**BEFORE THE GREATER WELLINGTON REGIONAL COUNCIL AND HUTT CITY COUNCIL**

**EASTERN BAYS SHARED PATH PROJECT**

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| Under | the Resource Management Act 1991 |
| In the matter | of applications for resource consents by Hutt City Council under section 88 of the Act, to carry out the Eastern Bays Shared Path Project |

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# STATEMENT OF EVIDENCE OF SHELLEY ALEXANDRA MCMURTRIE (INTERTIDAL AND SUBTIDAL ECOLOGY) ON BEHALF OF THE APPLICANT

30 November 2020

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## QUALIFICATIONS AND EXPERIENCE

1. My full name is **Shelley Alexandra McMurtrie**. I am a director and Principal Aquatic Ecology Scientist at EOS Ecology. EOS Ecology has been operating since 2000 and I have held both positions since that time.

2. My evidence is given on behalf of Hutt City Council ("**HCC**") in relation to its applications under section 88 of the Resource Management Act 1991 ("**RMA**") for resource consents for the Eastern Bays Shared Path Project ("**Project**").

3. I have the following qualifications and experience relevant to the evidence I shall give:

   (a) Bachelor of Science (double-majoring in Zoology and Plant & Microbial Sciences), and a Master of Science (First Class Honours) degree in Zoology, both from University of Canterbury;

   (b) I have two decades of commercial experience specialising in aquatic (freshwater and estuary including nearshore coastal) systems, including the impacts of anthropogenic activities on aquatic systems; the rehabilitation of aquatic systems; and biotic and abiotic factors governing aquatic fauna. I have been responsible for the development and oversight of long-term monitoring programmes for intertidal habitats, have been the ecology lead for the assessment of environmental effects of coastal infrastructure, stormwater and sediment discharges on intertidal and subtidal estuary/nearshore coastal systems within Canterbury and the lower North Island, and have been involved with the ecological oversight of seawall repairs.

4. I am a member of a number of relevant associations including:

   (a) the New Zealand Freshwater Sciences Society ("**NZFSS**") since 2001,

   (b) the Environment Institute of Australia and New Zealand ("**EIANZ**") since 2011, and

   (c) the International Erosion Control Association since 2020.

5. I confirm that I have read the 'Code of Conduct' for expert witnesses contained in the Environment Court Practice Note 2014. My evidence has been prepared in compliance with that Code. In particular, unless I state otherwise, this evidence is within my sphere of expertise and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

## BACKGROUND AND ROLE

6. In preparing my evidence I have considered:

(a) the technical reports I prepared in respect of the Project (see below);

(b) the latest set of proposed resource consent conditions as appended to the evidence of **Caroline van Halderen**;

(c) the submissions, as far as they make reference to intertidal or subtidal benthic ecology; and

(d) the section 42A report on behalf of Greater Wellington Regional Council ("**GWRC**") and the associated expert review comments on intertidal and subtidal beach ecology by Megan Oliver[1].

7. I am the lead author of:

(a) the technical report *Eastern Bays Shared Path: Assessment of Environmental Effects for intertidal ecology* dated March 2019 that forms Appendix A-1 of the Project's Assessment of Effects on the Environment ("**AEE**"); and

(b) the technical report *Eastern Bays Shared Path: Assessment of Environmental Effects of beach nourishment on intertidal and subtidal beach areas* dated April 2019 that forms Appendix A-2 of the AEE.

8. For clarity I will refer to these reports herewith as the '**Intertidal Technical Report**' and the '**Subtidal Technical Report**'.

9. In preparation of the technical reports I have undertaken site visits and developed and overseen surveys of intertidal and subtidal benthic ecology and broadscale substrate habitat mapping.

10. I also took part in the initial Multi Criteria Assessment ("**MCA**") process in 2017, where I scored each of the initial eight seawall options on the basis of their effects on intertidal ecology (as documented in McMurtrie (2017)[2]), and took part in three multidisciplinary workshops and site visits to determine the most suitable seawalls based on consideration of a range of criteria/disciplines (intertidal ecology, avifauna ecology, terrestrial ecology, coastal processes, landscape and visual, civil design, recreation, planning and consenting, and engagement). The MCA process is described further in the evidence of **Jamie Povall**.

11. I was also involved in further expert discussions regarding limiting encroachment into the coastal marine area ("**CMA**") where possible.

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[1] Appendix J of the GWRC section 42A Report: Oliver, M. 2019. Memo. Eastern Bays Shared Path notified consent – Review of Appendix A, Assessment of environmental effects on intertidal ecology, and Appendix C, Seagrass survey. Greater Wellington Regional Council, Wellington. 16 p.

[2] McMurtrie, S. 2017. Memorandum. Multi-criteria assessment for proposed Eastern Bays Shared Path seawall types on intertidal ecology. July 2017. EOS Ecology, Christchurch. 19 p (incl appendices).

12. Preparation of the intertidal and subtidal technical reports also drew on the findings given in the technical report on coastal processes by **Michael Allis**[3] and beach nourishment by **Richard Reinen-Hamill**[4]. As such my evidence also draws upon the evidence of **Dr Allis** on coastal processes and on **Mr Reinen-Hamill** on beach nourishment.

## SCOPE OF EVIDENCE

13. The purpose of my evidence is to outline the potential effects the proposed construction and operation of the Project are likely to have on intertidal and subtidal ecology. My evidence excludes seagrass which is covered in the evidence of **Fleur Matheson**.

14. My evidence addresses:

    (a) an overview of the existing intertidal and subtidal ecological values of the Project area;

    (b) the methodologies followed by the ecology team to identify the intertidal and subtidal ecological values of the Project area;

    (c) the potential effects of the Project on intertidal and subtidal ecological values;

    (d) steps taken to address potential adverse effects, including through Project design and proposed mitigation measures included in the conditions; and

    (e) responses to submissions and the Section 42A report.

15. Due to the fact that there are two different technical reports that form the basis of my evidence, I have divided my evidence into two parts as follows:

    (a) Part A covers the effects of the Project's proposed new shared path ("**Shared Path**") on intertidal benthic ecology; and

    (b) Part B covers the effects of beach nourishment on intertidal and subtidal benthic ecology.

16. Following those parts, I address the GWRC section 42A report in Part C and submissions in Part D.

## EXECUTIVE SUMMARY

### Part A: Effects of the shared path on intertidal ecology

17. The existing environment is already highly modified, with seawalls currently along the majority of the shoreline (87% of the Project length), and consisting primarily of angled concrete seawalls that support low species diversity and

[3] Appendix E of the Project AEE: Allis, M. 2019. Eastern Bays Shared Path: Coastal Physical Processes Assessment. NIWA Report No. 2018075HN. NIWA, Hamilton. 115 p (excl appendices).
[4] Appendix F of the Project AEE: Reinen-Hamill, R. 2019. Eastern Bays Shared Path Project - Consent Level Beach Nourishment Design and Effects Assessment. Tonkin & Taylor, March 2019, 21 p (excl appendices).

richness.  The community composition of the surveyed intertidal area was typical of rocky shore intertidal habitat and is similar to the rocky shore communities found elsewhere in the Te Whanganui-a-Tara / Wellington Harbour. There were no species of conservation concern (as listed in the threatened species list of Freeman *et al.* (2014)[5] and Nelson *et al*. (2019)[6]) were recorded.

18. Potential construction effects on the receiving benthic intertidal environment relate to sedimentation, release of contaminants, habitat disturbance from machinery working in the CMA, and encroachment into the subtidal area of the construction works site.  Potential operational effects relate to changes in habitat type and encroachment into the existing intertidal area.

19. A range of measures will be implemented during the construction phase to reduce the environmental effects, primarily relating to minimising the construction footprint, controlling the release of contaminants and undertaking the works in a staged approach.  The chosen design has avoided encroachment by choosing seawall options for a smaller footprint where possible, along with mitigation measures primarily relating to the addition of textures and creation of rockpool habitats within the new seawalls and revetments, along with the protection and replacement of existing larger rocky material colonised by biota.

20. I am satisfied that any potential effects to benthic ecology as a result of the Project's replacement and creation of seawalls have been adequately dealt with, and will limit the overall effects to a 'less than minor' level of effect in the context of the RMA.

**Part B: Effects of beach nourishment on intertidal and subtidal ecology**

21. The intertidal and subtidal fauna of the surveyed beach sediments were considered to be in a healthy condition.  The infauna community found in the bays proposed for beach nourishment were no different to those where beach nourishment will not occur, and there was similarly no difference in infauna samples from areas where initial placement or eventual redistribution of beach nourishment materials could occur compared to those samples not within those 'impact' areas.

22. The proposed beach nourishment of three beaches (Point Howard, Lowry Bay, York Bay) within the Project area has the potential for both short-term (initial introduction of beach material) and medium-term (natural redistribution of beach nourishment material) effects.  These include disturbance and possible compaction of habitat during excavation and machinery use (for initial excavations and introduction of beach material), smothering of intertidal

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[5] Freeman, D., Schnabel, K., Marshall, B., Gordon, D., Wing, S., Tracey, D., & Hitchmough, R. 2014. Conservation status of New Zealand marine invertebrates, 2013. Department of Conservation, Wellington, New Zealand.
[6] Nelson, W.A., Neill, K., D'Archino, R. & Rolfe, J.R. 2019. Conservation status of New Zealand macroalgae, 2019. New Zealand Threat Classification Series 30. Department of Conservation, Wellington, New Zealand. 33p.

habitat/biota during the initial introduction of beach material through to the medium-term movement of beach nourishment material beyond the initial introduction sites, and increased suspended sediment during the initial phases and later redistribution of materials via tide and waves.

23. A range of measures will be implemented to limit the effects of beach nourishment on infauna of the area, including ensuring the nature of the added materials is similar to the native beach sediment and absent of any fines, placing material during low tide and calm conditions, adding material in smaller volumes and keeping away from emergent rocky areas in Southern Lowry Bay, and the protection and replacement of woody debris in the beach wrack line.

