0.18	0.026	0.036	0.0027	14	3.4	6.59	95.9	38	8.1	23.3	<1.6	<10
24/02/2025	Whatapaka (WQ8)	<0.005	<0.002	<0.005	0.3	0.035	0.058	0.0063	14	8	6.45	90.7	37	8.2	21.5	1.7	10
10/03/2025	Whatapaka (WQ8)	0.021	<0.002	0.02	0.4	0.018	0.06	0.0066	40	11	6.66	89.8	37	8.3	19.3	<1.6	<10
24/03/2025	1 km North (WQ6)	<0.005	0.0038	<0.005	0.19	0.023	0.031	0.0018	5.2	1.7	7.04	97.7	38	8.3	20.7	17	<10
24/03/2025	1 km South (WQ1)	<0.005	0.006	0.006	0.15	0.026	0.035	0.0014	6.8	2.3	7	96.7	38	8.3	20.6	<1.7	<10
24/03/2025	250 m North (WQ5)	<0.005	0.0056	0.0056	0.17	0.024	0.034	0.0012	7.4	2.2	7.01	97.3	38	8.3	20.8	5	<10
24/03/2025	250m South (WQ2)	<0.005	<0.002	<0.005	0.16	0.024	0.035	0.0013	5.8	1.8	7.05	97.7	38	8.3	20.7	<1.7	<10
24/03/2025	3 km North (WQ7)	<0.005	0.0047	<0.005	0.14	0.022	0.031	0.00081	6.6	2.2	7.17	99.4	38	8.4	20.7	3.3	<10
24/03/2025	50 m North (WQ4)	<0.005	0.0079	0.0079	0.16	0.025	0.042	0.002	7	2.1	7.06	97.8	38	8.3	20.8	1.7	<10
24/03/2025	50 m South (WQ3)	<0.005	0.0067	0.0067	0.14	0.023	0.034	0.0018	5	1.6	7.06	97.9	38	8.3	20.8	<1.7	<10
24/03/2025	Taihiki (WQ10)	<0.005	0.0099	0.0099	0.17	0.027	0.038	0.0011	6.4	1.9	6.87	95.2	38	8.3	20.7	<1.7	<10
24/03/2025	Upper Waiuku (WQ9)	0.0053	0.011	0.016	0.15	0.028	0.037	0.0019	4.2	2	6.95	95.8	38	8.2	20.6	<1.7	<10
8/04/2025	1 km North (WQ6)	0.026	0.016	0.043	0.14	0.031	0.035	0.0022	12	4.3	7.02	93.9	34	8.2	19.5	3.3	10

Date	Site	NH_3NH_4 (mg/L)	TON (mg/L)	TIN (mg/L)	TN (mg/L)	DRP (mg/L)	TP (mg/L)	Chl a (mg/L)	TSS (mg/L)	Turbidity (NTU)	DO (mg/L)	DO (%)	Salinity (ppt)	pH	Temp (°C)	F coliforms (cfu/100 mL)	Entero (MPN/100 mL)
8/04/2025	1 km South (WQ1)	0.023	0.018	0.04	0.14	0.029	0.041	0.0025	12	2.6	7.09	95.1	35	8.2	19.4	13	10
8/04/2025	250 m North (WQ5)	0.023	0.017	0.04	0.14	0.031	0.035	0.00069	6.8	2.9	7.03	94	35	8.2	19.3	1.6	20
8/04/2025	250m South (WQ2)	0.025	0.017	0.041	0.15	0.03	0.041	0.0013	6.4	2.5	7.06	94.3	34	8.2	19.5	4.9	<10
8/04/2025	3 km North (WQ7)	0.02	0.015	0.034	0.15	0.03	0.029	0.003	8.8	3.3	7.15	95.6	35	8.3	19.4	1.6	<10
8/04/2025	50 m North (WQ4)	0.022	0.019	0.04	0.14	0.027	0.04	<0.0006	10	2.6	6.99	93.7	35	8.2	19.5	1.6	<10
8/04/2025	50 m South (WQ3)	0.023	0.019	0.042	0.13	0.028	0.04	0.0026	6.8	2.6	7.04	94.5	35	8.2	19.5	1.6	<10
8/04/2025	Taihiki (WQ10)	0.034	0.0251	0.059	0.16	0.033	0.043	0.0018	12	3.3	6.83	91.3	34	8.2	19.4	8.2	20
8/04/2025	Upper Waiuku (WQ9)	0.027	0.018	0.045	0.15	0.031	0.044	0.0027	6.8	3.4	7.04	93.4	34	8.2	19	4.9	<10
9/04/2025	Whatapaka (WQ8)	0.04	0.011	0.051	0.16	0.03	0.036	0.0027	14	6.8	7.35	93.5	34	8.1	17.2	46	52
8/05/2025	1 km North (WQ6)	0.0053	0.0462	0.052	0.2	0.023	0.038	0.00091	12	2.9	7.76	96.6	33	8	16.9	1.7	<10
8/05/2025	1 km South (WQ1)	0.0066	0.0488	0.055	0.2	0.023	0.038	0.00089	11	0.9	7.8	97	33	8	16.8	<1.7	<10
8/05/2025	250 m North (WQ5)	<0.005	0.0498	0.05	0.2	0.021	0.033	0.0015	5.4	0.85	7.74	96.5	33	8	17	<1.7	<10
8/05/2025	250m South (WQ2)	0.0082	0.0479	0.056	0.2	0.022	0.036	0.0013	8.6	4.1	7.76	96.7	33	8	16.9	<1.7	<10
8/05/2025	3 km North (WQ7)	0.0052	0.0388	0.044	0.19	0.021	0.035	0.0013	9.8	1.7	7.89	98.6	33	8.1	17.1	<1.7	10
8/05/2025	50 m North (WQ4)	0.012	0.0477	0.059	0.19	0.022	0.035	0.0013	5.4	1.4	7.76	96.7	33	8	16.9	1.7	<10
8/05/2025	50 m South (WQ3)	0.0091	0.0464	0.055	0.19	0.023	0.037	<0.0006	11	1.4	7.81	97.7	34	8	16.9	5	<10
8/05/2025	Taihiki (WQ10)	0.0055	0.0571	0.063	0.19	0.024	0.039	0.0011	10	0.7	7.63	94.3	33	8	16.7	1.7	<10
8/05/2025	Upper Waiuku (WQ9)	0.0065	0.0481	0.055	0.18	0.024	0.038	<0.0006	9	2.6	7.07	95.3	33	8	16.8	1.7	10
26/05/2025	Whatapaka (WQ8)	<0.005	0.014	0.014	0.16	0.025	0.04	0.0029	52	20	7.9	95.3	32	8.3	15.2	180	160
6/06/2025	1 km North (WQ6)	0.03	0.0379	0.068	0.19	0.022	0.03	0.0016	11	4.3		93.8	33	8	15.2	20	30
6/06/2025	1 km South (WQ1)	0.027	0.0344	0.062	0.17	0.022	0.027	0.0014	9.2	3.1		93.8	33	7.9	15.3	15	10
6/06/2025	250 m North (WQ5)	0.026	0.0368	0.063	0.17	0.022	0.028	0.00087	12	3.7		93.7	33	7.9	15.2	41	<10
6/06/2025	250m South (WQ2)	0.027	0.0367	0.063	0.19	0.022	0.028	0.001	8.4	2.9		93.8	33	8	15.2	16	10
6/06/2025	3 km North (WQ7)	0.029	0.0304	0.06	0.18	0.021	0.029	0.0012	16	6.4		95.1	34	8	15.3	4.9	<10
6/06/2025	50 m North (WQ4)	0.028	0.0383	0.067	0.17	0.02	0.027	0.00097	10	2.1		93.7	33	8	15.3	8.2	20
6/06/2025	50 m South (WQ3)	0.037	0.0392	0.076	0.17	0.022	0.026	<0.0006	7	3.1		93.4	33	8	15.3	64	10

Date	Site	NH_3NH_4 (mg/L)	TON (mg/L)	TIN (mg/L)	TN (mg/L)	DRP (mg/L)	TP (mg/L)	Chl a (mg/L)	TSS (mg/L)	Turbidity (NTU)	DO (mg/L)	DO (%)	Salinity (ppt)	pH	Temp (°C)	F coliforms (cfu/100 mL)	Entero (MPN/100 mL)
6/06/2025	Taihiki (WQ10)	0.034	0.0545	0.088	0.2	0.022	0.028	<0.0006	10	2.8		93.3	33	7.9	15.2	28	30
6/06/2025	Upper Waiuku (WQ9)	0.031	0.0396	0.071	0.18	0.023	0.024	<0.0006	4.4	1.5		93.8	33	7.9	15.1	18	<10
24/06/2025	Whatapaka (WQ8)	0.043	0.263	0.31	0.53	0.024	0.022	0.0014	21	11	8.47	95.2	27	8.1	13.1	140	62

Watercare Services Limited
52 Aintree Ave, Māngere, Auckland, 2022
PO Box 107028, Auckland, 2150
T: 0800 522 365
clientsupport@water.co.nz
www.watercarelabs.co.nz

Certificate of Analysis
Laboratory Reference: 250319-136

Attention:	Shane Kelly	*Final Report:*	**584224-0**
Client:	**COAST & CATCHMENT LTD**	*Report Issue Date:*	**31-Mar-2025**
Address:	**PO Box 193, CLEVEDON, 2248**	*Received Date:*	**19-Mar-2025**
Client Reference:	**CAC25201**	*Laboratory Activity Dates:*	**20-Mar-2025 - 26-Mar-2025**
Purchase Order:	**Not Available**	*Quote Reference :*	**17373**

