

**Before the Independent Hearing Panel appointed by
the Canterbury Regional Council**

IN THE MATTER OF The Resource Management Act
1991

AND

IN THE MATTER OF Application CRC242267 to
undertake erosion and inundation protection works at
Southshore and South New Brighton Park.

Addendum to Section 42A Officer's Report

Report of Melanie Jane Burns

Introduction

Background

1. This report forms part of the Canterbury Regional Council's (CRC) audit of the assessment of environmental effects (AEE) provided by Christchurch City Council [CCC] (the applicant) in support of resource consent applications for erosion and inundation protection works at Southshore and South New Brighton Park.
2. This report will provide the decision-maker with information and advice related to:
 - a. the actual and potential effects of the proposed activities on estuarine ecology and water quality in Southshore and South New Brighton Park.
3. While not required for a Council hearing for a resource consent application, I have read the Code of Conduct for Expert Witnesses in giving evidence to the Environment Court. I agree to comply with that code when giving evidence to the Hearing Panel in this matter. All my evidence is within my expertise and I have considered and stated all material facts known to me which might alter or qualify the opinions I express.

Qualifications

4. I hold the qualifications of Bachelor of Science in Ecology, and Master of Science in Environmental Science from University of Canterbury. My MSc research was undertaken in the Avon-Heathcote Estuary/Ihutai and my thesis was titled 'The effects of macroalgae mats on marine benthic fauna'.
5. I have nine years' experience as an environmental scientist specialising in estuarine ecology and coastal water quality. I also have 11 years' experience in resource consent monitoring of activities within the coastal marine area. I have been employed by Canterbury Regional Council as a Senior Scientist – Coastal Water Quality and Ecology since November 2021.
6. I have been involved with and led the estuarine ecology monitoring, coastal water quality, and contact recreational monitoring programmes at Environment Canterbury. I regularly contribute expert knowledge to internal technical requests including activities within the coastal marine environment.

Scope of Report

7. This report is prepared under the provisions of section 42A of the Resource Management Act 1991 (RMA). This section allows a council officer or consultant to provide a report to the decision-maker(s) on a resource consent application made to the council and allows the decision-maker(s) to consider the report at the hearing. Section 41(4) of the RMA allows the decision-maker(s) to request and receive from any person who makes a report under Section 42A "*any information or advice that is relevant and reasonably necessary to determine the application*".
8. This report is supplementary to the Section 42A Report prepared by the CRC for the above resource consent applications. Full details of the consent applications are provided in that report. To carry out this audit of the consent applications I have considered:
 - a. Assessment of Effects on the Environment (Jacobs, 2023);
 - b. Appendix C - Drawings (Jacobs, 2023);
 - c. Appendix D - Design Report (Jacobs, 2023);
 - d. Appendix M - Ecological Impact Assessment (Boffa Miskell, 2023);
 - e. Further information that was provided by the applicant on 9 April 2024, 23 October 2024, 20 November 2024, and 19 December 2024;
 - f. Amended Ecological Impact Assessment (Boffa Miskell, May 2025);
 - g. Memo of site visit and proposed amendments/further investigation (CCC, 16 July 2025).
 - h. Updated consent conditions (CCC, October 2025).

I have also reviewed relevant data from ecological monitoring of the Avon-Heathcote Estuary/Ihutai undertaken by Christchurch City Council and reported in Berthelsen et al. (2022). I have attended a site visit on 16 July 2025 with the applicant and their consultants. Finally, I have also considered relevant issues raised by submitters in relation to the effects I have considered in this report.

Assessment of Receiving Environment

9. The Ecological Impact Assessment (EIA) Report by Boffa Miskell (2023) has provided a detailed description of the estuarine ecology and mapped the eastern boundary of seagrass beds (*Nanozostera muelleri*, formerly *Zostera muelleri*) within the intertidal area along the project footprint in South New Brighton Park (SNBP) and Southshore.
10. I agree with the assessment of ecological value of the hard-bottom habitats in SNBP and the unvegetated soft sediment habitats along Southshore and SNBP as outlined in the EIA report (Boffa Miskell, 2023).
11. I disagreed with the assessment of ecological value of the vegetated soft sediment habitats where seagrass beds are present in Southshore as outlined in the EIA report (Boffa Miskell, 2023). However, Boffa Miskell have reconsidered their original assessment and there is now agreement that these beds have very high ecological value (Boffa Miskell, 2025).
12. Seagrass beds form a highly valuable estuarine habitat that supports a high biodiversity of fauna, act as a nursery for juvenile fish, provide important ecosystem services, including natural erosion protection. They are also important in reducing the effects of climate change through carbon sequestration. Seagrass (*N. muelleri*) are an 'At risk –