24. In relation to beach nourishment, I am satisfied that the proposed approach and measures to be adopted will limit the effects of beach nourishment on the benthic intertidal and subtidal environment to a ‘minor’ or ‘less than minor’ level of effect in the context of the RMA. However, as sediment migration can vary based on site-specific conditions, and as there is little detail as to the level of redistribution of sediments over time, I recommend that some monitoring of the movement of beach nourishment materials be undertaken, along with an assessment of the benthic intertidal and subtidal beach fauna at least 12 months after completion of the proposed works.

## PART A: EFFECTS OF THE SHARED PATH ON INTERTIDAL ECOLOGY

### Methodology

*Seawall Types*

25. Existing seawall types were determined during site walkovers and digitised as a GIS shape file in Arc software. Proposed seawall types provided as shape files by Stantec were imported to ArcMap, along with shape files for low, mid, and high, and mean high water springs ("**MHWS**") tide levels. Calculation of the proportion of length of proposed and existing seawalls was based on the Project length as defined in Figure 1 of the Intertidal Technical Report (presented here as **Appendix A Figure 1** of my evidence), and thus does not include the lineal length of foreshore that is not specified within that plan (i.e., the majority of Days Bay, and the promontory north of Days Bay).

*Broadscale Habitat Mapping*

26. Broadscale habitat mapping of the intertidal area within the Project length (i.e., from Point Howard to Windy Point, but excluding Days Bay) was undertaken during site walkovers. The area from (and including) the existing seawall down to the low tide line was classified based on the dominant substrate type as defined in Table 1 of the Intertidal Technical Report, and digitised in ArcMap where areas of each habitat type were then calculated.

Further detail on methodology is found in Section 2.2 (Habitat Types – Broad Scale) of the Intertidal Technical Report.

*Benthic Intertidal Ecology Surveys*

27. Benthic intertidal ecology surveys were undertaken in May 2016 and June 2017, with sampling on the latter date to incorporate an extension of the Project Area. A total of 29 sites were surveyed (see Figure 4 of the Intertidal Technical Report, and presented here as **Appendix 1 Figure 2** of my evidence). Site locations were chosen to ensure coverage of the dominant substrate types identified in the broadscale habitat mapping, as well as existing and proposed seawall types. Sites were included in areas where new seawalls are proposed (i.e., 'impact' sites) as well as in areas that will not undergo works (i.e., 'control' sites).

28. At each site 2-3 sampling locations along a transect were selected; with one from the existing seawall surface and 1-2 from the foreshore, giving a total of 71 epifauna samples. Site locations were georeferenced and sample locations measured from the seawall to allow for determination of the tidal level in which they sat. At each sample location the epifauna community was quantified by counting and identifying benthic invertebrates and calculating the percentage cover of different algae types within a 0.25$m^2$ quadrat. The substrate composition within the quadrat was also recorded. A wider search extending out 2m either side of the transect line was also undertaken, and any epifauna taxa not already identified in the quadrats were noted.

29. Given the predominantly rocky shore intertidal habitat, there were few areas where the substrate was fine enough to allow the collection of infauna core samples. At eight of the 29 sites, the substrate was fine enough to collect infauna core samples, which were transferred to our laboratory to count and identify the invertebrate infauna.

30. A visual check for *Macrocystis* (kelp) beds was undertaken in nearshore shallow subtidal areas of Point Howard Beach, Lowry Bay and York Bay by Fred Overmars of Sustainability Solutions, and Point Howard beach, Sorrento Bay, Lowry Bay, York Bay, Mahina Bay and the northern and southern end of Days Bay during dive surveys for the Subtidal Technical Report.

31. The collected data was summarised and analysed to compare the fauna within and outside of the Project's footprint, to characterise the ecological values of the existing benthic intertidal community, and to determine community tidal zonation patterns. Further details on data analysis can be found in Section 2.5 of the Intertidal Technical Report.

**Existing state of the environment**

*Seawall Types*

32. The coastal edge of the Eastern Bays area from Sorrento Bay to Windy Point is a modified urban environment. The transition from the CMA to the land is bisected by Marine Drive, which connects the Eastern Bays suburbs to the Hutt Valley. The interface between the CMA and the land is dominated by existing seawalls, that make up 87% of the total length of the Project area.

33. The majority (i.e., 68%) of the Project length consists of concrete seawalls - with either angled smooth concreted surfaces (40%), angled aggregate concreted surfaces (18%), or with a more modern curved concrete seawall (10%). Boulder revetments make up 17% of the Project length and gabion baskets make up 1%. Further detail regarding these existing seawall types can be found in Section 3.1 (Existing Seawalls) of the Intertidal Technical Report, and a map of the existing seawalls is provided here in **Appendix A Figure 3** of my evidence.

*Broadscale Habitat Mapping*

34. Broadscale habitat mapping showed that while the dominant habitat type differed between some of the bays, all bays provided a similar mix of habitat types, meaning that no one bay was unique in its mix of habitat types. Our findings were similar to how this area is described in EHEA (1998)[7], which defines the area as having areas of moderately to very sheltered rocky reef, with a mix of substrate dominated by either bedrock, pebbles & boulders, or sand. Further detail regarding broadscale habitat mapping can be found in Section 3.3 (Habitat Types – Broad Scale) of the Intertidal Technical Report.

35. The hydrodynamics of the area is covered in the evidence of **Dr Allis**.

*Benthic Intertidal Ecology*

36. The epifauna community was represented by 44 taxa and was dominated by the barnacle *Chamaesipho columna*, representing over 86% of total individuals counted. This was followed by a number of snail species: the blue-banded periwinkle *Austrolittorina antipodum* (6.2% relative abundance), the bluish topshell *Diloma nigerrimum* (2.2%), and the spotted topshell *D. aethiops* (2.1%). The remaining taxa each comprised less than 1% of overall abundance.

37. The universal pattern of zonation for intertidal habitats was obvious, with both diversity and density of epifauna invertebrates increasing from the high tide to low tide zone. This zonation pattern, which fits with the results from this

[7] EHEA, 1998 Te Whanganui A Tara Wellington Harbour. Review of scientific and technical studies of Wellington Harbour, New Zealand to 1997. East Harbour Environmental Association Inc., Eastbourne. 200 p.

survey, has snails in the high tide zone; mussels, barnacles and limpets in the mid tide zone; and macroalgae in the low tide zone.

38. Taxa richness and diversity was generally lower for existing seawall habitats than for foreshore habitat, although the large within-sample variability means that this may not be statistically significant. Overall the results indicated that tidal zonation was the dominant factor influencing the benthic intertidal epifauna community.

39. When comparing the epifauna community between areas where new seawalls are proposed (i.e., 'impact' sites) to areas that will not undergo works (i.e., 'control' sites) there was little difference in community composition. In general the sites undergoing change had lower taxa richness but higher densities. When just considering the larger revetments proposed for some of the rocky shore areas there was little difference in community composition or densities between control and impact sites. However, taxa richness was much lower in rocky shore areas within the footprint of the proposed revetments compared to areas outside of the footprint.

40. No invertebrate taxa of conservation concern (as listed in the threatened species list of Freeman *et al.* (2014)) were recorded. No epifauna or infauna taxa that are indicative of significant nutrient enrichment or fine sediment input were present in any great abundance. The benthic invertebrate community of the surveyed area was as would be expected for this general location (lower North Island) and rocky shore intertidal habitat, and supports a comparable fauna to that found in other intertidal rocky shore habitats of the Te Whanganui-a-Tara / Wellington Harbour area.

41. Macroalgae was not abundant within the surveyed areas, with only 16% of epifauna samples containing macroalgae and those more often limited to the larger stable substrate types of bedrock and concrete. The most common macroalgae recorded were *Ulva* spp. Other macroalgae present included flapjack (*Carpophyllum*), red erect coralline (*Corallina*) and Neptune's necklace *(Hormosira banksii*). These species are found throughout the wider Te Whanganui-a-Tara / Wellington Harbour area and are not of conservation concern according to the lists of Nelson *et al*. (2019).[8]

42. Giant kelp (*Macrocystis pyrifera*), which has a conservation status of "At Risk – Declining" (Nelson *et al*., 2019) have been reported within Te Whanganui-a-Tara / Wellington Harbour. However no kelp beds were observed in the nearshore or shallow subtidal areas of Point Howard, Sorrento Bay, Lowry Bay, York Bay, Mahina Bay or Days Bay. Based on this and the fact that the kelp beds grow at depths of three meters or more in Te Whanganui-a-Tara / Wellington Harbour (EHEA, 1998), I do not believe that there are any

[8] Whilst not identified to species level, the only *Carpophyllum* species with a threat classifcation in Nelson *et al.* (2019) is not found south of the East Cape, whilst *Corallina* species are listed at 'Not Threatened' or 'Data Deficient'. *Hormosira banksii* is listed at 'Not Threatened'.

significant kelp beds within the nearshore shallow subtidal area of the Project footprint. However, it is not known whether kelp is present in deeper water near to the Project area.

43. Available data on sediment contamination of finer bed materials within Lowry Bay showed a slight trend for both nutrients and heavy metals to be slightly enriched in the lower beach samples versus the higher beach samples, although the levels overall were not high. Levels of heavy metals (cadmium, chromium, copper, lead, nickel, and zinc) were all well below the ANZECC (2000)[9] ISQG-low trigger levels, as well as the Auckland Council's more conservative Environmental Response Criteria for copper, lead and zinc (ARC, 2004)[10], and the conclusion was that there was no sign of sediment contamination or sediment enrichment. This contrasts with higher contaminant levels found in fine sediments of Evans Bay, Lambton Harbour and the north-west side of Te Whanganui-a-Tara / Wellington Harbour. Heavy metals are typically bound to fine sediment particles and accumulate in sheltered areas. The intertidal zone of the Eastern Bays is relatively exposed for Te Whanganui-a-Tara / Wellington Harbour and experiences a dynamic and sometimes high energy hydrologic regime, meaning that very fine sediments are relatively limited in the intertidal area.

44. Further details of the intertidal benthic ecology results can be found in Section 3.4 (Intertidal Ecology (Benthic Invertebrates and Macroalgae) of the Intertidal Technical Report.

**Potential effects**

*Potential construction effects*

45. Construction works to build new seawalls will occur along 3.14km (71%) of the Project length.

46. Information regarding the construction methodology can be found in Section 4.2 (Overview of Construction Methodology) of the Intertidal Technical Report, along with the evidence of **Mr Povall**.

