

**To:** Jonny Edmonds,  
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**From:** Robyn Dunmore,  
Reid Forrest

**Company:** Nelson City Council

**SLR Consulting NZ**

**cc:** Rob Lieffering

**Date:** 2 November 2023

**Project No.** 840.V30037.00000

**RE: Bivalve Shellfish Surveys  
Nelson Wastewater Treatment Plant**

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## 1.0 Introduction

SLR Consulting NZ Limited (**SLR**) was engaged to undertake bivalve shellfish surveys as part of the assessment of environmental effects (**AEE**) for the consenting of the Nelson Wastewater Treatment Plant (**WWTP**). The surveys were carried out to examine whether bivalve shellfish were present at ten sites that had been modelled as part of the Quantitative Microbial Risk Assessments (**QMRA**) included in the AEE. We understand that the sites selected for the QMRA were primarily selected because primary and secondary contact recreational activities (e.g. swimming, surfing, kayaking, windsurfing etc.) occurred there. The QMRA also estimated the risks associated with consumption of uncooked bivalve shellfish<sup>1</sup> by the public, however no field assessments had been made at these sites to determine whether bivalve shellfish were present. Intertidal/shallow subtidal and subtidal surveys were therefore designed to target potential kaimoana bivalve shellfish species such as blue mussels, green-lipped mussels, ribbed mussels, Pacific oysters, dredge/flat oysters, scallops, pipi, and cockles.

## 2.0 Methods

Ten sites included in the QMRA were requested to be surveyed (**Table 1, Figure 1, Figure 2, and Figure 3**). Intertidal/shallow subtidal surveys were undertaken at all ten sites, and subtidal surveys were undertaken at five of these ten sites (**Table 1**). The intertidal/shallow subtidal surveys targeted potential kaimoana bivalve shellfish species such as blue mussels, green-lipped mussels, ribbed mussels, Pacific oysters, pipi, and cockles. The subtidal surveys were carried out to check whether scallops, dredge/flat oysters, or mussels were present in predominately soft sediment habitats at these sites.

All surveys were carried out by marine scientists experienced in ecological surveys who are also Worksafe-approved occupational scientific divers. Surveys of the intertidal/shallow subtidal were carried out by walking along the shoreline during low tide, or by snorkelling from a vessel during low- to mid-tide. Surveys in subtidal habitats were undertaken by divers using SCUBA, utilising a vessel to access the sites.

The intertidal/shallow subtidal surveys at Snapper Point, Akersten Street, Seafarers Memorial, and Magazine Point coincided with a low tide of 0.4 m above Chart Datum (**CD**) on 29 September 2023, and the first survey at Tahunanui Beach was done during a low tide

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<sup>1</sup> Bivalve shellfish are filter feeders and these types of shellfish can accumulate bacteria and viruses in their flesh. It should be noted that kaimoana shellfish such as paua and kina are not filter feeders.

of 0.3 m above CD on 2 October 2023. Intertidal/shallow subtidal surveys for most of the remaining sites were completed during the dive surveys on 23 October 2023 where the low tide was approaching neap tide (1.4 m above CD). Due to this smaller tide the low-shore zone at these sites was also snorkeled. The intertidal/shallow subtidal survey at Glenduan was completed on 29 October 2023.

During the intertidal surveys, the area was surveyed by proceeding along the shoreline, noting and photographing the general areas and different species observed, with particular attention paid to any kaimoana bivalve shellfish species. If these species were observed, the habitat they occurred in, semi-qualitative relative abundances (abundant, common, occasional, rare) and approximate sizes were noted. At sites with soft sediment habitats, the presence of infaunal bivalve shellfish species (that usually occur within the sediments, e.g. pipi, cockles) were examined. Sand was excavated to an approximate depth of 25 cm, within a surface area of approximately 20 cm by 20 cm, and the excavated material was sieved over an 8 mm mesh to retain the larger material. This material was examined and if live bivalves were observed, they were identified to the nearest group, counted, and measured.

For the subtidal surveys, scientific divers descended to the seabed at each site and swam a pattern of ~50 m x 50 m x 50 m, before ascending. During each dive, photos and notes were taken on the substrate type (mud / sand / cobble / boulder / bedrock), the taxa observed, and relative abundances. If shell hash was observed, the diver dug into the sand to see if any live bivalves were present as infauna.

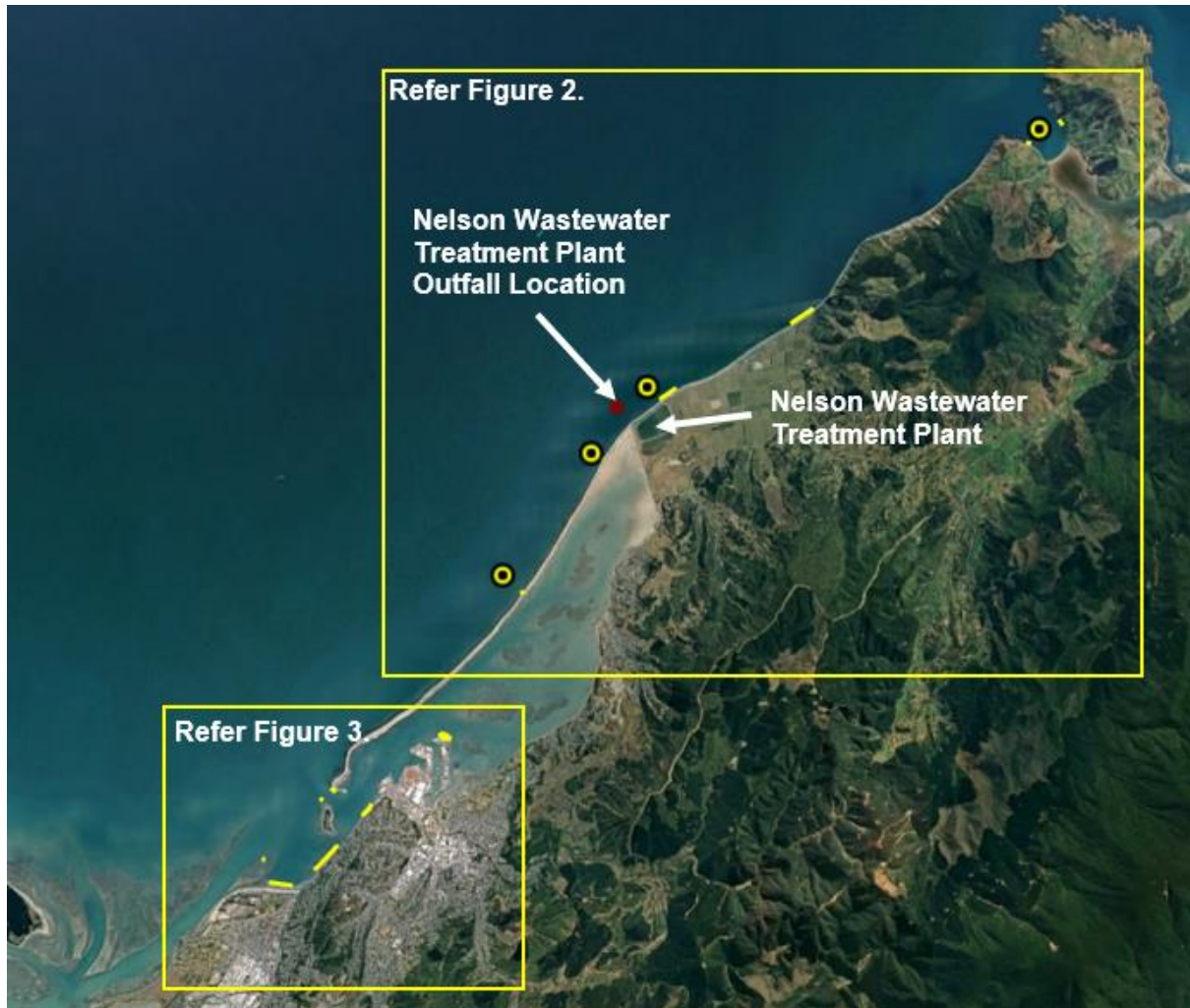
**Table 1 List of sites surveyed, depth zone (intertidal/shallow subtidal and/or subtidal) and date of survey.**

| Site                 | Intertidal/shallow subtidal date surveyed | Subtidal date surveyed |
|----------------------|---|------------------------|
| Cable Bay            | 23/10/23                                  | 23/10/23               |
| Glenduan             | 29/10/23                                  | 23/10/23               |
| Snapper Point        | 29/09/23                                  | 23/10/23               |
| 900 m SW of Outfall  | 23/10/23                                  | 23/10/23               |
| Outside Boulder Bank | 23/10/23                                  | 23/10/23               |
| The Cut <sup>#</sup> | North                                     | Not surveyed           |
|                      | Haulashore                                | Not surveyed           |
| Akersten Street      | 29/09/23                                  | Not surveyed           |
| Seafarers Memorial   | 29/09/23                                  | Not surveyed           |
| Magazine Point       | 29/09/23                                  | Not surveyed           |
| Tahunanui Beach      | 02/10/23 and 23/10/23                     | Not surveyed           |

