BEFORE THE WHANGAREI DISTRICT COUNCIL AND NORTHLAND REGIONAL COUNCIL

IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of a resource consent application by Northport Limited under section 88 of the Resource Management 1991 for a port expansion project at Marsden Point
APPLICATION NO.	APP.005055.38.01 LU 2200107

STATEMENT OF EVIDENCE OF DR SHANE KELLY

(MARINE ECOLOGY – EXCLUDING AVIFAUNA, MAMMALS, AND BIOSECURITY)

24 AUGUST 2023

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INTRODUCTION

Qualifications and experience

1. My name is Shane Kelly.

2. I have a BSc in Zoology and a PhD in Biological Sciences, both from the University of Auckland. I have a diverse range of experience, with a strong emphasis on applied science, environmental assessment, marine conservation and resource management. During my early career I was Project Leader/Principal Advisor in Environmental Research and Monitoring at the Auckland Regional Council (ARC). In this capacity I managed major research, monitoring, and strategic projects. These included State of the Environment monitoring programmes for water quality, sediment quality and ecosystem health. I was a key technical advisor on major urban infrastructure programmes and supported regulatory and planning teams by providing input to policy and plan development, major consents, and associated hearings and appeals. While at the ARC, I also co-authored the “Blueprint for Monitoring Urban Receiving Environments” and led the development of the Benthic Health Model (which was developed to assess the health of intertidal communities), and Waitematā Harbour and Pahurehure Contaminant Accumulation Models.

3. In 2008 I established Coast and Catchment Ltd, and since that time have provided technical advice on the effects of numerous coastal and land-use activities. Among other things, I have assessed and advised local and regional councils on impacts related to port dredging, port development and port discharges at Napier and Gisborne. I designed and reported on the harbour monitoring programme for New Zealand’s largest wastewater treatment plant at Mangere, and I am regularly commissioned to assess, monitor and/or advise on the effects of other wastewater plants.

4. My work has also included the assessment of environmental values and issues in multiple harbours and estuaries and providing effects assessments and technical advice on: water and sediment quality; ecological impacts of a range of coastal development activities; aquaculture development and regulation; and pollution spills. I was also the lead author of five “State of the Hauraki Gulf” reports.

5. I am a certified independent hearing commissioner. Examples of relevant hearings that I have sat on include applications to: abandon the Rena shipwreck; redevelop

the Wellington Interislander ferry terminal; and for dredging and redevelopment associated with the highly contaminated Calwell slipway in Port Nelson.

6. I am familiar with the application site and the surrounding locality. My involvement in the project has included reviewing technical reports on marine ecological matters prepared for Northport, providing general advice including participating in workshops involving the broader assessment team, conducting site visits and marine ecological surveys, co-authoring the Marine Ecological Assessment (Appendix 11 of the AEE) report with my colleague Dr Carina Sim-Smith, and responding to specific matters in the Northland Regional Council (NRC) s92 request for further information. I have also read the relevant parts of: the application; specific submissions; and the Section 42A Report. I have reviewed advanced draft versions of the statements of evidence of Mr Pettersson, Mr Reinen-Hamill, Professor Fox, and Mr Blackburn.

Code of Conduct

7. I confirm that I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note (2023) and I agree to comply with it. In that regard, I confirm that this evidence is written within my expertise, except where I state that I am relying on the evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

SCOPE OF EVIDENCE

8. In my evidence, I:

(a) provide an executive summary of my key conclusions;

(b) briefly describe the proposal, focussing on aspects most relevant to marine ecology;

(c) describe the environmental setting for the proposed activities, including the marine habitats and ecological values in and around the areas affected;

(d) describe and assess the potential effects of the proposed activities;

(e) comment on the draft proposed conditions advanced by Northport, including:

(i) the real-time dredging turbidity monitoring and management regime; and

(ii) the marine ecology assurance monitoring regime.

(f) respond to submissions; and

(g) respond to the s42A Report.

9. I note that the information I present under points (c) and (d) above essentially summarises the more detailed information contained in the Marine Ecological Assessment (Appendix 11 of the AEE) report and my responses to the NRC s92 request for further information.

10. For clarity, I also note that my evidence does not cover biosecurity issues, or effects on birds or mammals.

EXECUTIVE SUMMARY

11. The marine ecological values of Whangārei Harbour, and particularly Marsden Bay and its surrounds, were assessed through a desktop review and analysis of available information and data, plus additional data gathering from intertidal and subtidal habitats. The marine ecological effects of the proposed activities were assessed at system and footprint scales. Relevant effects primarily relate to:

- around 11.7 ha of additional reclamation on the eastern side of the existing and consented Northport facilities.

- capital and associated maintenance dredging to enlarge the existing swing basin and deepen it by around two metres, and to enable construction of the new wharf.

12. Issues of secondary ecological concern include:

- marine ecological effects associated with the creation of a 0.54 ha bird roost on the western side of the port.

- effects on the reef communities that have developed on existing revetment structures.

- the potential effects of additional stormwater runoff from Northport's wharf facilities.

13. Overall, Whangārei Harbour supports diverse and ecologically important marine communities. Northport sits within the outer harbour and entrance zone (OHEZ): a physically complex zone subject to strong currents with around 610 ha above chart datum and 1,970 ha below chart datum. It contains a mix of physical habitats and extensive areas of biogenic habitat (including extensive shell gravel beds, seaweed meadows, seagrass beds, sponges, horse mussels, scallops, and significant beds of other shellfish). This is reflected in a high diversity of ecological taxa in that zone. The OHEZ is considered to be a discrete and ecologically significant system, against which the scale of effects from the proposed activities are considered (in addition to the harbour scale).

14. Key factors considered in the assessments of effects were the:

    (a) values of the habitats, communities and biota likely to be affected;

    (b) extent, abundance and/or occurrence of features within the relevant ecological systems;

    (c) scale of effect relative to the size of the relevant ecological system; and

    (d) potential for recovery.

Effects on intertidal habitats and macrofaunal communities

15. Port reclamation will directly eliminate 6.6 ha, or 1.08%, of intertidal habitat, within the OHEZ. The construction of the proposed bird roost on the western side of the port (for the purposes of achieving positive ecological effects with respect to avifauna) will cover a further 0.54 ha of intertidal habitat (0.09% of intertidal habitat in the OHEZ), with natural processes shifting the position and extent of that feature over time. No at risk or threatened species of benthic macrofauna are known to occur in the proposed development, or surrounding area of Marsden Bay.

16. While intertidal habitats within the proposed reclamation and bird roost appear healthy and contribute to the broader diversity and ecological values of the harbour, the sites themselves do not contain unique or special ecological qualities. That, together with their small scale relative to the overall amount of intertidal habitat within Whangārei Harbour and the OHEZ, suggests that the effects of the

construction of the reclamation and bird roost on the extent of sandy intertidal habitat and the diversity of benthic macrofauna will be moderate at those scales.

Effects on subtidal macrofauna

17. Around 5.1 ha of habitat below chart datum (CD) will be lost beneath the proposed reclamation. Sampling indicates that sediments in that area contain a diverse infaunal community, with similar assemblages of taxa to that found on the western side of Northport. Few large epibiota were observed in video footage taken within the proposed reclamation area, and all are likely to be common. While subtidal habitats within the proposed reclamation footprint appear healthy and contribute to the broader diversity and ecological values of the harbour, the site itself does not contain unique or special ecological qualities. The loss of a small proportion (0.28%) of natural subtidal habitat in the OHEZ is unlikely to reduce overall biodiversity values or compromise ecological functions and processes within the zone. That, together with the small scale of reclamation relative to the overall amount of subtidal habitat within the harbour, suggests that the effects of reclamation will be moderate at both scales. However, ecological effects within the reclamation footprint itself will be more significant.

18. The proposed dredging will: remove the diverse benthic community in undredged areas; recontour and remove substrates from the consented, but yet to be, dredged area; remove biota and substrates that have reformed since previous dredging events; and lead to the alteration of current velocities. Most of those effects are already provided for under the current capital and maintenance dredging consent. Additional effects of the proposed dredging footprint include deepening the existing dredged basin by around 2 m. If the characteristics of the seabed substrates at the proposed dredging depth are similar to those existing at the currently consented depth, a similar community of benthic macroinvertebrates is expected to reform once dredging is complete. However, macrofaunal diversity would likely be lower if areas of dense shell were permanently lost.

19. Modelling predicts that sediment plumes generated during dredging will also affect the surrounding habitat. Subtidal areas predominantly to the west of the port are predicted to be periodically subjected to elevated suspended sediment concentrations. Those effects would be compounded by the impacts of sediment deposition that smothers seabed communities and habitats (particularly shell gravel). The methods used for dredging are predicted to have major influence on

sediment mobilisation, dispersal and deposition. Effects were conservatively assessed to potentially vary from High at the OHEZ and harbour scales if a trailing suction hopper dredger (TSHD) is used, to Moderate at those scales for cutter suction dredger (CSD) and backhoe dredger (BHD) operations. Risks will be reduced through turbidity monitoring and management processes proposed through conditions of consent. Based on the high ecological values observed in and around previously dredged areas, and assuming that shell gravel habitat re-establishes, ecological recovery is expected to occur over a period of around five years.

Effects on kai moana shellfish

20. The key shellfish likely to be affected by the proposed activities are cockles (tuangi), pipi, and possibly scallops (tipa). Cockles are a ubiquitous feature of intertidal sites throughout much of the harbour, whereas the distributions of pipi and scallops are patchier.

21. Sampling results indicated that densities of cockles in the proposed reclamation and bird roost sites were comparable to other sites in Marsden Bay, but very few cockles of harvestable size were obtained anywhere in the bay. The ubiquity of cockles, together with the small scale of the proposed reclamation and bird roost sites relative to the broad scale of habitat containing them in Whangārei Harbour suggests that the effects of those activities will be low at the harbour and OHEZ scales. Subtidal dredging has little potential to affect cockles.

22. In terms of pipi, available information suggests that:

(a) the occurrence of small pipi in the proposed reclamation and bird roost areas is likely to be augmented by eddies created by the existing Northport structures;

(b) the effects of the proposed reclamation will possibly be offset by a similar eddy that is expected to form and “entrap” pipi recruits on its eastern side;

(c) pipi do not reach harvestable sizes in the areas impacted by the proposed activities;

(d) the contribution of pipi from affected areas to broader spawning or harvestable stocks is likely to be minimal.

23. Pipi were not obtained in samples collected from the proposed dredging area. The effects of dredging and the dredging plume on pipi are therefore considered to be negligible. Overall, the effects of reclamation and dredging on pipi are considered to be low at the harbour and OHEZ scales.

24. No live scallops were observed in the reclamation area, but empty scallop shells were apparent around an octopus den, and low numbers of patchily distributed scallops were observed in the proposed dredging and nearby areas. Scallops will be permanently lost from the reclamation area. Scallops in the dredging area will either be displaced or killed during dredging, but recolonisation could occur once dredging ceases.

Effects on seagrass and macroalgae

25. Seagrass is listed as an "At Risk: Declining" species under the New Zealand Threat Classification System (NZTCS) due to the overall seagrass population being very large, but subject to low to high ongoing or predicted decline. The NZTCS includes the following qualifier for its classification of seagrass:

- it is a non-endemic species that is secure overseas; and
- the seagrass population experiences extreme fluctuations (de Lange et al., 2017).

26. Patches of intertidal seagrass within the proposed reclamation area will be permanently lost. The area covered by those patches is small (around 0.33 ha in 2021) compared to the current extent of seagrass beds within Whangārei Harbour (estimated to be around 6 km^2 in 2016). Therefore, effects on seagrass are expected to be low on harbour and OHEZ scales, equating to a less than minor effect.

27. Outer parts of Whangārei Harbour contain macroalgae meadows, with diverse, but low biomass, species assemblages that grow on subtidal shell and sediments. Surveys carried out over the past 30+ years, indicate that subtidal macroalgae meadows are a widespread and persistent feature in the harbour. Four "At Risk" macroalgae have been recorded in the outer harbour, with two of those species potentially present in areas affected by dredging. The latter two species are not endemic to New Zealand and the potential level of adverse effects on them are considered to be low, equating to a less than minor effect.

28. The effects of dredging on macroalgae will be similar to those previously discussed in relation to seabed communities and habitats (paragraphs 18 and 19). However, decreases in light levels caused by channel deepening may also alter the composition of the macroalgae community within that area.

Effects on reef habitat and biota

Reclamation will eliminate around 155 m of existing rock revetment and create around 483 m of rock revetment. All biota that cannot, or does not, move from the existing revetment structure will be smothered during reclamation. In the medium term (5–10 years), those effects will be offset by the colonisation of a new revetment by a similar reef assemblage. Consequently, the effect of reclamation on reef habitat and biota is assessed as positive in the medium to long term.

Effects on fish

29. Effects on fish are likely to be negligible because of the mobility of fish, relatively small scale of habitat permanently lost, and the likely recovery of habitats of importance to fish in other areas affected.

Effects on stormwater discharges

30. Assuming that past monitoring results are representative of existing discharge quality, and that a similar discharge quality will be maintained, the addition of the proposed reclamation area is not expected to cause any additional adverse ecological effects from stormwater discharges.

Cumulative effects

31. Effects on major habitats and features were assessed against what was considered to be the most ecologically relevant system. Overall, consents have been obtained (or are sought by Northport) for around 70 ha of dredging and reclamation in the OHEZ. Northport already have consent to carry out new dredging of around 13.2 ha of subtidal habitat, and reclamation of around 4.5 ha of mostly subtidal habitat on the eastern side of the port, which is yet to be constructed (Berth 4). Northport are seeking to reclaim an additional 6.6 ha of intertidal and 5.1 ha of subtidal habitat as part of their proposed reclamation project. The total area of marine habitat that will be lost, or disturbed in the OHEZ by the combined proposed Northport activities is therefore around 29.4 ha.