47. Potential construction effects on the receiving benthic intertidal environment relate to the following:

    (a) sedimentation effects (input of terrigenous sediment and disturbance and release of *in situ* fine sediment);

    (b) release of contaminants (release of *in situ* contaminants from disturbed fine materials or from the use of machinery in the CMA, release of cementitious products from any *in situ* pouring of seawalls or footings);

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[9] ANZECC. 2000. Australian and New Zealand Guidelines for Fresh and Marine Water Quality - Volume 1: The Guidelines. Australia and New Zealand Environment and Conservation Council, Agricultural and Resource Management Council of Australia and New Zealand.

[10] ARC, 2004. Blueprint for Monitoring Urban Receiving Environments. Technical Publication No. 168 Revised Edition - August 2004. Auckland Regional Council, Auckland.

(c) habitat disturbance from machinery working in the CMA; and encroachment into the subtidal area of the construction works site.

48. These are covered below.

49. **Sedimentation effects**: Fine sediment generation could occur during construction from the addition of materials to the site or via the disturbance of fine material in situ substrate during demolition and excavation for the new seawall footings. The uncontrolled release of excessive fine sediment would increase turbidity of the water and smother habitats, affecting biota. The predominantly coarse substrate (of a size range greater than fine sand) even in beach areas within the Project area means that the chance of fine sediment plumes in the wider area will be limited. It is equally likely that the biota in the receiving environment will be tolerant of some temporary increase in suspended and settled sediment since similar situations result from storm events. Thus with erosion and sediment control measures in place, the risk (and effects) of fine sediment release should be minimised.

50. **Release of contaminants**: Excavation of material is required for the pouring of seawall foundations. There is the potential for contaminants associated with fine materials to be released during this process. Based on the existing information on sediment contamination in the Project area, it appears that sediment contamination and nutrient enrichment is low. Combined with the fact that fine particles are not abundant, the risk of releasing contaminated fine sediments is very low.

51. There is a greater risk of releasing contaminants during the pouring of concrete for the seawall construction. Concrete or cementitious (mortar, grout, plaster, stucco, cement, slurry) washout wastewater is caustic and considered to be corrosive with a pH over 12. The release of untreated cementitious-contaminated water into the intertidal zone of the construction sites could locally alter pH and cause detrimental effects on the local ecosystem, particularly if it is concentrated in intertidal areas (i.e., tide pools, etc.) during low tide. As such a range of measures to reduce the risk of the release of cementitious products and contaminated wash-water will be implemented.

52. There is the risk that other contaminants associated with the machinery to be used in the intertidal area (i.e., petroleum-based products) could be released. However, it is expected that the use of the excavator on the beach would be minimised, and all machinery would use biodegradable hydraulic fluids and be stored and refuelled away from the beach.

53. **Habitat disturbance**: Construction of the seawalls requires a minimum working distance of three metres for revetment, and five metres for curved walls beyond the toe of the new seawall, to allow for the excavation and burying of the toe of the new seawalls. In total, the construction footprint is estimated to be 1.5ha. Within the CMA, this construction zone represents

1.2ha of localised disturbance beyond the actual footprint of the proposed seawalls. The construction activity itself may locally impact on the environment through the disturbance of the intertidal habitat through compaction of material and crushing of biota via the operation of machinery within the foreshore area. Given the predominantly dynamic rocky shore environment, it is likely any effects will be short-lived, with an abundant colonist source from the adjacent areas and lower tidal area available to re-colonise the part of the foreshore within the construction footprint following construction. However, some biota (such as rock fish) that can hide under rocks during tidal exposure could be crushed by any machinery working in the foreshore area, and so a requirement to relocate any fish from rock pools within the construction area has been included.

54. **Encroachment into the subtidal area during construction**: Because the construction footprint is larger than the footprint of the final seawall, some encroachment of the works site into the subtidal zone is possible during the construction phase. From the estimated construction extents, there is likely to be a length of 106 m where there may be some construction encroachment into the subtidal area, equating to approximately 0.01ha of encroachment into the subtidal zone. This includes an approximate 32m length in northern Lowry Bay; 18m in southern Lowry Bay; 16m in York Bay; 16m in northern Mahina Bay; and 24m in southern Mahina Bay. This is shown in Figure 37 of the Intertidal Technical Report, and indicates that these areas are small and on the edge of the subtidal zone. Working in permanently inundated areas comes with an increased risk of the release of fine sediment and contaminants.

55. Further information regarding the construction effects can be found in Section 5.1 (Construction Effects) of the Intertidal Technical Report.

*Potential operational effects*

56. Seawalls already exist along 87% of the Project length (i.e., 3.8km of the 4.4km Project length, as shown in **Appendix A Figure 3** of my evidence). Following completion of the proposed works there will be seawalls along 93% (4.1km) of the Project length (as shown in **Appendix A Figure 4** of my evidence). This includes keeping 1km of existing seawalls (a 2008-built curved seawall in York Bay and a revetment in southern Sunshine Bay) and the construction of 3.1km of new or replacement seawalls and access points. A total of 0.3km will remain without any seawalls, which are generally around headland locations.

57. Of the seawalls being built, the majority (84%) will be curved concrete seawalls (either single (6%), double (68%), double/triple (3%) or triple (7%)). A smaller portion will be rock revetments (14%) and the remainder will be access points (2%).

58. Further information regarding the different seawall types can be found in Section 4.1 (Proposed Seawalls and Shared Path Concept) of the Intertidal Technical Report, along with the evidence of **Mr Povall**.

59. The long-term operational effects to intertidal ecology relate to:

(a) changes in habitat type;

(b) encroachment into the existing intertidal area; and

(c) changes to local hydrodynamics.

60. **Changes in habitat type**: Artificial seawalls support less biodiversity than natural shore environments, as a result of a loss of heterogeneity of the surface, and the steeper aspect of the seawall compressing tidal zones[11]. Because 87% of the Project length already has a manmade seawall (increasing to 93% after construction of the Project), the likely changes to the intertidal community will be much less than if the area was changing from a natural rocky shore and/or sand and gravel beach environment to a seawall environment. In places where existing angled concrete seawalls will be replaced with a curved seawall (58% of the Project length), it is likely the change will be beneficial to intertidal benthic taxa as the concaved curved wall will improve shading and moisture retention during tidal exposure.

61. Sloping revetment options (such as the proposed sloping revetment), ensure a greater area available for intertidal biota compared to steeper/vertical seawalls, allowing more space between tidal zones and so decreasing competition and predation pressures between and within species, and better mimicking a more gradual natural shoreline. However, the use of harder rock (which is typically needed for durability and therefore longevity) can limit the habitat value of revetments to intertidal benthic invertebrates due to the lack of surface roughness, microhabitats, and rock pools. Any voids between the rocks will, however, provide cover for larger taxa such as fish during tidal inundation.

62. **Encroachment into the CMA**: The CMA is defined as being below the MHWS level. 1.8km (41% of the Project length) of new seawall will encroach into the CMA beyond the footprint of the existing seawalls. None of the proposed seawalls encroach into the subtidal area: the previously proposed large revetment in northern Lowry Bay and the curved wall plus revetment treatment type in southern Lowry Bay were changed to curved seawall types to reduce their encroachment into the subtidal zone.

63. Due to the dominating effect of tidal zonation patterns on intertidal benthic invertebrate communities (where taxa richness and diversity increases from the high tide to the low tide zone), the impact of encroachment is different

[11] Steep seawalls compress the tidal zone on the face of the seawall, meaning a loss of space within each tidal level and changes to community structure and functioning with the interaction of species from different tidal levels that might not otherwise interact on more gently sloping shores.

within the different tidal zones. Thus we ranked the proposed seawalls based on their proposed footprint extent and encroachment into the existing intertidal area.

64. A high encroachment rank (and thus higher potential level of impact on intertidal ecology) was given to seawalls encroaching beyond the existing seawall footprint into the more productive low-mid tide zone, where taxa diversity and density is at its greatest, and this represented 10% of the new seawall length. Seawalls that will extend beyond the toe of the existing seawall into the mid-high tide zone (47% of the new seawall length)[12] were given a medium encroachment rank. Those areas with no change in the existing seawall footprint (5% of the new seawall length) were given a low encroachment rank and those areas outside of the CMA (38% of the new seawall length) were recorded as 'not applicable' as they are outside of the intertidal area; both of these do not have an encroachment impact on intertidal ecology. Those areas with a 'high encroachment' rank are primarily where revetments are proposed, and those with a 'medium encroachment' rank are primarily where curved seawalls are proposed.

65. For locations where revetments are being used, this encroachment equates to 0.146ha, which is 2.9% of the Project intertidal area (i.e., the intertidal area within the 4.4km long Project length). This same area will still be available to intertidal biota with a gradually sloped intertidal area created by the sloped revetment. For such areas the ecological impact is more related to the change in materials which has been discussed in Paragraph 61.

66. For locations where curved seawalls are being used, this encroachment equates to 0.149ha, which is 3% of the Project intertidal area. This area of intertidal area will be lost under the new seawalls with the curved surface of the seawalls becoming part of the intertidal habitat. Beach access points (steps and ramps) which form part of the curved seawall infrastructure, represent only 0.003ha or 0.07% of the Project intertidal area. The texture of the curved seawall surface and the flat steps (for double or triple seawalls) will therefore need to be improved from the typical smooth surface in order to mitigate the loss of foreshore habitat.

67. **Altered hydrodynamics**: the potential effects of the proposed seawalls on local hydrodynamics are covered in the Coastal Processes technical report (Allis, 2019) and the evidence of **Dr Allis**. As Dr Allis has determined that effects to nearshore hydrodynamics and sediment movement will be minor, the subsequent environmental effects are therefore likely to be minor and localised. Small shifts in community composition may occur at some locations as a response to small scale changes to substrate size and altered hydrodynamics, but it is unlikely to greatly change the overall community composition of the intertidal area due to the localised nature of the changes

[12] Note that the 74% value presented on page 69 of the Intertidal AEE was a transcription error and should have stated 47%.

in substrate size and the already dynamic nature of the nearshore environment.

68. Further information regarding the operational effects can be found in Section 5.2 (Operational Effects) of the Intertidal Technical Report.