Declining' species under the New Zealand Threat Classification System (de Lange et al., 2023). In Canterbury, there are only a small number of locations where seagrass beds are present and the seagrass beds in Southshore are the largest area in the region. Long-term data at Plover Street, Southshore, suggests that these beds are increasing in percent cover (Berthelsen et al., 2022).

Assessment of Effects on the Environment

13. The application provides a detailed description of the existing erosion protection structures, and design and location of the new erosion protection structures. The application outlines the potential adverse effects from the construction of the structures and post-construction effects on the estuarine environment. I agree with the potential adverse effects that have been identified.
14. The potential adverse effects on the estuarine environment as outlined in the EIA report (Boffa Miskell, 2023) are:
 - a. Loss of habitat through reclamation and habitat disturbance (soft-bottom and hard-bottom),
 - b. Mortality of estuarine organisms,
 - c. Loss of estuarine vegetation,
 - d. Sedimentation and contamination, and movement of cobble beaches,
 - e. Noise and vibration effects,
 - f. Increased access to the estuary bed, and
 - g. Coastal squeeze.
15. I have considered the further information provided by the applicant and submissions. Outlined below are points of agreement and disagreement of these potential effects and my assessment of proposed mitigation.

Loss of Habitat through Reclamation and Habitat Disturbance

16. It is my understanding of the current proposal that only the consented structure at SNBP is considered existing environment. The remaining structures in SNBP and Southshore, have been removed from the calculations of 'declamation' and the overall reclamation assessment. Furthermore, the applicant has proposed design changes to the cobble beach area at SNBP, which will mean there will be an overall 'net zero' reclamation across the project footprint.
17. The applicant has indicated they are prepared to change the position of the erosion protection structures further landward than originally proposed to avoid all reclamation of soft sediment habitat and disturbance to seagrass beds, except in two specific locations (44a Rockinghorse Road and adjacent to the middens in SNBP) where there are site constraints. The applicant has stated that the detailed design drawings will reflect a 'net zero' or better reclamation of the estuary.
18. Condition 9 of the proposed General Conditions allows for non-material changes to be made to the detailed drawings/approved plans at any time. However, I recommend that any further revisions to the design drawings maintain an overall 'net zero' or better reclamation of the estuary. Also, any material changes to the design plans should be supplied to Environment Canterbury for review and approval. If a condition is included that outlines this mitigation measure, then I consider that the effects on habitat loss from reclamation will be negligible.

Mortality of estuarine organisms

19. The EIA report (Boffa Miskell, 2023) assessed that there will likely be mortality of sessile or slow-moving organisms (mobile organisms should be able to leave the area) from the disturbance of the soft sediment habitats during construction phase. The applicant proposes to mitigate these adverse effects by reinstating the excavated material within the same tidal window. Boffa Miskell assessed the resulting effects as very low. This proposed mitigation measure was not included in the proposed consent conditions. If a condition is included that outlines this measure, then I consider that the effects from mortality of estuarine organisms to be low, not very low as assessed by Boffa Miskell.

Loss of estuarine vegetation

20. My understanding of the current proposal is that the proposed erosion protection structures will not overlap with any seagrass beds or patches, and the eastern boundary (estuary edge) of the seagrass habitat will be re-mapped before construction begins to confirm the extent of overlap between the seagrass beds and the project footprint. If needed the project design will be revised to avoid seagrass beds overlapping with the footprint of the new structures.
21. The applicant has also outlined that if there are severe design constraints (e.g. at 44a Rockinghorse Road) and the overlap is limited to a very small number of isolated seagrass plants, that they will discuss with the consenting authority a suitable measure to avoid impacts on the seagrass habitat.
22. The applicant proposes to minimise the disturbance to seagrass beds by requiring that any works within 10 m of seagrass habitat is undertaken in accordance with a Seagrass and Saltmarsh Management Plan (SSMP). The SSMP will include (but not be limited to) requiring that the existing structures are removed from the landside only, with no machinery permitted to enter the estuary, and manual removal of the structures. Where the footing of the existing structures can't be removed without disturbing the seagrass beds, they will be left insitu and cut off at a level of 100 mm above the estuary bed. The works overseen by a suitably qualified and experienced marine ecologist.
23. These mitigation measures have been included in the proposed consent conditions (General Conditions - Condition 5 and Regional Consent - Conditions 4, 5 and 6). Therefore, I consider that the risk of any adverse effects on seagrass beds will be low.