32. Channel Infrastructure NZ Ltd have also gained consent to dredge around 144 ha from the approach and entrance channel to Whangārei Harbour, but are yet to exercise it. That includes around 40 ha in the OHEZ. It is important to note that the consented Channel Infrastructure activities:

(a) Do not include reclamation or stormwater discharges.

(b) Are confined to dredging subtidal channel habitat that is devoid of reefs. Consequently, Channel Infrastructure dredging effects on intertidal habitat and subtidal reefs are likely to be negligible.

(c) Are to be conducted in areas that do not contain macroalgae meadows or seagrass (based on detailed surveys conducted for Channel Infrastructure).

(d) Were assessed to have low effects on fish because the affected species are mobile and able to utilise other locations.

(e) Are likely to have relatively minor impacts on mussels or other kai moana shellfish. No live scallops, pipi or cockles were detected during the 2015 survey of the Channel Infrastructure dredging area, but live mussels were detected at five sampling stations. Those mussel beds were rapidly depleted by overharvesting, with only few, scattered clumps of mussels being observed in recent years.

33. Consequently, when considered together (cumulatively) with Northport's application, the Channel Infrastructure activities add no or little additional effects on, or arising from:

(a) intertidal sediment habitats and macrofauna;

(b) reclamation on subtidal habitat and benthic macrofauna;

(c) seagrass;

(d) macroalgae;

(e) fish;

(f) reef habitat;

(g) kai moana shellfish; or,

(h) stormwater discharges.

34. Levels of effects for the proposed Northport activities alone, and in combination with Channel Infrastructure activities, were ranked from Moderate to High depending on the dredging methods used. However, the combined effects of the proposed Northport and Channel Infrastructure activities are not expected to increase the level of effect beyond High. I also note that, with my input, Northport's proposed conditions prohibit the commencement of capital dredging for Northport's proposed expansion project during or within six months of a capital dredging event (over a prescribed volume) authorised by Channel Infrastructure's Crude Shipping Project resource consents. This will assist with managing potential cumulative marine ecology effects between the two projects.

Effects summary

35. The below table, reproduced from paragraph 119 below, summarises the proposal's adverse effects:[1]

Table 1. Summary of the Assessment of Ecological Effects (including cumulative effects) of the proposed development at the scale of the: harbour; outer harbour and entrance zone (OHEZ); and development footprint (the most relevant system for each effect is in black with blue shading).

Potential effects	System		
	Harbour	**OHEZ**	**Footprint**
Effects on intertidal sediment habitats and macrofauna	Moderate	Moderate	Very high
Effects on kai moana shellfish	Low	Low	High
Effects on subtidal habitat and benthic macrofauna - Reclamation	Moderate	Moderate	Very high
Effects on subtidal habitat and benthic macrofauna - Dredging	Moderate to High	Moderate to High	Moderate to High
Effects on seagrass	Low	Low	Very High
Effects on macroalgae	Moderate to High	Moderate to High	Moderate to High
Effects on fish	Low	Low	Low
Effects on reef habitat	Low and positive in medium to long term	Low and positive in medium to long term	Low and positive in medium to long term
Effects of stormwater discharges	Low	Low	Low

[1] Table 2, and the effects assessment undertaken generally, represent conservative assessments (i.e. likely to over-estimate effects) for the reasons set out in the Marine Ecological Assessment (Appendix 11 of the AEE - refer to footnote 4).

36. For completeness:

(a) The ecological effects of the proposal on threatened or at-risk species (seagrass and macroalgae), or the Significant Ecological Areas (SEAs) identified in the Proposed Regional Plan will be in the range of negligible to less than minor (and in some cases temporary).

(b) Noting that most of the proposed dredging area is already subject to dredging, if the proposed best practice methods for managing dredging effects are applied, then ecological effects on other potential areas of significant indigenous vegetation and habitats of indigenous fauna under Appendix 5 of the Regional Policy Statement (RPS) can also be kept within minor and/or transitory levels.

THE PROPOSAL

37. Details of the proposed activities are covered in the AEE and evidence of Mr Hood, Mr Blomfield, and Mr Pettersson (among others). I therefore refer the Panel to those documents rather than repeating detailed information here. However, I note that marine ecological effects primarily relate to:

- around 11.7 ha of additional reclamation on the eastern side of the existing and consented Northport facilities;
- capital and associated maintenance dredging to enlarge the existing swing basin and deepen it by around two metres, and to enable construction of the new wharf.

38. Issues of secondary ecological concern include:

- marine ecological effects associated with the creation of a 0.54 ha bird roost on the western side of the port.
- effects on the reef communities that have developed on existing revetment structures.
- the potential effects of additional stormwater runoff from Northport's wharf facilities.

GENERAL ENVIRONMENTAL SETTING

Physical attributes of Whāngārei Harbour

39. Whangārei Harbour is approximately 24 km in length, and has a surface area of around 100 km^2, of which, 58% is intertidal. It has a mean depth of 4 m and a maximum depth of 31 m near Marsden Point. Key features of the harbour are shown in Figure 1.

40. The outer harbour and entrance are particularly complex, with strong tidal currents creating a series of tidal deltas (i.e., Calliope, Mair, Snake and MacDonald Banks), channel systems, and a seafloor consisting predominantly of gravel shell lag and shelly sand. In contrast, Pārua Bay, on the northern shore of the harbour, is a sheltered, depositional inlet that opens to the outer harbour through a relatively narrow entrance.

41. The mid-harbour section is a rectangular shaped water body, around 8.5 km long and 4 to 5 km wide, with large intertidal and shallow subtidal flats, and a relatively large blind channel running between the main channel and the northern shore. The main channel in the mid-harbour has three defined reaches (Shell Cut, Tamaterau, and Wellington), with depths varying from around 6–16 m. Deeper sections are associated with a series of "holes" in the Wellington Reach.

42. The main channel splits around Limestone Island, with the northern upper harbour branch diverging to head north up Hātea River, past Otaika and Limeburners Creeks, Whangārei Port and Whangārei township. The Southern upper harbour branch becomes Mangapai River, passing Portland and Tokitoki Creek, before branching and terminating as a series of small tidal creeks.

43. Intertidal sediments in the mid and outer harbour are predominantly sandy, with sediments becoming muddier in the upper harbour. Subtidal sediments around the harbour entrance consist of large areas of gravel-shell lag, interspersed with sand. Intertidal sediments around Northport are predominantly sand, except for the area immediately west of the port, which is muddy sand. Subtidal sediments around Northport consist of sand or gravelly sand.

44. Whangārei Harbour has been, and continues to be, subject to significant coastal development and anthropogenic stressors including Whangārei township, Northport, Port Whangārei, Marsden Point oil refinery (now the Channel

Infrastructure import terminal), marine farms, and multiple marinas, boat ramps and moorings.

45. Between the 1920s to late 1970s, around 3 million m^3 of sediment fines (of which 90% were under 10 microns in diameter) from the Portland Cement Works were disposed of in the harbour (Millar 1980). An additional 2 million m^3 of channel dredging material was deposited at various harbour locations in the 1960s (Dickie 1984). Sedimentation from land run-off is also a major historical and on-going issue. Research by NIWA indicates that the upper harbour has now been substantially infilled with eroded catchment soils, leading to mud being transported further downstream and accumulating in the northern bays and inlets (Swales et al. 2013).

46. The main channel of the harbour has been extensively dredged to maintain navigable depths. This includes cutting through a shallow shell bank that historically traversed the main channel between One Tree and Manganese Points, effectively delineating the outer and mid harbour (Morrison 2003).

47. Monitoring and assessments indicate that sediment concentrations of copper, lead and zinc frequently exceed guideline values in the upper reaches of the harbour, but are typically low in the mid to outer harbour where the port is situated. Sediment nitrogen and phosphorus concentrations are also high in the upper harbour and low in the mid to outer harbour. Similarly, water quality improves down the harbour, with sites near the harbour entrance having the best quality.

Marine ecological values

48. The marine ecological values of the Harbour, and particularly Marsden Bay and its surrounds, were assessed through:

(a) a desktop review and analysis of available information and data,

(b) additional data gathering and analysis, including:

(i) a rapid intertidal survey of Marsden Bay;

(ii) a comprehensive, quantitative survey of benthic macrofauna in Marsden Bay; and

(iii) a video survey of subtidal habitats around Northport.

49. Reviews of the ecological habitats and communities of Whangārei Harbour show that the harbour supports diverse and ecologically important marine communities. Approximately 35% of the harbour is designated as a Significant Ecological Area (SEA), with the One Tree Point–Marsden Bay SEA situated adjacent to the western side of Northport. Among other things, the SEA contains seagrass beds and sandflats that provide important feeding habitat for shorebirds. A marine reserve is present across the channel from Northport around Motukaroro Island.

Seagrass

50. Seagrass was historically abundant in Whangārei Harbour, with past extents covering around 10–14 km^2 of the harbour. By 1970 it had virtually disappeared, but since 1999 it has been expanding in intertidal areas. Around 6 km^2 of seagrass was estimated to be present in the harbour in 2016. Extensive seagrass beds are now present on the intertidal flats between One Tree Point and Northport, and small patches (estimated to cover a total of 0.33 ha in 2021) are also present within the proposed reclamation area.

51. Seagrass is listed as an “At Risk: Declining” species under the New Zealand Threat Classification System (NZTCS) due to the overall seagrass population being very large, but subject to low to high ongoing or predicted decline. The NZTCS includes the following qualifier for its classification of seagrass:

(a) it is a non-endemic species that is secure overseas; and

(b) the seagrass population experiences extreme fluctuations (de Lange et al., 2017).

52. Satellite images indicate that the distribution and spatial extent of seagrass beds in Marsden Bay are highly variable over relatively short periods of time. Similarly, high levels of temporal variability have been reported in other regions, such as the northern Manukau Harbour where a significant increase in seagrass extent occurred between 2013 and 2021 (Kelly 2021), and conversely, the central Kaipara Harbour where a significant decline in seagrass extent occurred between 2010 and 2019 (Kelly 2020).

Macroalgae

53. The shelly sand and shell gravel habitats of the outer harbour contain a diverse, but low biomass, macroalgae community. A recent survey recorded 119

macroalgae taxa growing on intertidal and subtidal soft sediments at six harbour sites, including One Tree Point, Mair Bank and Reotahi Bay (across the channel from Northport) (Neill & Nelson 2016). Although algae biomass was low, the number of taxa collected from these sites represented around 28% of the known regional flora across all habitat types. Macroalgae were also one of the key ecological features observed in video footage obtained during a survey conducted by Coast and Catchment in November 2021.

54. Four of the 119 macroalgae taxa recorded in the outer Whangārei Harbour by Neill and Nelson (2016) have been listed as “At Risk: Naturally Uncommon” with “Stable +/-10%” population trends under the NZTCS (https://nztcs.org.nz/; Nelson et al., 2019). All of these species are tagged with the qualifier “Data Poor”. In relation to that qualifier, the NZTCS manual (Townsend et al. 2008) encourages Expert Panels to make every effort to assign a taxon to a threat category rather than list it as “Data Deficient”, and then use “Data Poor” (DP) to indicate the uncertainty about the listing due to the lack of data.

55. The four “At Risk: Naturally Uncommon” species are:

(a) *Microdictyon mutabile*, an endemic green seaweed with a distinct growth pattern. It typically grows on sheltered gently sloping rocks in open, sunny locations of mid to low intertidal areas in northern New Zealand. The seaweed forms bushy, turfing pads over the substrate, is present all year round, and is commonly epiphytic on coralline algae (*Corallina officinalis*). (Adams 1994; Wilcox 2018; Nelson 2020).

(b) *Aeodes nitidissima*, a red seaweed that occupies low intertidal and subtidal rocky habitats on open coasts and sheltered harbours of northern North Island (Wilcox 2018; Nelson 2020). In the intertidal zone, it typically grows in intertidal runnels (Wilcox 2018). It is unclear whether *A. nitidissima* is an endemic species (Nelson 2020), as it has also been reported in Tasmania and South Australia (Scott 2012; Fowles et al. 2018). However, further work is required to confirm whether specimens from Australia and New Zealand are the same species, and to determine the morphological and ecological boundaries of this species (Russell et al. 2009). In Auckland, it is mostly found in the inner Hauraki Gulf, though specimens have been obtained throughout the eastern coast of the Auckland Region, apart from offshore islands.

(c) *Feldmannia mitchelliae*, a filamentous brown seaweed that is little known and poorly studied in New Zealand (Nelson, 2020), but is fairly common on the east coast of Auckland and widespread internationally (Wilcox, 2018; Guiry 2020a). In New Zealand, *F. mitchelliae* is known to grow on other seaweeds, seagrass, stones, shells, and mooring ropes. On occasion, nuisance quantities have been reported growing as thick skeins on top of intertidal seagrass in Whangārei Harbour, and on Neptune's necklace (*Hormosira banksia*) south of Bay of Islands (Nelson et al. 2015).

(d) *Hincksia granulosa*, a filamentous brown seaweed that is also little known and poorly studied in New Zealand (Nelson 2020), but is widespread internationally, particularly in temperate seas (Hewitt et al. 1999; Guiry 2020b). This species has been observed floating on other buoyant seaweeds and plastics. Research suggests that its broad international geographic distribution may be related to dispersal on floating substrata (Macaya et al. 2016). In New Zealand, it has also been reported on the hull of a fishing vessel (Piola & Conwell 2010), and is known to grow on other seaweeds and marina pontoons (Wilcox 2018).