**Steps taken to address potential adverse effects**

*Reducing construction effects*

69. The following is a summary of the measures that will be undertaken to reduce the construction effects. These relate to Section 6.1 (Construction Phase Mitigation Measures) of the Intertidal Technical Report and include both ‘currently proposed’ and (what was then) ‘additional recommended’ mitigation. HCC has adopted these measures through conditions as appended to the evidence of **Ms van Halderen.**

(a) Staging the construction works will help to minimise the extent and duration that a site is exposed (as a smaller site will be easier to maintain than a larger site), meaning less risk of accidental discharges etc[13].

(b) Measures for containing the construction site to minimise sediment and contaminant release, for protecting the site from tidal intrusion and storm events, and protocols to address any overtopping event that may occur during construction[14].

(c) Imported fill material to be used in the reclamations shall be restricted to clean natural sand, gravels and rock, and thus free of any fines[15].

(d) Having machinery work from the road verge where possible, the use of weight-bearing mats on the foreshore substrate to reduce compaction of looser substrate and help to protect the intertidal surface structure. It will also provide a defined road for the machinery to work from, reducing unnecessary impact to the foreshore substrate[16].

(e) No storing or refueling of machinery on the beach, machinery working on the foreshore will use biodegradable hydraulic fluids, and a spill kit will be maintained on site at all times[17].

(f) Clear demarcation of the construction zone within the foreshore area to avoid undue encroachment of the construction zone into adjacent areas[18].

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[13] Covered in proposed Consent Condition GC.7, C.6
[14] Covered in proposed Consent Condition GC.7, C.1, C.6, C.7.
[15] Covered in proposed Consent Condition GC.7, C.9, C.10.
[16] Covered in proposed Consent Condition GC.7, GC.7, C.6
[17] Covered in proposed Consent Condition GC.7
[18] Covered in proposed Consent Condition GC.7, C.1, C.4

(g) There are also specific controls required for the pouring of concrete, including appropriate wash-down facilities for all concreting equipment to prevent wash water from entering the CMA, and ensuring that any water or liquid that has come into contact with cementitious products has a pH similar to that of the local receiving environment prior to discharge[19].

(h) Looking at all measures to reduce the construction footprint in those areas where the construction footprint may encroach into the subtidal area. Undertaking measures to isolate the construction site from the subtidal area, including the ability to increase the length of the work site to contain any continuous length of subtidal area into the one site[20].

(i) Stockpiling (at the appropriate nearby tidal level) and replacement of natural larger colonised rock material from the construction footprint of intertidal and subtidal areas to create additional habitat and aid in recolonisation of the areas disturbed during construction[21].

(j) Checking any rock pools within the construction area for fish (such as rock fish) and relocating them outside of the construction zone prior to commencing works[22].

*Reducing operational effects*

70. The following is a summary of the measures that will be undertaken to reduce the operational effects. These relate to Section 6.2 (Operational Phase Mitigation Measures) of the Intertidal Technical Report and include both 'currently proposed' and 'additional recommended' mitigation. Again, these measures have been adopted by HCC, through the latest set of proposed resource consent conditions appended to the evidence of **Ms van Halderen**, and as specified via footnote references below:

(a) Limiting the level of encroachment into the CMA by orientating beach access steps and ramps parallel to the seawall and using mini steps where possible, using single instead double curved seawalls in some beach locations, and limiting the use of revetments which have a larger footprint[23].

(b) Creating a textured surface to the curved surfaces and depressions to the flat platforms to all of the constructed curved seawalls to provide intertidal habitat, increasing surface area and small-scale surface heterogeneity. Textured seawalls are being increasingly implemented as a means of improving intertidal seawall habitat around the world.

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[19] Covered in proposed Consent Condition GC.7, C.6
[20] Covered in proposed Consent Condition CG.7, C.1, C.6, EM.11, EM.11
[21] Covered in proposed Consent Condition EM.11, EM.19
[22] Covered in proposed Consent Condition EM.10
[23] Undertaken during earlier design iterations, and covered in proposed Consent Condition LV.4, LV.5, LV.7 as it relates to the detailed design phase.

This equates to roughly 0.21ha of new curved seawall surface area that will have a textured curved surface (0.15ha[24]) and flat platform area (0.06ha[25]) within the current CMA area, which is more than the 0.152ha area of intertidal foreshore habitat that will be lost by the encroachment of the new curved seawalls and access points. Applying these textures to all seawalls both within and outside the current CMA (equating to 0.41ha of surface with textures or depressions), also provides some ecological resilience to future sea level rise[26].

(c) The addition of add-on structures to the face of the new curved seawalls to mimic intertidal rock pools where possible without compromising the structural integrity of the seawall surface[27].

(d) Re-use of larger colonised rocky material to create new habitat in front of the new curved seawalls and in the new revetments and to facilitate recolonisation of the new areas[28].

(e) Minimising the excavation of in situ rock where possible, and reducing the revetment footprint where possible without compromising the structural integrity, overtopping protection, or coastal processes[29].

(f) Drilling rock pools into the surface of some of the hard revetment rocks within the mid tide area of the seawall[30].

**Final effects consideration following implementation of measures to address potential effects**

*Construction effects*

71. With the implementation of the above measures, and particularly on the basis of appropriate construction measures to isolate, contain, and treat water potentially contaminated by wet cementitious products, combined with the dynamic nature of the environment and presence of similar community composition in areas not affected by the works, it is my opinion that construction effects should be able to be kept within a ‘less than minor’ level.

*Operational effects*

72. With the implementation of the above measures, I consider that the potential operational effects on the intertidal benthic community will be less than minor due to the following considerations:

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[24] Based on a curved surface height of 0.6 m and taking into account sections with double or triple curved walls
[25] Based on the available flat surface being 0.3 m wide.
[26] Covered in proposed Consent Condition C.2, EM.19
[27] Covered in proposed Consent Condition EM.19, EM.19
[28] Covered in proposed Consent Condition C.2, EM.11, EM.19
[29] Covered in proposed Consent Condition C.2
[30] Covered in proposed Consent Condition C.2, EM.19

(a) There were no species of conservation concern (based on Freeman *et al.* (2014) and Nelson *et al*. (2019)), and the fauna is similar to that of the wider area.

(b) The intertidal benthic community of the intertidal habitat within areas affected by the Project is not dissimilar to that found in areas that will not be affected.

(c) The existing environment is already highly modified, with seawalls currently along the majority of the shoreline (87% of the Project length), and consisting primarily of angled concrete seawalls that support low species diversity and richness.

(d) The majority of the proposed seawalls are curved seawalls (60% of the total Project length). These will replace mostly existing old angled concrete seawalls. The curved seawalls will provide additional protection from desiccation during tidal exposure, whilst the addition of the texture to the curved surfaces, small depressions in the flat step of the seawall, and add-on rock pool features will provide more habitat for intertidal biota than what currently exists on the current seawall faces. The total surface area where textures and depressions are to be applied is greater than the area of intertidal habitat to be lost from encroachment of the curved seawall footprint, while use of such habitat features on seawalls currently above the CMA will provide for some ecological resilience to future sea level rise.

(e) The encroachment into the CMA has been minimised as much as possible, and represents only 5.9% of the existing intertidal area. Based on the tidal zonation pattern, the greatest impact from encroachment is in the mid-low tide area which is limited to the footprint of the rock revetments. Compared to more vertical seawalls, revetments retain a more natural intertidal zonation, and with the addition of some existing softer rock and the creation of rockpools should provide improved habitat over existing rock revetments. In addition, taxa richness and taxa density was lower in the rocky shore habitat within the proposed revetment footprint, compared to areas outside of the encroachment, and there was no significant difference in community composition.

(f) The Project works will be staged bay by bay over a number of years, meaning that relatively small areas will be disturbed at once, facilitating recolonisation of fauna from adjacent undisturbed areas.

73. Overall, I am satisfied that any potential effects to benthic ecology as a result of the Project's replacement and creation of seawalls have been adequately dealt with, to limit the overall effects to a 'less than minor' level of effect in the context of the RMA. In particular I consider the inclusion of textures,

depressions and rock pool habitats in the new seawalls reflects the global recognition of the ecological value of improving habitat complexity of manmade seawall structures.

**PART B: EFFECTS OF BEACH NOURISHMENT ON INTERTIDAL AND SUBTIDAL ECOLOGY**

74. The following relates to the potential effects of beach nourishment in Point Howard, Lowry Bay and York Bay (as shown in Figure 1 of my Subtidal Technical Report and presented here as **Appendix 2 Figure 5** of my evidence) on the benthic intertidal and subtidal ecology of these beach areas.

**Methodology**

75. Ecological surveys were undertaken in December 2018 and February 2019 to supplement data already collected for the Intertidal Technical Report. A total of 31 intertidal and 47 subtidal infauna samples were collected from different tidal zones (upper intertidal zone from mid-high tide, lower intertidal zone from mid-low tide, subtidal nearshore in water depths <1m, and subtidal shallow in water depths between 1-5 m). These sites are shown in Figure 4 of the Subtidal Technical Report and presented here as **Appendix 2 Figure 6** of my evidence.

76. Sample locations were chosen to cover a range of intertidal and subtidal zones, from areas that will and will not likely be affected by the initial placement or eventual redistribution of beach nourishment materials (as indicated in **Appendix 2 Figure 7** of my evidence), and from bays where beach nourishment is proposed as well as comparison bays where no beach nourishment is planned.

77. All intertidal samples were collected from the shore during low tide whilst all subtidal samples were collected by divers (Commercial Dive Services under the supervision of an EOS Ecology scientist). All infauna samples were transferred to our laboratory to count and identify the invertebrate infauna.

78. A visual check for *Macrocystis* (kelp) beds was undertaken in nearshore shallow subtidal areas of Point Howard beach, Lowry Bay and York Bay by Fred Overmars of Sustainability Solutions. Underwater visual checks were undertaken at Point Howard beach, Sorrento Bay, Lowry Bay, York Bay, Mahina Bay and the northern and southern end of Days Bay during dive surveys to collect the subtidal infauna samples.