Sedimentation, contamination, and movement of cobble beaches

24. The EIA report (Boffa Miskell, 2023) outlined the potential for resuspension of benthic sediment and associated contaminants from the excavated area, as well as the runoff of terrestrial sediment and contaminants from the works on the adjacent land. The applicant has included erosion and sediment control measures in the proposed General Conditions 17, 18, 19 and 20 to manage the runoff of terrestrial sediment and contaminants. I recommend that the erosion and sediment control plan is provided to Environment Canterbury for review prior to commencement of work. If this mitigation measure is included, then I consider that the risk of adverse effects from sedimentation to be low. However, the mitigation measures to minimise the potential for resuspension of benthic sediments and contaminants which included working only during low tide windows, reinstating the disturbed area of seabed within same low tide window, and ensuring that the disturbed areas are compacted and level with the surrounding seabed, have not been included in the proposed consent conditions. If a condition is included that outlines these mitigation measures, then I consider that the effects from resuspension of benthic sediment and contaminants to be low as well.
25. Establishment of cobble beach areas are proposed as part of the erosion protection structures in SNBP and Southshore. I was concerned about the potential damage to the

soft sediment habitats from the movement of these cobbles and the long-term changes in the composition of substrate in this area. The applicant has proposed to monitor the toe of the cobble beaches annually and after large storm events and remove any displaced cobble material and reposition it back into the cobble beach.

26. The proposed Regional Consent Conditions 10 and 11 include these mitigation measures. However, Condition 11 does not include the requirement to remove this material by hand. I have suggested some changes to the wording of Condition 11 (paragraph 50 below) to include this mitigation measure. If this is included, then I consider that the potential adverse effects to be low.
27. The EIA report (Boffa Miskell, 2025) assessed that if the deposited cobble and rock material is not free from fine sediment that this could result in adverse effects on water quality and estuarine organisms through both increased suspended and deposited fine sediment. I agree with this assessment. However, the management of the quality of the deposited material has not been included as a proposed consent condition. Furthermore, the cobble and rock material needs to be free from contaminated material, soil, and pest species, as these could also have adverse effects on the estuarine ecology. If appropriate mitigation measures controlling these attributes are included as consent conditions, then I consider the potential adverse effects on water quality and estuarine organisms to be low.

Noise and Vibration

28. The EIA report (Boffa Miskell, 2023) assessed the offloading of material, excavation and piling operations as having a very low level of effect as it will only occur intermittently and at low tide (so no propagation of noise through the water column). There has been a subsequent change to the application, and the Tern Street Jetty is no longer included, so there won't be any piling operations. I agree that the effects of noise and vibration on aquatic life will be very low.