56. Habitat types favoured by *M. mutabile* were not present in the areas affected, and no macroalgae resembling that species were observed during recent Marsden Bay intertidal or subtidal surveys. Similarly, habitats favoured by *A. nitidissima* are not present in the areas directly affected, and absent or very limited in the areas indirectly affected by the proposed activities. It is therefore unlikely that the proposed activities will adversely affect either of these species.

57. The other two "At Risk" macroalgae (*F. mitchelliae* and *H. granulosa*) are not endemic. They are internationally widespread, and known to disperse long distances attached to flotsam, other floating seaweeds, and potentially through hull fouling.

Sediment dwelling macrofauna

58. A substantial amount of data is available on the composition and distribution of sediment dwelling communities in Whangārei Harbour. It shows that the harbour sustains a diverse assemblage of benthic taxa. Benthic communities in upper sections of Hātea and Mangapai Rivers are clearly distinct and typical of those found in upper estuary systems. Further out into the harbour the community patterns are more diverse. An analysis of harbour-wide data obtained by Northland

Regional Council in 2012 indicated that the intertidal macrofaunal communities at sites in Marsden Bay were similar to intertidal communities in other parts of the harbour, including communities from sites in the upper, mid and outer harbour.

59. Finer scale sampling of Marsden Bay intertidal benthic community carried out in June 2022 showed that the diversity and abundance of macroinvertebrates varied across the Bay with marked differences apparent between intertidal sites on the western and eastern side of Northport. Ninety-seven taxa and 10,952 individual macroinvertebrate specimens were obtained from the 83 Marsden Bay core samples. Numbers of taxa and individuals in core samples taken from the eastern side of Northport (including areas within and beyond the proposed reclamation) were lower than in cores taken from the western side of the port (Figure 2).

60. Cockles are widespread in Whangārei Harbour and are particularly abundant around the outer harbour (Marsden Bay, McLeod Bay, Snake Bank and MacDonald Bank). Cockles were common throughout most of the June 2022 Marsden Bay survey area, but were not obtained from cores east of the proposed reclamation area.

61. Pipi were previously commercially harvested from Marsden and Mair Banks just outside of the harbour entrance, but commercial harvesting has been prohibited since 2011 and 2014, respectively, due to low biomass levels. Surveys of Marsden and Mair Banks between 2013–2019 found that pipis had a very patchy distribution, with low numbers of large (>50 mm) shellfish (Pawley 2014, 2016; Williams et al. 2017; Shirkey 2019). A survey of a narrow bank on the eastern edge of Marsden Bank in 2018 found much higher densities of pipis, but no large (>50 mm) pipis (Berkenbuisch & Neubauer 2018).

62. Juvenile pipis are present at several sites in the mid to outer harbour, with highest densities found at Marsden Bay and the western side of Northport, though very few pipis were of harvestable size (>50 mm) in all areas (Cummings & Hatton 2003; Griffiths 2012; Shirkey 2019). Small pipi (predominantly ≤20 mm in length) were common in samples collected during the June 2022 Marsden Bay survey, but numbers were low (Figure 3)[2]. Highest pipi counts occurred immediately east

[2] Note that this figure corrects an error in Figure 47 of Appendix 11 in the AEE. Two sampling stations in the proposed reclamation area were not shown in the original Appendix 11, Figure 47 because the upper end of the pipi count scale was unintentionally set too low in the mapping software.

and west of Northport, where tidal eddies are created during incoming and outgoing tides (Figure 4).

63. Small pipi can redisperse by drifting in the water column, suspended by a mucus thread. The eddies either side of Northport therefore have the potential to "trap" drifting pipi, and are possibly, if not probably, a key factor in the relatively high numbers immediately west and east of Northport (Figure 4).

64. Pipi within the proposed reclamation area were predominantly ≤5 mm in length, with highest counts coming from two cores that contained 19 pipi each. In those two samples, 16 and 18 pipi were ≤5 mm in length, with the remaining four pipi 6–10 mm in length. Core samples from the remaining five stations had total counts of 0 to 7 pipi each (counts of 0 to 3 pipi that were ≤5 mm in length), with a maximum size of ≤15 mm.

65. Subtidal sampling indicated that infaunal and epifaunal macroinvertebrate diversity is very high around the port, with areas of dense shell, a variety of large sessile species known to form biogenic habitat, and diverse communities of encrusting organisms. Grab samples collected for Northport contained a total of 198 taxa in 47 samples (Ahern 2020; Knue 2021). Remarkably similar numbers of taxa were obtained in two recent subtidal surveys of the outer harbour/harbour entrance:

- Kerr and Grace (2016) obtained 197 taxa from 11 stations (5 samples per station);
- West and Don (2016) obtained 189 taxa from 17 stations (1 sample per station).

66. In the Northport surveys, counts of many subtidal taxa were very patchy, with over a quarter of taxa (57) obtained from single samples. Fourteen taxa obtained from the proposed reclamation area were not found in the other areas sampled, but it is highly unlikely that any of those taxa are unique to that area.

67. The most diverse taxa groups were molluscs (63 taxa), annelid polychaetes (59 taxa from 28 families), and crustaceans (48 taxa from 28 families, including 21 decapods). The molluscs included 41 bivalves, 14 gastropods (snails), four opisthobranchs (e.g., sea hares, sea slugs and nudibranchs), and three chitons. The 20 most abundant taxa included nine polychaetes (particularly *Euchone* sp.

and *Spio* sp.), seven small crustaceans (mostly amphipods), two bivalves, an ascidian and an oligochaete worm. Most taxa occurred in low numbers, with combined total counts in pooled samples having a median of eight for individual taxa (10^{th} and 90^{th} percentiles of 1 and 194, respectively).

68. Two macroinvertebrate taxa that were only identified to genus level were from genera known to contain At Risk species. Those genera also contain very common and broadly distributed species, which are present in the area. In comparison, the At Risk species from those genera are naturally uncommon and range restricted. In my opinion, it is almost certain that the specimens found were the commonly occurring species within those genera and not At Risk species.

Subtidal biogenic habitat

69. Video footage obtained during a subtidal video survey carried out by Coast and Catchment (Figure 5) indicated that the ecological values of subtidal seabed habitats and communities around Northport were generally high, and largely consisted of patchy and/or contiguous sand and shell with a variety of biogenic features (see appended Figure 6 to Figure 12). Examples of the habitats and features present include:

- extensive areas of shell hash/gravel;
- macroalgae meadows;
- areas that were almost completely covered with a variety of sessile organisms including macroalgae, sponges, bryozoans, hydroids and other invertebrates;
- numerous small holes in sediments, which are likely to be worm tubes, shellfish siphons, and/or crustacean burrows;
- large biota, including the starfish (mainly *Astropecten polyacanthus* and cushion stars (*Patiriella regularis)*), horse mussels (*Atrina zelandica*), scallops (*Pecten novaezealandiae*), anemones, horn shells (likely to be *Maoricolpus roseus*), Mediterranean fan worm (*Sabella spallanzanii*), hydroids and bryozoans.

70. Transects through the proposed reclamation area (v to x in Figure 5 and Figure *6*) displayed clear changes with depth and distance from the shore. Habitat in the:

- deepest (~15 m deep) outer transect consisted of sand with little epibiota;
- central transect consisted of sand with patches of red algae densely packed with turret shells (possibly dead shells occupied by hermit crabs), scattered starfish (*A. polyacanthus*), macroalgae, sponges, and an octopus den;
- shallowest (~4 m deep) inner transect consisted of bare sand with numerous cushion stars.

71. Three inshore transects on the western side of Northport (transects m. to o. in Figure 5) also contained sand, dense patches of red macroalgae (some with dense aggregations of turret shells) scattered sponges and scattered to moderate densities of starfish. Isolated kelp (*Ecklonia radiata*) and scattered patches of low-density seagrass were also present in that area (Figure *7*). The outermost transect through the western side (Transect p. in Figure *5*) appeared to contain coarser sediments with dense beds of red macroalgae, a bed of large red or brown macroalgae, and sand and shell gravel with numerous small holes likely to be formed by worm tubes, shellfish siphons, and/or crustacean burrows (Figure *8*).

72. Clear transitions were also observed along two transects that were run through the consented, but undredged area, down a dredge batter slope and out to the base of the previously dredged area (Transects q. and r. in Figure 5). The consented, but undredged, area contained a mix of sand and shell gravel, with scattered macroalgae, and a variety of other species including occasional scallops, starfish, sponges, anemones, and octopus. The batter slope consisted of bare sand, while the seafloor of the previously dredged area was almost completely covered with a variety of sessile organisms including sponges, bryozoans, hydroids and macroalgae (Figure *9*). Other parts of the previously dredged area (Transects s. to u. in Figure *5*) contained a mix of sand, scattered and dense shell, and biogenic species such as scattered macroalgae and sponges (Figure *10*).

73. Surrounding reference areas also contained a mix of sand and shell gravel habitats with scattered to dense macroalgae beds and localised areas containing sparse seagrass (Figure *11* and Figure *12*). Notable features that were not observed in the areas and previously described above were:

- reasonably high numbers of horse mussels at the eastern end of Transect c.

- a high diversity and abundance of macroalgae in Transect i, together with relatively high numbers of bushy hydroids;
- patches with high densities of anemones in Transect e.

74. As noted above, a few scattered scallops were observed in video footage obtained from the proposed dredging area. Large, abundant scallop beds historically occurred in and around Whangārei Harbour, but surveys of beds in Smugglers Bay and Urquharts/Taurikura Bays in 2006 and 2007 found mean densities of legal sized scallops (>100 mm) were low (Williams et al. 2008; Williams 2009). Similar findings from the eastern Waikato, Auckland and Northland scallop fisheries has recently led to the closure of scallop harvesting throughout those areas (Parker 2022).

Fish

75. A variety of fishes utilise Whangārei Harbour. Fish communities around Northport appear similar to those that inhabit nearby reef areas, with leatherjackets (*Parika scaber*), red moki (*Cheilodactylus spectabilis*), spotty (*Notolabrus celidotus*), sweep (*Scorpis lineolatus*), triplefins (various), kingfish (*Seriola lalandi*), jack mackerel (*Trachurus novaezealandiae*), two-spot demoiselle (*Chromis dispilus*), and goatfish (*Upeneicthys lineatus*) commonly observed around the rock revetments of Northport. None of the reef species recorded are listed as Threatened or At Risk.

ASSESSMENT OF ECOLOGICAL EFFECTS

The ecological system

76. Potential effects were assessed using a system-wide approach, which recognised that the scale of effects from the proposed activities is proportional to the size and sensitivity of the area of indigenous biodiversity. The harbour ecological system is made up of at least four distinct zones:

(a) the outer harbour and entrance including flood and ebb tide deltas, a channel complex, and relatively narrow intertidal sandflats;

(b) Pārua Bay, on the northern shore of the harbour, which is a largely enclosed, sheltered, depositional inlet;

(c) the mid-harbour between the shell bank that historically traversed the main channel and Limestone Island, with its broad intertidal and subtidal flats, and channel system;

(d) the sheltered upper harbour, that splits into Hātea and Mangapai Rivers which narrow upstream and become increasing influenced by freshwater inputs and adjoining landuses.

77. As noted earlier, Northport sits within the outer harbour and entrance zone (OHEZ, Figure 1): a physically complex zone subject to strong currents with around 610 ha above chart datum and 1,970 ha below chart datum. It contains diverse physical habitats, extensive areas of biogenic habitat (including extensive shell gravel beds, seaweed meadows, seagrass beds, sponges, horse mussels, scallops, and significant beds of other shellfish). This is reflected in the high diversity of ecological taxa in that zone. The coastal margin and central area of this zone almost completely consist of SEAs (and a marine reserve), with areas that have not been mapped as SEAs mainly consisting of subtidal channels. Therefore, the OHEZ is considered to be a discrete and ecologically significant system, against which the scale of effects from the proposed activities are considered (in addition to the harbour scale).

Ranking levels of effect

78. Key factors considered in the assessments of effects were the:

(a) values of the habitats, communities and biota likely to be affected;

(b) extent, abundance and/or occurrence of features within the relevant ecological systems;

(c) scale of effect relative to the size of the relevant ecological system; and

(d) potential for recovery.

79. The Environmental Institute of Australia and New Zealand (EIANZ) guideline terminology for assessing the magnitude of effects was adopted for the assessment (Table 2, Roper-Lindsay et al. 2018). The EIANZ guidelines also include criteria for assigning ecological values to terrestrial and freshwater habitats. However, similar guidelines are not provided for marine habitats. Values

were therefore assessed using information gathered through the literature review and additional assessments, combined with professional judgement.

Table 2: Ranking system of the EIANZ Guideline (Roper-Lindsay et al. 2018) for assessing the magnitude of adverse environmental effects.

Magnitude	Description
Negligible	Very slight change from the existing baseline condition. Change barely distinguishable, approximating to the 'no change' situation; AND/OR Having negligible effect on the known population or range of the element/feature.
Low	Minor shift away from existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances or patterns; AND/OR Having a minor effect on the known population or range of the element/feature.
Moderate	Loss or alteration to one or more key elements/features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be partially changed; AND/OR Loss of a moderate proportion of the known population or range of the element/feature.
High	Major loss or major alteration to key elements/features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed; AND/OR Loss of a high proportion of the known population or range of the element/feature.
Very high	Total loss of, or very major alteration to, key elements/features/ of the existing baseline conditions, such that the post-development character, composition and/or attributes will be fundamentally changed and may be lost from the site altogether; AND/OR Loss of a very high proportion of the known population or range of the element/feature.