79. The collected data was summarised and analysed to characterise the ecological values of the existing benthic intertidal community, compare the benthic invertebrate within and outside of the beach nourishment bays, and within and outside of the areas potentially affected by the beach nourishment through the addition and movement of the beach materials over time. The potential areas affected by the addition and possible movement of beach

materials is indicated in Figure 15 of the Subtidal Technical Report and presented here as **Appendix 2 Figure 6** of my evidence.

80. Further details on the survey methodology can be found in Section 2 (Methods) of the Subtidal Technical Report.

**Existing state of the environment**

81. The *Beach Nourishment* Report (Appendix F to the AEE) describes the beach areas as a mix of sand and gravels, with increasing sand content from York Bay north to Point Howard. The *Beach Nourishment Report* states that sediments within the Eastern Bays from Sunshine Bay to Point Howard are likely sourced from the bays' own catchment. Further details regarding the substrate type can be found in the evidence of **Mr Reinen-Hamill**.

82. Coastal processes and sediment transport of the Eastern Bays area is also covered in the evidence of **Dr Allis**.

83. The infauna beach community (consisting of both intertidal and subtidal areas) was represented by 92 taxa and was dominated by polychaetes, followed by crustaceans and a lesser proportion of molluscs.

84. There were no significant differences in community composition, taxa richness, or density between the different bays within the Project area, meaning that the fauna of the bays proposed for beach nourishment were no different to those where beach nourishment will not occur.

85. In comparison, there were differences in community composition, taxa richness and density between the subtidal and intertidal zone. The intertidal community was generally dominated by polychaetes (*Aonides* 23% abundance and *Prionospio* 17.5%), followed by crustaceans (Gammaridae amphipods at 17.3% abundance. The subtidal community was generally dominated by polychaetes (*Magelona dakini* 32% abundance, *Heteromastus filiformis* 15.7%, and Sabellidae 7.7%) followed by molluscs (*Macomona liliana* or large wedge shell 4.5%).

86. In general, taxa richness and density were substantially higher in the subtidal zone compared to the intertidal zone. Taxa richness also consistently increased down the shoreline; from the mid-high intertidal zone through to the shallow subtidal zone.

87. However, when comparing the mix of intertidal and subtidal samples from the area of initial placement or eventual possible redistribution of beach nourishment materials (as indicated in **Appendix 2 Figure 7** of my evidence) compared to those samples not within those 'impact' areas, there was no difference in community composition, taxa richness, or density. Whilst there was a lower density of infauna in the intertidal samples within the potential

impact area compared to non-impact samples, this was not statistically significant due to large within-site variation.

88. The intertidal and subtidal fauna of the beach sediments were considered to be in a healthy condition with dominant species indicative of no adverse nutrient enrichment or chemical contamination. The dominant fauna were more typical of sandy environments and generally less tolerant of finer sediments (i.e., mud).

89. No species of conservation concern (as listed in Freeman *et al.*, (2014) and Nelson *et al*. (2019)) were recorded from the collected samples.

90. The subtidal community of the sampled Eastern Bays area appears to be dominated by different species to those recorded by subtidal surveys of the deeper harbour, western bays and northern nearshore subtidal area. These differences are most likely attributable to depth and substrate differences, along with the higher sediment contamination levels in some other surveyed areas of Te Whanganui-a-Tara / Wellington Harbour. There is less existing data available for the intertidal and subtidal community of other nearby Eastern Bay beaches, but existing data from the nearby Petone beach indicates a broadly similar subtidal and intertidal benthic infauna to that found in our samples, although Petone beach supports a greater density of bivalves (especially pipis) likely due to the finer sands of that beach.

91. Macroalgae were generally absent from the surveyed intertidal beach areas, and were more located more within areas of intertidal rocky shore or larger stable substrate. No kelp (*Macrocystis*) was observed during the surveys undertaken to collect samples from the nearshore and shallow subtidal areas.

92. Further details on the benthic ecology results can be found in Section 3 (Existing State of the Environment) of the Subtidal Technical Report.

**Potential ecological effects of beach nourishment**

93. An overview of the beach nourishment approach that forms the basis of my determination of potential effects is described in Section 4 (Overview of Design and Methodology for Beach Nourishment) of the Subtidal Technical Report. The evidence of **Mr Reinen-Hamill** also details the beach nourishment approach.

94. Coastal processes and sediment transport of the Eastern Bays area is also covered in the evidence of **Dr Allis**.

95. The current proposed beach nourishment of three beaches (Point Howard, Lowry Bay, York Bay) within the Project area has the potential for both short-term (initial introduction of beach material) and medium-term (natural redistribution of beach nourishment material) effects. These include:

(a) disturbance and possible compaction of habitat during excavation and machinery use (for initial excavations and introduction of beach material);

(b) smothering of intertidal habitat/biota during the initial introduction of beach material, as well as the medium-term movement of beach nourishment material beyond the initial introduction; and

(c) increased suspended sediment during the initial phases and possibly during the later redistribution of materials via tide and waves.

96. My assessment is that small shifts in community composition may occur at some locations as a response to the shifting beach nourishment material, but it is unlikely to greatly change the overall community composition of the subtidal area due to the similarity of beach nourishment material to the *in situ* material, lack of fines in the introduced material, the localised nature of the sediment movement, the already dynamic nature of the nearshore environment, and the similarity in the subtidal benthic invertebrate community within and between the bays that will allow for recolonisation.

97. A greater level of impact is expected within the intertidal zone where the beach nourishment materials will be introduced, primarily due to the fact that the added material (which will be up to 0.6m deep when initially added) may bury some *in situ* biota. Yet this is minimised to some extent by the addition of some of the beach material to the area above the high tide mark, the lower diversity and density of taxa higher up the shore and in the intertidal beach areas compared to the subtidal beach areas, and the similarity of the infauna community within the impact areas to the wider unaffected areas, which will help to facilitate recolonisation (primarily via larval dispersal and settlement) after the initial disturbance. The similarity (in grain size and colour) of the added materials to the existing/native beach sediment will also improve survivability of *in situ* taxa.

98. Further details on my assessment of potential effects of beach nourishment can be found in Section 5.1 (Initial Excavation and Use of Machinery in the Intertidal Beach Area) and 5.2 (Initial Addition and Redistribution of Beach Nourishment Material) of the Subtidal Technical Report.

**Steps taken to address potential adverse effects**

99. The following is a summary of the measures that will be undertaken to reduce the potential effects of beach nourishment on benthic ecology. These relate to Section 5.3 (Mitigation Measures) of the Subtidal Technical Report. HCC has adopted these measures through the proposed conditions as appended to the evidence of **Ms van Halderen**:

(a) Following the recommended mitigation measures relating to construction of the seawall as outlined in the Intertidal Technical Report and also discussed above.

(b) Adding beach nourishment material in smaller volumes over multiple occasions and locations[31].

(c) The beach nourishment material will have similar grain size and properties of the beach sediments, and not contain more than 2-3% of fine material in the nourishment sediment[32].

(d) Ensuring beach nourishment material is not contaminated[33].

(e) The initial placement of beach nourishment material at/around low tide, in calm weather conditions, and done in such a way as to avoid as much as possible the initial placement of material in the subtidal area[34].

(f) Minimising the working area and mobilisation of sediment[35].

(g) Stockpiling any returning woody debris in the wrack line of the beaches following completion of the beach nourishment[36].

(h) Avoiding initial placement of beach nourishment material at the southern extreme of Lowry Bay where there are emergent larger rocky substrates within the finer beach materials[37].

100. I understand that our recommendation that the beach nourishment follow the completion of the seawall construction within the Bay as closely as possible (so that the duration of disturbance is minimised) has been superseded to limit beach nourishment to the winter months to minimise disturbance to avifauna. I am comfortable that such an approach will not negate my overall conclusions regarding the level of impact on the benthic fauna of the beach areas.

**Final effects consideration following implementation of measures to address potential effects**

101. With the implementation of the above measures, I consider that the potential effects of beach nourishment on the benthic intertidal and subtidal environment will be short-lived and within a range that is experienced within the existing environment naturally, and as such will be limited to a 'minor' or 'less than minor' level of effect.

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[31] Covered in proposed Consent Condition EM.13, EM.14
[32] Covered in proposed Consent Condition EM.14
[33] Covered in proposed Consent Condition EM14
[34] Covered in proposed Consent Condition EM.14
[35] Covered in proposed Consent Condition EM.14
[36] Covered in proposed Consent Condition EM.14
[37] Covered in proposed Consent Condition EM.14

102. However, as sediment migration can vary based on site-specific conditions, and as there is little detail as to the level of redistribution of sediments over time, I have recommended that some monitoring of the redistribution of beach nourishment materials be undertaken, along with an assessment of the benthic intertidal and subtidal beach fauna at least 12 months after completion of the proposed works. The results of this monitoring will help to inform any future additional beach nourishment or 'top ups'. HCC has adopted these monitoring recommendations through proposed conditions EM.15-18 as appended to the evidence of **Ms van Halderen**.

**PART C: RESPONSE TO SUBMISSIONS**

103. Of 200 submissions, only seven refer to intertidal or subtidal benthic ecology (excluding seagrass) and four refer to offshore structures. These are addressed below. Any reference related to coastal processes such as beach loss and sea level rise is outside my specialist area and is covered in the evidence of **Dr Allis** regarding coastal processes. Similarly matters relating to seagrass are covered by the evidence of **Dr Matheson**.

104. John Butt (63) states "*there has been no testing of beach sands in Okiwi-iti bay for the presence of molluscs, the bay in 2001 was covered in large snails, since eaten by over-fishing, but it remains full of wildlife*." I understand that Okiwi-iti Bay is what is referred to as Days Bay on the Project plans. No surveys were undertaken for the Intertidal Technical Report as the area is not within the Project area, but intertidal and subtidal infauna samples were collected as part of the Subtidal Technical Report to provide comparison data for the assessment of ecological effects on beach nourishment. If the submitter is referring to the beach just south of what the Project refers to as Windy Point, then no surveys were undertaken as it was outside of (southward of) the Project area.