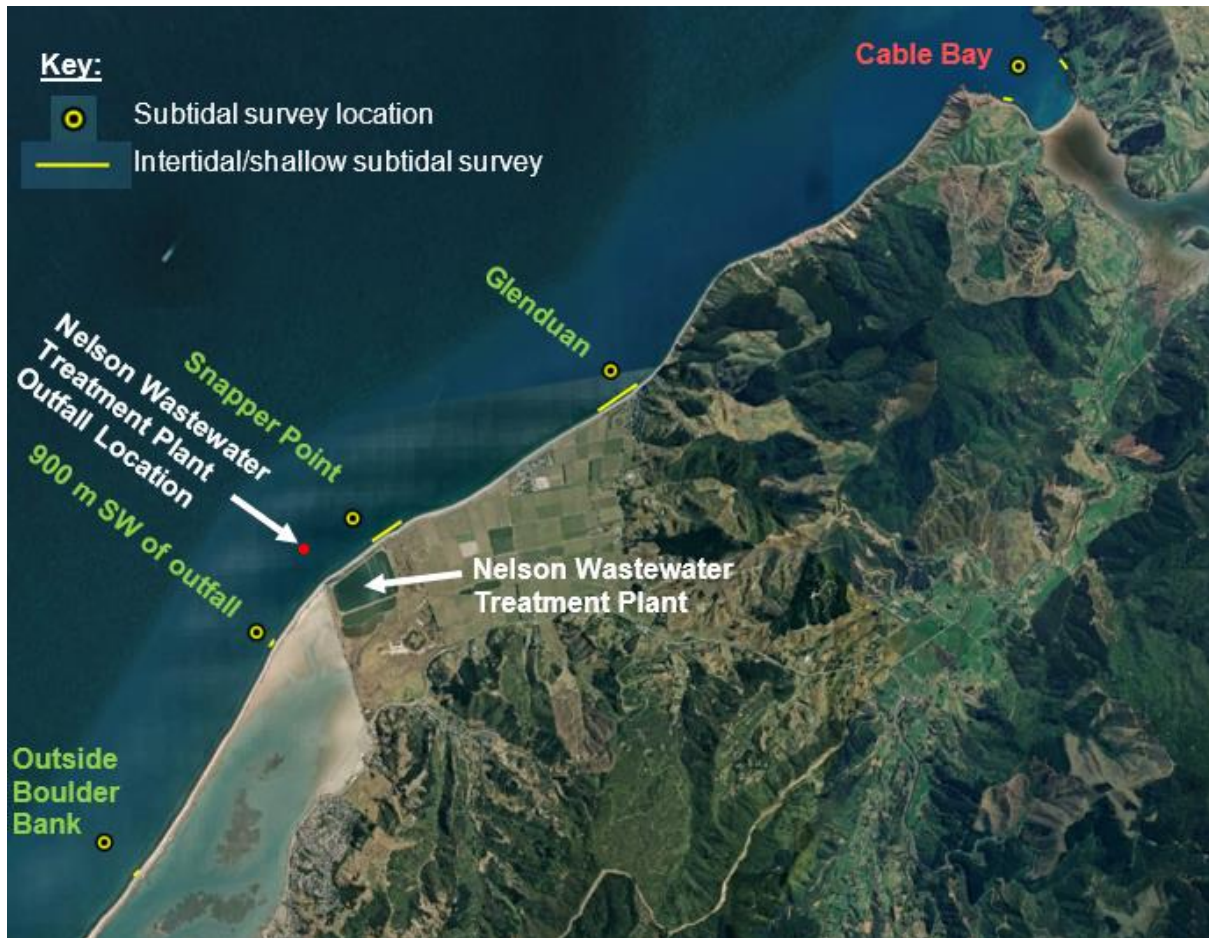
<sup>#</sup> 'The Cut' is the main entrance to Port Nelson and Nelson Haven located between the southern end of the Boulder Bank and the northern end of Haulashore Island. This site was divided into two subsites, one on the northern part of the channel (The Cut – North) and one on the southern part, being Haulashore Island (The Cut – Haulashore). The survey at The Cut – Haulashore was undertaken on the southern side of the rock/concrete training wall that extends in a northwest direction from Haulashore Island into Tasman Bay (refer **Figure 3**).



**Figure 1 Overview Map of Survey sites. Yellow lines are intertidal/shallow subtidal areas surveyed and yellow/black points are start points for the subtidal surveys.**



**Figure 2** Survey sites near the NWWTP. Yellow lines are intertidal/shallow subtidal areas surveyed and yellow/black points are start points for the subtidal surveys. Red labelled sites had kaimoana bivalve shellfish present, green labelled sites did not.



**Figure 3** Survey sites around Nelson City. Yellow lines are intertidal/shallow subtidal areas surveyed. Red labelled sites had kaimoana bivalve shellfish present.



### 3.0 Results

Summary descriptions of the substrate types and any kaimoana bivalve shellfish observed at each site are included in **Table 2**, with representative photographs in **Figure 4** to **Figure 13**, and lists of other taxa encountered included as **Appendix A**.

The main kaimoana bivalve shellfish observed across the sites were encountered in the intertidal zone and included blue and green-lipped mussels (*Mytilus galloprovincialis* and *Perna canaliculus*, respectively) and Pacific oysters (*Magallana gigas*). Blue mussels, green-lipped mussels, and Pacific oysters were found in intertidal areas at Cable Bay, The Cut, Seafarers Memorial, and Magazine Point. Pacific oysters and a single green-lipped mussel were observed at Akersten Street.

While little black mussels (*Xenostrobus pulex*) were observed at several of the sites, this species is not considered to be a kaimoana species due to its very small size and is not included in **Table 1**. Ribbed mussels (*Aulacomya maoriana*) are known to be kaimoana, but were not observed at any of the sites.

Low numbers of small pipi (*Paphies australis*) and cockles (*Austrovenus stutchburyi*) were excavated from in the soft sediment habitat at the end of Akersten Street, and a small number of pipi were found at Tahunanui Beach. Extensive areas of cockle and pipi shell



hash were observed at Akersten Street, possibly suggesting the presence of shellfish beds nearby (possibly in other parts of Nelson Haven or deeper subtidal), or possibly existing historically in this area. The area had significant soft sand deposits which appeared to be highly mobile – which could result in shellfish beds becoming covered/uncovered.

No scallops (*Pecten novaezelandiae*) were observed in any of the subtidal surveys, but two horse mussels (*Atrina zelandica*) were present at Cable Bay. New Zealand geoduck shell valves were observed amongst shell hash at Cable Bay, but an attempt to excavate a live individual from a suspected siphon hole was unsuccessful. Window oysters (*Pododesmus (Monia) zelandicus*) were present on boulders at Glenduan, Snapper Point, Outside Boulder Bank, and Seafarers Memorial sites, but this species is not generally considered to be collected as kaimoana<sup>2</sup> and as such has not been included in **Table 1**.