Increased access to the estuary bed

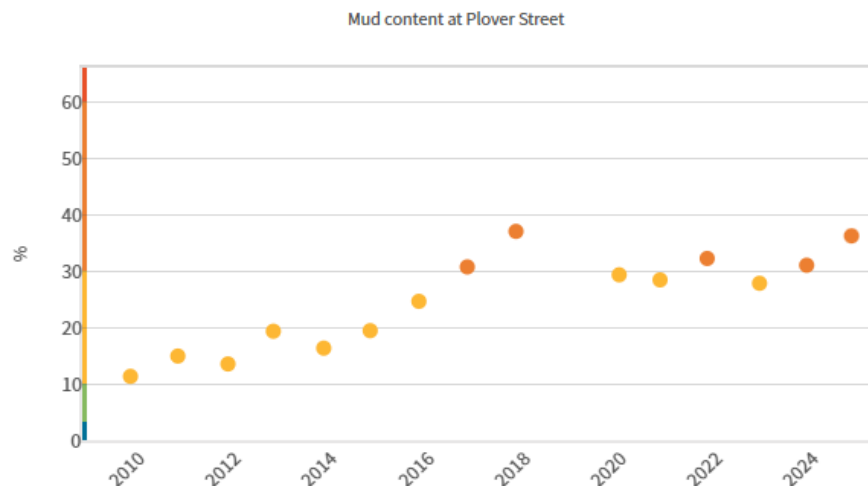
29. The new erosion protection structures will include new stepped facilities to facilitate access to the estuary. I was concerned that the new stepped facilities may result in an increased number of people, watercraft, and vehicles, accessing the estuary bed. Which could result in trampling and disturbance to the soft sediment habitats and seagrass beds, as well as littering.
30. My understanding of the current proposal is that the number of stepped facilities along the project footprint will be limited to two formal well designed access points at Tern Street and Godwit Street. Furthermore, the applicant proposed that the access points will be designed to be a minimum of 30 metres from significant seagrass beds to minimise the disturbance from launching watercraft (e.g. kayaks). Also, new educational signage outlining ecological values, shellfish safety and dog access rules will be installed.
31. The proposed consent conditions (General Conditions 1 and 33) outline that there will only be two stepped facilities and new signage will be installed advising on the ecological values and water quality in the area. However, the proposed conditions do not require that these stepped facilities must be at least 30 metres from the edge of seagrass beds or significant patches to minimise the adverse effects. If this mitigation measure is included as a consent condition, then I consider that the adverse effects from increased access to the estuary bed to be low.

Coastal Squeeze

32. The applicant has proposed to install gabian baskets (SNBP), rock revetments (Southshore) and cobble beach structures (SNBP and Southshore) to protect the inundation bund from erosion. These structures could contribute to “coastal squeeze” in the intertidal zone, reducing soft sediment habitat and the area available for seagrass beds, as well as increasing water levels.
33. The applicant has agreed to trial a ‘soft edge’ natural beach in SNBP (replacing part of a cobble beach) but plans to retain the other cobble beach structures along Southshore as well as the rock revetment structures.
34. Advice from Environment Canterbury’s Senior Natural Hazard’s Scientist, Mr Bruce Gabites, is that apart from two areas between Heron Street and Penguin Street, the current position of the LINZ bund is located a sufficient distance landward of the existing protection structures that it is unlikely to be subject to coastal erosion in the next 20 years. Mr Gabites also considers that there is no reason from a coastal process and hazard perspective why a ‘harder’ engineered rock revetment is required for the majority of the Southshore estuary shoreline when a slightly ‘softer’ engineered cobble beach would be sufficient.
35. The applicant engaged NIWA (now Earth Sciences New Zealand) to assess whether vertical land movement, Sea Level Rise (SLR) and sedimentation will increase water levels and reduce the intertidal zone. This was to help determine if the proposed activities could contribute to “coastal squeeze”. I have reviewed the report by NIWA (2024) and the updated EIA by Boffa Miskell (2025).
36. The NIWA (2024) report highlights that over the proposed consent duration (20 years: expiry 2045) there will be a small loss (between 1.8 m and 16.2 m) of intertidal area (due to it becoming submerged at low tide) under the lower SLR scenarios (SSP 2-4.5 p17 and SSP 5-8.5 p50). Most of these areas are around the slopes of the low tide channels (Boffa Miskell, 2025). However, under the higher SLR scenario (SSP 5-8.5 p87) there could be a much larger loss of intertidal area up to 303.5 m particularly at the northern end of the site (Table 3-1, NIWA 2024).
37. The NIWA (2024) report then assessed the proportion of the intertidal area currently occupied by seagrass beds that could be lost under the different SLR scenarios. Most of the intertidal area currently covered by seagrass will remain intertidal and continue to experience an alternation of emersion/immersion periods (Boffa Miskell, 2025). Except under the most extreme scenario (SSP 5-8.5 p83) where some of the seagrass beds will become permanently submerged (up to 47% at the northern end of the site).
38. Although seagrass beds will only be affected under the most extreme SLR scenario, the unvegetated soft sediment habitats will be reduced under all SLR scenarios. Boffa Miskell (2025) considered that this would only result in a very slight change to macroinvertebrates compared to existing baseline conditions and assessed the adverse effects to be very low. In my opinion, there is still uncertainty about the potential adverse effects on the macroinvertebrate communities within the unvegetated soft sediment habitats. This is because macroinvertebrate community composition in intertidal soft sediment habitats is often strongly zoned by the tide. The loss of intertidal area could result in a loss of species or change in composition of communities if they are not able to migrate shoreward (Rullens et al., 2022). Mr Andrew Crossland who is an avifauna expert at the CCC also share concerns about the loss of intertidal habitat. Mr Crossland is concerned that the loss of intertidal habitat from coastal squeeze could affect a wide range of bird species that rely on the exposed mudflats, seagrass beds and shallow waters to meet their daily feeding requirements (Crossland, 2025).
39. The NIWA (2024) report also assessed the depth of high-water spring tides in the intertidal area which will increase with rising SLR and land subsidence. Boffa Miskell