Effects of the proposed Northport activities on intertidal habitats and macrofaunal communities

80. Port reclamation will directly eliminate 6.6 ha, or 1.08%, of intertidal habitat, within the OHEZ. The construction of the proposed bird roost on the western side of the port (for the purposes of achieving positive ecological effects with respect to avifauna) will cover a further 0.54 ha of intertidal habitat (0.09% of intertidal habitat in the OHEZ), with natural processes shifting the position and extent of that feature over time. No At Risk or Threatened species of benthic macrofauna are known to occur in the proposed development, or broader Marsden Bay area.

81. While intertidal habitats within the proposed reclamation and bird roost appear healthy and contribute to the broader diversity and ecological values of the harbour, the sites themselves do not contain unique or special ecological qualities. That, together with their small scale relative to the overall amount of intertidal habitat within Whangārei Harbour and the OHEZ, suggests that the effects of the

construction of the reclamation and bird roost on the extent of sandy intertidal habitat and the diversity of benthic macrofauna will be moderate at those scales.

82. Dredging is not proposed in intertidal areas, and sediment plumes and deposition associated with the dredging are predicted to be largely confined to subtidal channels. Intertidal ecological effects from dredging are therefore expected to be negligible.

Effects of the proposed Northport activities on subtidal macrofauna

83. Around 5.1 ha of habitat below chart datum (CD) will be lost beneath the proposed reclamation. Sampling indicates that sediments in that area contain a diverse infaunal community, with similar assemblages of taxa to that found on the western side of Northport. Few large epibiota were observed in video footage taken within the proposed reclamation area, and all are likely to be common. Species directly observed included dense aggregations of turret shells (these were probably dead shells occupied by hermit crabs), scattered starfish (*A. polyacanthus and P. regularis*), scattered small sponges, and Mediterranean fan worm, which is a marine pest. An octopus den and numerous small holes in seabed sediments were also observed. The latter are probably worm tubes, shellfish siphons, or crustacean burrows.

84. While subtidal habitats within the proposed reclamation footprint appear healthy and contribute to the broader diversity and ecological values of the harbour, the site itself does not contain unique or special ecological qualities. The loss of a small proportion (0.28%) of natural subtidal habitat in the OHEZ is unlikely to reduce overall biodiversity values or compromise ecological functions and processes within the zone. That, together with the small scale of reclamation relative to the overall amount of subtidal habitat within the harbour, suggests that the effects of reclamation will be moderate at both scales. However, ecological effects within the reclamation footprint itself will be more significant.

85. The proposed dredging will: remove the diverse benthic community from the consented, but yet to be, dredged area; recontour and remove substrates from that area; remove biota and substrates that have reformed since previous dredging events; and lead to the alteration of current velocities. Most of those effects have already been considered under the current capital and maintenance dredging consent. Additional effects of the proposed dredging footprint include deepening

the existing dredged basin by around 2 m. If the characteristics of the seabed substrates at the proposed dredging depth are similar to those existing at the currently consented depth, a similar community of benthic macroinvertebrates is expected to reform once dredging is complete. However, macrofaunal diversity would likely be lower if areas of dense shell were permanently lost.

86. Modelling predicts that sediment plumes generated during dredging will also affect the surrounding habitat. Subtidal areas predominantly to the west of the port are predicted to be periodically subjected to elevated suspended sediment concentrations. Those effects would be compounded by the impacts of sediment deposition that smothers seabed communities and habitats (particularly shell gravel). The methods used for dredging are predicted to have major influence on sediment mobilisation, dispersal, and deposition. Effects are (conservatively) likely to vary from High at the OHEZ and harbour scales if a trailing suction hopper dredger (TSHD) is used, to Moderate at those scales for cutter suction dredger (CSD) and backhoe dredger (BHD) operations. Based on the high ecological values observed in and around previously dredged areas, and assuming that shell gravel habitat re-establishes, ecological recovery is expected to occur over a period of around five years.

Effects of the proposed Northport activities on kai moana shellfish

87. The key shellfish likely to be, or that will potentially be affected by the proposed activities are cockles (tuangi), pipi, and possibly scallops (tipa). Cockles are a ubiquitous feature of intertidal sites throughout much of the harbour, whereas the distributions of pipi and scallops are patchier. Green-lipped mussels (kuku) may also be present in the OHEZ, but have not been observed in surveys within the areas where the proposed activities will occur.

88. Sampling results indicated that densities of cockles in the proposed reclamation and bird roost sites were comparable to other sites in Marsden Bay, but very few cockles of harvestable size were obtained anywhere in the bay. The ubiquity of cockles, together with the small scale of the proposed reclamation and bird roost sites relative to the broad scale of habitat containing them in Whangārei Harbour suggests that the effects of those activities will be low at the harbour and OHEZ scales. Subtidal dredging has little potential to affect cockles.

89. Effects on the availability of pipi for harvesting depends on the abundance of harvestable pipi at the impact sites and the relative contribution of the impacted sites to harvestable pipi populations at broader scales. In turn, that depends on:

(a) whether pipi in the impacted sites can settle, survive and grow to harvestable sizes *in situ*; or

(b) whether small pipi in the impacted sites can disperse and resettle in other suitable areas, where they survive and grow to harvestable sizes; and

(c) the relative contribution of pipi from the impacted areas to the overall population of harvestable pipi at broader scales. This depends on the proportion of the overall population of harvestable pipi that:

(i) reach harvestable sizes within the impacted areas;

(ii) originate from larvae released within the impacted areas that disperse, settle, survive and grow to harvestable sizes elsewhere; and/or,

(iii) originate from small pipi that disperse from impacted areas, and resettle, survive and grow to harvestable sizes elsewhere.

90. The presence of small pipi indicates that primary (larval settlement) or secondary settlement (small pipi that drift into the area) occurs in and/or around the bird roost and proposed reclamation sites. As noted earlier, eddies either side of Northport are possibly, if not probably, a key factor in the relatively high numbers of small pipi immediately west and east of Northport (Figure 4). A similar eddy is expected to form in the lee of the proposed reclamation and should also act to enhance pipi recruitment east of it.

91. Pipi size frequency data also indicates that pipi survive long enough for initial growth to occur. Small pipi are present in the proposed reclamation area and around the proposed bird roost, but harvestable sizes were not detected (Figure *13* and Figure *14*). The maximum size of pipi within the proposed reclamation area was <u><</u>15 mm, and most pipi were <u><</u>10 mm. Larger pipi were obtained around the proposed bird roost, but none were of a harvestable size. These findings suggest that few, if any pipi survive and grow to harvestable sizes in and/or around the bird roost and proposed reclamation sites.

92. Similarly, pipi from the proposed reclamation and bird roost sites were all, or mostly, below the size of maturity (typically 40 mm length, but individuals between

30–40 mm length can have gonads with sex cells (Hooker & Creese 1995)). This finding is consistent with the results of a previous NIWA study (Lundquist & Broekhuizen 2012), which predict a spawning rate of zero per m^2 per day in those areas (I also note that Lundquist and Broekhuizen (2012) predicted the habitat quality for pipi settlement success was low in the proposed reclamation and bird roost sites).

93. At broader scales, the NIWA modelling study predicts that pipi recruitment under calm conditions is dominated by pipi spawned on Snake and Mair Banks, and near the mouth of Parua Bay, with highest settlement on MacDonald Bank, in the deeper mid-channel, and on the northern shore of the harbour. However, pipi larval concentrations were predicted to be high at One Tree Point. Notably, the contribution of pipi spawning in the southern and upper harbour to overall pipi recruitment was predicted to be minimal.

94. Note that the NIWA report highlighted that a limited amount of data was used to estimate a key input to the model (spawning density) and it cautions that this probably led to discrepancies between predicted concentrations of cockle larvae and field measurements using combined bivalve concentrations. Predicted larval concentrations of pipi compared better to field observations than cockle data.

95. It is possible that small pipi on either side of Northport redisperse and resettle in other suitable areas. However, the eddies formed in the lee of the existing reclamation, which possibly (if not probably) promote settlement in those areas, are also like to impede redispersal. Even if redispersal did occur, the contribution from the relatively small areas affected would be minimal.

96. Available information therefore suggests that:

(a) the occurrence of small pipi in the proposed reclamation and bird roost areas is likely to be augmented by eddies created by existing Northport structures;

(b) the effects of the proposed reclamation will possibly be offset by a similar eddy that is expected to form and “entrap” pipi recruits on its eastern side;

(c) pipi do not reach harvestable sizes in the areas impacted by the proposed activities;

(d) the contribution of pipi from affected areas to the broader spawning or harvestable stocks is likely to be minimal.

97. Pipi were not obtained in samples collected from the proposed dredging area. The effects of dredging and the dredging plume on pipi are therefore considered to be negligible.

98. Overall, all cockles and pipi will be lost from the reclamation and roost area. However, given the widespread distribution of cockles around the harbour, and the absence or low abundance of harvestable and mature pipi in the proposed reclamation and roost areas, effects on harvestable cockles and pipi are likely to be low at the harbour and OHEZ scales.

99. No live scallops were observed in the reclamation area, but empty scallop shells were apparent around an octopus den, and low numbers of patchily distributed scallops were observed in the proposed dredging and nearby areas. Scallops in the reclamation area would be permanently lost, but they could recolonise dredged areas.

100. Green lipped mussels were once reported to have been common in the channel adjacent to Mair Bank, but were commercially dredged and disappeared in the late 1960s (Mason & Ritchie 1979; Morrison 2003). A large mussel bed reappeared on Mair Bank in 2015, and reportedly covered approximately 12,800 m^2 in 2016 (Pawley 2016). However, concerns over excessive harvesting led to a rahui being placed over collection of all shellfish from Mair and Marsden Banks in 2018 (Ministry of Fisheries 2018). Despite that, the mussel bed has almost completely disappeared, with only a few scattered clumps of mussels observed in recent years (Lee 2020). Given that, and because mussels have not been observed in surveys within the areas where the proposed activities will occur, effects on them are therefore expected to be negligible.

Effects of the proposed Northport activities on seagrass and macroalgae

101. Patches of intertidal seagrass within the proposed reclamation area will be permanently lost within the proposed reclamation footprint. The area covered by those patches is small (around 0.33 ha in 2021) compared to the current extent of seagrass beds within Whangārei Harbour (estimated to be around 6 km^2 in 2016), and temporal fluctuation in seagrass extent. Therefore, effects on seagrass are expected to be low on harbour and OHEZ scales, equating to a less than minor effect.

102. Outer parts of Whangarei Harbour contain macroalgae meadows, with diverse, but low biomass species assemblages that grow on subtidal shell and sediments. Surveys carried out over the past 30+ years, indicate that subtidal macroalgae meadows are a widespread and persistent feature in the harbour. Four "At Risk" species have been recorded in the outer harbour, with two of those species (*F. mitchelliae* and *H. granulosa*) potentially present – but not observed – in areas affected by dredging. However, those species are not endemic to New Zealand and the potential level of adverse effects on those species is considered to be low, equating to a less than minor effect. If present, adverse effects on them are likely to be inconsequential in terms of global extinction risk, and it is also unlikely that the proposed activities will compromise the sustainability of New Zealand populations.

103. In regard to dredging effects on macroalgae communities, I note that:

(a) Existing macroalgae and the substrates they attach to (shell gravel) will be removed or disturbed within the dredging footprint. Those effects are largely provided for under the existing capital and maintenance dredging consent.

(b) If shell gravel is still present at the dredged depths, or reaccumulates after dredging ceases, then recolonisation by macroalgae is expected to occur in the dredged basin after 5+ years. However, decreases in light levels at the seabed due to increased depth may alter the composition of the macroalgae community within that area.

(c) Fewer macroalgae are likely to recolonise the dredged area if shell gravel is not present at the dredged depths or does not reaccumulate after dredging ceases. Macroalgae are still likely to attach to other hard substrates such as emergent shellfish (e.g., horse mussels) and other material that accumulates on the seabed.

104. Based on the presence of macroalgae in and around previously dredged areas, and assuming that gravel-shell lag habitat re-establishes, ecological recovery is expected to occur over a period of around five years. Effects are conservatively expected to vary from High at the OHEZ and harbour scales if a trailing suction hopper dredger (TSHD) is used, to Moderate at those scales for cutter suction dredger (CSD) and backhoe dredger (BHD) operations. Risks will be reduced

through monitoring and management processes proposed in conditions of consent.

Effects of the proposed Northport activities on reef habitat and biota

105. A reef community has developed on the existing port revetment. Reclamation will eliminate around 155 m of existing rock revetment and create around 483 m of rock revetment. All biota that cannot, or does not, move from the existing revetment structure will be smothered during reclamation. In the medium term (5–10 years), those effects will be offset by the colonisation of a new revetment by a similar reef assemblage. Given that: the existing revetment is an artificial construction; recovery will gradually occur; and more habitat will be created than lost; the effect of reclamation on reef habitat and biota is assessed as positive in the medium to long term at all scales.

Effects of the proposed Northport activities on fish

106. Whangārei Harbour has relatively diverse fish assemblages. Effects on fish are likely to be negligible because of the mobility of fish relative to the small scale of habitat that will be permanently lost, and the likely recovery of habitats of importance to fish in other affected areas. Overall, effects on fish are expected to be low at all scales.

Effects of the proposed Northport activities on stormwater discharges

107. Analysis of available monitoring information and toxicity testing suggests that the current stormwater discharge poses little ecological risk. The existing stormwater system will be upgraded to accommodate runoff from the proposed reclamation areas. Importantly, no logs or other bulk freight are proposed to be stored on the proposed reclamation area. Consequently, discharge water quality is expected to be similar, or better, than that provided by the existing system (due to inputs of cleaner stormwater), but discharge loads may increase slightly. Assuming that past monitoring results are representative of existing discharge quality, and that a similar discharge quality will be maintained, the addition of the proposed reclamation area is not expected to cause any additional adverse ecological effects from stormwater discharges.