105. The East Harbour Environmental Association ("**EHEA**") (80) states "*The use of heavy machinery on rocks and beaches which could cause significant damage to their flora and fauna. The claim in the application that there would be less than minor adverse effect does not appear to us backed up by adequate evidence.*" The potential for damage from machinery during the construction phase has been covered in Section 5.13 of the Intertidal Technical Report and Section 5.1 of the Subtidal Technical Report. As noted above, based on the dynamic nature of the environment, the temporary nature of the construction phase, the measures to limit use of machinery on the foreshore, to temporarily remove and return larger colonised material in rocky shore areas, the similar community composition of taxa within the area and thus presence of recolonist taxa, it is my opinion that the potential effects of heavy machinery on the foreshore have been adequately minimised.

106. The Royal Forest and Bird Protection Society of New Zealand ("**RFBPS**") (170) states "*The proposal will have significant adverse effects on the fragile*

*ecology of the inter-tidal coastal margin, including the permanent loss of habitat for indigenous species. Of particular concern is the risk of adverse effects to seagrass and the little penguin. The conditions for mitigation and remediation are also uncertain and inadequate to protect the indigenous biodiversity values of the coastal environment. The mitigation measures set out in the AEE to address identified adverse effects are not apparent in the proposed conditions of consent. In particular the condition for the CEMP to avoid as far as practicable is uncertain with the respect to policies 11, 13 and 15 of NZCPS."*

107. It is not clear in the submission how much of this statement relates to intertidal benthic ecology versus seagrass and little penguins. As indicated in the Intertidal Technical Report and Subtidal Technical Report and as stated in here in my evidence, it is my opinion that the measures proposed, including the creation of a textured surface, depressions and rock pool habitat in the new seawalls, and minimisation of encroachment into the CMA, will appropriately limit the effects of the Project on intertidal and subtidal benthic ecology values. The measures included in Section 6 of the Intertidal Technical Report and Section 5.3 of the Subtidal Technical Report (and as summarised in Paragraph 69, 70, and 99 of my evidence) have been incorporated into the resource consent conditions as appended to the evidence of **Ms van Halderen**. The evidence of **Ms van Halderen** responds to planning matters outlined in the RFBPS submission, as these are outside the scope of my expertise.

108. Judy Lawrence (177) requests "*A condition in the monitoring conditions that at 2 years a review be undertaken by a coastal professional to determine whether the monitoring should continue and to link to the longer term adaptive pathways and if they have not been developed to continue monitoring so as to have a continuous record that can smoothly inform the pathways when they are developed.*" I take this to refer to the monitoring of beach volume (as opposed to the intertidal and subtidal benthic invertebrate monitoring) which is specified in the resource consent conditions as appended to the evidence of **Ms van Halderen** as being for two years. As such this is covered in the evidence of **Mr Reinen-Hamill** on beach nourishment.

109. Warren Owen (182) makes a positive statement ("*On a more uninformed note, I suspect a very healthy ecosystem could emerge in and around a well planned seawall/pathway.*") and Gertrud Bruhimann (190) an opposing statement *("… 35 years of "carte blanche' to destroy and disturb the beaches again and again for maintenance, and to deposit and discharge contaminants to the foreshore is too high a price for a shared path….*") about matters that broadly intercept with aspects of intertidal or subtidal ecology but are not specific enough for me to adequately respond to.

110. EHEA (80), Harvey Calder (200) Janice Heine (128) and Sally Bain (158) suggest that rip-rap rock islands, 'breakwalls', surf breaks or breakwaters and other artificial structures could be constructed offshore from the beaches as an alternative structure to absorb the power of waves instead of the proposed design. The use of such artificial structures were considered to not be suitable for the Project as outlined in the evidence of **Dr Allis**, and as such they were not included in my assessment of effects.

**PART D: RESPONSE TO COUNCIL OFFICER'S SECTION 42A REPORT**

111. The GWRC Section 42A Report makes reference to intertidal and subtidal ecology in Section 12.6 (effects on water quality), Section 12.7 (construction effects on intertidal and subtidal ecology), and Section 12.9 (permanent loss and modification of intertidal habitat). In general both the section 42A Report and the associated expert review comments by Dr Oliver that the section 42A Report draws upon, are in agreement that the overall effects pertaining to these matters will be appropriately managed to an acceptable level or will be no more than minor, on the basis that the recommended consent conditions are implemented.

112. The section 42A Report recommends some other mitigation measures via inclusion of additional consent conditions beyond what are covered in the proposed conditions as appended to the evidence of **Ms van Halderen.** These are as follows[38]:

(a) Beach Nourishment Plan Condition EM.15(e) (viii) – A new condition around staging of beach nourishment to add material in small volumes across several treatments instead of in one lot.

(b) Beach Nourishment Plan Condition EM.15(e) (xiv) –a new condition around creating a bench above the high tide line for any excavated material from the construction of the seawalls.

(c) Beach Nourishment Plan Condition EM.15(e) (xv) – a new condition around the timing of the beach nourishment to follow seawall construction as closely as possible.

(d) Intertidal and subtidal ecology Condition EM.10 – amended wording inserting an additional requirement for the supervision of any fish/biota salvage during the construction phase by a suitably qualified person.

(e) Contaminant release Condition C.9 – new condition requiring that any discharge should not give rise to effects in the CMA, which pertain to floatable suspensible material other than sediment (such as films and

[38] The consent condition numbering given in the following bullets is as per those in 'Appendix A Recommended Consent Conditions' that formed part of the Council Officer's section 42A Report. As such the numbering is different to the consent conditions as provided in the proposed conditions appended to the evidence of **Ms van Halderen.**

scums); odours; visual clarity (i.e., suspended sediment) outside of a 50 m mixing zone; and any significant effects on aquatic or marine life.

(f) Contaminant release Condition C.10 – new condition setting a discharge limit of 100 g/m$^3$ total suspended solids on discharges of sediment-laden water from the construction site to the CMA or stormwater system.

113. Item 112 (a) was a measure recommended in the Subtidal Technical Report. Whilst it was not included in the submitted consent conditions in its original wording, it is covered by consent condition EM.14e (vi)[39] and EM.14f[40] as appended to the evidence of **Ms van Halderen**. I am comfortable that the wording of these conditions covers the intention of our original recommended measure.

114. Item 112 (b) was a measure recommended in the Intertidal Technical Report. Whilst it was not included in the submitted consent conditions in its original wording, it is covered by consent condition EM.14e (v)[41] as appended to the evidence of **Ms van Halderen**, that states "*Forming the high tide construction beach with a slightly over-steepened profile."* However I can understand that the wording may be obtuse in this regard, and as such recommend the wording is changed to be as follows: "*During the construction of seawalls in beach areas, form any high tide construction beach from excavated beach material with a slightly over-steepened profile, so as to initially place the beach material above the MHWS line wherever possible".*

115. As noted in Paragraph 100 of my evidence, the condition identified in item 112 (c) above has been superseded in the consent conditions to limit beach nourishment to the winter months to minimise disturbance to avifauna. My expert opinion relating to that has been covered in Paragraph 100 of my evidence.

116. Item 112 (d) removes the wording around initial training and guidance by an ecologist relating to removing any fish from the seawall construction zone and replaces it with the words "*Any salvage or relocation of fish or invertebrate shall be supervised by a suitably qualified person*." Given that the transfer of aquatic life requires permits and approvals under MPI and DOC, I agree that the suggested change in wording to "…*shall be supervised by a suitably qualified and experienced person*" is appropriate. However, as this condition is about the salvage of fish (such as rock fish) that may be under rocks with the construction area, reference to invertebrates should not be made. Thus I would recommend that the amended wording by GWRC be

[39] The proposed consent condition EM.14e (vi) states "Only depositing as much sediment on the beach as can be transferred along the placement area in the day of placement."
[40] The proposed consent condition EM.14f states "Placing imported beach sediment along the entire designated placement area rather than in one discrete location."
[41] The proposed consent condition EM.14e (v) states "Forming the high tide construction beach with a slightly over-steepened profile."

altered to say "*Any salvage or relocation of fish shall be supervised by a suitably qualified and experienced person*."

117. I do not support the inclusion of the condition identified in item 112 (e) above, as I do not consider that it would be possible to determine whether the water clarity measured outside any 'mixing zone' is a result of any discharge from the site or due to resuspension of the shallow sediments within the wider embayment as a result of wind and tides. Concomitantly it would be similarly difficult to determine whether any films/scums have come from the construction site or from boats or other sources in the wider embayment, and I am unsure what odours would conceivably result from a discharge of water from excavating into the existing foreshore area. In relation to the effects on marine life; it would be difficult to establish a monitoring programme that could adequately differentiate any lasting effects on marine life related to any short-term discharge from the construction site and over what time scale this would be relevant to; and as noted in my evidence and as agreed in the review by Dr Oliver, construction effects on benthic biota are considered to be less than minor with the implementation of the recommended mitigation measures. Finally the CEMP, which the consent condition require is submitted to GRWC for certification prior to works commencing, will include measures to contain and manage construction discharges.

118. Based on my interpretation of the section 42A Report, the inclusion of item 112 (f) above, that specifies a limit on the discharge of sediment-laden water to the CMA, relates to mention in the Coastal Processes report that the CEMP should provide provision for visual observations of turbidity and suspended sediment during construction of the seawalls which could trigger an action for review of sediment control measures, but that there is no such inclusion of this in the proposed consent conditions. It is my opinion that setting a limit of 100 $mg/m^3$ for suspended sediment in any discharge to the CMA (or stormwater network) would be a more practical option than the inclusion of item 112 (e) above, and something that is better able to be monitored by the contractor and dealt with if there is an issue. The evidence of **Dr Allis** also addresses this matter.