(2025) stated that this could lead to longer periods of immersion in deeper water at high tide (or continuous immersion in areas no longer emerged at low tide), which could reduce the photosynthetic capacity of seagrass with the severity of effect being dependent on water clarity.

40. Boffa Miskell (2025) consider that given the limited changes in photosynthetically active radiation (PAR) at Southshore at high tide due to the good water clarity, and the ability of seagrass to up-regulate photosynthesis at low tide, that the magnitude of pressure from coastal squeeze on seagrass beds under the two lower RCP scenarios would be negligible. They also state that even under the most extreme SLR scenario the seagrass beds will only be a few centimetres below mean low water spring tide and with good water clarity should still have access to suitable light (Boffa Miskell, 2025).
41. Therefore, to minimise the adverse effects on seagrass beds from increasing water levels from coastal squeeze, requires either water clarity to remain high (i.e. low turbidity) so that seagrass beds can continue to photosynthesis with increasing water depths; or sediment mud content (from deposited sediment) to remain low so they can compensate for high turbidity by photosynthesising during low tide periods (emerged).
42. Long-term water quality monitoring at Penguin Street (Southshore) by Environment Canterbury has shown decreasing trends in turbidity over the last 10 years. However, increasing turbidity is expected to occur simultaneously with sea-level rise in many places (Flowers et al. 2023a). Although Southshore currently has good water clarity, it may become vulnerable in the future through the increasing frequency and intensity of extreme weather events that deliver more land-derived sediment and nutrients, which can increase water column turbidity (Seneviratne et al., 2012 as cited in Mangan et al., 2020).
43. Also, the ability of seagrass beds to up-regulate during low tide depends on not only the duration of emergence, but whether suspended sediments settle out and smother primary producers (Drylie et al., 2018). Monitoring of estuarine sediment grainsize by CCC at Plover Street¹ shows an increasing proportion of mud content in the surface sediment (see graph below) over the last 15 years.



44. Seagrass beds have shown some resilience to increases in mud content (up to ~33%). While areas of high mud content (>39%) are likely to lead to degradation and loss of seagrass habitats and the expansion of unvegetated soft sediment habitats (Flowers et

1.

¹<https://www.lawa.org.nz/explore-data/canterbury-region/estuaries/avon-heathcote-estuary/hutai/plover-street>

- al., 2023b). The mud content at Plover Street in 2025 was recorded around 36%. Therefore, it is possible that the seagrass beds at Plover Street (Southshore) are already experiencing stress, which could reduce their ability to up-regulate with increasing SLR.
45. In my opinion, there is still some uncertainty around the level of adverse effects that increased immersion periods and higher water levels, arising from coastal squeeze, could have on seagrass beds.
 46. Boffa Miskell (2025) also stated that to understand the adverse effects under the most extreme SLR scenario more comprehensive mapping across Southshore area is needed to assess the likely changes to the intertidal area, depth patterns in the new permanently submerged areas and whether some areas of soft sediment habitat not colonised by seagrass could become suitable/available for colonisation.
 47. The applicant has proposed a consent condition stating that a decommissioning plan for the structures will be provided at least 12 months prior to expiry of the consent unless a new consent is sought to authorise the continued occupation of the structures.
 48. Overall, the construction of rock revetments and cobble beaches along the estuary edge in Southshore will under all SLR scenarios result in coastal squeeze over the duration of the consent. It is my opinion that there is still uncertainty regarding the potential adverse effects from coastal squeeze on seagrass habitats and intertidal soft sediment habitats and the resulting effect on macroinvertebrate community composition. Given the advice from Mr Gabites, it is my recommendation that a 'softer engineered' solution along Southshore should be used instead of the rock revetments. Furthermore, a monitoring plan should be implemented to collect data to inform future coastal adaptation strategies along Southshore and consent applications.