**Table 2 Descriptions of habitats at sites and kaimoana bivalve shellfish observed in intertidal/shallow subtidal and subtidal zones. Other taxa observed are listed in Appendix A.**

| <b>Site</b><br>Bivalve shellfish kaimoana present/absent | Intertidal/shallow subtidal  | Subtidal  |
|--|--|---|
| <b>Cable Bay</b><br>Kaimoana bivalve shellfish present   | North: Cobble, boulders, and reef habitats. Clumps of blue mussels relatively common in the mid shore (30-50 mm). Green-lipped mussels rare (only two observed, 40 mm size). Pacific oysters (30-60 mm) common, mostly on the high shore.<br><br>South: Cobble, boulders. Clumps of blue mussels (30-50 mm) occasional to common. Green-lipped mussels rare (only one observed, 40 mm size). | Muddy sand ripples, changing into clean sand ripples. Two live horse mussels observed, and many horse mussel shells also present. New Zealand geoduck shell valves were observed amongst shell hash, but an attempt to excavate a live individual from a suspected siphon hole was unsuccessful.<br>Visibility: ~6 m. |
| <b>Glenduan</b><br>Kaimoana bivalve shellfish absent     | Cobble/boulder habitat. No live kaimoana bivalve shellfish observed.   | Boulders interspersed with sand. Some dog cockle shells present, but no live cockles observed when digging into the sediment. No live kaimoana bivalve shellfish observed.<br>Visibility ~4 m.  |

<sup>2</sup> Window oysters are a member of the Anomiidae family and according to Wikipedia the flesh of members of this family is unpleasantly bitter and not eaten (<https://en.wikipedia.org/wiki/Anomiidae>).



| <b>Site</b><br>Bivalve shellfish kaimoana<br>present/<br>absent  | Intertidal/shallow subtidal  | Subtidal  |
|--|--|---|
| <b>Snapper Point</b><br>Kaimoana bivalve shellfish absent        | Cobble/boulder habitat. No live kaimoana bivalve shellfish observed.   | Cobble and boulder interspersed with sand. No live kaimoana bivalve shellfish observed. Visibility ~3 m.                          |
| <b>900 m SW of Outfall</b><br>Kaimoana bivalve shellfish absent  | Cobble/boulder habitat. No live kaimoana bivalve shellfish observed.   | Sand ripple, with occasional cobble/boulders. No live kaimoana bivalve shellfish observed. Visibility ~2 m.                       |
| <b>Outside Boulder Bank</b><br>Kaimoana bivalve shellfish absent | Cobble/boulder habitat. No live kaimoana bivalve shellfish observed.   | Boulders in shallow areas, changing to sand. Small shell hash but no live kaimoana bivalve shellfish observed. Visibility ~1.5 m. |
| <b>The Cut</b><br>Kaimoana bivalve shellfish present             | North: Boulder rip-rap wall. Pacific oysters common (40-60 mm). Blue mussels (40-50 mm) common in clumps, but green-lipped mussels less abundant (40-70 mm).<br><br>Haulashore: Boulder rip-rap wall. Pacific oysters common (30-90 mm), with larger individuals closer to Haulashore Island. Occasional clumps of blue mussels (40-50 mm).  | Not surveyed  |
| <b>Akersten Street</b><br>Kaimoana bivalve shellfish present     | Rip-rap wall, changing to soft muddy sand. Occasional Pacific oysters (50-70 mm) on rock, along with a single green-lipped mussel (70 mm). A few (<10 individuals) small pipi (30-45 mm) and cockles (15-30 mm) sampled in the muddy sand. Extensive cockle and pipi shell hash suggestive of nearby and/or historic shellfish beds was present.   | Not surveyed  |
| <b>Seafarers Memorial</b><br>Kaimoana bivalve shellfish present  | Piles, steps, rip-rap, cobble, and seawall habitats. Pacific oysters were common on the piles, rip-rap and seawall (30-70 mm). Blue mussels were common on the memorial wharf steps and on the piles of 'The Boathouse' building (up to 100 mm). Green-lipped mussels were rare, with only a few individuals observed on the memorial wharf steps, 'The Boathouse' piles, and on cobble near the 'Boat Shed Café' building (up to 120 mm). | Not surveyed  |

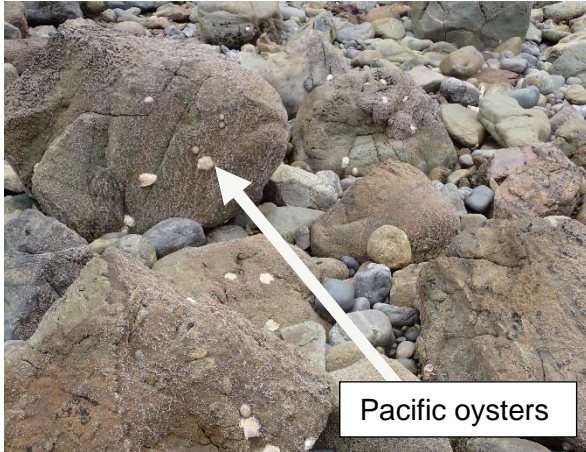


| <b>Site</b><br>Bivalve shellfish kaimoana<br>present/<br>absent | Intertidal/shallow subtidal   | Subtidal     |
|---|---|--------------|
| <b>Magazine Point</b><br>Kaimoana bivalve shellfish present     | Seawall, cobble, sand, bedrock reef habitats. Occasional Pacific oysters (50-60 mm) on the seawall and bedrock reef. Blue mussels common on the reef, with larger mussels higher on the shore, and smaller individuals lower on the shore (50-100 mm). Green-lipped mussels were occasional to common on the reef (30-100 mm). Two groups of people were observed collecting shellfish on the shore. One group had several bags of mussels and on questioning, confirmed they were collecting the mussels for consumption. The other group were too far away to be sure of what they were targeting, but were collecting from the rocky reef habitat (rather than from the soft sediment habitat). Three small (25-30 mm) purple sunset shells ( <i>Gari stangeri</i> ) excavated from a soft sediment habitat, but no pipi or cockles were observed. | Not surveyed |
| <b>Tahunanui Beach</b><br>Kaimoana bivalve shellfish present    | Sand with some shell hash. A small number (3) of juvenile (10-35 mm) pipi were sampled along the beachfront, and a two larger pipi 30-35 mm) were sampled from the more mobile sands present on the spit.   | Not surveyed |

**Figure 4 Cable Bay: top, intertidal/shallow subtidal general habitat views of north (left) and south (right) sites; middle and bottom left, Pacific oysters and blue mussel clumps; bottom right, subtidal horse mussel.**