Cumulative effects

108. Activities with the potential to cause effects that could act in a cumulative fashion were identified[3], and cumulative impacts on major habitats and features, and for activities of particular significance[4] were assessed. For each of these, an assessment was made against, what was considered to be, the most ecologically relevant system.

109. The combined impacts of dredging and reclamation around Northport were the only activities identified with the capacity to cause cumulative effects of potential ecological concern. In my opinion, the contributions that other identified activities[5] could make to cumulative effects of ecological concern, would be negligible.

110. The only activities of potential concern in the vicinity of Northport were the consented (but not yet constructed) and proposed Northport activities, and the consented (but not yet implemented) dredging by Channel Infrastructure.

111. Overall, consents have been obtained (or are being sought by Northport) for around 70 ha of dredging and reclamation in the OHEZ. Northport has consent for activities associated with constructing Berth 4, including the future reclamation of around 4.3 ha of subtidal habitat and 0.18 ha of intertidal revetment, on the eastern side of the port. Those activities do not involve the loss of any sandy intertidal habitat. Northport already have consent to carry out dredging in an approximately 60 ha subtidal area (dredging is yet to be carried out in around 13.2 ha of that area).

112. Through this application, Northport are seeking to: deepen and slightly adjust the footprint of the previously consented dredged basin (described in the evidence of Mr Hood); reclaim around 6.6 ha of predominantly sandy intertidal habitat; reclaim an additional 5.1 ha of sandy subtidal habitat; and, to create a bird roost covering around 0.5 ha of intertidal habitat.

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3 While I understand that there may be some 'overlap' between the concepts of the existing environment and cumulative effects, I leave that to be addressed in more detail in legal submissions and/or planning evidence on behalf for Northport. In my evidence I have set out my approach to assessing effects, including cumulative effects.

4 Effects on, or arising from intertidal sediment habitats and macrofauna; subtidal habitat and benthic macrofauna; seagrass; macroalgae; fish; reef habitat; kai moana shellfish; or, stormwater discharges.

5 For example, Port Nikau marina extension and Whangārei Marina Management Trust's new marina in the upper harbour, and Ruakaka wastewater discharge.

113. Channel Infrastructure have also gained consent to dredge around 144 ha from the approach and entrance channel to Whangārei Harbour (Kemble et al. 2017; NRC 2018), but are yet to exercise it. Georectified images indicate that around 40 ha will be dredged from the OHEZ.

114. In relation to the relevant Channel Infrastructure activities, it is important to note that:

(a) They do not include reclamation or stormwater discharges.

(b) Dredging by Channel Infrastructure is confined to subtidal channel habitat that is devoid of reefs. Consequently, Channel Infrastructure dredging effects on intertidal habitat and subtidal reefs are likely to be negligible.

(c) Detailed surveys conducted for Channel Infrastructure suggest that the areas consented for their dredging do not contain macroalgae meadows or seagrass.

(d) Effects on fish are assessed as low because the affected species are mobile and able to utilise other locations.

(e) No live scallops, pipi or cockles were detected during the 2015 survey of the Channel Infrastructure dredging area (West & Don 2016). However, live mussels were detected at five sampling stations. Briefly, mussel beds around the harbour mouth reappeared in 2015 after many years' absence, but were rapidly depleted by overharvesting. Few, scattered clumps of mussels have been observed in recent years. Against that background, the effects of Channel Infrastructure dredging on mussels and other kai moana shellfish are likely to be relatively minor.

115. Consequently, the Channel Infrastructure activities add no or little additional effects on, or arising from:

(a) intertidal sediment habitats and macrofauna;

(b) reclamation on subtidal habitat and benthic macrofauna;

(c) seagrass;

(d) macroalgae;

(e) fish;

(f) reef habitat;

(g) kai moana shellfish; or,

(h) stormwater discharges.

116. The effects of Northport and Channel Infrastructure dredging activities on subtidal habitat and benthic macrofauna could act in a cumulative fashion. Levels of effects for the proposed Northport activities alone, and in combination with Channel Infrastructure activities were ranked from Moderate to High depending on the dredging methods used. Those rankings reflect the high diversity values of the OHEZ benthos and the potential scale of effects. The combined effects of the proposed Northport and Channel Infrastructure activities are not expected increase the level of effect beyond “High”, because:

(a) The combined magnitude of effect will not meet the EIANZ “Very High” criteria (Roper-Lindsay et al. 2018) of *“Total loss of, or very major alteration to, key elements/features/ of the existing baseline conditions, such that the post-development character, composition and/or attributes will be fundamentally changed and may be lost from the site altogether; AND/OR Loss of a very high proportion of the known population or range of the element/feature.”*

(b) Current benthic values in previously dredged areas remain high, despite the past dredging events.

(c) The effects of the proposed dredging will also be temporary. A similar community is expected to develop if similar seabed substrates are present after the proposed dredging ceases. If similar substrates do not occur, benthic ecological values may be reduced, but they will not be eliminated.

(d) The assessment of sediment plume effects is considered to be conservative.[6]

(e) Northport’s proposed dredging effects are already largely provided for under the current capital and maintenance dredging consent.

(f) Effects can be diminished through responsive management using real time turbidity monitoring during dredging, as proposed in conditions.

[6] See the footnote below.

117. I also note that, with my input, Northport's proposed conditions prohibit the commencement of capital dredging for Northport's proposed expansion project during or within six months of a capital dredging event (over a prescribed volume) authorised by Channel Infrastructure's Crude Shipping Project resource consents. This will assist with managing potential cumulative marine ecology effects between the two projects.

118. The overall adverse effects are summarised in Table 3 and Table 4 below.[7]

119. For completeness:

(a) The ecological effects of the proposal on threatened or at risk species (seagrass and macroalgae), or the Significant Ecological Areas (SEAs) identified in the Proposed Regional Plan will be in the range of negligible to less than minor (and in some cases temporary).

(b) Noting that most of the proposed dredging area is already subject to dredging — if the proposed best practice methods for managing dredging effects are applied, then the ecological effects on any other potential areas of significant indigenous vegetation and habitats of indigenous fauna under Appendix 5 of the Regional Policy Statement (RPS) can also be kept within minor and/or transitory levels.

7 Tables 2 and 3, and the effects assessment undertaken generally, represent conservative assessments (i.e. likely to over-estimate effects) for the reasons set out in the Marine Ecological Assessment (Appendix 11 of the AEE).

Table 3. Summary of the Assessment of Ecological Effects of the proposed development at the scale of the: harbour; outer harbour and entrance zone (OHEZ); and development footprint (the most relevant system for each effect is in black with blue shading).

Potential effects	**System**		
	Harbour	**OHEZ**	**Footprint**
Effects on intertidal sediment habitats and macrofauna	Moderate	Moderate	Very high
Effects on kai moana shellfish	Low	Low	High
Effects on subtidal habitat and benthic macrofauna - Reclamation	Moderate	Moderate	Very high
Effects on subtidal habitat and benthic macrofauna - Dredging	Moderate to High	Moderate to High	Moderate to High
Effects on seagrass	Low	Low	Very High
Effects on macroalgae	Moderate to High	Moderate to High	Moderate to High
Effects on fish	Low	Low	Low
Effects on reef habitat	Low and positive in medium to long term	Low and positive in medium to long term	Low and positive in medium to long term
Effects of stormwater discharges	Low	Low	Low

Table 4: Effects level rankings for the most relevant ecological system, and the alternative system considered in the ecological assessment. See appended Tables 11 to 19 of Appendix 11 of the AEE, for the rationale used to rank levels of effect for the most relevant system.

Potential effects	Most relevant system	Level of Effect	Alternative system	Level of Effect	Notes on alternative system
Effects on intertidal benthic habitats and macrofauna	Harbour	Moderate	OHEZ	Upper range of Moderate	High values, permanent loss, but relatively small proportion of available habitat affected (1.2 % of intertidal habitat in the OHEZ). The overall abundance of common infaunal taxa will be slightly reduced, but changes to infaunal biodiversity are not expected. Channel Infrastructure activities do not directly affect intertidal habitats.
Effects on kai moana shellfish	Harbour	Low	OHEZ	Low	Cockles, pipi, scallops and mussels potentially affected. Cockles are ubiquitous in the OHEZ. No harvestable pipi in the detected in the reclamation area or in areas affected by dredging. Few live scallops observed. Past records of mussels, but their occurrence has been greatly diminished by overharvesting.
Effects on subtidal habitat and benthic macrofauna – Reclamation	OHEZ	Moderate	Harbour	Moderate	Combined reclamation areas comprise a small proportion of subtidal habitats in the Harbour (0.22%). There are few high value features in Northport's proposed reclamation areas. Channel Infrastructure consents do not authorise any reclamation.
Effects on subtidal habitat and benthic macrofauna – Dredging	OHEZ	Moderate to High	Harbour	Moderate to High	Moderate proportion of subtidal habitat with high ecological values directly affected (2.3% of the total Harbour subtidal). Effects will depend on the method of dredging. Effects will be temporary. A similar community is expected to develop if similar seabed substrates are present once the proposed dredging ceases. If that does not occur, ecological values may be reduced, but they will not be eliminated. The effects of Northport dredging are largely provided for under the current capital and maintenance dredging consent.
Effects on seagrass	Harbour	Low	OHEZ	Low	Only small patches of seagrass will be lost. Other large beds occur in the OEHZ.

Potential effects	Most relevant system	Level of Effect	Alternative system	Level of Effect	Notes on alternative system
					Significant recovery in seagrass extent has occurred over the past two decades. Species displays large fluctuation in extent. Detailed surveys conducted for Channel Infrastructure suggest that the areas consented for their dredging do not contain seagrass.
Effects on macroalgae	OHEZ	Moderate to High	Harbour	Moderate to High	The outer harbour contains soft sediment macroalgae meadows with diverse, but low biomass species assemblages. At Risk species are potentially present in affected areas, but adverse effects on those are likely to be low. Little macroalgae present in the proposed reclamation area, but it is common throughout areas directly and indirectly affected by the proposed (and currently consented) dredging. Distribution has not been accurately determined but are likely to be limited to patchy beds in the mid-outer parts of the harbour. Around 3.36% of the OHEZ directly affected by dredging and reclamation, with the scale and magnitude of indirect effects varying widely depending on the method of dredging. Some uncertainty about the effects of increased light attenuation. Changes to light conditions may alter the composition of the macroalgae community within the dredged area. Potential for risks can be reduced through monitoring and management regimes (as proposed by Northport). Detailed surveys conducted for Channel Infrastructure suggest that the areas consented for their dredging do not contain macroalgae meadows.
Effects on fish	Harbour	Low	OHEZ	Low	Affected species mobile and able to utilise other locations.

Potential effects	Most relevant system	Level of Effect	Alternative system	Level of Effect	Notes on alternative system
Effects on reef habitat	Harbour	Low and positive in medium to long term	OHEZ	Low and positive in medium to long term	Anthropogenic features that support high value ecological community. The extent of rocky reef is limited in the OHEZ. Community associated with existing rocky revetments will be lost, but they will reform on new revetments. The length of revetment created will be greater than the length lost.
Effects of stormwater discharges	Beyond the mixing zone	Low	All scales beyond the mixing zone	Low	Adverse ecological effects beyond the mixing zone managed through site controls, monitoring and discharge standards.

COMMENT ON DRAFT PROPOSED CONDITIONS ADVANCED BY NORTHPORT

120. My input on the draft conditions relates to the conditions that require the production, certification and implementation of an Environmental Monitoring and Management Plan (EMMP) that provides for (among other things):

- real time turbidity monitoring and management response processes to minimise the risk of elevated turbidity during capital dredging; and
- marine ecological assurance monitoring.

121. Details on the real time turbidity monitoring, triggers for action, and response process are provided in the evidence of Mr Pettersson and Professor Fox. I simply note here that I am familiar with the proposed approach, as similar methods have been applied at other New Zealand ports, including Napier and Lyttleton. I acted as a technical adviser for Hawkes Bay Regional Council who granted Napier Port a dredging and disposal consent with similar monitoring/management conditions. In that case, turbidity monitoring was used to primarily address key concerns about the effects of dredging related sediment dispersal on Pania Reef – a culturally and ecological significant feature in Hawkes Bay. Similar to the approach proposed here, Napier Port monitor turbidity and established a system of response triggers. They also provide real time turbidity monitoring data through a publicly available website dashboard[8], and monitor the ecology of Pania Reef. The latest ecological report (Sneddon & Dunmore 2022) covering the third survey since dredging at Napier began concluded that:

> *"All lines of evidence from the Pania Reef monitoring record suggested that there has been no deterioration since the baseline in the marine communities the Reef supports. Diver observations and the photographic and video record also gave no indication of an ecologically significant change in the prevalence of sand and silt accumulations on the reef."*

122. While not directly comparable to Whāngārei, the experience from Napier is informative, and in that case, monitoring indicates the approach has been effective. Overall, I consider Napier Port's approach, and Northport's proposed approach to be consistent with best practice.

8 Vista Data Vision (vdvcloud.com)

123. In the case of Northport, the actual extent and magnitude of ecological effects on benthic communities (which I consider to be the most sensitive to adverse effects) will be confirmed through marine ecological assurance monitoring carried out in accordance with proposed conditions. Details of that monitoring are outlined in the draft EMMP attached to the evidence of Mr Pettersson. I note that the purpose of the ecological assurance monitoring is not to provide real-time detection of effects (the sampling, sample processing and reporting are likely to take months to complete), nor is it designed to trigger real-time management responses to the detection of ecological of habitat changes. Instead, it will complement the real-time turbidity monitoring and associated response measures, by providing feedback on their efficacy.