Sample Details				
Lab Sample ID:	**250319-136-1**	**250319-136-2**	**250319-136-3**	**250319-136-4**
Client Sample ID:				
Sample Date/Time	24/10/2024	24/10/2024	24/10/2024	24/10/2024
Description:	OA245/1	OA245/2	OA245/3	OA245/4
Chemistry Detailed				
Polycyclic Aromatic Hydrocarbon Compounds (Dry Weight Basis) by Gas Chromatography-Mass Spectrometry(Trace level)				
Acenaphthene: Dry Weight Basis, Trace level mg/kg	<0.001	<0.001	<0.001	<0.001
acenaphthylene: Dry Weight Basis, Trace level mg/kg	<0.001	<0.001	<0.001	<0.001
Anthracene: Dry Weight Basis, Trace level mg/kg	<0.001	<0.001	<0.001	<0.001
BAP Equivalent mg/kg	<0.001	<0.001	<0.001	<0.001
Benzo(a)anthracene: Dry Weight Basis, Trace level mg/kg	<0.001	<0.001	<0.001	<0.001
Benzo(a)pyrene: Dry Weight Basis, Trace level mg/kg	<0.001	<0.001	<0.001	<0.001
Benzo(b)fluoranthene: Dry Weight Basis, Trace level mg/kg	<0.001	<0.001	<0.001	<0.001
Benzo(ghi)perylene: Dry Weight Basis, Trace level mg/kg	<0.001	<0.001	<0.001	<0.001
Benzo(k)fluoranthene: Dry Weight Basis, Trace level mg/kg	<0.001	<0.001	<0.001	<0.001
Chrysene: Dry Weight Basis, Trace level mg/kg	<0.001	<0.001	<0.001	<0.001
Dibenzo(ah)anthracene: Dry Weight Basis, Trace level mg/kg	<0.001	<0.001	<0.001	<0.001
Fluoranthene: Dry Weight Basis, Trace level mg/kg	<0.001	<0.001	<0.001	<0.001
Fluorene: Dry Weight Basis, Trace level mg/kg	<0.001	<0.001	<0.001	<0.001
Indeno(1,2,3,c,d)pyrene: Dry Weight Basis, Trace level mg/kg	<0.001	<0.001	<0.001	<0.001
Naphthalene: Dry Weight Basis, Trace level mg/kg	<0.001	<0.001	<0.001	<0.001
Phenanthrene: Dry Weight Basis, Trace level mg/kg	<0.001	<0.001	<0.001	<0.001
Pyrene: Dry Weight Basis, Trace level mg/kg	<0.001	<0.001	<0.001	<0.001
General Testing				
Total Solids %	99.9	99.9	99.9	99.9
Metals				
Recoverable Metals by ICP-MS—Trace				
Arsenic (Recoverable Dry Wt.) mg/kg	5.2	4.6	5.5	4.1
Cadmium (Recoverable Dry Wt.) mg/kg	<0.088	<0.088	<0.092	<0.09
Chromium (Recoverable Dry Wt.) mg/kg	9.3	9.9	9.6	5.7
Copper (Recoverable Dry Wt.) mg/kg	1.8	2.0	2.0	1.3
Lead (Recoverable Dry Wt.) mg/kg	2.9	3.1	3.1	2.5
Mercury (Recoverable Dry Wt.) mg/kg	<0.044	<0.044	<0.046	<0.045
Nickel (Recoverable Dry Wt.) mg/kg	3.8	4.3	4.3	2.4
Phosphorus (Recoverable Dry Wt.) mg/kg	330	320	290	160
Zinc (Recoverable Dry Wt.) mg/kg	26	26	26	17
Organics				

Sample Details (continued)		SOLIDS	SOLIDS	SOLIDS	SOLIDS
Lab Sample ID:		**250319-136-1**	**250319-136-2**	**250319-136-3**	**250319-136-4**
Client Sample ID:					
Sample Date/Time:		24/10/2024	24/10/2024	24/10/2024	24/10/2024
Description:		OA245/1	OA245/2	OA245/3	OA245/4
Organics					
Adhoc investigation					
Comments		Analysed by CNS Analyser *	Analysed by CNS Analyser *	Analysed by CNS Analyser *	Analysed by CNS Analyser *
Total Nitrogen	%	<0.05 *	<0.05 *	<0.05 *	<0.05 *
Total Organic Carbon	%	0.21 *	0.22 *	0.21 *	0.23 *

Sample Details					
Lab Sample ID:		**250319-136-5**	**250319-136-6**	**250319-136-7**	**250319-136-8**
Client Sample ID:					
Sample Date/Time		24/10/2024	24/10/2024	24/10/2024	24/10/2024
Description:		OA245/5	OA245/6	OA245/7	OA245/8
Chemistry Detailed					
Polycyclic Aromatic Hydrocarbon Compounds (Dry Weight Basis) by Gas Chromatography-Mass Spectrometry(Trace level)					
Acenaphthene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
acenaphthylene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Anthracene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
BAP Equivalent	mg/kg	0.018	<0.001	<0.001	<0.001
Benzo(a)anthracene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Benzo(a)pyrene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Benzo(b)fluoranthene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Benzo(ghi)perylene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Benzo(k)fluoranthene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Chrysene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Dibenzo(ah)anthracene: Dry Weight Basis, Trace level	mg/kg	0.016	<0.001	<0.001	<0.001
Fluoranthene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Fluorene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Indeno(1,2,3,c,d)pyrene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Naphthalene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Phenanthrene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Pyrene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
General Testing					
Total Solids	%	99.9	99.8	99.7	99.7
Metals					
Recoverable Metals by ICP-MS—Trace					
Arsenic (Recoverable Dry Wt.)	mg/kg	4.3	4.1	4.5	5.7
Cadmium (Recoverable Dry Wt.)	mg/kg	<0.091	<0.089	<0.091	<0.09
Chromium (Recoverable Dry Wt.)	mg/kg	6.3	5.6	8.3	7.8
Copper (Recoverable Dry Wt.)	mg/kg	1.4	1.3	2.1	1.8
Lead (Recoverable Dry Wt.)	mg/kg	2.8	2.6	3.5	3.4
Mercury (Recoverable Dry Wt.)	mg/kg	<0.045	<0.044	<0.046	<0.045
Nickel (Recoverable Dry Wt.)	mg/kg	2.5	2.0	4.0	3.6
Phosphorus (Recoverable Dry Wt.)	mg/kg	170	150	240	220
Zinc (Recoverable Dry Wt.)	mg/kg	18	16	24	23
Organics					
Adhoc investigation					
Comments		Analysed by CNS Analyser *	Analysed by CNS Analyser *	Analysed by CNS Analyser *	Analysed by CNS Analyser *
Total Nitrogen	%	<0.05 *	<0.05 *	0.05 *	<0.05 *
Total Organic Carbon	%	0.21 *	0.20 *	0.33 *	0.29 *

Sample Details					
Lab Sample ID:		**250319-136-9**	**250319-136-10**	**250319-136-11**	**250319-136-12**
Client Sample ID:					
Sample Date/Time		24/10/2024	24/10/2024	24/10/2024	24/10/2024
Description:		OA245/9	OA245/10	OA245/11	OA245/12
Chemistry Detailed					
Polycyclic Aromatic Hydrocarbon Compounds (Dry Weight Basis) by Gas Chromatography-Mass Spectrometry(Trace level)					
Acenaphthene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
acenaphthylene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Anthracene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
BAP Equivalent	mg/kg	<0.001	<0.001	<0.001	<0.001
Benzo(a)anthracene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Benzo(a)pyrene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Benzo(b)fluoranthene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Benzo(ghi)perylene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Benzo(k)fluoranthene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Chrysene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Dibenzo(ah)anthracene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Fluoranthene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Fluorene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Indeno(1,2,3,c,d)pyrene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Naphthalene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Phenanthrene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Pyrene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
General Testing					
Total Solids	%	99.5	99.1	98.8	98.9
Metals					
Recoverable Metals by ICP-MS—Trace					
Arsenic (Recoverable Dry Wt.)	mg/kg	4.8	12	14	13
Cadmium (Recoverable Dry Wt.)	mg/kg	<0.092	<0.092	<0.091	<0.09
Chromium (Recoverable Dry Wt.)	mg/kg	8.3	17	17	16
Copper (Recoverable Dry Wt.)	mg/kg	1.9	5.3	5.3	5.0
Lead (Recoverable Dry Wt.)	mg/kg	3.4	8.2	8.3	7.9
Mercury (Recoverable Dry Wt.)	mg/kg	<0.046	<0.046	<0.046	<0.045
Nickel (Recoverable Dry Wt.)	mg/kg	3.5	7.6	7.4	7.3
Phosphorus (Recoverable Dry Wt.)	mg/kg	230	560	570	540
Zinc (Recoverable Dry Wt.)	mg/kg	24	52	53	49
Organics					
Adhoc investigation					
Comments		Analysed by CNS Analyser *	Analysed by CNS Analyser *	Analysed by CNS Analyser *	Analysed by CNS Analyser *
Total Nitrogen	%	0.05 *	0.11 *	0.12 *	0.12 *
Total Organic Carbon	%	0.34 *	1.04 *	1.12 *	1.07 *

Sample Details					
Lab Sample ID:		**250319-136-13**	**250319-136-14**	**250319-136-15**	**250319-136-16**
Client Sample ID:					
Sample Date/Time		24/10/2024	24/10/2024	24/10/2024	24/10/2024
Description:		OA245/13	OA245/14	OA245/15	OA245/16
Chemistry Detailed					
Polycyclic Aromatic Hydrocarbon Compounds (Dry Weight Basis) by Gas Chromatography-Mass Spectrometry(Trace level)					
Acenaphthene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.00104	<0.001
acenaphthylene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.00104	<0.001
Anthracene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.00104	<0.001