Proposed Conditions

49. I have reviewed the proposed General Consent conditions and Regional Consent conditions and have suggested additions underlined.
50. Regional Consents - Condition 11
If needed, based on the results of the yearly mapping and of any post-storm inspection:
 - a. Reinstate the original position of the toe of the cobble beach structures.
 - b. Remove any material washed onto the soft sediment habitat and saltmarsh habitats, by hand (i.e. no machinery in the CMA).
 - c. Re-establish saltmarsh plants in areas where cobbles have caused damage to the saltmarsh vegetation.
 - d. Results of the yearly mapping and post-storm inspections and any activities associated with clauses a. – c. shall be documented and provided on request to Canterbury Regional Council.
46. General Conditions – Condition 12
At least 10 working days prior to the proposed commencement of construction, the consent holder shall submit to the Consent Authorities for certification, the following management plans:
 - a) A Construction Environmental Management Plan (CEMP);
 - b) A Construction Traffic Management Plan (CTMP);
 - c) An Erosion, Sediment and Dust Control Plan (ESDCP);

- d) A Spill Response Plan;
- e) Heritage Management Plan;
- f) Seagrass and Saltmarsh Management Plan (SSMP).

For the purpose of clarity, Canterbury Regional Council will take the lead in relation to feedback on the CEMP, ESDCP and Spill Response Plans.

Christchurch City Council will lead the feedback on the CTMP and Heritage Management Plan.

51. General Consents - Condition14

The Construction Environmental Management Plan (CEMP) required by Condition [x] shall clearly set out the measures to be undertaken to comply with the conditions of this consent.

The CEMP shall be submitted to the Canterbury Regional Council: Attention: Regional Leader Monitoring and Compliance, and Christchurch City Council at least five 30 working days prior to construction works commencing and shall be adhered to by the Consent Holder.

The CEMP shall include, but is not limited to:

- a) A map showing the location of all works;
- b) Details of the construction methods proposed for the inundation bund, gabion baskets, rock revetment, cobble beach and soft beach area; seawall;
- c) Details of forecast monitoring frequency including methodology for providing temporary joining of the inundation bund where tidal and rainfall events are likely to pose an inundation risk;
- d) A programme of works including an indicative timeframe and sequence of works, consistent with any seasonal and tidal restrictions specified in Condition [x] and the Construction Methodology required by Condition [x];
- e) The methodology for stabilising the site if works are abandoned;
- f) Controls on the disturbances within the CMA, including the placement of geotextiles or geofabrics in excavations
- g) Construction noise and vibration controls;
- 1. h) Water quality management;
- i) Reference to the Spill Response Plan (required by Condition [x]), outlining how compliance with its procedures will be achieved;
- j) Reference to the Seagrass and Salt Marsh Management Plan [SSMP] (required by Condition [x]), outlining how adverse effects on seagrass and saltmarsh habitats will be avoided;
- j) Archaeological and Cultural Discovery protocols;
- k) Site notices to inform the public of the works and direct people safely to alternative routes;
- l) The monitoring and visual observations, required in accordance with condition (x) to (x).
- m) Details of site induction processes for all personnel, covering all relevant environmental, health and safety, and cultural protocols;

- n) Contact details for all key project personnel, including the designated Site Supervisor and specialist technical advisors (eg SQEP, archaeologist); and
- o) Waste management and recycling protocols for all construction-generated waste.

Advice Note: The CEMP may be prepared as a combined joint document that addresses the matters required by both the Canterbury Regional Council and Christchurch City Council land use resource consents.