124. Northport have proposed, what I consider to be, a very comprehensive set of marine ecological assurance monitoring conditions, and I have prepared an associated Ecological Assurance Monitoring Plan in accordance with those conditions.[9] In summary, the Ecological Assurance Monitoring Plan includes the collection of:

- grab samples for the analysis of sediment grain size and subtidal macrofaunal communities (which include kai moana shellfish) in seabed sediments along the channels north and south of Snake Bank, and in the harbour entrance;

- subtidal video and drop-camera footage for the analysis of habitat characteristics and large marine biota living on seabed sediments (including kai moana shellfish) in the channels north and south of Snake Bank, and in the harbour entrance;

- intertidal core samples for the analysis of sediment grain size and macrofaunal communities (which include kai moana shellfish) in Marsden Bay and at a reference site at Tamaterau; and

- seagrass mapping using georeferenced and orthocorrected photogrammetry obtained using low tide drone surveys of Marsden Bay.

125. The proposed marine ecological monitoring will be carried out before, during, and after dredging occurs. The design allows the data to be analysed using a variety

[9] The *Ecological Assurance Monitoring Plan* is attached to the Draft EMMP annexed to Mr Pettersson's statement of evidence.

of univariate and multivariate statistical analyses, and to be mapped using heat maps, bubble plots, aerial extents (in the case of seagrass) and similar presentation methods to visualise ecological patterns and changes.

126. Overall, I consider the proposed marine ecological monitoring conditions to also be consistent with best practice.

Summary

127. In summary, for the reasons outlined in my evidence I support the conditions of consent proposed by Northport (as attached to the statement of evidence of Mr Hood) that are within my area of expertise.

RESPONSE TO SUBMISSIONS

128. Below I respond to certain submissions, to the extent I have not already covered the matters raised in those submissions.

DoC

129. The submission of the Director-General of Conservation voices concerns that the Application underemphasises the actual or potential effects on marine ecology. The submission states:

> *The Assessment of Effects within the Application lists the extent of proposed and consented reclamation and dredging areas expressed as percentages of the intertidal and subtidal area within the outer harbour and entrance zone (OHEZ) ecological system. However, not all intertidal and subtidal habitat is uniform or comparable and assumes all intertidal and subtidal habitat within that zone is equally available for species to inhabit. Habitat type and suitability for different species and communities will depend on factors such as sediment type, mud content, current velocity, height above or below low tide, current level of disturbance, etc. Therefore, listing the total loss and disturbance of 3.02% (for example) of the total OHEZ area will not accurately represent the extent of suitable habitat loss for different species and benthic communities.*

130. Firstly, I note that the example given (3.02% of the total area) comes from Table 10 of the AEE report (page 131). The purpose of Table 10 is to contextualise the scale of potential cumulative impacts, rather than provide conclusions about the significance of those impacts. This is explained in the reference to the table on page 129 of Appendix 11 in the AEE, which states "*Breakdowns of the combined*

areas of intertidal and subtidal habitat affected by consented and proposed reclamation and dredging are provided in Table 8–Table 10, and the combined significance of effects are considered in the following section."

131. Secondly, I agree the OHEZ is a physically and biologically complex system. It contains depth gradients, variation in tidal currents and eddies, varying degrees of physical and tidal exposure, abrupt changes in habitat and species abundances creating mosaics of species and substrates, and myriad other patterns. At least 119 macroalgae, 198 subtidal and 97 intertidal sediment-dwelling benthic taxa have been identified in the area. It also supports a variety of fish and reef-dwelling invertebrates. Distributions vary from species to species. They often overlap, occur along gradients, cross physical and ecological boundaries and display patchiness. These patterns emerge through the consideration of the system.

132. Finally, the assessment did not focus on assessing effects against specific habitats, communities, or species. Rather, a system-wide approach was taken in accordance with Policy D.2.18(5) of the Proposed Regional Plan for Northland. I consider it appropriate for the assessment to be carried out at the system scale. I also note that the appropriate system scale may vary depending on the values and effects being considered (i.e. the context). Our assessment therefore presented conclusions at two system scales (Harbour and OHEZ) and in relation to the activity footprint. It also identifies what I consider to be the most appropriate system scale in the context of each relevant adverse effect.

Forest and Bird

133. The submission from Forest and Bird voices concerns about the assessment concluding effects on harvestable pipi at the Harbour and OHEZ scales will be low, purportedly because they are not of harvestable size. The submission also suggests it is odd for an ecological assessment to concern itself with harvestable pipi and that there is no assessment of the reclamation on pipi.

134. In my opinion and experience, the effects of activities on harvested species are appropriately and frequently included in ecological assessments. I also note that pipi are a component of the intertidal community, and as such, are included in the assessment of reclamation effects. In addition, the assessment of effects on pipi – both in the AEE report and in my evidence – is not limited to harvestable pipi

only.[10] However, in response to the concerns of Forest and Bird, additional details and conclusions on pipi have been provided in paragraphs 89 to 98 of this evidence.

RESPONSE TO THE SECTION 42A REPORT

135. The s42a Report includes a review of our assessment of marine ecological effects in a technical memo prepared by Dr Drew Lohrer (Appendix C3).

136. Dr Lohrer agrees with a number of key aspects from our assessment, including:

(a) that the assessment methods used are appropriate and that there is sufficient physical and ecological data from which to make assessments.[11]

(b) that the three spatial scales adopted (Harbour, OHEZ, and Footprint) are clear and understandable,[12] and that the assessment framework is consistent with *"planning policy directives to consider that the scale of the effect of an activity is generally proportional to its size".*[13]

(c) that all of the major effect types have been assessed.[14]

137. He also agrees that the following statements are factually correct:

(a) only a small amount of habitat will be affected;

(b) some of the area designated for reclamation and dredging is already consented for reclamation and dredging;

(c) the organisms and communities that will be eliminated by reclamation and dredging are not unique;

(d) species listed as 'threatened' or 'at-risk' are not common in the proposed reclamation and dredging areas;

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[10] See for example page 112 of the AEE report concluding: *"Given the widespread distribution of cockles around the harbour, and the absence of harvestable pipi in the proposed reclamation area, the direct effects on harvestable cockles and pipi are likely to be low at the harbour and OHEZ scales.* ***However, the proposed reclamation will cause the complete loss of cockles and small pipi within the reclamation footprint****"* (emphasis amended).

[11] Dr Lohrer memo, page 4.

[12] Dr Lohrer memo, page 4.

[13] Dr Lohrer memo, page 4.

[14] Dr Lohrer memo, page 3.

(e) rocky revetments host diverse reef communities and will increase in net extent; and

(f) ecological values in the area are high, despite the presence of Northport.

However, Dr Lohrer states that he does not agree with the reasoning or conclusions drawn from those statements.[15]

138. Dr Lohrer usefully summarises his conclusions regarding the magnitude of effects on/from individual features in a table on pages 6-7 of his memo. In most cases our conclusions align, but his conclusions differ slightly in relation to effects on intertidal sediment habitats and macrofauna, and effects on kaimoana shellfish. Overall, Dr Lohrer also concludes that the actual and potential adverse effects of the proposal on the marine ecology of the Whangarei/Bream Bay system will be significant[16].

139. For the reasons outlined in our original assessment and this evidence, I disagree with Dr Lohrer's conclusions that do not align with mine. I provide some additional responses to specific matters raised in Dr Lohrer's memo below.

140. In relation to intertidal sediment habitats and macrofauna, we both rank the magnitude of effects as moderate, but Dr Lohrer concludes that the appropriate system for the assessment of effects is the OHEZ, whereas I consider it to be the harbour. Dr Lohrer's reasoning is "*the dissimilarity of the muddy upper harbour and Pārua Bay intertidal sediment habitats relative to those affected by proposal*". My reasoning is based on an analysis of harbour-wide data obtained by Northland Regional Council which indicated that the intertidal macrofaunal communities at sites in Marsden Bay were similar to intertidal communities in other parts of the harbour, including communities from sites in the upper, mid and outer harbour. However, I accept that parts of the harbour are muddier than Marsden Bay and therefore the appropriate system scale may be somewhere between the whole harbour and the OHEZ. Having said that, I consider my conclusion of a moderate effect at the harbour scale to be more conservative than Dr Lohrer's one of a moderate effect at the OHEZ, given the harbour is substantially larger.

141. For kai moana shellfish I have identified the harbour as the appropriate system and ranked effects as low, whereas Dr Lohrer considers the OHEZ to be the

15 Dr Lohrer memo, page 5.
16 Dr Lohrer memo, page 14.

appropriate system and ranks effects as moderate. The rationale provided by Dr Lohrer includes:

(a) the potential for the proposed activities to disrupt sediment and propagule transport pathways for pipi, cockles, and mussels.

(b) sediment concentrations and deposition rates from dredging activities will have deleterious effects on suspension-feeding shellfish kaimoana including pipi, cockles, mussels and scallops.

(c) kai moana densities are highest in the OHEZ (Snake Bank, Mair/Marsden Bank, Urquharts Bay) and this is where effects will be most intense.

142. The rationale from my conclusion is largely provided in Paragraphs 87 to 100 above, and I do not repeat that. I also note that sediment plumes and deposition associated with the dredging are predicted to be largely confined to subtidal channels. Based on that, there appears to be little potential for sediment plumes to adversely affect intertidal pipi and cockle beds.

143. In relation to cumulative effects, on page 8 of his memo Dr Lohrer states:

> *"The AMEE (p 127) acknowledges the potential for cumulative disturbance and loss of habitat and biota through the combined impacts of dredging and reclamation. The AMEE covers nine types of potential impacts to the marine environment but does not meaningfully consider the potential cumulative effects of these."*

144. I have outlined in this evidence and our assessment accompanying the AEE, how I have assessed potential cumulative effects and the outcomes of that assessment. In my opinion, besides the direct impacts of increasing the extent of habitat loss through reclamation and the construction of the proposed bird roost, the only activity with the potential to cause impacts that act (materially) in a cumulative fashion is dredging and its effects on subtidal habitat and benthic macrofauna. I consider those effects in my response to a s92 request for further information (attachment 5 of the 21 February 2023 response letter), and in paragraphs 108 to 119 of this evidence. Beyond that, I consider the potential for ecological or other interactions to produce effects of greater magnitude than those already described, to be negligible. Other, specific matters raised by Dr Lohrer in relation to cumulative effects are considered below.

145. Dr Lohrer goes on to describe the existing environment, noting its ecological values and changes arising from (or that appear to have arisen from) historic actions (particularly declines in shellfish populations, alterations in sand transport, and potentially, alterations in the dispersal of pipi). He concludes that:

> *"While the existing Northport structure is unlikely to be removed, the loss (through reclamation) and alternation (due to dredging-related hydrodynamic and sediment effects) of additional habitat near where pipi were once highly abundant should be minimised so as to not further erode their contributions to ecosystem services such as, e.g, water filtration, seabed armouring, provision of wild seafood, and support of cultural heritage and identity. Further cumulative pressure on pipi populations could lead to irreversible damage."*

146. I agree that it is likely the construction of the existing port reclamation altered the dispersal patterns of pipi. However, the additional effects of the proposed reclamation and bird roost on harvestable pipi are likely to be low at the harbour and OHEZ scales (see paragraphs 89 to 98 above), and similar conclusions could be drawn for the pipi population in general. As indicated in paragraph 142 above, modelling suggests there is little potential for sediment plumes to adversely affect intertidal pipi and cockle beds. Further, in relation to the alteration of additional habitat where pipi were once highly abundant (including Snake Bank, Mair/Marsden Bank), I refer the Panel to the evidence of Mr Reinen-Hamill who considers the stability of those, and other features.

147. I disagree with Dr Lohrer's views regarding our assessment of the effects of sediment. He states that our assessment suggests little concern for the potential for impacts of deposition, noting our conclusion that "*it is reasonable to assume that biota in energetic areas (such as Marsden Bay) are adapted to living in dynamic environments where marine sediments are regularly resuspended and redeposited by wave action*". I note that this statement was in relation to deposition in intertidal habitats and the following sentence provides important additional context, stating "*Such processes are known to occur in Marsden Bay where Swales et al. (2013) reported that sediments had a thin surface mixed layer, 0 to 1 cm deep, composed of laminated sands and silts consistent with wave resuspension*."

148. I also refer to paragraph 86 of my evidence where I conclude that the subtidal effects of dredging on the OHEZ are conservatively assessed as moderate to high (depending on dredging method), with recovery expected to take around 5 years.

Note, that conclusion did not take into account multiple mitigating factors, including conservatism in the modelling, assessments showing that high ecological values persist despite past dredging, and the proposed turbidity monitoring and management approach provided in the draft conditions.

149. I also have concerns about the “experimental evidence” Dr Lohrer refers to in relation to his discussion of the above matters (page 13 of his memo). The evidence involves a study that assessed the ecological effects of depositing terrigenous sediment on intertidal flats. In my opinion the study is not comparable to the Northport situation. For instance:

- The experiment was conducted on low energy intertidal flats in a narrow, sheltered tidal inlet (Okura Estuary), whereas Marsden Bay is situated in a relatively large, energetic harbour.

- The deposited material used in the experiment was obtained from a sediment retention pond used during motorway construction. It was terrigenous in origin and dominated by medium to very fine silts and clays. Dredging of the channel involves sediments of marine origin within predominantly fine to medium sand layers (see the evidence of Mr Reinen-Hamill).

- Sediment in the experiment was deposited in one event using a helicopter and monsoon bucket. In the proposed situation, modelling suggests that little ecologically meaningful deposition of dredged sediment is likely to occur on the intertidal habitats of Marsden Bay, and that dredging related subtidal sediment accumulation will occur over time.