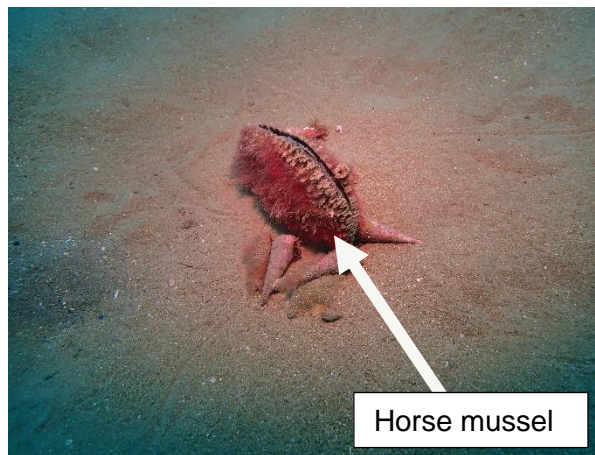
Pacific oysters



Blue mussels



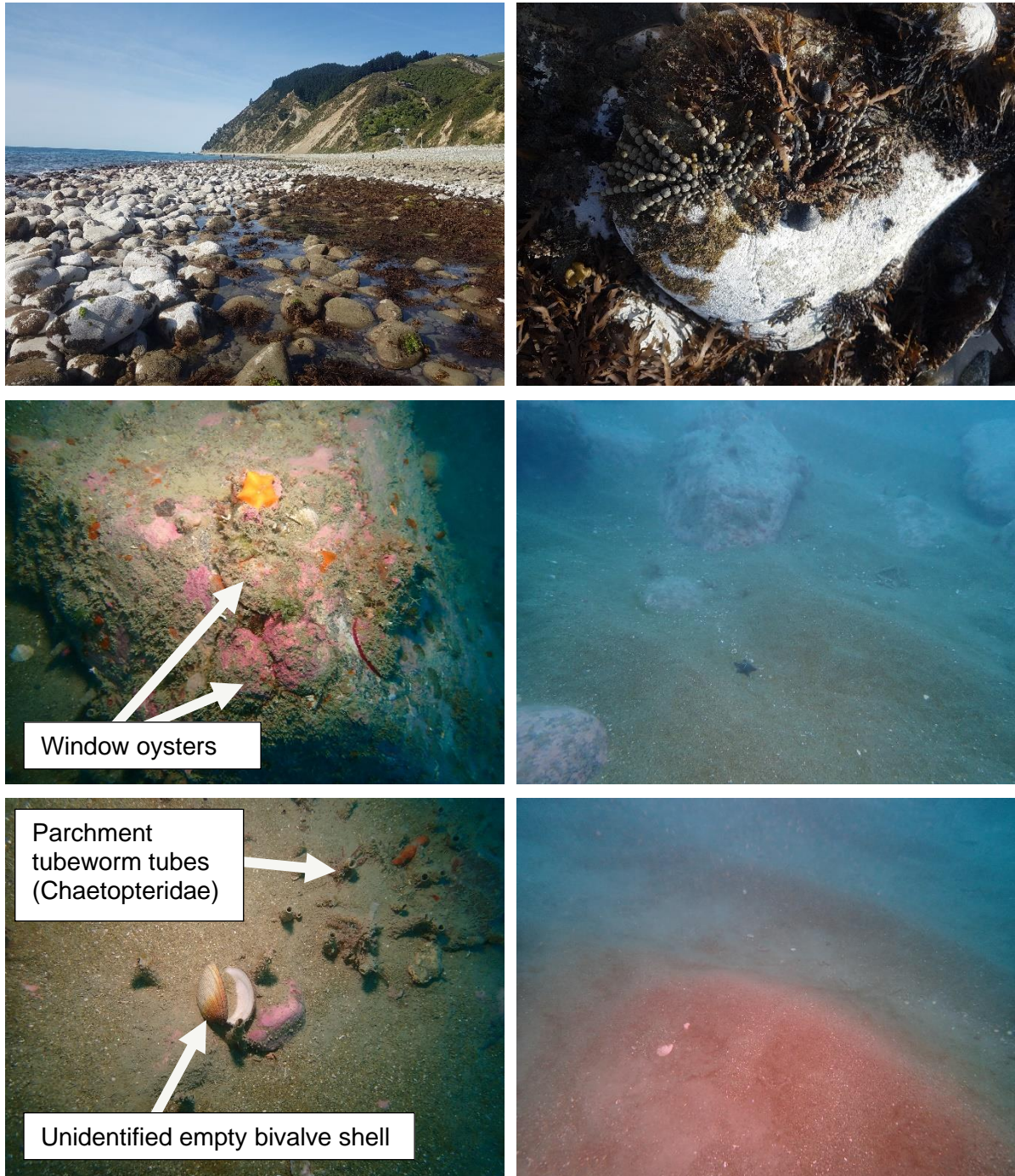
Blue mussels



Horse mussel



**Figure 5** Glenduan: Top, intertidal/shallow subtidal general site view (left) and cobble/boulder habitat (right); middle, subtidal habitat showing window oysters on a boulder (left), and boulders interspersed with sand (right); bottom: unidentified bivalve shell amongst parchment tubeworm tubes (left) and sand ripples (right).



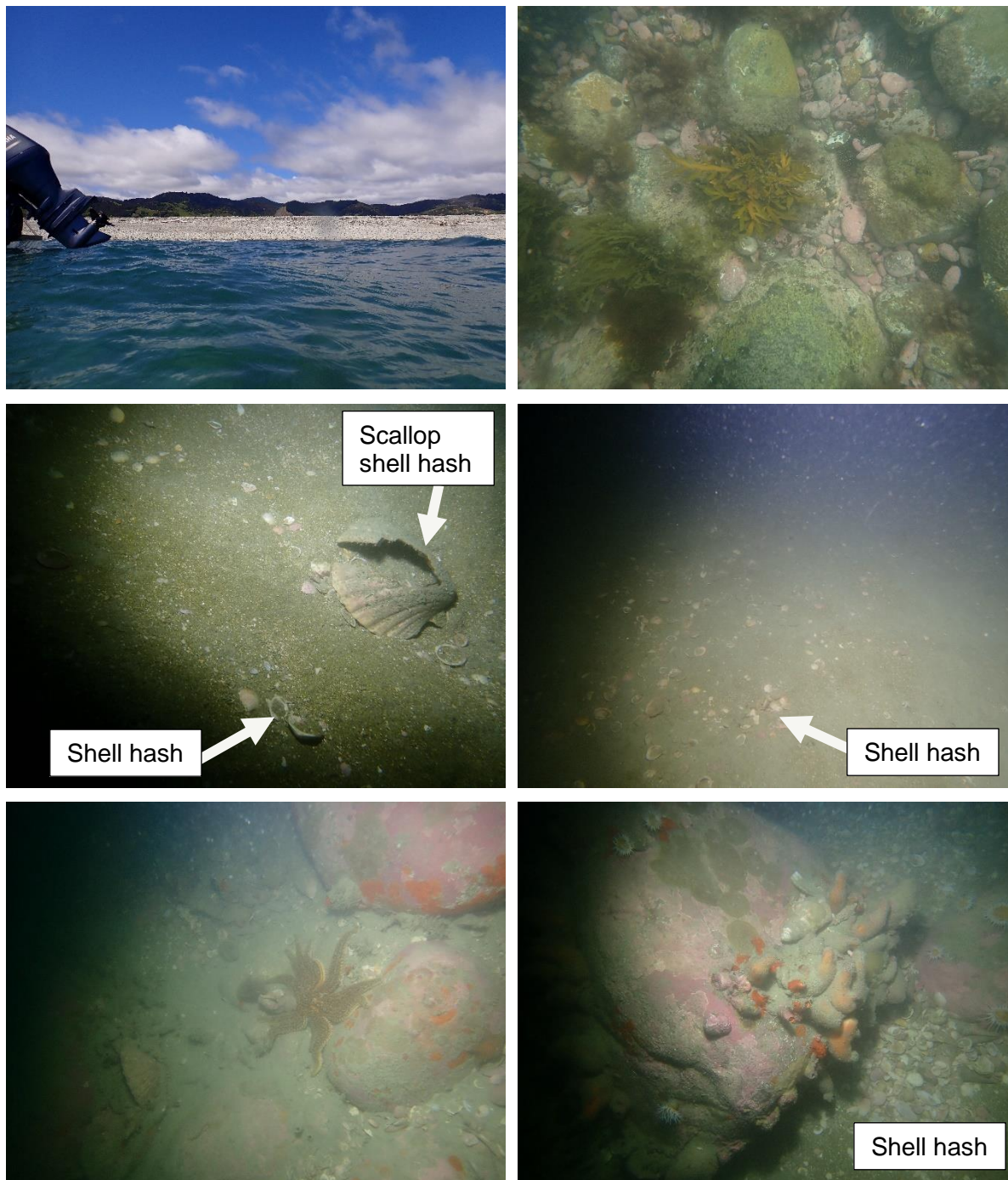
**Figure 6 Snapper Point: top, intertidal general habitat view (left) and mobile cobble habitat (right); middle and bottom, subtidal habitat of boulders interspersed with sand, with a variety of epibiota such as sponges, colonial stony corals, anemones, sea stars, sea cucumbers, and macroalgae.**



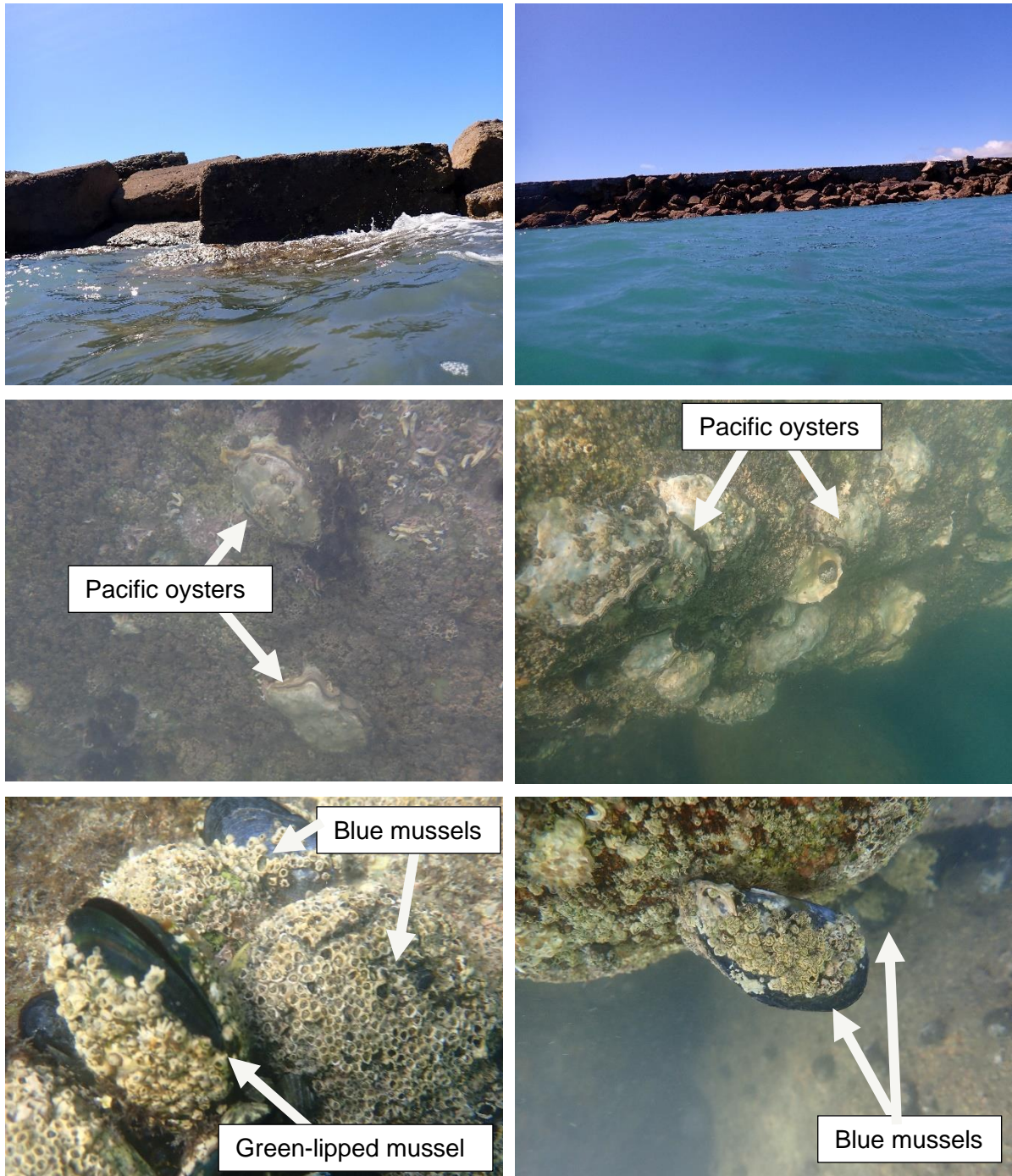
**Figure 7 900 m SW of Outfall: top, boulder/cobble habitat in the intertidal/shallow subtidal zone; middle and bottom, subtidal areas with small boulders extending out of the sand, covered in epibiota such as sponges, ascidians, anemones, and red macroalgae.**