Response to issues raised by submitters

- 52. Ihutai Estuary Trust raised concerns about loss of estuary habitat through coastal squeeze, the use of cobble beaches and reduced ecosystem functionality, and increased access onto the intertidal soft sediment habitats. I agree with their concerns and consider that I have covered these within my advice.
- 53. Department of Conservation (DOC) raises concerns about coastal squeeze reducing the areas of saltmarsh and soft sediment habitat due to the proposed erosion protection structures and recommend monitoring seagrass and soft sediment habitat for effects of coastal squeeze. I agree with their concerns and consider that I have covered these within my advice.
- 54. Simon Francis Watts is in support of the application and says that seagrass meadows will be naturally replenished from offshore meadows. I am unaware of any offshore seagrass meadows within the Canterbury region. Seagrass beds in Canterbury predominately occur in intertidal areas with some extending into shallow subtidal areas.

Conclusions and Recommendations

- 55. I agree with the assessment of the ecological value of the hard-bottom habitats in SNBP and unvegetated soft sediment habitats along Southshore and SNBP. There is now agreement that the seagrass habitats along Southshore have very high ecological value.
- 56. The applicant has made changes to the design plans to address earlier concerns that were raised by CRC. However, there are still some mitigation measures that I recommend are included as consent conditions before I consider the adverse effects to be low.
- 57. I consider that there is still uncertainty around the potential adverse effects from coastal squeeze (and higher water levels) on seagrass beds and loss of intertidal soft sediment habitats on macroinvertebrate community composition, over the duration of the consent. It is my recommendation that a 'softer engineered' solution along Southshore is adopted and that a monitoring plan is implemented to collect data to inform future coastal adaptation strategies and consent applications.

References

Berthelsen, A., Clark, D., & Pavanato, H. (2022). The sediments and biota within Te Ihutai/Avon-Heathcote Estuary 2007-2021.

Boffa Miskell (2023). Southshore and South New Brighton Park Flood Protection Works: Ecological Impact Assessment. Report prepared by Boffa Miskell for Christchurch City Council dated 1 December 2023.

Boffa Miskell (2025). Southshore and South New Brighton Park Flood Protection Works: Ecological Impact Assessment. Report prepared by Boffa Miskell for Christchurch City Council dated 29 May 2025.

Crossland, A. (2025). Southshore and South New Brighton Park coastal protection works. Avifauna memorandum.

De Lange, P.J., Gosden, J., Courtney, S.P., Fergus, A.J., Barkla, J.W., Beadel, S.M., Champion, P.D., Hindmarsh-Walls, R., Mekan, T., Michel, P. (2024). Conservation status of vascular plants in Aotearoa New Zealand, 2023. New Zealand Threat Classification Series 43.

Drylie, T.P., Lohrer, A.M., Needham, H.R., Bulmer, R.H., & Pilditch, C.A. (2018). Benthic primary production in emerged intertidal habitats provides resilience to high water column turbidity. *Journal of Sea Research* 142 (2018) 101-112.

Flowers, G.L., Needham, H.R., Bulmer, R.H., Lohrer, A.M., & Pilditch, C.A. (2023a). The implications of sea-level rise and reduced light availability on intertidal primary production.

Flowers, G.L., Needham, H.R., Bulmer, R.H., Lohrer, A.M., & Pilditch, C.A. (2023b). The effect of sediment mud content on primary production in seagrass and unvegetated intertidal flats. *Estuaries and Coasts* <https://doi.org/10.1007/s12237-024-01403-1>

Mangan, S., Bryan, K.R., Thrush, S.F., Gladstone-Gallagher, R.V., Lohrer, A.M., & Pilditch, C.A. (2020). Shady business: the darkening of estuaries constrains benthic ecosystem function. *Marine Ecology Progress Series*, Vol. 647: 33-48.

NIWA (2024). Assessment of future bed level change in Ihutai/Avon-Heathcote Estuary. Prepared for Christchurch City Council.

Rullens, V., Mangan, S., Stephenson, F., Clark, D.E, Bulmer, R.H, Berthelsen, A., Crawshaw, J., Gladstone-Gallagher, R.V., Thomas, S., Ellis, J.I & Pilditch, C.A (2022). Understanding the consequences of sea level rise: the ecological implications of losing intertidal habitat, *New Zealand Journal of Marine and Freshwater Research*, 56:3, 353-370, DOI: 10.1080/00288330.2022.2086587