150. As discussed on pages 105-106 of our assessment, a more comparable situation is the disposal of dredged marine sediment at sea. Multiple New Zealand studies and monitoring programmes have shown that the effects of such deposition are relatively minor and short-lived. Having said that, The Northport situation differs in that the areas potentially affected contain biogenic habitat, which includes large sessile filter feeders, macroalgae meadows and shell. Those features are likely to be particularly sensitive to smothering. I therefore regard my conclusion that the effects of dredging will be moderate to high (depending on dredging method), with recovery taking around 5 years to be appropriate. I also note that sediment effects will be managed through the real-time turbidity monitoring and management

regime, and that the marine ecological assurance monitoring has been designed to detect dredging effects and track ecological recovery.

151. Dr Lohrer also states in his memo[17] that: *"In short, I consider that [the AEE ecological assessment] conclusions are based primarily on proportional size (relative to OHEZ or Harbour) and do not adequately consider the potential broader importance of the taxa, habitats, and ecosystem functions of the affected areas."* I do not agree with Dr Lohrer's characterisation that our assessment conclusions are based primarily on proportional size.[18] While the scale of effect is an important consideration, among other things, our assessment also takes into account the characteristics of the existing environment, the ecological values affected by the proposed activities and the nature of likely effects. It also identifies sensitive biogenic, and other high value features that have particularly important ecological functions. In addition, it considers whether similar values are present elsewhere in the harbour or OHEZ, and whether effects are permanent or temporary, along with potential recovery times.

152. Finally, Dr Lohrer raises concerns about the potential for the effects of the proposed activities to compound those of climate change/extremes and sea level rise. In particular, two issues are raised:

- Potential changes in coastal processes, including changes to seabed armouring. Mr Reinen-Hamill addresses coastal processes matters in his statement of evidence.

- Sediment impacts arising from extreme events such as recent storms and Cyclone Gabrielle. I refer to the evidence of Mr Reinen-Hamill, and Mr Pettersson with respect to sediment processes and the real-time turbidity monitoring and management regime proposed for dredging. I also note that a study of sediment dynamics in the harbour entrance by Black et al. (1989) indicates that currents in the channel consistently exceed the threshold speed for sand entrainment, and that sand is continually being winnowed out on the channel floor. It therefore seems unlikely that finer terrigenous sediments associated with extreme weather events will settle and remain in the channel. As for intertidal habitats, modelling suggests that little deposition of dredged sediment is likely to occur in those habitats.

17 Page 7.
18 See also paragraphs 129-130 above regarding this matter.

153. In summary, the climate change and sea level matters raised by Mr Lohrer do not materially impact my overall conclusions on ecological effects. In particular, the proposal is unlikely to materially increase the marine ecological effects of climate change/sea level rise in the area.

Shane Kelly
Coast and Catchment

24 August 2023

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FIGURES

Figure 1: Whangārei Harbour showing key features and the harbour zones referred to in this evidence.

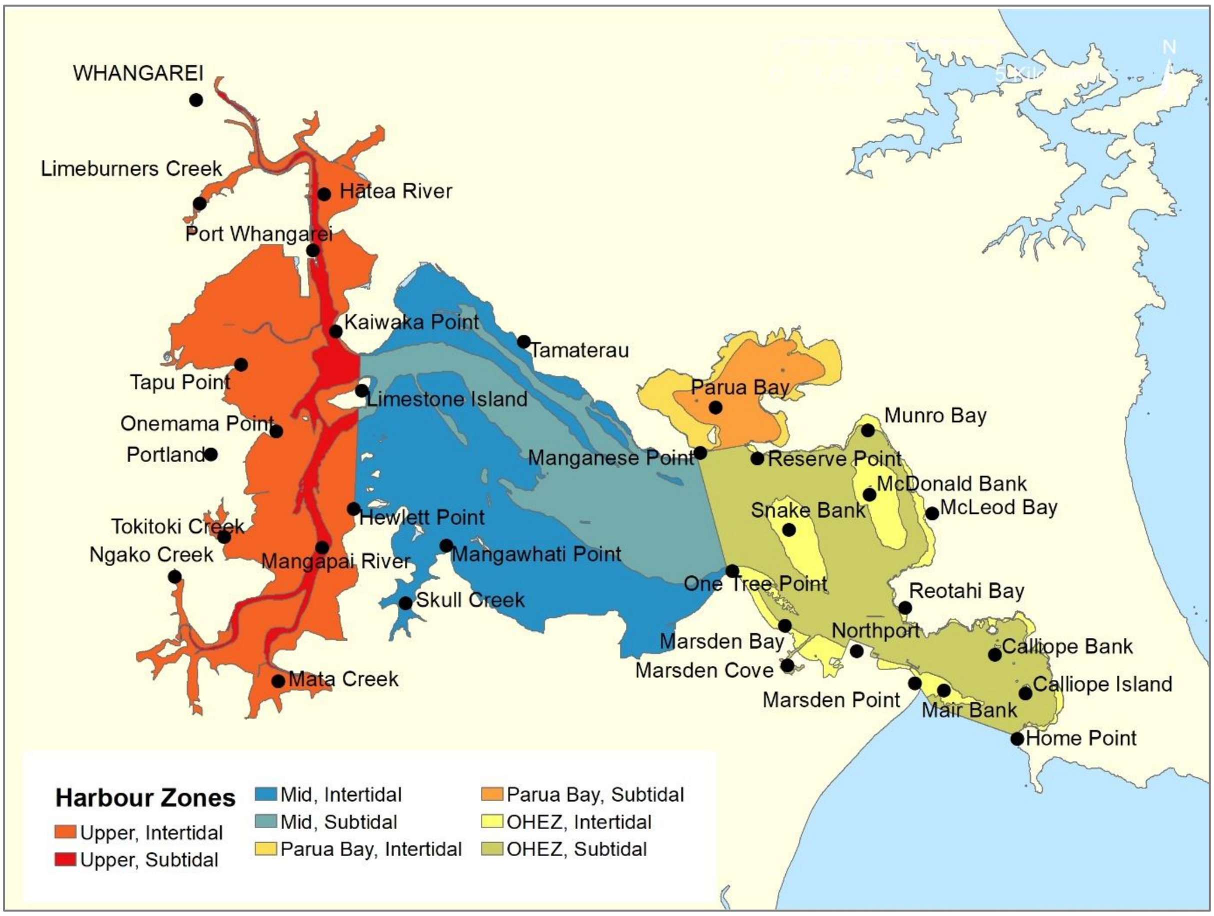

Figure 2: Bubble plots and interpolated (by Kriging) heat maps of: A. the number of macroinvertebrate taxa and B. total counts of all macrofauna obtained from core samples in Marsden Bay.

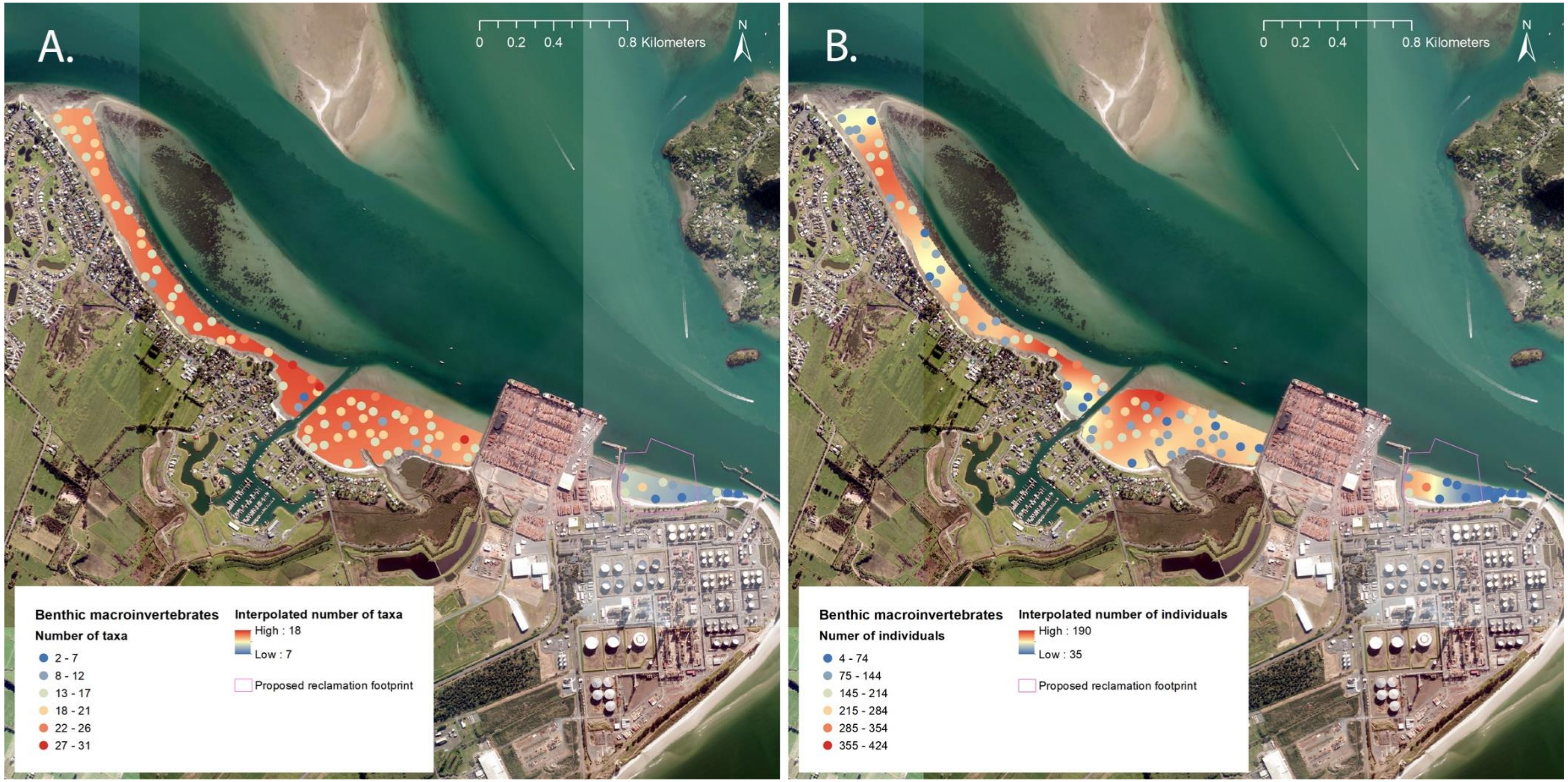

Figure 3: Variation in the abundance of a. cockles 0 to 20 mm in size, b. cockles > 20 mm in size, c. pipi 0 to 20 mm in size, and d. pipi > 20 mm in size.

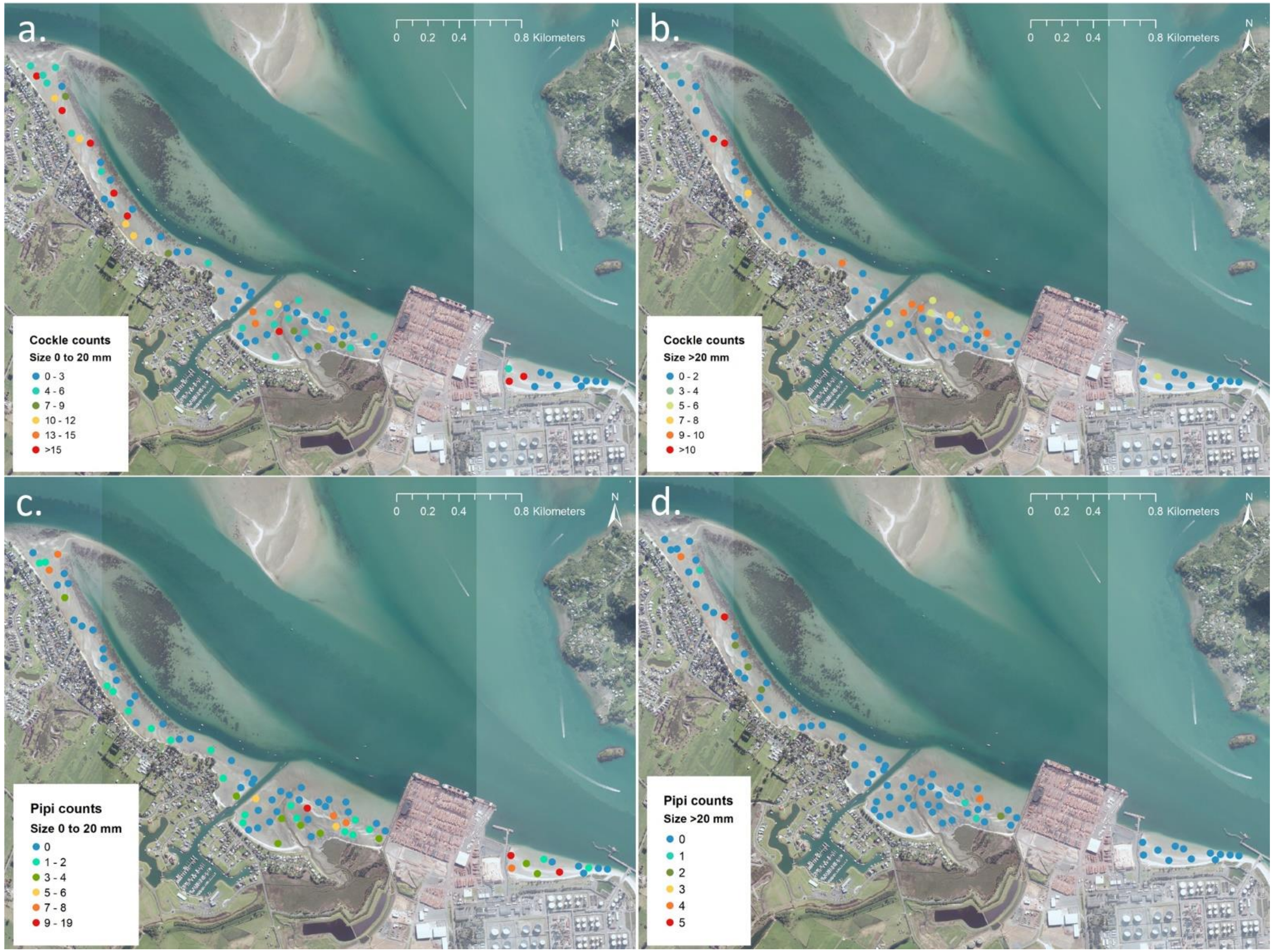

Figure 4: Variation in the abundance of 0 to 20 mm pipi with modelled flood and ebb flows during spring tides overlaid (taken from Reinen-Hamill, 2022, original source MetOcean Solutions, 2018).