Sample Details (continued)		SOLIDS	SOLIDS	SOLIDS	SOLIDS
Lab Sample ID:		**250319-136-13**	**250319-136-14**	**250319-136-15**	**250319-136-16**
Client Sample ID:					
Sample Date/Time:		24/10/2024	24/10/2024	24/10/2024	24/10/2024
Description:		OA245/13	OA245/14	OA245/15	OA245/16
Chemistry Detailed					
Polycyclic Aromatic Hydrocarbon Compounds (Dry Weight Basis) by Gas Chromatography-Mass Spectrometry(Trace level)					
BAP Equivalent	mg/kg	<0.001	0.010	<0.001	<0.001
Benzo(a)anthracene: Dry Weight Basis, Trace level	mg/kg	<0.001	0.005	<0.00104	<0.001
Benzo(a)pyrene: Dry Weight Basis, Trace level	mg/kg	<0.001	0.008	<0.00104	<0.001
Benzo(b)fluoranthene: Dry Weight Basis, Trace level	mg/kg	<0.001	0.004	<0.00104	<0.001
Benzo(ghi)perylene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.00104	<0.001
Benzo(k)fluoranthene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.00104	<0.001
Chrysene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.00104	<0.001
Dibenzo(ah)anthracene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.00104	<0.001
Fluoranthene: Dry Weight Basis, Trace level	mg/kg	<0.001	0.009	<0.00104	<0.001
Fluorene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.00104	<0.001
Indeno(1,2,3,c,d)pyrene: Dry Weight Basis, Trace level	mg/kg	<0.001	0.006	<0.00104	<0.001
Naphthalene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.00104	<0.001
Phenanthrene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.00104	<0.001
Pyrene: Dry Weight Basis, Trace level	mg/kg	<0.001	0.008	<0.00104	<0.001
General Testing					
Total Solids	%	99.4	99.5	99.4	99.3
Metals					
Recoverable Metals by ICP-MS—Trace					
Arsenic (Recoverable Dry Wt.)	mg/kg	6.8	6.7	7.6	8.2
Cadmium (Recoverable Dry Wt.)	mg/kg	<0.089	<0.091	<0.092	<0.092
Chromium (Recoverable Dry Wt.)	mg/kg	8.9	9.7	11	10
Copper (Recoverable Dry Wt.)	mg/kg	2.6	3.0	3.2	3.2
Lead (Recoverable Dry Wt.)	mg/kg	4.1	4.8	5.1	6.0
Mercury (Recoverable Dry Wt.)	mg/kg	<0.045	<0.046	<0.046	<0.046
Nickel (Recoverable Dry Wt.)	mg/kg	3.6	4.3	4.6	4.7
Phosphorus (Recoverable Dry Wt.)	mg/kg	270	260	270	330
Zinc (Recoverable Dry Wt.)	mg/kg	27	30	32	34
Organics					
Adhoc investigation					
Comments		Analysed by CNS Analyser *	Analysed by CNS Analyser *	Analysed by CNS Analyser *	Analysed by CNS Analyser *
Total Nitrogen	%	0.07 *	0.07 *	0.06 *	0.09 *
Total Organic Carbon	%	0.55 *	0.49 *	0.51 *	0.66 *

Sample Details					
Lab Sample ID:		**250319-136-17**	**250319-136-18**	**250319-136-19**	**250319-136-20**
Client Sample ID:					
Sample Date/Time		24/10/2024	24/10/2024	24/10/2024	24/10/2024
Description:		OA245/17	OA245/18	OA245/19	OA245/20
Chemistry Detailed					
Polycyclic Aromatic Hydrocarbon Compounds (Dry Weight Basis) by Gas Chromatography-Mass Spectrometry(Trace level)					
Acenaphthene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.00101
acenaphthylene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.00101
Anthracene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.00101
BAP Equivalent	mg/kg	<0.001	<0.001	<0.001	<0.001
Benzo(a)anthracene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.00101
Benzo(a)pyrene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.00101

Sample Details (continued)		SOLIDS	SOLIDS	SOLIDS	SOLIDS
Lab Sample ID:		**250319-136-17**	**250319-136-18**	**250319-136-19**	**250319-136-20**
Client Sample ID:					
Sample Date/Time:		24/10/2024	24/10/2024	24/10/2024	24/10/2024
Description:		OA245/17	OA245/18	OA245/19	OA245/20
Chemistry Detailed					
Polycyclic Aromatic Hydrocarbon Compounds (Dry Weight Basis) by Gas Chromatography-Mass Spectrometry(Trace level)					
Benzo(b)fluoranthene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.00101
Benzo(ghi)perylene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.00101
Benzo(k)fluoranthene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.00101
Chrysene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.00101
Dibenzo(ah)anthracene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.00101
Fluoranthene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.00101
Fluorene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.00101
Indeno(1,2,3,c,d)pyrene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.00101
Naphthalene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.00101
Phenanthrene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.00101
Pyrene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.00101
General Testing					
Total Solids	%	99.3	99.3	99.7	99.7
Metals					
Recoverable Metals by ICP-MS—Trace					
Arsenic (Recoverable Dry Wt.)	mg/kg	8.5	8.3	4.1	4.6
Cadmium (Recoverable Dry Wt.)	mg/kg	<0.091	<0.09	<0.09	<0.089
Chromium (Recoverable Dry Wt.)	mg/kg	9.2	9.8	4.0	4.2
Copper (Recoverable Dry Wt.)	mg/kg	2.7	2.8	0.79	0.83
Lead (Recoverable Dry Wt.)	mg/kg	5.2	5.8	2.4	2.5
Mercury (Recoverable Dry Wt.)	mg/kg	<0.045	<0.045	<0.045	<0.044
Nickel (Recoverable Dry Wt.)	mg/kg	4.2	4.3	1.4	1.4
Phosphorus (Recoverable Dry Wt.)	mg/kg	270	330	120	110
Zinc (Recoverable Dry Wt.)	mg/kg	31	33	11	12
Organics					
Adhoc investigation					
Comments		Analysed by CNS Analyser *	Analysed by CNS Analyser *	Analysed by CNS Analyser *	Analysed by CNS Analyser *
Total Nitrogen	%	0.1 *	0.09 *	<0.05 *	<0.05 *
Total Organic Carbon	%	0.70 *	0.61 *	0.22 *	0.22 *

Sample Details					
Lab Sample ID:		**250319-136-21**	**250319-136-22**	**250319-136-23**	**250319-136-24**
Client Sample ID:					
Sample Date/Time		24/10/2024	24/10/2024	24/10/2024	24/10/2024
Description:		OA245/21	OA245/22	OA245/23	OA245/24
Chemistry Detailed					
Polycyclic Aromatic Hydrocarbon Compounds (Dry Weight Basis) by Gas Chromatography-Mass Spectrometry(Trace level)					
Acenaphthene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
acenaphthylene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Anthracene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
BAP Equivalent	mg/kg	<0.001	<0.001	<0.001	0.0064
Benzo(a)anthracene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Benzo(a)pyrene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	0.005
Benzo(b)fluoranthene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	0.004
Benzo(ghi)perylene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001

Sample Details (continued)		SOLIDS	SOLIDS	SOLIDS	SOLIDS
Lab Sample ID:		**250319-136-21**	**250319-136-22**	**250319-136-23**	**250319-136-24**
Client Sample ID:					
Sample Date/Time:		24/10/2024	24/10/2024	24/10/2024	24/10/2024
Description:		OA245/21	OA245/22	OA245/23	OA245/24
Chemistry Detailed					
Polycyclic Aromatic Hydrocarbon Compounds (Dry Weight Basis) by Gas Chromatography-Mass Spectrometry(Trace level)					
Benzo(k)fluoranthene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Chrysene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Dibenzo(ah)anthracene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Fluoranthene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	0.007
Fluorene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Indeno(1,2,3,c,d)pyrene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Naphthalene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Phenanthrene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	<0.001
Pyrene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001	0.007
General Testing					
Total Solids	%	99.7	99.4	99.4	99.3
Metals					
Recoverable Metals by ICP-MS—Trace					
Arsenic (Recoverable Dry Wt.)	mg/kg	4.7	9.6	10	9.2
Cadmium (Recoverable Dry Wt.)	mg/kg	<0.091	<0.092	<0.092	<0.09
Chromium (Recoverable Dry Wt.)	mg/kg	4.1	9.3	8.8	9.8
Copper (Recoverable Dry Wt.)	mg/kg	0.87	2.2	2.3	2.3
Lead (Recoverable Dry Wt.)	mg/kg	2.6	5.1	5.3	15
Mercury (Recoverable Dry Wt.)	mg/kg	<0.045	<0.046	<0.046	<0.045
Nickel (Recoverable Dry Wt.)	mg/kg	1.4	3.1	3.5	3.3
Phosphorus (Recoverable Dry Wt.)	mg/kg	120	330	280	300
Zinc (Recoverable Dry Wt.)	mg/kg	12	29	30	32
Organics					
Adhoc investigation					
Comments		Analysed by CNS Analyser *	Analysed by CNS Analyser *	Analysed by CNS Analyser *	Analysed by CNS Analyser *
Total Nitrogen	%	<0.05 *	0.08 *	0.06 *	0.07 *
Total Organic Carbon	%	0.23 *	0.42 *	0.47 *	0.42 *

Sample Details				
Lab Sample ID:		**250319-136-25**	**250319-136-26**	**250319-136-27**
Client Sample ID:				
Sample Date/Time		24/10/2024	24/10/2024	24/10/2024
Description:		OA245/25	OA245/26	OA245/27
Chemistry Detailed				
Polycyclic Aromatic Hydrocarbon Compounds (Dry Weight Basis) by Gas Chromatography-Mass Spectrometry(Trace level)				
Acenaphthene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001
acenaphthylene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001
Anthracene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001
BAP Equivalent	mg/kg	0.0060	0.0053	<0.001
Benzo(a)anthracene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001
Benzo(a)pyrene: Dry Weight Basis, Trace level	mg/kg	0.004	0.004	<0.001
Benzo(b)fluoranthene: Dry Weight Basis, Trace level	mg/kg	0.004	0.003	<0.001
Benzo(ghi)perylene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001
Benzo(k)fluoranthene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001
Chrysene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001
Dibenzo(ah)anthracene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001

Sample Details (continued)		SOLIDS	SOLIDS	SOLIDS
Lab Sample ID:		**250319-136-25**	**250319-136-26**	**250319-136-27**
Client Sample ID:				
Sample Date/Time:		24/10/2024	24/10/2024	24/10/2024
Description:		OA245/25	OA245/26	OA245/27
Chemistry Detailed				
Polycyclic Aromatic Hydrocarbon Compounds (Dry Weight Basis) by Gas Chromatography-Mass Spectrometry(Trace level)				
Fluoranthene: Dry Weight Basis, Trace level	mg/kg	0.006	0.006	<0.001
Fluorene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001
Indeno(1,2,3,c,d)pyrene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001
Naphthalene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001
Phenanthrene: Dry Weight Basis, Trace level	mg/kg	<0.001	<0.001	<0.001
Pyrene: Dry Weight Basis, Trace level	mg/kg	0.006	<0.001	<0.001
General Testing				
Total Solids	%	99.4	99.5	99.5
Metals				
Recoverable Metals by ICP-MS—Trace				
Arsenic (Recoverable Dry Wt.)	mg/kg	8.4	7.6	7.4
Cadmium (Recoverable Dry Wt.)	mg/kg	<0.089	<0.089	<0.091
Chromium (Recoverable Dry Wt.)	mg/kg	8.5	8.7	8.4
Copper (Recoverable Dry Wt.)	mg/kg	2.1	2.1	2.2
Lead (Recoverable Dry Wt.)	mg/kg	5.4	5.2	4.9
Mercury (Recoverable Dry Wt.)	mg/kg	<0.044	<0.045	<0.046
Nickel (Recoverable Dry Wt.)	mg/kg	3.3	3.2	3.2
Phosphorus (Recoverable Dry Wt.)	mg/kg	210	230	220
Zinc (Recoverable Dry Wt.)	mg/kg	26	26	27
Organics				
Adhoc investigation				
Comments		Analysed by CNS Analyser *	Analysed by CNS Analyser *	Analysed by CNS Analyser *
Total Nitrogen	%	0.05 *	0.05 *	0.05 *
Total Organic Carbon	%	0.43 *	0.41 *	0.41 *

*Results marked with * are not accredited to International Accreditation New Zealand. A dash indicates no test performed.*

Where samples have been supplied by the client, they are tested as received.