**Figure 8 Outside Boulder Bank: top, intertidal/shallow subtidal general view (left) and cobble/boulder habitat (right); middle, subtidal muddy sand with shell hash including scallop shell hash (left); bottom, boulders amongst shell hash, covered in various epibiota including solitary ascidians, sponges, crustose coralline algae, anemones, sea stars, and encrusting bryozoans (right).**



**Figure 9 The Cut – North (left) and The Cut – Haulashore (right) general views;  
middle, Pacific oysters; bottom, mussels.**



**Figure 10 Akersten Street: top, general site view (left), and shell hash covering the low shore (none live) (right); bottom, green-lipped mussel (left) and Pacific oysters (right) on the rip-rap wall.**



**Figure 11 Seafarers Memorial: top, general views along the shore from Seafarers Memorial towards ‘The Boathouse’ (left) and along cobble/boulder habitat towards the Boat Shed Café (right); middle, close-up of a pile covered in barnacles, little black mussels and young Pacific oysters (left) and a pile with older Pacific oysters (right); bottom, blue mussels on rip-rap and base of piles (left), and blue mussel and a green-lipped mussel on steps (right).**

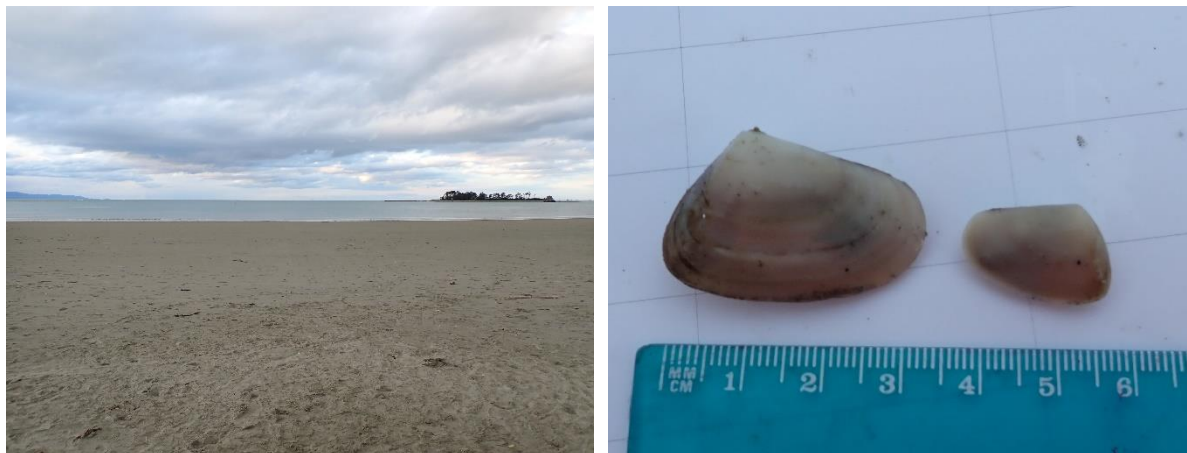




**Figure 12 Magazine Point: top, intertidal/shallow subtidal general habitat views; middle, rock oysters and a dense band and clumps of little black mussels on the seawall; bottom, blue mussels on bedrock reef (left), with close-up showing a green-lipped mussel with blue mussels (right).**



**Figure 13 Tahunanui Beach: general site view (left), and pipi (right).**



## 4.0 Closure

In summary, kaimoana bivalve shellfish were observed in intertidal and shallow subtidal habitats at Cable Bay, The Cut (at both subsites), Akersten Street, Seafarers Memorial, Magazine Point, and Tahunanui Beach. These kaimoana bivalve shellfish included blue mussels, green-lipped mussels, Pacific oysters, pipi, and cockles in quantities that could potentially be targeted and harvested by the public for consumption.

Regards,

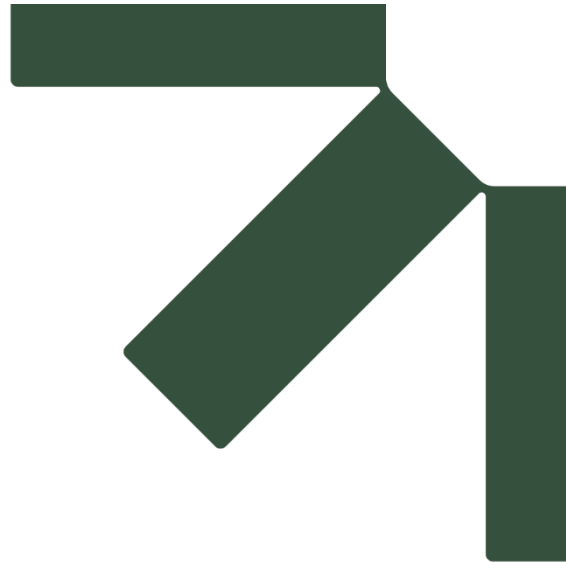
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# Appendix A Indices of taxa observed at each site.

Note: these are not biodiversity surveys, rather lists of conspicuous taxa observed when searching for bivalves.

## Bivalve Shellfish Surveys Nelson Wastewater Treatment Plant

Nelson City Council



**Table A.1 Cable Bay**

| Zone                           | Habitat             | Taxa                                | Common name                              |                        |
|--------------------------------|---------------------|-------------------------------------|--|------------------------|
| Intertidal/shallow<br>subtidal | Cobble/boulder/reef | <i>Xenostrobus pulex</i>            | Little black mussel                      |                        |
|                                |                     | <i>Chamaesipho</i> spp.             | Acorn barnacles                          |                        |
|                                |                     | Serpulidae                          | Polychaete                               |                        |
|                                |                     | <i>Lunella smaragda</i>             | Cat's eye snail                          |                        |
|                                |                     | <i>Diloma aethiops</i>              | Spotted top-shell                        |                        |
|                                |                     | <i>Sypharochiton pelliserpentis</i> | Snakeskin chiton                         |                        |
|                                |                     | <i>Haustrum scobina</i>             | Oyster borer whelk                       |                        |
|                                |                     | <i>Haustrum haustorium</i>          | Brown rock shell (whelk)                 |                        |
|                                |                     | <i>Cellana radians</i>              | Radiate limpet                           |                        |
|                                |                     | <i>Cellana ornata</i>               | Ornate limpet                            |                        |
|                                |                     | <i>Siphonaria</i> sp.               | Siphon limpet                            |                        |
|                                |                     | <i>Haliotis iris</i>                | Black foot paua                          |                        |
|                                |                     | <i>Patiriella regularis</i>         | Common cushion star                      |                        |
|                                |                     | <i>Stegnaster inflatus</i>          | Ambush sea star                          |                        |
|                                |                     | <i>Evechinus chloroticus</i>        | Kina                                     |                        |
|                                |                     | <i>Mytilus galloprovincialis</i>    | Blue mussel                              |                        |
|                                |                     | <i>Perna canaliculus</i>            | Green-lipped mussel                      |                        |
|                                |                     | <i>Magallana gigas</i>              | Pacific oyster                           |                        |
|                                |                     | <i>Gelidium</i> sp.                 | Red alga                                 |                        |
|                                |                     | <i>Laurencia thrysifera</i>         | Red alga                                 |                        |
|                                |                     |                                     | Filamentous red algae                    |                        |
|                                |                     |                                     | Coralline turf, crustose coralline algae | Coralline algae        |
|                                |                     |                                     | <i>Hormosira banksii</i>                 | Neptune's necklace     |
|                                |                     |                                     | <i>Cystophora torulosa</i>               | Zig-zag weed           |
|                                |                     |                                     | <i>Carpophyllum maschalocarpum</i>       | Flapjack               |
|                                |                     |                                     | <i>Scytothamnus australis</i>            | Brown alga             |
|                                |                     |                                     |  | Encrusting brown algae |
|                                |                     |                                     | <i>Colpomenia</i> sp.                    | Bubble weed            |
| Subtidal (~6 m<br>visibility)  | Sand                | <i>Evechinus chloroticus</i>        | Kina                                     |                        |
|                                |                     | <i>Patiriella regularis</i>         | Common cushion star                      |                        |
|                                |                     | <i>Coscinasterias muricata</i>      | 11-armed seastar                         |                        |
|                                |                     | <i>Ophiopsammus maculata</i>        | Snake brittle star                       |                        |
|                                |                     | <i>Atrina zelandica</i>             | Horse mussel                             |                        |
|                                |                     | <i>Pagurus</i> sp.                  | Hermit crab                              |                        |
|                                |                     |                                     | Whelks                                   |                        |
|                                |                     | Chaetopteridae                      | Parchment tubeworms                      |                        |
|                                |                     | <i>Maoricolpus roseus</i>           | Turret snail                             |                        |
|                                |                     |                                     | Filamentous red algae                    |                        |