**Shelley Alexandra McMurtrie**

**30 November 2020**

## APPENDIX A: FIGURES AND TABLES FROM THE INTERTIDAL TECHINCAL REPORT

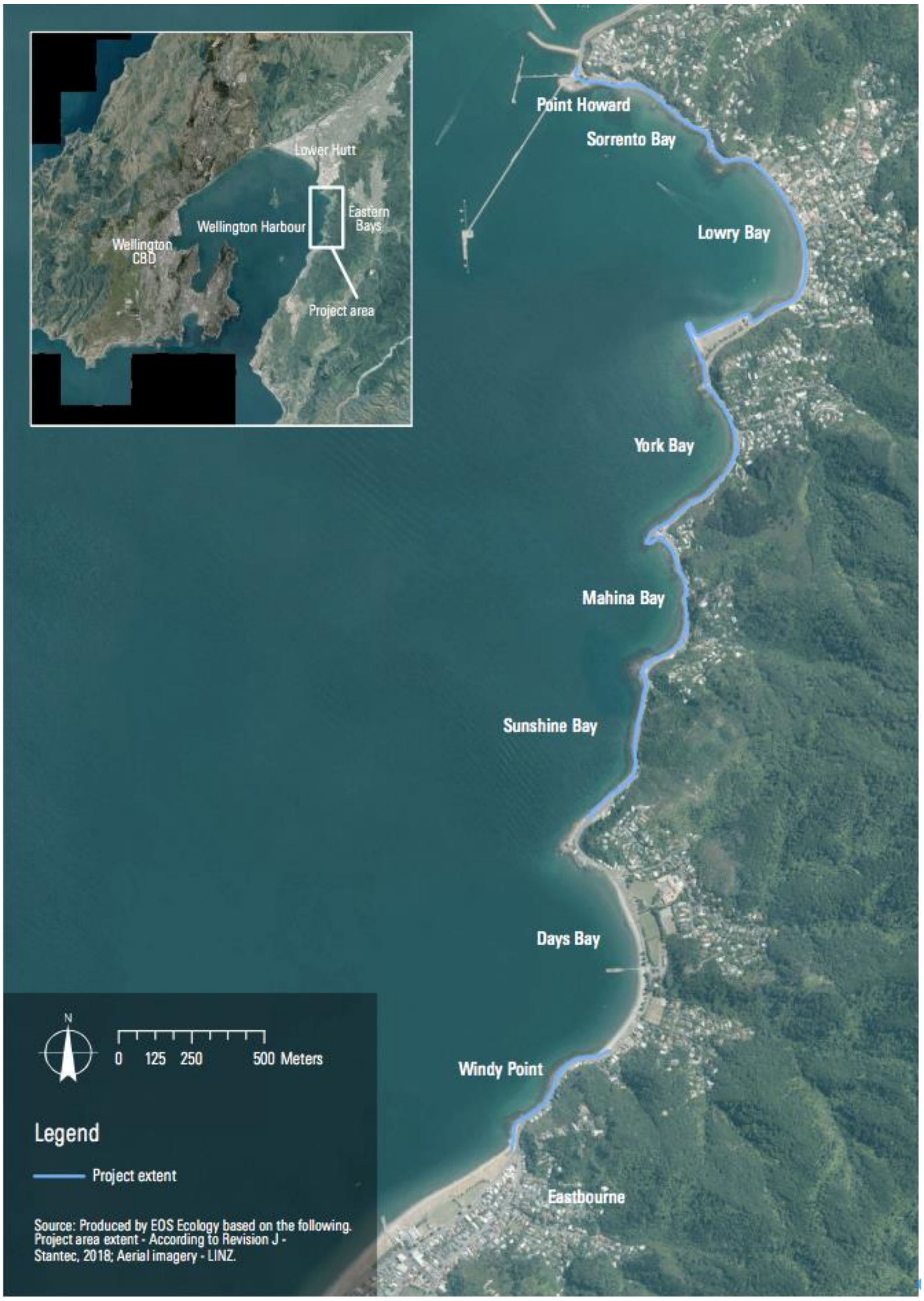


*Figure 1*[42] *Map showing the extent of the Project.*

[42] Note that this is Figure 1 in the Intertidal Technical Report (Appendix A-1 of the Project AEE).

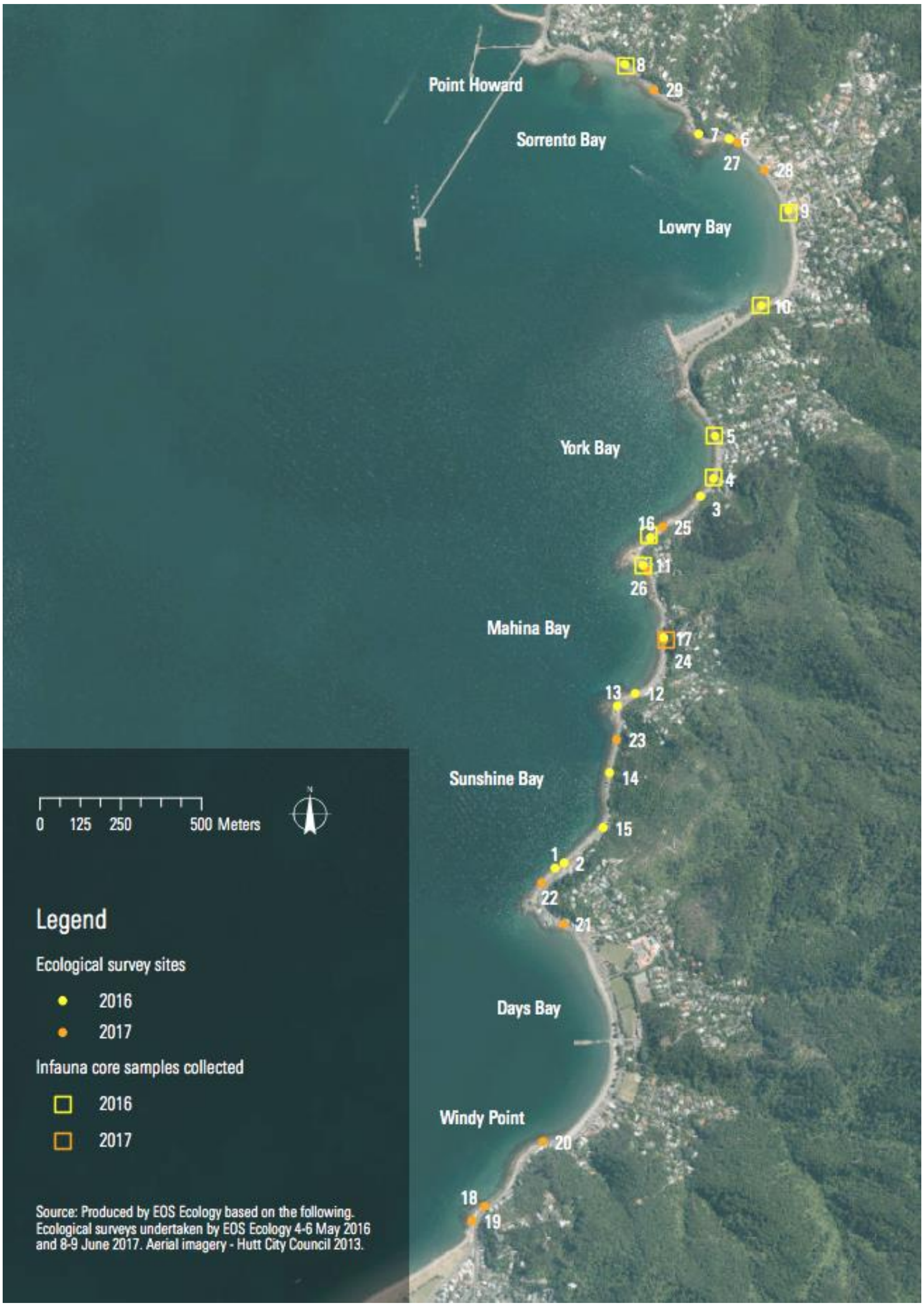


*Figure 2[43] Map showing the location of infauna and epifauna surveys.*

[43] Note that this is Figure 4 in the Intertidal Technical Report (Appendix A-1 of the Project AEE).

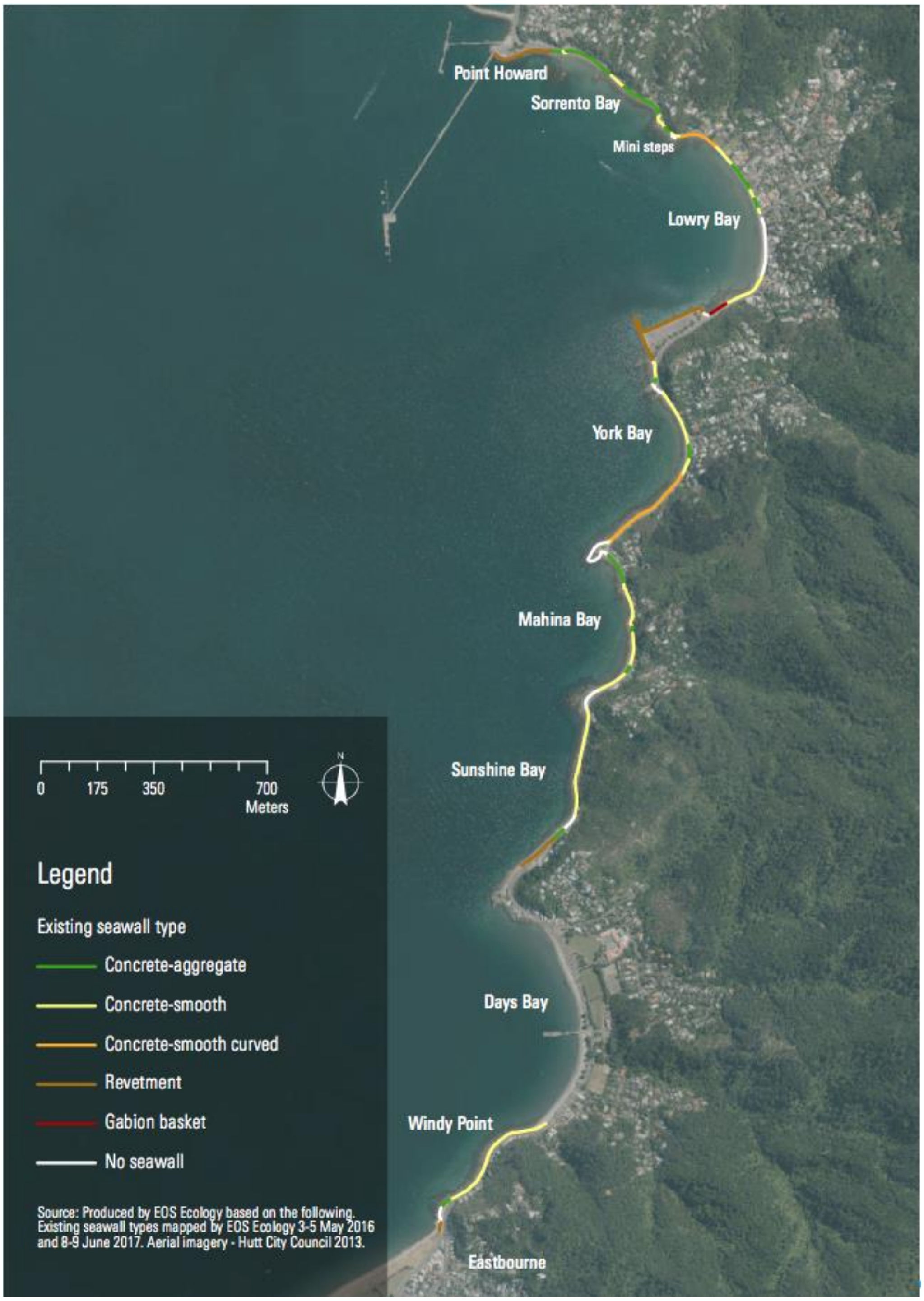


*Figure 3[44] Map of the existing seawall types in the Project Area.*

[44] Note that this is Figure 6 in the Intertidal Technical Report (Appendix A-1 of the Project AEE).