The results of analysis contained in this report relate only to the sample(s) tested. Where sample collection was performed by the laboratory, the results of analysis contained in this report relate only to the sample(s) collected.

Reference Methods

The sample(s) referred to in this report were analysed by the following method(s)

Analyte	Method Reference	MDL	Samples	Location
Chemistry Detailed				
Polycyclic Aromatic Hydrocarbon Compounds (Dry Weight Basis) by Gas Chromatography-Mass Spectrometry(Trace level)				
Acenaphthene: Dry Weight Basis, Trace level	USEPA 8270	0.001 mg/kg	All	Auckland
acenaphthylene: Dry Weight Basis, Trace level	USEPA 8270	0.001 mg/kg	All	Auckland
Anthracene: Dry Weight Basis, Trace level	USEPA 8270	0.001 mg/kg	All	Auckland
BAP Equivalent	USEPA 8270	0.001 mg/kg	All	Auckland
Benzo(a)anthracene: Dry Weight Basis, Trace level	USEPA 8270	0.001 mg/kg	All	Auckland
Benzo(a)pyrene: Dry Weight Basis, Trace level	USEPA 8270	0.001 mg/kg	All	Auckland
Benzo(b)fluoranthene: Dry Weight Basis, Trace level	USEPA 8270	0.001 mg/kg	All	Auckland
Benzo(ghi)perylene: Dry Weight Basis, Trace level	USEPA 8270	0.001 mg/kg	All	Auckland
Benzo(k)fluoranthene: Dry Weight Basis, Trace level	USEPA 8270	0.001 mg/kg	All	Auckland
Chrysene: Dry Weight Basis, Trace level	USEPA 8270	0.001 mg/kg	All	Auckland
Dibenzo(ah)anthracene: Dry Weight Basis, Trace level	USEPA 8270	0.001 mg/kg	All	Auckland
Fluoranthene: Dry Weight Basis, Trace level	USEPA 8270	0.001 mg/kg	All	Auckland
Fluorene: Dry Weight Basis, Trace level	USEPA 8270	0.001 mg/kg	All	Auckland
Indeno(1,2,3,c,d)pyrene: Dry Weight Basis, Trace level	USEPA 8270	0.001 mg/kg	All	Auckland
Naphthalene: Dry Weight Basis, Trace level	USEPA 8270	0.001 mg/kg	All	Auckland
Phenanthrene: Dry Weight Basis, Trace level	USEPA 8270	0.001 mg/kg	All	Auckland
Pyrene: Dry Weight Basis, Trace level	USEPA 8270	0.001 mg/kg	All	Auckland
General Testing				
Total Solids by Gravimetry	APHA (online edition) 2540 G	0.1 %	All	Auckland
Metals				

Metals				
Recoverable Metals by ICP-MS—Trace				
Arsenic (Recoverable Dry Wt.)	APHA (online edition) 3125 B by ICPMS	0.02 mg/kg	All	Auckland
Cadmium (Recoverable Dry Wt.)	APHA (online edition) 3125 B by ICPMS	0.01 mg/kg	All	Auckland
Chromium (Recoverable Dry Wt.)	APHA (online edition) 3125 B by ICPMS	0.05 mg/kg	All	Auckland
Copper (Recoverable Dry Wt.)	APHA (online edition) 3125 B by ICPMS	0.05 mg/kg	All	Auckland
Lead (Recoverable Dry Wt.)	APHA (online edition) 3125 B by ICPMS	0.03 mg/kg	All	Auckland
Mercury (Recoverable Dry Wt.)	APHA (online edition) 3125 B by ICPMS	0.005 mg/kg	All	Auckland
Nickel (Recoverable Dry Wt.)	APHA (online edition) 3125 B by ICPMS	0.05 mg/kg	All	Auckland
Phosphorus (Recoverable Dry Wt.)	APHA (online edition) 3125 B by ICPMS	2 mg/kg	All	Auckland
Zinc (Recoverable Dry Wt.)	APHA (online edition) 3125 B by ICPMS	0.75 mg/kg	All	Auckland
Organics				
Adhoc investigation				
Comments	As specified above		All	Auckland
Preparations				
Accelerated Solvent Extraction (ASE)	USEPA 8270		All	Auckland
Digest for Recoverable Metals in Solids	US EPA 200.8 (1:1 Nitric:Hydrochloric Acid)		All	Auckland
Drying and Milling	US EPA 200.8		All	Auckland

The method detection limit (MDL) listed is the limit attainable in a relatively clean matrix. If dilutions are required for analysis the detection limit may be higher. For more information please contact the Compliance and Projects Manager.

Samples, with suitable preservation and stability of analytes, will be held by the laboratory for a period of two weeks after results have been reported, unless otherwise advised by the submitter.

Watercare Laboratory Services is a division of Watercare Services Limited .

Robyn Abernethy
Compliance and Projects Manager

10.4 BENTHIC MACROFAUNA MEAN COUNTS

Site	Side of Channel	Phylum	Class	Family	Taxa	Mean Count
Ohiku Creek	West	Annelida	Clitellata		Oligochaeta	0.58
Ohiku Creek	West	Annelida	Polychaeta	Dorvilleidae	Dorvilleidae	0.08
Ohiku Creek	West	Annelida	Polychaeta	Glyceridae	*Glycera ovigera*	0.17
Ohiku Creek	West	Annelida	Polychaeta	Nereididae	*Perinereis vallata*	0.17
Ohiku Creek	West	Annelida	Polychaeta	Syllidae	Exogoninae (not Sphaerosyllis)	0.42
Ohiku Creek	West	Annelida	Polychaeta	Syllidae	*Sphaerosyllis semiverrucosa*	0.58
Ohiku Creek	West	Annelida	Polychaeta	Oweniidae	*Owenia petersenae*	0.17
Ohiku Creek	West	Annelida	Polychaeta	Capitellidae	*Heteromastus filiformis*	7.92
Ohiku Creek	West	Annelida	Polychaeta	Maldanidae	*Macroclymenella stewartensis*	1
Ohiku Creek	West	Annelida	Polychaeta	Opheliidae	*Armandia maculata*	0.25
Ohiku Creek	West	Annelida	Polychaeta	Orbiniidae	*Scoloplos cylindrifer*	0.42
Ohiku Creek	West	Annelida	Polychaeta	Paraonidae	*Aricidea* sp.	0.25
Ohiku Creek	West	Annelida	Polychaeta	Paraonidae	*Paradoneis lyra*	1.67
Ohiku Creek	West	Annelida	Polychaeta	Pectinariidae	*Lagis australis*	0.67
Ohiku Creek	West	Annelida	Polychaeta	Magelonidae	*Magelona dakini*	0.08
Ohiku Creek	West	Annelida	Polychaeta	Spionidae	*Aonides trifida*	8.33
Ohiku Creek	West	Annelida	Polychaeta	Spionidae	*Prionospio aucklandica*	8.33
Ohiku Creek	West	Annelida	Polychaeta	Spionidae	*Pseudopolydora paucibranchiata*	0.17
Ohiku Creek	West	Annelida	Polychaeta	Ampharetidae	Ampharetidae	0.17
Ohiku Creek	West	Annelida	Polychaeta	Cirratulidae	Cirratulidae including Timarete	0.42
Ohiku Creek	West	Arthropoda	Malacostraca	Paracalliopidae	*Paracalliope novizealandiae*	0.08
Ohiku Creek	West	Arthropoda	Malacostraca	Phoxocephalidae	*Torridoharpinia hurleyi*	2.33
Ohiku Creek	West	Arthropoda	Malacostraca	Hymenosomatidae	*Halicarcinus whitei*	1.08

Site	Side of Channel	Phylum	Class	Family	Taxa	Mean Count
Ohiku Creek	West	Arthropoda	Malacostraca	Macrophthalmidae	*Hemiplax hirtipes*	0.25
Ohiku Creek	West	Arthropoda	Malacostraca	Palaemonidae	*Palaeman affinis*	0.08
Ohiku Creek	West	Arthropoda	Malacostraca	Sphaeromatidae	*Isocladus* sp.	0.5
Ohiku Creek	West	Arthropoda	Malacostraca		Mysida	2.83
Ohiku Creek	West	Arthropoda	Maxillopoda	Balanomorpha	*Austrominius modestus*	0.08
Ohiku Creek	West	Cnidaria	Anthozoa	Actiniidae	*Anthopleura aureoradiata*	1.67
Ohiku Creek	West	Mollusca	Bivalvia	Nuculidae	*Linucula hartvigiana*	43
Ohiku Creek	West	Mollusca	Bivalvia	Lasaeidae	*Arthritica bifurca*	1.17
Ohiku Creek	West	Mollusca	Bivalvia	Mactridae	*Cyclomactra ovata*	0.17
Ohiku Creek	West	Mollusca	Bivalvia	Semelidae	*Theora lubrica*	0.08
Ohiku Creek	West	Mollusca	Bivalvia	Tellinidae	*Macomona liliana*	3
Ohiku Creek	West	Mollusca	Bivalvia	Veneridae	*Austrovenus stutchburyi*	65.83
Ohiku Creek	West	Mollusca	Gastropoda	Batillariidae	*Zeacumantus lutulentus*	0.17
Ohiku Creek	West	Mollusca	Gastropoda	Buccinulidae	*Cominella glandiformis*	0.08
Ohiku Creek	West	Mollusca	Gastropoda	Lottidae	*Notoacmea scapha*	8.25
Ohiku Creek	West	Mollusca	Gastropoda	Trochidae	*Diloma subrostrata*	0.58
Ohiku Creek	West	Mollusca	Gastropoda	Philinidae	*Philine* sp.	0.08
Ohiku Creek	West	Mollusca	Polyplacophora	Chitonidae	*Chiton glaucus*	0.33
Ohiku Creek	West	Mollusca	Gastropoda	Nassariidae	*Tritia burchardi*	0.17
Ohiku Creek	West	Nemertea			Nemertean	1
Rauau North	West	Annelida	Clitellata		Oligochaeta	0.42
Rauau North	West	Annelida	Polychaeta	Glyceridae	*Glycera ovigera*	0.33
Rauau North	West	Annelida	Polychaeta	Hesionidae	Hesionidae	0.08
Rauau North	West	Annelida	Polychaeta	Nephtyidae	Ceratonereis	0.5
Rauau North	West	Annelida	Polychaeta	Nereididae	*Nicon aestuariensis*	0.17
Rauau North	West	Annelida	Polychaeta	Nereididae	*Perinereis vallata*	0.5