**Table A.2 Glenduan**

| Zone                        | Habitat                 | Taxa  | Common name                              |
|-----------------------------|-------------------------|---|--|
| Intertidal/shallow subtidal | Cobble/boulder          | <i>Chamaesipho</i> spp.                       | Acorn barnacles                          |
|                             |                         | Serpulidae                                    | Polychaete                               |
|                             |                         | <i>Lunella smaragda</i>                       | Cat's eye snail                          |
|                             |                         | <i>Coelotrochus viridus</i>                   | Green top shell                          |
|                             |                         | <i>Cominella virgata</i>                      | Red-mouthed whelk                        |
|                             |                         | <i>Haustrum haustorium</i>                    | Brown rock shell (whelk)                 |
|                             |                         | <i>Cellana radians</i>                        | Radiate limpet                           |
|                             |                         | <i>Cellana stellifera</i>                     | Star limpet                              |
|                             |                         | <i>Siphonaria</i> sp.                         | Siphon limpet                            |
|                             |                         | <i>Patelloida corticata</i>                   | Encrusted limpet                         |
|                             |                         | <i>Haliotis iris</i>                          | Black foot paua                          |
|                             |                         | <i>Sypharochiton pelliserpentis</i>           | Snakeskin chiton                         |
|                             |                         | <i>Stegnaster inflatus</i>                    | Ambush sea star                          |
|                             |                         | <i>Coscinasterias muricata</i>                | 11-arm sea star                          |
|                             |                         | <i>Patriella regularis</i>                    | Common cushion star                      |
|                             |                         | <i>Stichaster australis</i>                   | Reef star                                |
|                             |                         | <i>Ophionereis fasciata</i>                   | Mottled brittlestar                      |
|                             |                         | <i>Evechinus chloroticus</i>                  | Kina                                     |
|                             |                         |   | Shrimp                                   |
|                             |                         | <i>Petrolisthes elongatus</i>                 | Blue half-crab                           |
|                             |                         | <i>Guinusia chabrus</i>                       | Red rock crab                            |
|                             |                         | <i>Hemigrapsus sexdentatus</i>                | Purple rock crab                         |
|                             |                         | <i>Forsterygion</i> sp.                       | Triplefins                               |
|                             |                         | <i>Gastrosocyphus Hectoris</i>                | Clingfish                                |
|                             |                         | <i>Gelidium</i> sp.                           | Red alga                                 |
|                             |                         | <i>Laurencia thysifera</i>                    | Red alga                                 |
|                             |                         |   | Filamentous red algae                    |
|                             |                         |   | Coralline turf, crustose coralline algae |
|                             |                         |   | Coralline algae                          |
|                             |                         | <i>Hormosira banksii</i>                      | Neptune's necklace                       |
|                             |                         | <i>Cystophora torulosa</i>                    | Zig-zag weed                             |
|                             |                         | <i>Cystophora retroflexa</i>                  | Slender zig-zag weed                     |
|                             |                         | <i>Carpophyllum maschalocarpum</i>            | Flapjack                                 |
| <i>Sargassum sinclairii</i> | Brown alga              |   |  |
| <i>Dictyota</i> sp.         | Brown alga              |   |  |
|                             | Encrusting brown alga   |   |  |
| <i>Ulva</i> sp.             | Sea lettuce             |   |  |
| Subtidal (~4 m visibility)  | Cobble/boulder          | <i>Evechinus chloroticus</i>                  | Kina                                     |
|                             |                         | <i>Patriella regularis</i>                    | Common cushion star                      |
|                             |                         | <i>Coscinasterias muricata</i>                | 11-armed seastar                         |
|                             |                         | <i>Ophiopsammus maculata</i>                  | Snake brittlestar                        |
|                             |                         | <i>Australostichopus mollis</i>               | Sea cucumber                             |
|                             |                         | <i>Stegnaster inflatus</i>                    | Ambush sea star                          |
|                             |                         | <i>Cryptochonchus porosus</i>                 | Butterfly chiton                         |
|                             |                         | Chaetopteridae                                | Parchment tubeworms                      |
|                             |                         | <i>Botrylloides leachii</i>                   | Compound ascidian                        |
|                             |                         |   | Solitary ascidians                       |
|                             |                         | <i>Ecionemia alata</i>                        | Grey cup sponge                          |
|                             |                         | <i>Crella incrustans</i>                      | Red encrusting sponge                    |
|                             |                         | <i>Aaptos globosum</i>                        | Blue encrusting sponge                   |
|                             |                         | <i>Tethya berquistae</i>                      | Pink golfball sponge                     |
|                             |                         | <i>Callyspongia ramosa? Dactylia palmata?</i> | Finger sponge                            |
|                             |                         | <i>Culicia rubeola</i>                        | Colonial stony corals                    |
|                             |                         | <i>Pododesmus (Monia) zelandicus</i>          | Window oyster                            |
|                             |                         | <i>Cephaloscyllium isabella</i>               | Carpet shark                             |
|                             |                         | <i>Notolabrus celidotus</i>                   | Spotties                                 |
|                             |                         | <i>Forsterygion</i> sp.                       | Triplefins                               |
|                             |                         |   | Coralline turf, crustose coralline algae |
|                             |                         |   | Coralline algae                          |
|                             |                         |   | Red filamentous algae                    |
|                             | Green filamentous algae |   |  |