*Figure 4[45] Map of the proposed seawall types and access points as outlined in the Revision J Design Plans.*

[45] Note that this is Figure 2 and Figure 34 in the Intertidal Technical Report (Appendix A-1 of the Project AEE).

## APPENDIX B: FIGURES AND TABLES FROM THE SUBTIDAL TECHINCAL REPORT


*Figure 5[46] Map showing proposed beach nourishment areas compared to the Project length.*

[46] Note that this is Figure 1 in the Subtidal Technical Report (Appendix A-2 of the Project AEE).

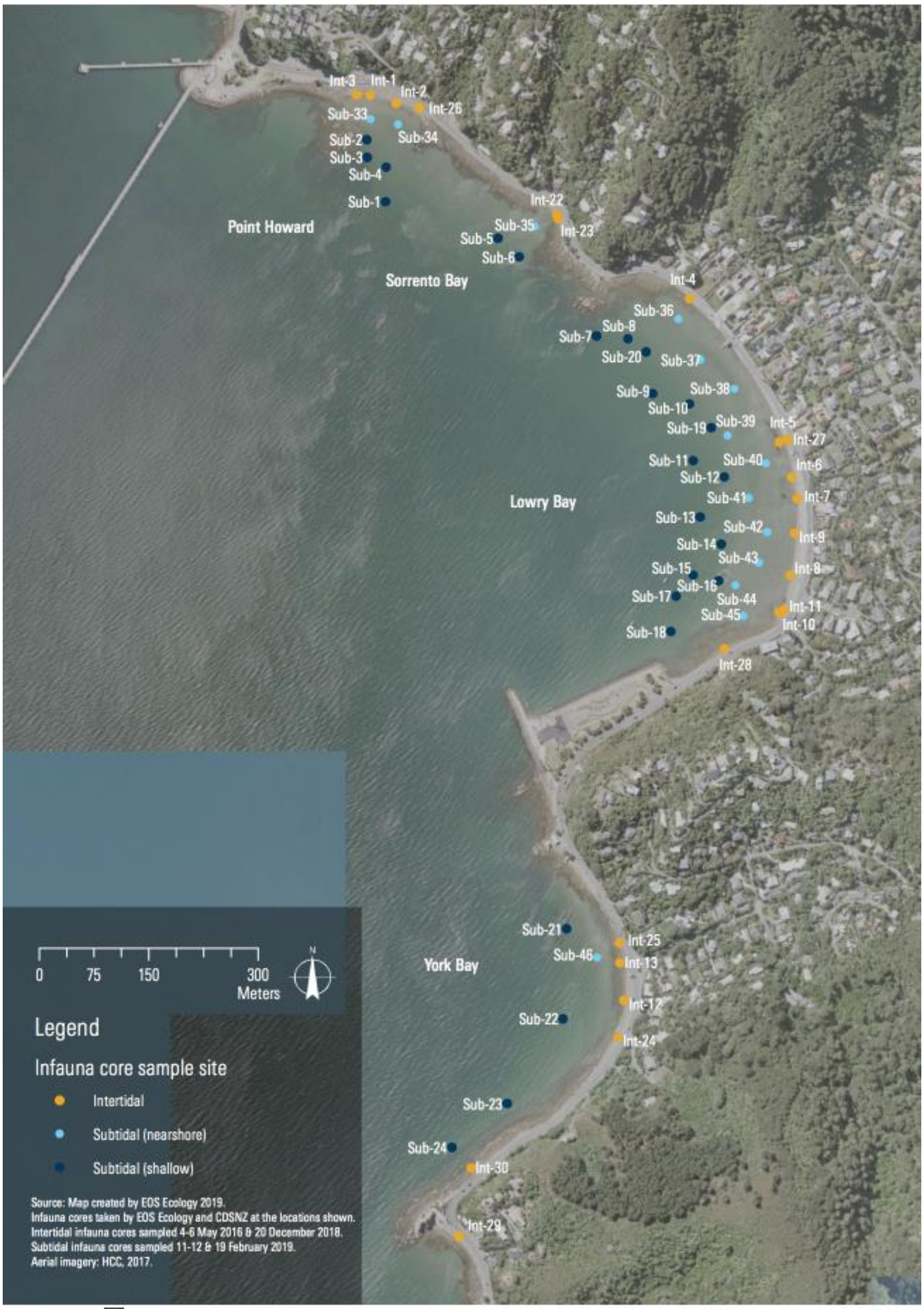


*Figure 6*[47] *Map showing the location of infauna and epifauna surveys.*

[47] Note that this is Figure 3 in the Subtidal Technical Report (Appendix A-2 of the Project AEE).

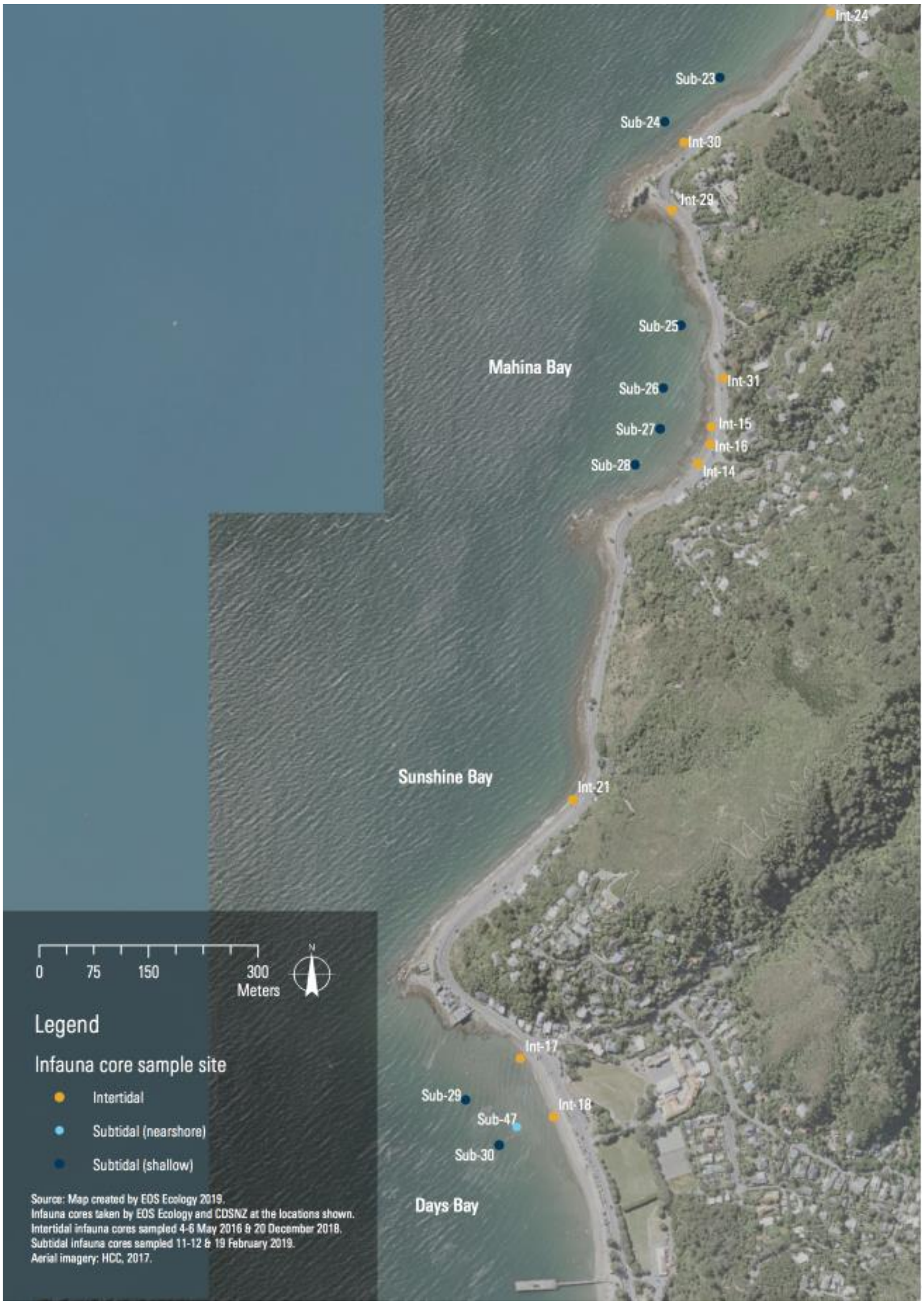


*Figure 6 continued.*


*Figure 6 continued.*

*Figure 7*[48] *Map showing the possible impact zones.* Apart from the 'Impact 1' area, which were based off maps provided in Reinen-Hamill (2019) as the area where beach nourishment material will be added and will spread to in the 'initial adjustment' phase, the other impact areas are estimations of where sediment may move to over time based on the statement in Reinen-Hamill (2019) that "there may be significant movement of nourished sediment within the embayment following similar sediment transport processes as currently occur" and the indication by Allis (2019) that there is a 'general northward movement of materials' within the project area.

[48] Note that this is Figure 15 in the Subtidal Technical Report (Appendix A-2 of the Project AEE).