Site	Side of Channel	Phylum	Class	Family	Taxa	Mean Count
Rauau North	West	Annelida	Polychaeta	Syllidae	*Sphaerosyllis semiverrucosa*	1.83
Rauau North	West	Annelida	Polychaeta	Capitellidae	*Heteromastus filiformis*	5.33
Rauau North	West	Annelida	Polychaeta	Cossuridae	*Cossura consimilis*	0.08
Rauau North	West	Annelida	Polychaeta	Maldanidae	*Macroclymenella stewartensis*	0.33
Rauau North	West	Annelida	Polychaeta	Opheliidae	*Armandia maculata*	0.5
Rauau North	West	Annelida	Polychaeta	Orbiniidae	*Scoloplos cylindrifer*	1.67
Rauau North	West	Annelida	Polychaeta	Paraonidae	*Aricidea* sp	0.33
Rauau North	West	Annelida	Polychaeta	Paraonidae	*Paradoneis lyra*	0.42
Rauau North	West	Annelida	Polychaeta	Pectinariidae	*Lagis australis*	0.08
Rauau North	West	Annelida	Polychaeta	Spionidae	*Aonides trifida*	26.58
Rauau North	West	Annelida	Polychaeta	Spionidae	*Prionospio aucklandica*	28.58
Rauau North	West	Annelida	Polychaeta	Spionidae	*Pseudopolydora paucibranchiata*	0.08
Rauau North	West	Annelida	Polychaeta	Spionidae	*Scolecolepides benhami*	0.17
Rauau North	West	Annelida	Polychaeta	Cirratulidae	Cirratulidae including Timarete	0.58
Rauau North	West	Arthropoda	Malacostraca	Paracalliopidae	*Paracalliope novizealandiae*	1.33
Rauau North	West	Arthropoda	Malacostraca	Phoxocephalidae	*Torridoharpinia hurleyi*	1.75
Rauau North	West	Arthropoda	Malacostraca	Hymenosomatidae	*Halicarcinus whitei*	0.5
Rauau North	West	Arthropoda	Malacostraca	Macrophthalmidae	*Hemiplax hirtipes*	0.75
Rauau North	West	Arthropoda	Malacostraca	Varunidae	*Hemigrapsus sexdentatus*	0.25
Rauau North	West	Arthropoda	Malacostraca	Sphaeromatidae	*Isocladus* sp.	0.08
Rauau North	West	Arthropoda	Malacostraca		Mysida	1.58
Rauau North	West	Arthropoda	Maxillopoda	Balanomorpha	*Austrominius modestus*	2.83
Rauau North	West	Chaetognatha			Chaetognath	0.08
Rauau North	West	Cnidaria	Anthozoa	Actiniidae	*Anthopleura aureoradiata*	7.5
Rauau North	West	Mollusca	Bivalvia	Nuculidae	*Linucula hartvigiana*	39.75
Rauau North	West	Mollusca	Bivalvia	Lasaeidae	*Arthritica bifurca*	3.67

Site	Side of Channel	Phylum	Class	Family	Taxa	Mean Count
Rauau North	West	Mollusca	Bivalvia	Mesodesmatidae	*Paphies australis*	0.33
Rauau North	West	Mollusca	Bivalvia	Semelidae	*Theora lubrica*	0.08
Rauau North	West	Mollusca	Bivalvia	Tellinidae	*Macomona liliana*	4
Rauau North	West	Mollusca	Bivalvia	Veneridae	*Austrovenus stutchburyi*	82.92
Rauau North	West	Mollusca	Gastropoda	Batillariidae	*Zeacumantus lutulentus*	0.75
Rauau North	West	Mollusca	Gastropoda	Buccinulidae	*Cominella glandiformis*	0.33
Rauau North	West	Mollusca	Gastropoda	Lottidae	*Notoacmea scapha*	13.75
Rauau North	West	Mollusca	Gastropoda	Muricidae	*Xymene* sp.	0.08
Rauau North	West	Mollusca	Gastropoda	Trochidae	*Diloma subrostrata*	0.25
Rauau North	West	Mollusca	Polyplacophora	Chitonidae	*Chiton glaucus*	0.08
Rauau North	West	Mollusca	Gastropoda	Nassariidae	*Tritia burchardi*	0.08
Rauau North	West	Nemertea			Nemertean	1.08
Rauau North	West	Platyhelminthes	Rhabditophora	Stylochidae	Stylochidae	0.08
Tokaroa North	West	Annelida	Clitellata		Oligochaeta	0.92
Tokaroa North	West	Annelida	Polychaeta	Hesionidae	Hesionidae	0.08
Tokaroa North	West	Annelida	Polychaeta	Nereididae	*Nicon aestuariensis*	0.08
Tokaroa North	West	Annelida	Polychaeta	Nereididae	*Perinereis vallata*	0.58
Tokaroa North	West	Annelida	Polychaeta	Nereididae	*Platynereis australis*	0.08
Tokaroa North	West	Annelida	Polychaeta	Syllidae	Exogoninae (not Sphaerosyllis)	0.08
Tokaroa North	West	Annelida	Polychaeta	Syllidae	*Sphaerosyllis semiverrucosa*	5.5
Tokaroa North	West	Annelida	Polychaeta	Oweniidae	*Owenia petersenae*	3.33
Tokaroa North	West	Annelida	Polychaeta	Capitellidae	*Heteromastus filiformis*	7.92
Tokaroa North	West	Annelida	Polychaeta	Maldanidae	*Macroclymenella stewartensis*	1.25
Tokaroa North	West	Annelida	Polychaeta	Opheliidae	*Armandia maculata*	0.42
Tokaroa North	West	Annelida	Polychaeta	Paraonidae	*Aricidea* sp.	0.67
Tokaroa North	West	Annelida	Polychaeta	Paraonidae	*Paradoneis lyra*	2.92

Site	Side of Channel	Phylum	Class	Family	Taxa	Mean Count
Tokaroa North	West	Annelida	Polychaeta	Pectinariidae	*Lagis australis*	0.17
Tokaroa North	West	Annelida	Polychaeta	Magelonidae	*Magelona dakini*	1.67
Tokaroa North	West	Annelida	Polychaeta	Spionidae	*Aonides trifida*	15.83
Tokaroa North	West	Annelida	Polychaeta	Spionidae	*Boccardia syrtis*	0.17
Tokaroa North	West	Annelida	Polychaeta	Spionidae	*Prionospio aucklandica*	1.25
Tokaroa North	West	Annelida	Polychaeta	Spionidae	*Pseudopolydora paucibranchiata*	0.08
Tokaroa North	West	Annelida	Polychaeta	Spionidae	*Scolecolepides benhami*	0.17
Tokaroa North	West	Arthropoda	Malacostraca	Exoedicerotidae	*Methalimedon* sp.	0.08
Tokaroa North	West	Arthropoda	Malacostraca	Paracalliopidae	*Paracalliope novizealandiae*	6.42
Tokaroa North	West	Arthropoda	Malacostraca	Phoxocephalidae	*Torridoharpinia hurleyi*	0.83
Tokaroa North	West	Arthropoda	Malacostraca	Diastylidae	*Colurostylis lemurum*	5.83
Tokaroa North	West	Arthropoda	Malacostraca	Hymenosomatidae	*Halicarcinus whitei*	0.5
Tokaroa North	West	Arthropoda	Malacostraca	Macrophthalmidae	*Hemiplax hirtipes*	0.17
Tokaroa North	West	Arthropoda	Malacostraca		Mysida	0.08
Tokaroa North	West	Arthropoda	Malacostraca		Stomatapoda	0.08
Tokaroa North	West	Chaetognatha			Chaetognath	0.33
Tokaroa North	West	Cnidaria	Anthozoa	Actiniidae	*Anthopleura aureoradiata*	1
Tokaroa North	West	Mollusca	Bivalvia	Mytilidae	*Arcuatula senhousia*	1.75
Tokaroa North	West	Mollusca	Bivalvia	Nuculidae	*Linucula hartvigiana*	13.25
Tokaroa North	West	Mollusca	Bivalvia	Solemyidae	*Solemya parkinsonii*	0.08
Tokaroa North	West	Mollusca	Bivalvia	Lasaeidae	*Arthritica bifurca*	1.08
Tokaroa North	West	Mollusca	Bivalvia	Psammobiidae	*Hiatula siliquens*	1.58
Tokaroa North	West	Mollusca	Bivalvia	Tellinidae	*Macomona liliana*	9
Tokaroa North	West	Mollusca	Bivalvia	Veneridae	*Austrovenus stutchburyi*	22.5
Tokaroa North	West	Mollusca	Gastropoda	Batillariidae	*Zeacumantus lutulentus*	0.5
Tokaroa North	West	Mollusca	Gastropoda	Buccinulidae	*Cominella glandiformis*	0.17