**Table A.3 Snapper Point**

| Zone                        | Habitat        | Taxa   | Common name              |
|-----------------------------|----------------|--|--------------------------|
| Intertidal/shallow subtidal | Cobble/boulder | <i>Xenostrobus pulex</i>                             | Little black mussel      |
|                             |                | <i>Chamaesipho</i> spp.                              | Acorn barnacles          |
|                             |                | Serpulidae   | Polychaete               |
|                             |                | <i>Lunella smaragda</i>                              | Cat's eye snail          |
|                             |                | <i>Diloma</i> sp.                                    | Top shell                |
|                             |                | <i>Sypharochiton pelliserpentis</i>                  | Snakeskin chiton         |
|                             |                | <i>Haustrum scobina</i>                              | Oyster borer whelk       |
|                             |                | <i>Haustrum haustorium</i>                           | Brown rock shell (whelk) |
|                             |                | <i>Cellana radians</i>                               | Radiate limpet           |
|                             |                | <i>Haliotis iris</i>                                 | Black foot paua          |
|                             |                | <i>Phlyctenactis tuberculosa</i>                     | Wandering sea anemone    |
|                             |                | <i>Corynactis australis</i>                          | Jewel anemone            |
|                             |                | <i>Cosinasterias muricata</i>                        | 11-arm sea star          |
|                             |                | <i>Patiriella regularis</i>                          | Common cushion star      |
|                             |                | <i>Evechinus chloroticus</i>                         | Kina                     |
|                             |                | <i>Alope spinifrons</i>                              | Painted shrimp           |
|                             |                | <i>Petrolisthes elongatus</i>                        | Blue half-crab           |
|                             |                | <i>Tethya burtoni</i>                                | Orange golf ball sponge  |
|                             |                | <i>Gelidium</i> sp.                                  | Red alga                 |
|                             |                | <i>Laurencia thrysifera</i>                          | Red alga                 |
|                             |                | Filamentous red algae                                | Red alga                 |
|                             |                | <i>Champia novae-zelandiae</i>                       | Red alga                 |
|                             |                | Coralline turf, crustose coralline algae             | Coralline algae          |
|                             |                | <i>Undaria pinnatifida</i>                           | Wakame                   |
|                             |                | <i>Hormosira banksii</i>                             | Neptune's necklace       |
|                             |                | <i>Cystophora torulosa</i>                           | Zig-zag weed             |
|                             |                | <i>Carpophyllum maschalocarpum</i>                   | Flapjack                 |
|                             |                | <i>Scytosiphon lomentaria</i>                        | Brown alga               |
|                             |                | <i>Dictyota</i> sp.                                  | Brown alga               |
|                             |                | <i>Scytothamnus australis</i>                        | Brown alga               |
|                             |                | Encrusting brown alga                                | Brown alga               |
|                             |                | <i>Colpomenia</i> sp.                                | Bubble weed              |
|                             |                | <i>Ulva</i> sp.                                      | Sea lettuce              |
| Subtidal (~3 m visibility)  | Cobble/boulder | <i>Evechinus chloroticus</i>                         | Kina                     |
|                             |                | <i>Patiriella regularis</i>                          | Common cushion star      |
|                             |                | <i>Coscinasterias muricata</i>                       | 11-armed seastar         |
|                             | Sand           | <i>Stichaster australis</i>                          | Reef star                |
|                             | Boulder, sand  | <i>Australostichopus mollis</i>                      | Sea cucumber             |
|                             |                | <i>Stegnaster inflatus</i>                           | Ambush sea star          |
|                             |                |  | Crabs                    |
|                             |                |  | Whelks                   |
|                             |                | Chaetopteridae                                       | Parchment tubeworms      |
|                             |                |  | Compound ascidians       |
|                             |                |  | Solitary ascidians       |
|                             |                | <i>Ecionemia alata</i>                               | Grey cup sponge          |
|                             |                | <i>Crella incrustans</i>                             | Red encrusting sponge    |
|                             |                | <i>Tethya berquistae</i>                             | Pink golfball sponge     |
|                             |                | <i>Callyspongia ramosa?</i> <i>Dactylia palmata?</i> | Finger sponge            |
|                             |                | <i>Anthothoe albocincta</i>                          | White-striped anemones   |
|                             |                | <i>Culicia rubeola</i>                               | Colonial stony corals    |
|                             |                | <i>Pododesmus (Monia) zelandicus</i>                 | Window oyster            |
|                             |                | <i>Cephaloscyllium isabella</i>                      | Carpet shark             |
|                             |                | <i>Notolabrus celidotus</i>                          | Spotties                 |
|                             |                | <i>Forsterygion</i> sp.                              | Triplefins               |
|                             |                |  | Crustose coralline algae |
|                             |                |  | Red filamentous algae    |



**Table A.4 900 m SW of Outfall**

| Zone                        | Habitat                 | Taxa                                     | Common name              |
|-----------------------------|-------------------------|--|--------------------------|
| Intertidal/shallow subtidal | Cobble                  | <i>Chamaesipho</i> spp.                  | Acorn barnacles          |
|                             |                         | <i>Lunella smaragda</i>                  | Cat's eye snail          |
|                             |                         | <i>Diloma</i> sp.                        | Top shell                |
|                             |                         | <i>Haustrum scobina</i>                  | Oyster borer whelk       |
|                             |                         | <i>Cellana radians</i>                   | Radiate limpet           |
|                             |                         | <i>Phlyctenactis tuberculosa</i>         | Wandering sea anemone    |
|                             |                         | <i>Patiriella regularis</i>              | Common cushion star      |
|                             |                         | <i>Evechinus chloroticus</i>             | Kina                     |
|                             |                         | <i>Guinusia chabrus</i>                  | Red rock crab            |
|                             |                         | <i>Laurencia thysifera</i>               | Red alga                 |
|                             |                         |  | Filamentous red algae    |
|                             |                         | <i>Champia novae-zelandiae</i>           | Red alga                 |
|                             |                         | Coralline turf, crustose coralline algae | Coralline algae          |
|                             |                         | <i>Undaria pinnatifida</i>               | Wakame                   |
|                             |                         | <i>Hormosira banksii</i>                 | Neptune's necklace       |
|                             |                         | <i>Cystophora torulosa</i>               | Zig-zag weed             |
|                             |                         | <i>Carpophyllum maschalocarpum</i>       | Flapjack                 |
|                             |                         | <i>Dictyota</i> sp.                      | Brown alga               |
|                             |                         | <i>Scytothamnus australis</i>            | Brown alga               |
|                             |                         |  | Encrusting brown alga    |
|                             | <i>Colpomenia</i> sp.   | Bubble weed                              |                          |
|                             | <i>Forsterygion</i> sp. | Triplefins                               |                          |
| Subtidal (~2 m visibility)  | Cobble/boulder/sand     | <i>Patiriella regularis</i>              | Common cushion star      |
|                             |                         | <i>Coscinasterias muricata</i>           | 11-armed seastar         |
|                             |                         | <i>Cryptochonchus porosus</i>            | Butterfly chiton         |
|                             |                         |  | Whelks                   |
|                             |                         | <i>Pagurus</i> sp.                       | Hermit crabs             |
|                             |                         | <i>Anthothoe albocincta</i>              | White striped anemone    |
|                             |                         | <i>Aplidium phortax</i>                  | Compound ascidian        |
|                             |                         |  | Solitary ascidians       |
|                             |                         | <i>Ecionemia alata</i>                   | Grey cup sponge          |
|                             |                         | <i>Crella incrustans</i>                 | Red encrusting sponge    |
|                             |                         | <i>Aptos globosum</i>                    | Gobular sponge           |
|                             |                         | <i>Ciocalyptra polymastia</i>            | Sponge                   |
|                             |                         | <i>Callyspongia ramosa? Dactylia</i>     | Finger sponge            |
|                             |                         | <i>Anthothoe albocincta</i>              | White-striped anemones   |
|                             |                         | <i>Culicia rubeola</i>                   | Colonial stony corals    |
|                             |                         | <i>Forsterygion</i> sp.                  | Triplefins               |
|                             |                         |  | Foliose red algae        |
|                             |                         |  | Crustose coralline algae |
|                             | Red filamentous algae   |  |                          |



**Table A.5 Outside Boulder Bank**

| Zone                         | Habitat                  | Taxa                                 | Common name            |
|------------------------------|--------------------------|--------------------------------------|------------------------|
| Intertidal/shallow subtidal  | Cobble/boulders          | <i>Chamaesipho</i> spp.              | Acorn barnacles        |
|                              |                          | Serpulidae                           | Polychaete             |
|                              |                          | <i>Lunella smaragda</i>              | Cat's eye snail        |
|                              |                          | <i>Diloma aethiops</i>               | Spotted top shell      |
|                              |                          | <i>Cellana radians</i>               | Radiate limpet         |
|                              |                          | <i>Evechinus chloroticus</i>         | Kina                   |
|                              |                          | <i>Laurencia thrysifera</i>          | Red alga               |
|                              |                          |                                      | Filamentous red algae  |
|                              |                          | Coralline turf, crustose coralline   | Coralline algae        |
|                              |                          | <i>Hormosira banksii</i>             | Neptune's necklace     |
|                              |                          | <i>Carpophyllum maschalocarpum</i>   | Flapjack               |
|                              |                          | <i>Dictyota</i> sp.                  | Brown alga             |
|                              |                          | <i>Scytothamnus australis</i>        | Brown alga             |
|                              |                          |                                      | Encrusting brown alga  |
|                              |                          |                                      | Encrusting red alga    |
| Subtidal (~1.5 m visibility) | Cobble/boulder/sand      | <i>Colpomenia</i> sp.                | Bubble weed            |
|                              |                          | <i>Evechinus chloroticus</i>         | Kina                   |
|                              |                          | <i>Patiriella regularis</i>          | Common cushion star    |
|                              |                          | <i>Coscinasterias muricata</i>       | 11-armed seastar       |
|                              |                          | <i>Australostichopus mollis</i>      | Sea cucumber           |
|                              |                          |                                      | Crabs                  |
|                              |                          |                                      | Whelks                 |
|                              |                          | <i>Coelotrochus viridus</i>          | Green top shell        |
|                              |                          | <i>Cryptochonchus porosus</i>        | Butterfly chiton       |
|                              |                          | Chaetopteridae                       | Parchment tubeworms    |
|                              |                          | <i>Aplidium phortax</i>              | Compound ascidian      |
|                              |                          |                                      | Solitary ascidians     |
|                              |                          |                                      | Encrusting bryozoan    |
|                              |                          | <i>Crella incrustans</i>             | Red encrusting sponge  |
|                              |                          | <i>Anthothoe albocincta</i>          | White-striped anemones |
|                              |                          | <i>Culicia rubeola</i>               | Colonial stony corals  |
|                              |                          | <i>Pododesmus (Monia) zelandicus</i> | Window oyster          |
|                              |                          | <i>Forsterygion</i> sp               | Triplefins             |
|                              | Crustose coralline algae |                                      |                        |