Site	Side of Channel	Phylum	Class	Family	Taxa	Mean Count
Tokaroa North	West	Mollusca	Gastropoda	Philinidae	*Philine* sp.	0.08
Tokaroa North	West	Mollusca	Gastropoda	Nassariidae	*Tritia burchardi*	0.08
Tokaroa North	West	Nemertea			Nemertean	1.08
Wairoa Point	West	Annelida	Clitellata		Oligochaeta	1.25
Wairoa Point	West	Annelida	Polychaeta	Dorvilleidae	Dorvilleidae	0.08
Wairoa Point	West	Annelida	Polychaeta	Glyceridae	*Glycera ovigera*	0.08
Wairoa Point	West	Annelida	Polychaeta	Nereididae	*Nicon aestuariensis*	0.75
Wairoa Point	West	Annelida	Polychaeta	Nereididae	*Perinereis vallata*	0.33
Wairoa Point	West	Annelida	Polychaeta	Oweniidae	*Owenia petersenae*	1.33
Wairoa Point	West	Annelida	Polychaeta	Sabellidae	Sabellaridae	0.08
Wairoa Point	West	Annelida	Polychaeta	Capitellidae	*Heteromastus filiformis*	9.75
Wairoa Point	West	Annelida	Polychaeta	Cossuridae	*Cossura consimilis*	0.42
Wairoa Point	West	Annelida	Polychaeta	Maldanidae	*Macroclymenella stewartensis*	0.33
Wairoa Point	West	Annelida	Polychaeta	Opheliidae	*Armandia maculata*	0.08
Wairoa Point	West	Annelida	Polychaeta	Paraonidae	*Aricidea* sp.	0.67
Wairoa Point	West	Annelida	Polychaeta	Paraonidae	*Levinsenia gracilis*	0.08
Wairoa Point	West	Annelida	Polychaeta	Paraonidae	*Paradoneis lyra*	2
Wairoa Point	West	Annelida	Polychaeta	Pectinariidae	*Lagis australis*	0.67
Wairoa Point	West	Annelida	Polychaeta	Magelonidae	*Magelona dakini*	0.5
Wairoa Point	West	Annelida	Polychaeta	Spionidae	*Aonides trifida*	4.5
Wairoa Point	West	Annelida	Polychaeta	Spionidae	*Prionospio aucklandica*	0.75
Wairoa Point	West	Annelida	Polychaeta	Spionidae	*Pseudopolydora paucibranchiata*	0.17
Wairoa Point	West	Annelida	Polychaeta	Spionidae	*Scolecolepides benhami*	0.33
Wairoa Point	West	Annelida	Polychaeta	Cirratulidae	Cirratulidae including Timarete	0.08
Wairoa Point	West	Arthropoda	Malacostraca	Paracalliopidae	*Paracalliope novizealandiae*	4.5
Wairoa Point	West	Arthropoda	Malacostraca	Phoxocephalidae	*Torridoharpinia hurleyi*	3.17

Site	Side of Channel	Phylum	Class	Family	Taxa	Mean Count
Wairoa Point	West	Arthropoda	Malacostraca	Diastylidae	*Colurostylis lemurum*	3.25
Wairoa Point	West	Arthropoda	Malacostraca	Hymenosomatidae	*Halicarcinus whitei*	0.42
Wairoa Point	West	Arthropoda	Malacostraca	Macrophthalmidae	*Hemiplax hirtipes*	0.83
Wairoa Point	West	Arthropoda	Malacostraca	Paguridae	Hermit crab	0.08
Wairoa Point	West	Arthropoda	Malacostraca	Palaemonidae	*Palaeman affinis*	0.08
Wairoa Point	West	Arthropoda	Malacostraca		Mysida	0.08
Wairoa Point	West	Arthropoda	Malacostraca		Nebalia	0.08
Wairoa Point	West	Chaetognatha			Chaetognath	0.17
Wairoa Point	West	Cnidaria	Anthozoa	Actiniidae	*Anthopleura aureoradiata*	0.33
Wairoa Point	West	Cnidaria	Anthozoa	Edwardsiidae	*Edwardsia* sp.	0.08
Wairoa Point	West	Mollusca	Bivalvia	Nuculidae	*Linucula hartvigiana*	2.33
Wairoa Point	West	Mollusca	Bivalvia	Solemyidae	*Solemya parkinsonii*	0.08
Wairoa Point	West	Mollusca	Bivalvia	Lasaeidae	*Arthritica bifurca*	2.75
Wairoa Point	West	Mollusca	Bivalvia	Mactridae	*Cyclomactra ovata*	0.17
Wairoa Point	West	Mollusca	Bivalvia	Semelidae	*Theora lubrica*	0.58
Wairoa Point	West	Mollusca	Bivalvia	Tellinidae	*Macomona liliana*	6.42
Wairoa Point	West	Mollusca	Bivalvia	Veneridae	*Austrovenus stutchburyi*	12.42
Wairoa Point	West	Mollusca	Gastropoda	Batillariidae	*Zeacumantus lutulentus*	0.08
Wairoa Point	West	Mollusca	Gastropoda	Buccinulidae	*Cominella glandiformis*	0.08
Wairoa Point	West	Mollusca	Gastropoda	Iravadiidae	*Nozeba emarginata*	0.83
Wairoa Point	West	Mollusca	Gastropoda	Muricidae	*Xymene* sp.	0.08
Wairoa Point	West	Mollusca	Gastropoda	Trochidae	*Diloma subrostrata*	0.08
Wairoa Point	West	Mollusca	Gastropoda	Haminoeidae	*Haminoea zelandiae*	0.08
Wairoa Point	West	Mollusca	Gastropoda	Skeneidae	*Zalipais lissa*	0.08
Wairoa Point	West	Mollusca	Gastropoda	Nassariidae	*Tritia burchardi*	0.33
Wairoa Point	West	Nemertea			Nemertean	0.92

Site	Side of Channel	Phylum	Class	Family	Taxa	Mean Count
Waiau	East	Annelida	Clitellata		Oligochaeta	1.58
Waiau	East	Annelida	Polychaeta	Glyceridae	*Glycera ovigera*	0.25
Waiau	East	Annelida	Polychaeta	Goniadidae	*Glycinde trifida*	0.08
Waiau	East	Annelida	Polychaeta	Hesionidae	Hesionidae	0.08
Waiau	East	Annelida	Polychaeta	Nereididae	*Nicon aestuariensis*	0.5
Waiau	East	Annelida	Polychaeta	Nereididae	*Perinereis vallata*	0.08
Waiau	East	Annelida	Polychaeta	Syllidae	Exogoninae (not Sphaerosyllis)	0.17
Waiau	East	Annelida	Polychaeta	Syllidae	*Sphaerosyllis semiverrucosa*	0.5
Waiau	East	Annelida	Polychaeta	Capitellidae	*Heteromastus filiformis*	11.33
Waiau	East	Annelida	Polychaeta	Cossuridae	*Cossura consimilis*	4.42
Waiau	East	Annelida	Polychaeta	Maldanidae	*Macroclymenella stewartensis*	3.25
Waiau	East	Annelida	Polychaeta	Opheliidae	*Armandia maculata*	0.17
Waiau	East	Annelida	Polychaeta	Paraonidae	*Aricidea* sp.	0.17
Waiau	East	Annelida	Polychaeta	Paraonidae	*Paradoneis lyra*	2.92
Waiau	East	Annelida	Polychaeta	Pectinariidae	*Lagis australis*	0.08
Waiau	East	Annelida	Polychaeta	Magelonidae	*Magelona dakini*	0.17
Waiau	East	Annelida	Polychaeta	Spionidae	*Aonides trifida*	4.83
Waiau	East	Annelida	Polychaeta	Spionidae	*Boccardia syrtis*	0.08
Waiau	East	Annelida	Polychaeta	Spionidae	*Prionospio aucklandica*	12.75
Waiau	East	Annelida	Polychaeta	Spionidae	*Pseudopolydora paucibranchiata*	0.08
Waiau	East	Annelida	Polychaeta	Cirratulidae	Cirratulidae including Timarete	0.08
Waiau	East	Arthropoda	Malacostraca	Paracalliopidae	*Paracalliope novizealandiae*	1.92
Waiau	East	Arthropoda	Malacostraca	Phoxocephalidae	*Torridoharpinia hurleyi*	2
Waiau	East	Arthropoda	Malacostraca	Hymenosomatidae	*Halicarcinus whitei*	0.92
Waiau	East	Arthropoda	Malacostraca	Macrophthalmidae	*Hemiplax hirtipes*	0.33
Waiau	East	Arthropoda	Malacostraca	Varunidae	*Hemigrapsus sexdentatus*	0.08

Site	Side of Channel	Phylum	Class	Family	Taxa	Mean Count
Waiau	East	Arthropoda	Malacostraca		Mysida	20.17
Waiau	East	Arthropoda	Maxillopoda	Balanomorpha	*Austrominius modestus*	0.67
Waiau	East	Cnidaria	Anthozoa	Actiniidae	*Anthopleura aureoradiata*	0.67
Waiau	East	Mollusca	Bivalvia	Nuculidae	*Linucula hartvigiana*	22.08
Waiau	East	Mollusca	Bivalvia	Lasaeidae	*Arthritica bifurca*	0.75
Waiau	East	Mollusca	Bivalvia	Semelidae	*Theora lubrica*	0.42
Waiau	East	Mollusca	Bivalvia	Tellinidae	*Macomona liliana*	3.25
Waiau	East	Mollusca	Bivalvia	Veneridae	*Austrovenus stutchburyi*	51.25
Waiau	East	Mollusca	Gastropoda	Batillariidae	*Zeacumantus lutulentus*	1.42
Waiau	East	Mollusca	Gastropoda	Buccinulidae	*Cominella glandiformis*	0.67
Waiau	East	Mollusca	Gastropoda	Lottidae	*Notoacmea scapha*	6.25
Waiau	East	Mollusca	Gastropoda	Trochidae	*Diloma subrostrata*	0.5
Waiau	East	Mollusca	Gastropoda	Haminoeidae	*Haminoea zelandiae*	0.08
Waiau	East	Mollusca	Gastropoda	Nassariidae	*Tritia burchardi*	0.33
Waiau	East	Nemertea			Nemertean	1.08
Ngahere	East	Annelida	Clitellata		Oligochaeta	3.42
Ngahere	East	Annelida	Polychaeta	Dorvilleidae	Dorvilleidae	0.08
Ngahere	East	Annelida	Polychaeta	Glyceridae	*Glycera ovigera*	0.25
Ngahere	East	Annelida	Polychaeta	Nereididae	*Nicon aestuariensis*	0.83
Ngahere	East	Annelida	Polychaeta	Syllidae	*Sphaerosyllis semiverrucosa*	0.08
Ngahere	East	Annelida	Polychaeta	Oweniidae	*Owenia petersenae*	0.08
Ngahere	East	Annelida	Polychaeta	Capitellidae	*Heteromastus filiformis*	8.42
Ngahere	East	Annelida	Polychaeta	Cossuridae	*Cossura consimilis*	19.75
Ngahere	East	Annelida	Polychaeta	Maldanidae	*Macroclymenella stewartensis*	0.17
Ngahere	East	Annelida	Polychaeta	Opheliidae	*Armandia maculata*	0.58
Ngahere	East	Annelida	Polychaeta	Paraonidae	*Aricidea* sp.	0.25