**Table A.6 The Cut (North and Haulashore) – intertidal/shallow subtidal habitat**

| Habitat                | Taxa                                     | Common name         |
|------------------------|--|---------------------|
| Boulders               | <i>Chamaesipho</i> spp.                  | Acorn barnacles     |
|                        | Serpulidae                               | Polychaete          |
|                        | <i>Lunella smaragda</i>                  | Cat's eye snail     |
|                        | <i>Diloma aethiops</i>                   | Spotted top shell   |
|                        | <i>Sypharochiton pelliserpentis</i>      | Snakeskin chiton    |
|                        | <i>Haustrum scobina</i>                  | Oyster borer whelk  |
|                        | <i>Cellana radians</i>                   | Radiate limpet      |
|                        | <i>Haliotis iris</i>                     | Black foot paua     |
|                        | <i>Mytilus galloprovincialis</i>         | Blue mussel         |
|                        | <i>Perna canaliculus</i>                 | Green-lipped mussel |
|                        | <i>Magallana gigas</i>                   | Pacific oyster      |
|                        | <i>Evechinus chloroticus</i>             | Kina                |
|                        |  | Solitary ascidian   |
|                        | <i>Gelidium</i> sp.                      | Red alga            |
|                        | <i>Laurencia thrysifera</i>              | Red alga            |
|                        | Coralline turf, crustose coralline algae | Coralline algae     |
|                        | Encrusting brown algae                   |                     |
| <i>Ulva</i> sp.        | Sea lettuce                              |                     |
| <i>Forsterygion</i> sp | Triplefins                               |                     |

**Table A.7 Akersten Street – intertidal/shallow subtidal habitat**

| Habitat         | Taxa                            | Common name           |
|-----------------|---------------------------------|-----------------------|
| Rip-rap         | <i>Xenostrobus pulex</i>        | Little black mussel   |
|                 | <i>Austrominius modestus</i>    | Beaked barnacle       |
|                 | <i>Epopella plicatus</i>        | Plicate barnacle      |
|                 | Serpulidae                      | Polychaete            |
|                 | <i>Diloma aethiops</i>          | Spotted top shell     |
|                 | <i>Haustrum scobina</i>         | Oyster borer whelk    |
|                 | <i>Perna canaliculus</i>        | Green-lipped mussel   |
| Muddy sand      | <i>Cominella glandiformis</i>   | Mudflat whelk         |
|                 | <i>Cominella adpersa</i>        | Speckled whelk        |
|                 | <i>Australostichopus mollis</i> | Sea cucumber          |
|                 | <i>Paphies australis</i>        | Pipi                  |
|                 | <i>Austrovenus stutchburyi</i>  | Cockle                |
|                 | <i>Magallana gigas</i>          | Oyster                |
|                 |                                 | Foliose red algae     |
|                 |                                 | Filamentous red algae |
| <i>Ulva</i> sp. | Sea lettuce                     |                       |



**Table A.8 Seafarers Memorial – intertidal/shallow subtidal habitat**

| Habitat                  | Taxa                                 | Common name                     |
|--------------------------|--------------------------------------|---------------------------------|
| Piles                    | <i>Xenostrobus pulex</i>             | Little black mussel             |
|                          | <i>Austrominius modestus</i>         | Beaked barnacle                 |
|                          | <i>Cellana radians</i>               | Radiate limpet                  |
| Sea wall, piles          | <i>Chamaesipho</i> spp.              | Acorn barnacles                 |
|                          | <i>Haustrum scobina</i>              | Oyster borer whelk              |
| Piles, rip-rap, sea wall | <i>Magallana gigas</i>               | Pacific oyster                  |
| Steps, piles             | <i>Mytilus galloprovincialis</i>     | Blue mussel                     |
|                          | <i>Perna canaliculus</i>             | Green lipped mussel             |
| Sea wall                 | <i>Siphonaria</i> sp.                | Siphon limpet                   |
|                          | <i>Diloma aethiops</i>               | Spotted top shell               |
| Cobble, sea wall         | <i>Sypharochiton pelliserpentis</i>  | Snakeskin chiton                |
| Cobble                   | <i>Pododesmus (Monia) zelandicus</i> | Flat oyster                     |
|                          | <i>Lunella smaragda</i>              | Cat's eye snail                 |
|                          | <i>Coelotrochus viridus</i>          | Green top shell                 |
|                          | <i>Cominella glandiformis</i>        | Mudflat whelk                   |
|                          | <i>Cominella virgata</i>             | Red-mouthed whelk               |
|                          | <i>Scutus breviculus</i>             | Shield shell/Duck's bill limpet |
|                          | <i>Chiton glaucus</i>                | Green chiton                    |
|                          | <i>Cosinasterias muricata</i>        | 11-arm sea star                 |
|                          | <i>Patiriella regularis</i>          | Common cushion star             |
|                          | <i>Styela clava</i>                  | Clubbed tunicate                |
|                          |                                      | Solitary ascidian               |
| Sea wall, cobbles        | <i>Gelidium</i> sp.                  | Red alga                        |
| Cobble                   |                                      | Foliose red algae               |
|                          |                                      | Filamentous red algae           |
|                          | <i>Undaria pinnatifida</i>           | Wakame                          |
|                          | <i>Ulva</i> sp.                      | Sea lettuce                     |



**Table A.9 Magazine Point – intertidal/shallow subtidal habitat**

| Habitat               | Taxa                                     | Common name              |
|-----------------------|--|--------------------------|
| Sand                  | <i>Gari strangeri</i>                    | Purple sunset shell      |
|                       | <i>Pagurus</i> sp.                       | Hermit crab              |
| Sea wall, reef        | <i>Magallana gigas</i>                   | Oyster                   |
| Sea wall              | <i>Xenostrobus pulex</i>                 | Little black mussel      |
|                       | <i>Chamaesipho</i> spp.                  | Acorn barnacles          |
|                       | Serpulidae                               | Polychaete               |
|                       | <i>Lunella smaragda</i>                  | Cat's eye snail          |
|                       | <i>Diloma</i> sp.                        | Top shell                |
|                       | <i>Sypharochiton pelliserpentis</i>      | Snakeskin chiton         |
|                       | <i>Haustrum scobina</i>                  | Oyster borer whelk       |
|                       | <i>Haustrum haustorium</i>               | Brown rock shell (whelk) |
|                       | <i>Cellana radians</i>                   | Radiate limpet           |
| Tide pools            | <i>Doris wellingtonensis</i>             | Sea slug, nudibranch     |
|                       | <i>Cosinasterias muricata</i>            | 11-arm sea star          |
| Reef                  | <i>Patiriella regularis</i>              | Common cushion star      |
|                       | <i>Evechinus chloroticus</i>             | Kina                     |
|                       | <i>Alope spinifrons</i>                  | Painted shrimp           |
|                       | <i>Gelidium</i>                          | Red alga                 |
|                       | <i>Laurencia thrysifera</i>              | Red alga                 |
|                       |  | Filamentous red algae    |
|                       | <i>Champia novae-zelandiae</i>           | Red alga                 |
|                       | Coralline turf, crustose coralline algae | Coralline algae          |
|                       | <i>Undaria pinnatifida</i>               | Wakame                   |
|                       | <i>Hormosira banksii</i>                 | Neptune's necklace       |
|                       | <i>Cystophora torulosa</i>               | Zig-zag weed             |
|                       | <i>Carpophyllum maschalocarpum</i>       | Flapjack                 |
|                       | <i>Scytosiphon lomentaria</i>            | Brown alga               |
|                       | <i>Dictyota</i> sp.                      | Brown alga               |
|                       | <i>Scytothamnus australis</i>            | Brown alga               |
|                       |  | Encrusting brown alga    |
| <i>Colpomenia</i> sp. | Bubble weed                              |                          |
| <i>Ulva</i> sp.       | Sea lettuce                              |                          |