Site	Side of Channel	Phylum	Class	Family	Taxa	Mean Count
Ngahere	East	Annelida	Polychaeta	Paraonidae	*Paradoneis lyra*	4.83
Ngahere	East	Annelida	Polychaeta	Pectinariidae	*Lagis australis*	0.25
Ngahere	East	Annelida	Polychaeta	Magelonidae	*Magelona dakini*	1.42
Ngahere	East	Annelida	Polychaeta	Spionidae	*Prionospio aucklandica*	9.42
Ngahere	East	Annelida	Polychaeta	Spionidae	*Pseudopolydora paucibranchiata*	0.08
Ngahere	East	Annelida	Polychaeta	Spionidae	*Scolecolepides benhami*	0.42
Ngahere	East	Annelida	Polychaeta	Cirratulidae	*Cirratulidae including Timarete*	1.83
Ngahere	East	Arthropoda	Malacostraca	Phoxocephalidae	*Torridoharpinia hurleyi*	1.5
Ngahere	East	Arthropoda	Malacostraca	Diastylidae	*Colurostylis lemurum*	0.08
Ngahere	East	Arthropoda	Malacostraca	Hymenosomatidae	*Halicarcinus whitei*	0.08
Ngahere	East	Arthropoda	Malacostraca	Macrophthalmidae	*Hemiplax hirtipes*	0.83
Ngahere	East	Arthropoda	Malacostraca	Sphaeromatidae	*Isocladus* sp.	0.08
Ngahere	East	Arthropoda	Malacostraca		Mysida	65.75
Ngahere	East	Arthropoda	Maxillopoda	Balanomorpha	*Austrominius modestus*	0.75
Ngahere	East	Mollusca	Bivalvia	Nuculidae	*Linucula hartvigiana*	2.58
Ngahere	East	Mollusca	Bivalvia	Lasaeidae	*Arthritica bifurca*	3
Ngahere	East	Mollusca	Bivalvia	Mactridae	*Cyclomactra ovata*	0.08
Ngahere	East	Mollusca	Bivalvia	Semelidae	*Theora lubrica*	0.83
Ngahere	East	Mollusca	Bivalvia	Tellinidae	*Macomona liliana*	3.33
Ngahere	East	Mollusca	Bivalvia	Veneridae	*Austrovenus stutchburyi*	66
Ngahere	East	Mollusca	Gastropoda	Batillariidae	*Zeacumantus lutulentus*	0.25
Ngahere	East	Mollusca	Gastropoda	Lottidae	*Notoacmea scapha*	1.83
Ngahere	East	Mollusca	Gastropoda	Trochidae	*Diloma subrostrata*	0.17
Ngahere	East	Mollusca	Gastropoda	Nassariidae	*Tritia burchardi*	2.42
Ngahere	East	Nemertea			Nemertean	1.42
Clarks West	East	Annelida	Clitellata		Oligochaeta	0.33

Site	Side of Channel	Phylum	Class	Family	Taxa	Mean Count
Clarks West	East	Annelida	Polychaeta	Dorvilleidae	Dorvilleidae	0.08
Clarks West	East	Annelida	Polychaeta	Glyceridae	*Glycera ovigera*	0.58
Clarks West	East	Annelida	Polychaeta	Goniadidae	*Glycinde trifida*	0.17
Clarks West	East	Annelida	Polychaeta	Hesionidae	*Hesionidae*	0.42
Clarks West	East	Annelida	Polychaeta	Nereididae	*Nicon aestuariensis*	0.42
Clarks West	East	Annelida	Polychaeta	Nereididae	*Perinereis vallata*	0.67
Clarks West	East	Annelida	Polychaeta	Syllidae	Exogoninae (not Sphaerosyllis)	0.25
Clarks West	East	Annelida	Polychaeta	Syllidae	*Sphaerosyllis semiverrucosa*	0.5
Clarks West	East	Annelida	Polychaeta	Oweniidae	*Owenia petersenae*	2
Clarks West	East	Annelida	Polychaeta	Capitellidae	*Capitella* spp.	0.17
Clarks West	East	Annelida	Polychaeta	Capitellidae	*Heteromastus filiformis*	8.75
Clarks West	East	Annelida	Polychaeta	Maldanidae	*Macroclymenella stewartensis*	9.58
Clarks West	East	Annelida	Polychaeta	Opheliidae	*Armandia maculata*	0.42
Clarks West	East	Annelida	Polychaeta	Orbiniidae	*Orbinia papillosa*	0.25
Clarks West	East	Annelida	Polychaeta	Paraonidae	*Aricidea* sp.	0.33
Clarks West	East	Annelida	Polychaeta	Paraonidae	*Levinsenia gracilis*	0.08
Clarks West	East	Annelida	Polychaeta	Paraonidae	*Paradoneis lyra*	1
Clarks West	East	Annelida	Polychaeta	Pectinariidae	*Lagis australis*	1
Clarks West	East	Annelida	Polychaeta	Magelonidae	*Magelona dakini*	1.92
Clarks West	East	Annelida	Polychaeta	Spionidae	*Aonides trifida*	130.58
Clarks West	East	Annelida	Polychaeta	Spionidae	*Boccardia syrtis*	0.67
Clarks West	East	Annelida	Polychaeta	Spionidae	*Prionospio aucklandica*	2.08
Clarks West	East	Annelida	Polychaeta	Spionidae	*Pseudopolydora corniculata*	0.25
Clarks West	East	Annelida	Polychaeta	Spionidae	*Pseudopolydora paucibranchiata*	5.67
Clarks West	East	Annelida	Polychaeta	Spionidae	*Scolecolepides benhami*	0.58
Clarks West	East	Annelida	Polychaeta	Cirratulidae	Cirratulidae including Timarete	0.75

Site	Side of Channel	Phylum	Class	Family	Taxa	Mean Count
Clarks West	East	Arthropoda	Malacostraca	Exoedicerotidae	*Methalimedon* sp.	0.25
Clarks West	East	Arthropoda	Malacostraca	Paracalliopidae	*Paracalliope novizealandiae*	0.83
Clarks West	East	Arthropoda	Malacostraca	Phoxocephalidae	*Phoxocephalidae other*	1.33
Clarks West	East	Arthropoda	Malacostraca	Phoxocephalidae	*Torridoharpinia hurleyi*	3.58
Clarks West	East	Arthropoda	Malacostraca	Bodotriidae	*Cyclapsis thomsoni*	0.92
Clarks West	East	Arthropoda	Malacostraca	Diastylidae	*Colurostylis lemurum*	2.67
Clarks West	East	Arthropoda	Malacostraca	Hymenosomatidae	*Halicarcinus whitei*	2.5
Clarks West	East	Arthropoda	Malacostraca	Sphaeromatidae	*Isocladus* sp.	0.33
Clarks West	East	Arthropoda	Malacostraca		Mysida	1.17
Clarks West	East	Chaetognatha			Chaetognath	0.42
Clarks West	East	Cnidaria	Anthozoa	Actiniidae	*Anthopleura aureoradiata*	1.17
Clarks West	East	Cnidaria	Anthozoa	Edwardsiidae	*Edwardsia* sp.	0.08
Clarks West	East	Mollusca	Bivalvia	Modiolidae	*Xenostrobus pulex*	0.08
Clarks West	East	Mollusca	Bivalvia	Mytilidae	*Arcuatula senhousia*	0.08
Clarks West	East	Mollusca	Bivalvia	Nuculidae	*Linucula hartvigiana*	3.58
Clarks West	East	Mollusca	Bivalvia	Lasaeidae	*Arthritica bifurca*	1.17
Clarks West	East	Mollusca	Bivalvia	Psammobiidae	*Hiatula siliquens*	1.08
Clarks West	East	Mollusca	Bivalvia	Semelidae	*Theora lubrica*	0.08
Clarks West	East	Mollusca	Bivalvia	Tellinidae	*Macomona liliana*	13.25
Clarks West	East	Mollusca	Bivalvia	Veneridae	*Austrovenus stutchburyi*	62.75
Clarks West	East	Mollusca	Gastropoda	Lottidae	*Notoacmea scapha*	1.33
Clarks West	East	Mollusca	Gastropoda	Trochidae	*Diloma subrostrata*	0.08
Clarks West	East	Mollusca	Gastropoda	Nassariidae	*Tritia burchardi*	0.5
Clarks West	East	Nemertea			Nemertean	1.67
Clarks West	East	Sipunculida			Sipunculida	0.08
Lower Clarks Beach	East	Annelida	Clitellata		Oligochaeta	0.83

Site	Side of Channel	Phylum	Class	Family	Taxa	Mean Count
Lower Clarks Beach	East	Annelida	Polychaeta	Dorvilleidae	Dorvilleidae	0.08
Lower Clarks Beach	East	Annelida	Polychaeta	Glyceridae	*Glycera ovigera*	0.33
Lower Clarks Beach	East	Annelida	Polychaeta	Goniadidae	*Glycinde trifida*	0.25
Lower Clarks Beach	East	Annelida	Polychaeta	Hesionidae	Hesionidae	0.08
Lower Clarks Beach	East	Annelida	Polychaeta	Hesionidae	*Oxydromus angustifrons*	0.08
Lower Clarks Beach	East	Annelida	Polychaeta	Nereididae	*Nicon aestuariensis*	0.25
Lower Clarks Beach	East	Annelida	Polychaeta	Nereididae	*Perinereis vallata*	0.08
Lower Clarks Beach	East	Annelida	Polychaeta	Nereididae	*Platynereis australis*	0.58
Lower Clarks Beach	East	Annelida	Polychaeta	Polynoidae	*Paralepidonotus ampulliferus*	0.08
Lower Clarks Beach	East	Annelida	Polychaeta	Oweniidae	*Owenia petersenae*	0.08
Lower Clarks Beach	East	Annelida	Polychaeta	Capitellidae	*Capitella* spp.	0.08
Lower Clarks Beach	East	Annelida	Polychaeta	Capitellidae	*Heteromastus filiformis*	9.92
Lower Clarks Beach	East	Annelida	Polychaeta	Maldanidae	*Macroclymenella stewartensis*	15.92
Lower Clarks Beach	East	Annelida	Polychaeta	Opheliidae	*Armandia maculata*	1
Lower Clarks Beach	East	Annelida	Polychaeta	Paraonidae	*Aricidea* sp.	0.5
Lower Clarks Beach	East	Annelida	Polychaeta	Paraonidae	*Levinsenia gracilis*	0.25
Lower Clarks Beach	East	Annelida	Polychaeta	Paraonidae	*Paradoneis lyra*	5.42
Lower Clarks Beach	East	Annelida	Polychaeta	Pectinariidae	*Lagis australis*	0.33
Lower Clarks Beach	East	Annelida	Polychaeta	Magelonidae	*Magelona dakini*	0.17
Lower Clarks Beach	East	Annelida	Polychaeta	Spionidae	*Aonides trifida*	0.33
Lower Clarks Beach	East	Annelida	Polychaeta	Spionidae	*Boccardia syrtis*	13.92
Lower Clarks Beach	East	Annelida	Polychaeta	Spionidae	*Prionospio aucklandica*	9.33
Lower Clarks Beach	East	Annelida	Polychaeta	Spionidae	*Pseudopolydora paucibranchiata*	0.75
Lower Clarks Beach	East	Annelida	Polychaeta	Spionidae	*Scolecolepides benhami*	0.42
Lower Clarks Beach	East	Annelida	Polychaeta	Cirratulidae	Cirratulidae including Timarete	0.25
Lower Clarks Beach	East	Arthropoda	Malacostraca	Dexaminidae	Dexaminidae	0.08

Site	Side of Channel	Phylum	Class	Family	Taxa	Mean Count
Lower Clarks Beach	East	Arthropoda	Malacostraca	Ischyroceridae	Ischyroceridae	0.42
Lower Clarks Beach	East	Arthropoda	Malacostraca	Paracalliopidae	*Paracalliope novizealandiae*	8
Lower Clarks Beach	East	Arthropoda	Malacostraca	Phoxocephalidae	Phoxocephalidae other	0.08
Lower Clarks Beach	East	Arthropoda	Malacostraca	Phoxocephalidae	*Torridoharpinia hurleyi*	9.5
Lower Clarks Beach	East	Arthropoda	Malacostraca	Bodotriidae	*Cyclapsis thomsoni*	0.75
Lower Clarks Beach	East	Arthropoda	Malacostraca	Hymenosomatidae	*Halicarcinus varius*	1.92
Lower Clarks Beach	East	Arthropoda	Malacostraca	Hymenosomatidae	*Halicarcinus whitei*	1.17
Lower Clarks Beach	East	Arthropoda	Malacostraca	Macrophthalmidae	*Hemiplax hirtipes*	0.58
Lower Clarks Beach	East	Arthropoda	Malacostraca	Varunidae	*Hemigrapsus sexdentatus*	0.08
Lower Clarks Beach	East	Arthropoda	Malacostraca	Sphaeromatidae	*Isocladus* sp.	0.33
Lower Clarks Beach	East	Arthropoda	Malacostraca		Mysida	1.08
Lower Clarks Beach	East	Arthropoda	Malacostraca		Nebalia	0.25
Lower Clarks Beach	East	Arthropoda	Maxillopoda	Balanomorpha	*Austrominius modestus*	0.08
Lower Clarks Beach	East	Echinodermata	Asteroidea	Asterinidae	*Patiriella regularis*	0.17
Lower Clarks Beach	East	Mollusca	Bivalvia	Mytilidae	*Arcuatula senhousia*	0.58
Lower Clarks Beach	East	Mollusca	Bivalvia	Nuculidae	*Linucula hartvigiana*	49.25
Lower Clarks Beach	East	Mollusca	Bivalvia	Solemyidae	*Solemya parkinsonii*	0.08
Lower Clarks Beach	East	Mollusca	Bivalvia	Lasaeidae	*Arthritica bifurca*	1.17
Lower Clarks Beach	East	Mollusca	Bivalvia	Mactridae	*Cyclomactra ovata*	0.08
Lower Clarks Beach	East	Mollusca	Bivalvia	Semelidae	*Theora lubrica*	0.33
Lower Clarks Beach	East	Mollusca	Bivalvia	Tellinidae	*Macomona liliana*	2.33
Lower Clarks Beach	East	Mollusca	Bivalvia	Veneridae	*Austrovenus stutchburyi*	74
Lower Clarks Beach	East	Mollusca	Gastropoda	Buccinulidae	*Cominella glandiformis*	0.58
Lower Clarks Beach	East	Mollusca	Gastropoda	Lottidae	*Notoacmea scapha*	15.83
Lower Clarks Beach	East	Mollusca	Gastropoda	Trochidae	*Diloma subrostrata*	0.25
Lower Clarks Beach	East	Mollusca	Gastropoda	Skeneidae	*Zalipais lissa*	0.83

Site	Side of Channel	Phylum	Class	Family	Taxa	Mean Count
Lower Clarks Beach	East	Mollusca	Polyplacophora	Chitonidae	*Chiton glaucus*	0.25
Lower Clarks Beach	East	Nemertea			Nemertean	1
Lower Clarks Beach	East	Platyhelminthes	Rhabditophora	Stylochidae	Stylochidae	0.08
Clarks Beach	East	Annelida	Clitellata		Oligochaeta	0.92
Clarks Beach	East	Annelida	Polychaeta	Dorvilleidae	Dorvilleidae	0.17
Clarks Beach	East	Annelida	Polychaeta	Glyceridae	*Glycera ovigera*	0.08
Clarks Beach	East	Annelida	Polychaeta	Goniadidae	*Glycinde trifida*	0.33
Clarks Beach	East	Annelida	Polychaeta	Hesionidae	*Oxydromus angustifrons*	0.17
Clarks Beach	East	Annelida	Polychaeta	Nereididae	*Nicon aestuariensis*	0.17
Clarks Beach	East	Annelida	Polychaeta	Nereididae	*Platynereis australis*	1.42
Clarks Beach	East	Annelida	Polychaeta	Sphaerodoridae	Sphaerodoridae	0.17
Clarks Beach	East	Annelida	Polychaeta	Syllidae	Exogoninae (not Sphaerosyllis)	0.42
Clarks Beach	East	Annelida	Polychaeta	Syllidae	Syllinae	0.67
Clarks Beach	East	Annelida	Polychaeta	Oweniidae	*Owenia petersenae*	2
Clarks Beach	East	Annelida	Polychaeta	Capitellidae	*Capitella spp*	0.25
Clarks Beach	East	Annelida	Polychaeta	Capitellidae	*Heteromastus filiformis*	14.25
Clarks Beach	East	Annelida	Polychaeta	Maldanidae	*Macroclymenella stewartensis*	13.58
Clarks Beach	East	Annelida	Polychaeta	Opheliidae	*Armandia maculata*	0.25
Clarks Beach	East	Annelida	Polychaeta	Orbiniidae	*Orbinia papillosa*	0.08
Clarks Beach	East	Annelida	Polychaeta	Paraonidae	*Aricidea* sp.	1.17
Clarks Beach	East	Annelida	Polychaeta	Paraonidae	*Paradoneis lyra*	19.08
Clarks Beach	East	Annelida	Polychaeta	Pectinariidae	*Lagis australis*	0.08
Clarks Beach	East	Annelida	Polychaeta	Magelonidae	*Magelona dakini*	0.58
Clarks Beach	East	Annelida	Polychaeta	Spionidae	*Aonides trifida*	0.17
Clarks Beach	East	Annelida	Polychaeta	Spionidae	*Boccardia syrtis*	9.17
Clarks Beach	East	Annelida	Polychaeta	Spionidae	*Prionospio aucklandica*	0.67

Site	Side of Channel	Phylum	Class	Family	Taxa	Mean Count
Clarks Beach	East	Annelida	Polychaeta	Spionidae	*Pseudopolydora corniculata*	1.58
Clarks Beach	East	Annelida	Polychaeta	Spionidae	*Pseudopolydora paucibranchiata*	1.17
Clarks Beach	East	Annelida	Polychaeta	Spionidae	*Scolecolepides benhami*	0.17
Clarks Beach	East	Annelida	Polychaeta	Cirratulidae	Cirratulidae including Timarete	0.08
Clarks Beach	East	Arthropoda	Malacostraca	Dexaminidae	Dexaminidae	2.75
Clarks Beach	East	Arthropoda	Malacostraca	Ischyroceridae	Ischyroceridae	0.75
Clarks Beach	East	Arthropoda	Malacostraca	Paracalliopidae	*Paracalliope novizealandiae*	10.17
Clarks Beach	East	Arthropoda	Malacostraca	Phoxocephalidae	Phoxocephalidae other	1.92
Clarks Beach	East	Arthropoda	Malacostraca	Phoxocephalidae	*Torridoharpinia hurleyi*	10.17
Clarks Beach	East	Arthropoda	Malacostraca	Bodotriidae	*Cyclapsis thomsoni*	1.17
Clarks Beach	East	Arthropoda	Malacostraca	Crangonidae	*Philocheras australis*	0.5
Clarks Beach	East	Arthropoda	Malacostraca	Hymenosomatidae	*Halicarcinus varius*	0.75
Clarks Beach	East	Arthropoda	Malacostraca	Hymenosomatidae	*Halicarcinus whitei*	0.92
Clarks Beach	East	Arthropoda	Malacostraca	Macrophthalmidae	*Hemiplax hirtipes*	0.5
Clarks Beach	East	Cnidaria	Anthozoa	Actiniidae	*Anthopleura aureoradiata*	0.08
Clarks Beach	East	Echinodermata	Holothuroidea	Chiridotidae	*Taeniogyrus dendyi*	0.08
Clarks Beach	East	Echinodermata	Ophiuroidea	Amphiuridae	Amphiura	0.08
Clarks Beach	East	Mollusca	Bivalvia	Mytilidae	*Arcuatula senhousia*	0.08
Clarks Beach	East	Mollusca	Bivalvia	Nuculidae	*Linucula hartvigiana*	15.83
Clarks Beach	East	Mollusca	Bivalvia	Solemyidae	*Solemya parkinsonii*	0.42
Clarks Beach	East	Mollusca	Bivalvia	Lasaeidae	*Arthritica bifurca*	1.92
Clarks Beach	East	Mollusca	Bivalvia	Tellinidae	*Macomona liliana*	1.83
Clarks Beach	East	Mollusca	Bivalvia	Ungulinidae	*Zemysia zelandica*	2.17
Clarks Beach	East	Mollusca	Bivalvia	Veneridae	*Austrovenus stutchburyi*	0.5
Clarks Beach	East	Mollusca	Gastropoda	Buccinulidae	*Cominella glandiformis*	0.08
Clarks Beach	East	Mollusca	Gastropoda	Lottidae	*Notoacmea scapha*	0.17

Site	Side of Channel	Phylum	Class	Family	Taxa	Mean Count
Clarks Beach	East	Mollusca	Gastropoda	Skeneidae	*Zalipais lissa*	0.08
Clarks Beach	East	Mollusca	Gastropoda	Nassariidae	*Tritia burchardi*	0.08
Clarks Beach	East	Nemertea			Nemertean	3.33