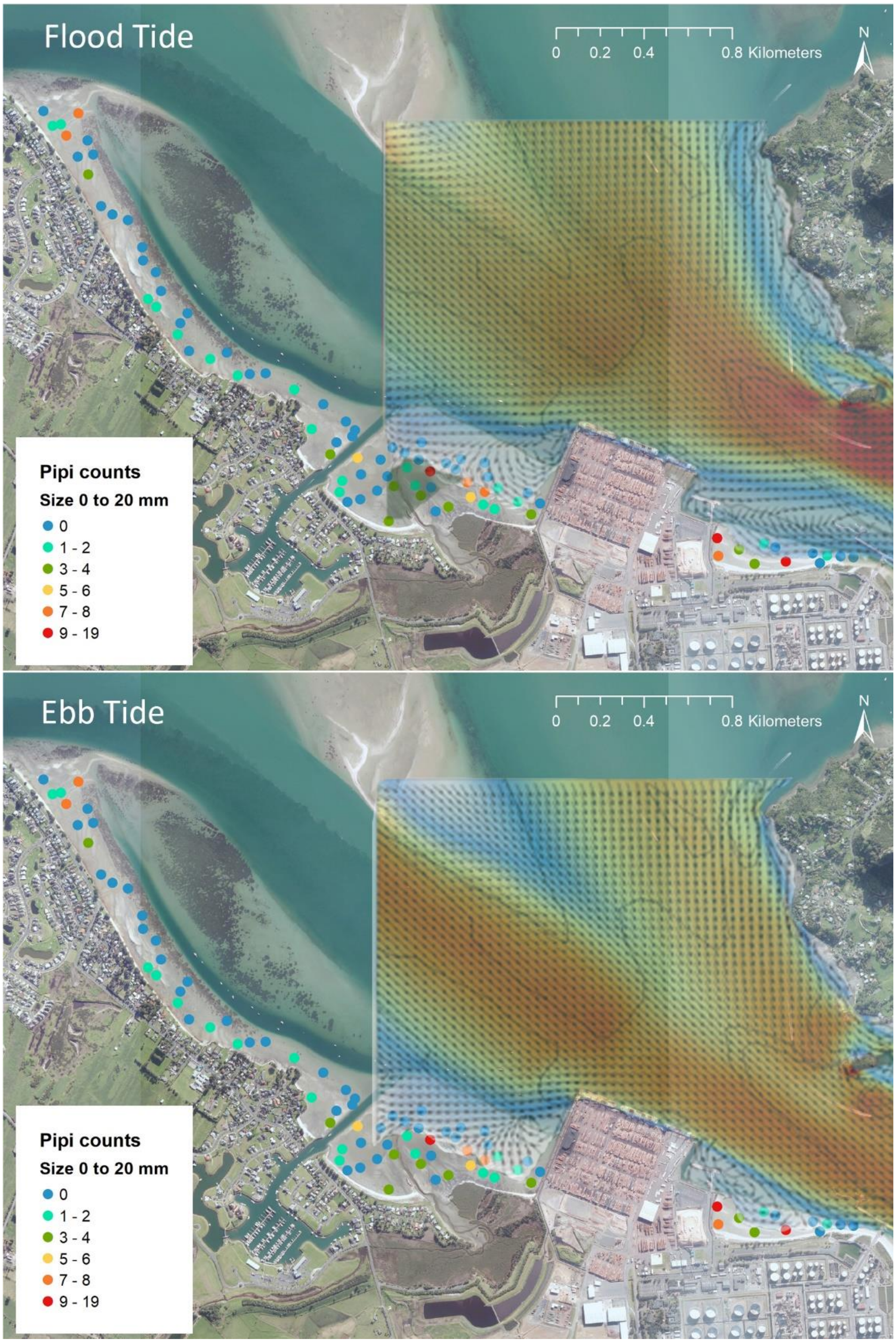

Figure 5: Video transect run lines overlaid on an image of channel bathymetry (provided by Northport), consented dredging area, and proposed dredging area as modelled by MetOcean.

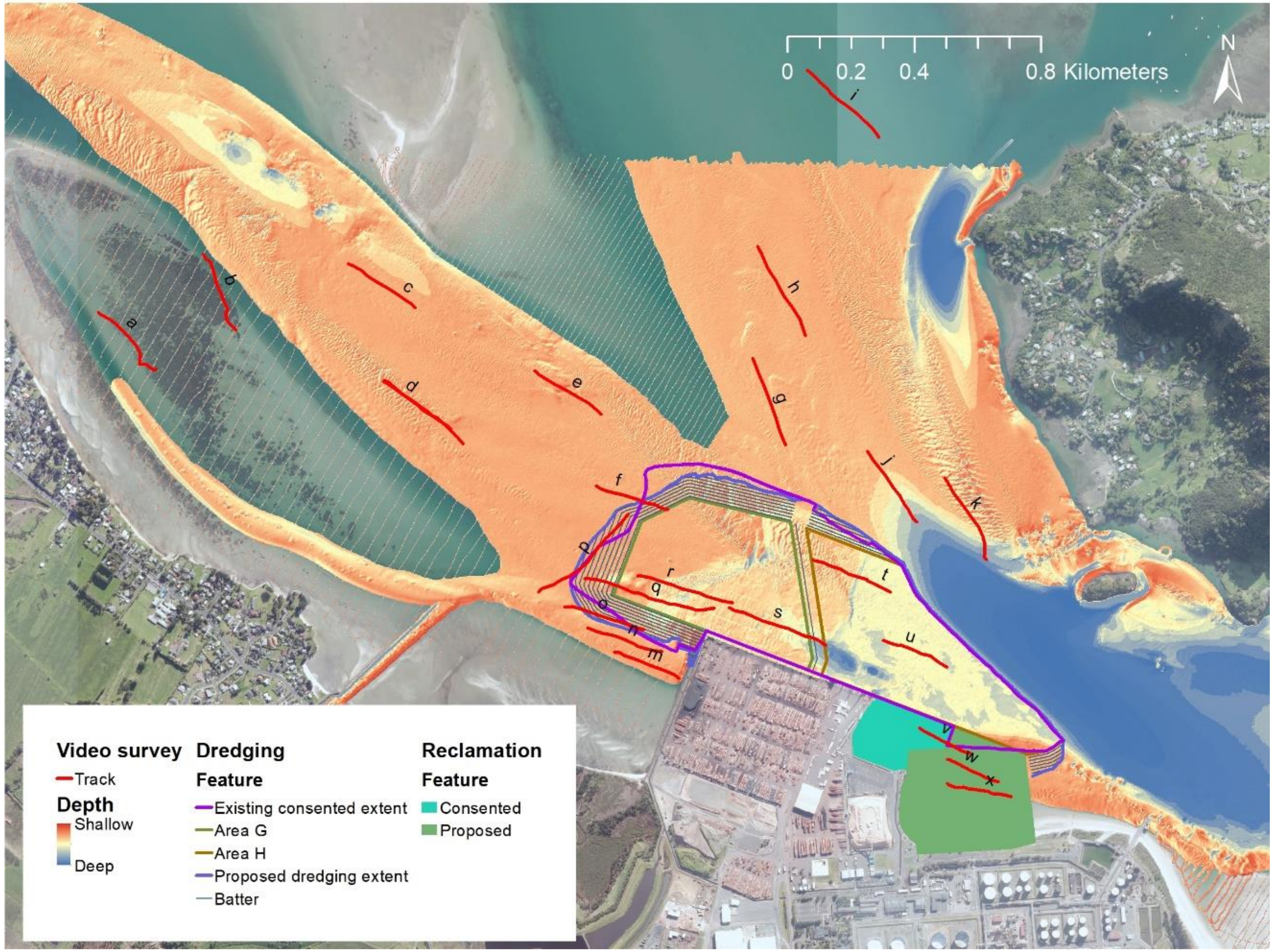

Figure 6. Video stills taken from within the proposed reclamation area: A. Sand with abundant holes caused by an unknown animal in the outer transect (v. in Figure 5). B. Comb star (*Astropecten polyacanthus*, white arrow) and ball sponge (blue arrow) in the central transect (w. in Figure 5); C. A very dense aggregation of horn shells (possibly dead *Maoricolpus roseus* shells with hermit crabs) amongst red algae in the central transect; D. The pest, Mediterranean fan worm (*Sabella spallanzanii*) in central transect; E. An octopus den surrounded by empty scallop shells in central transect; F. Cushion stars (*Patiriella regularis*) in the inshore transect (x. in Figure 5).

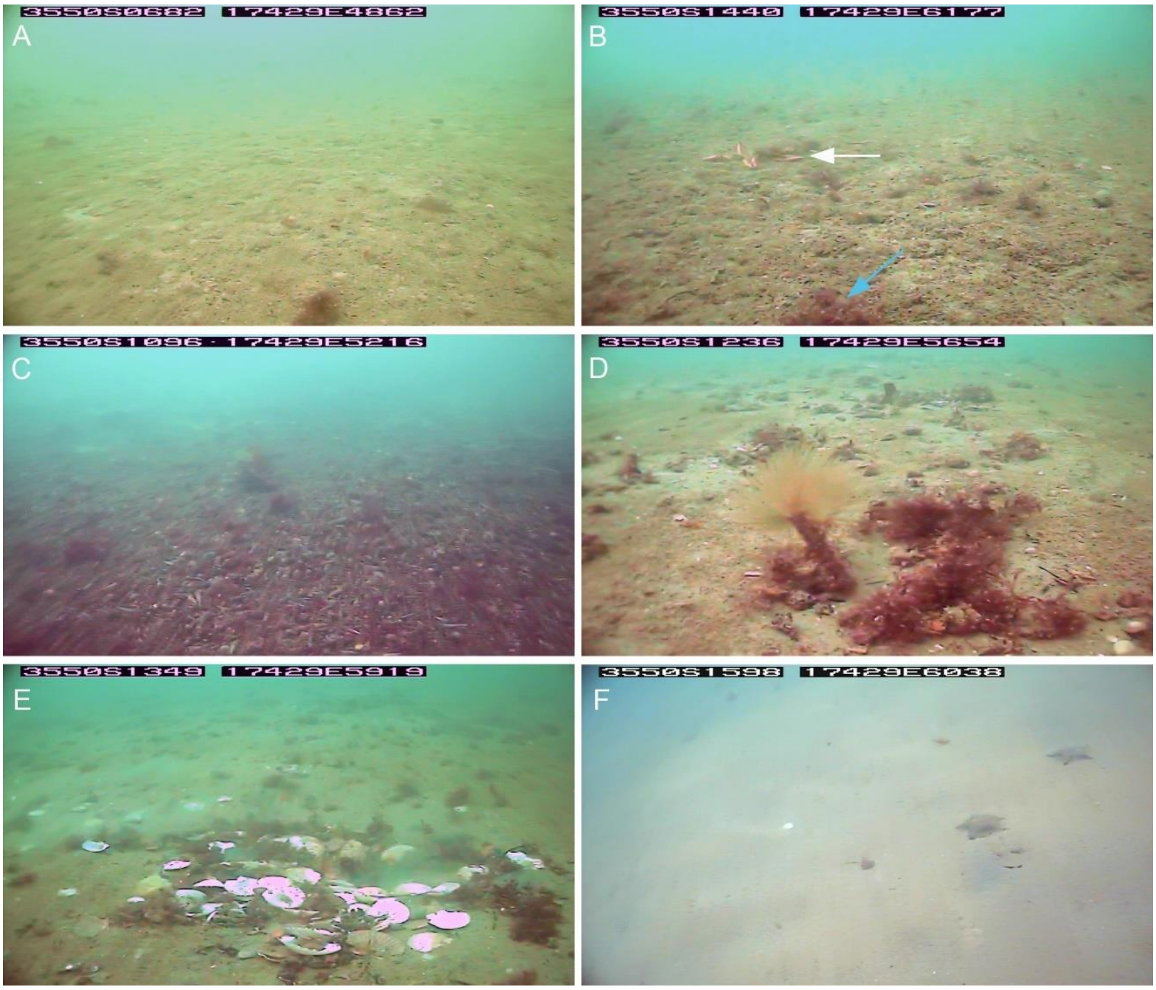

Figure 7. Video stills taken from west of Northport (Transects m to o in Figure 5): A. Patch of sparsely distributed seagrass (arrow shows a single blade); B. A comb star amidst a dense patch of red macroalgae; C. Several comb stars on sand; D. A bed of red macroalgae with a high density of turret shells; E. Worm tubes protruding through the surface; F. Macroalgae and a Mediterranean fan worm (arrow) growing on the rock revetment.

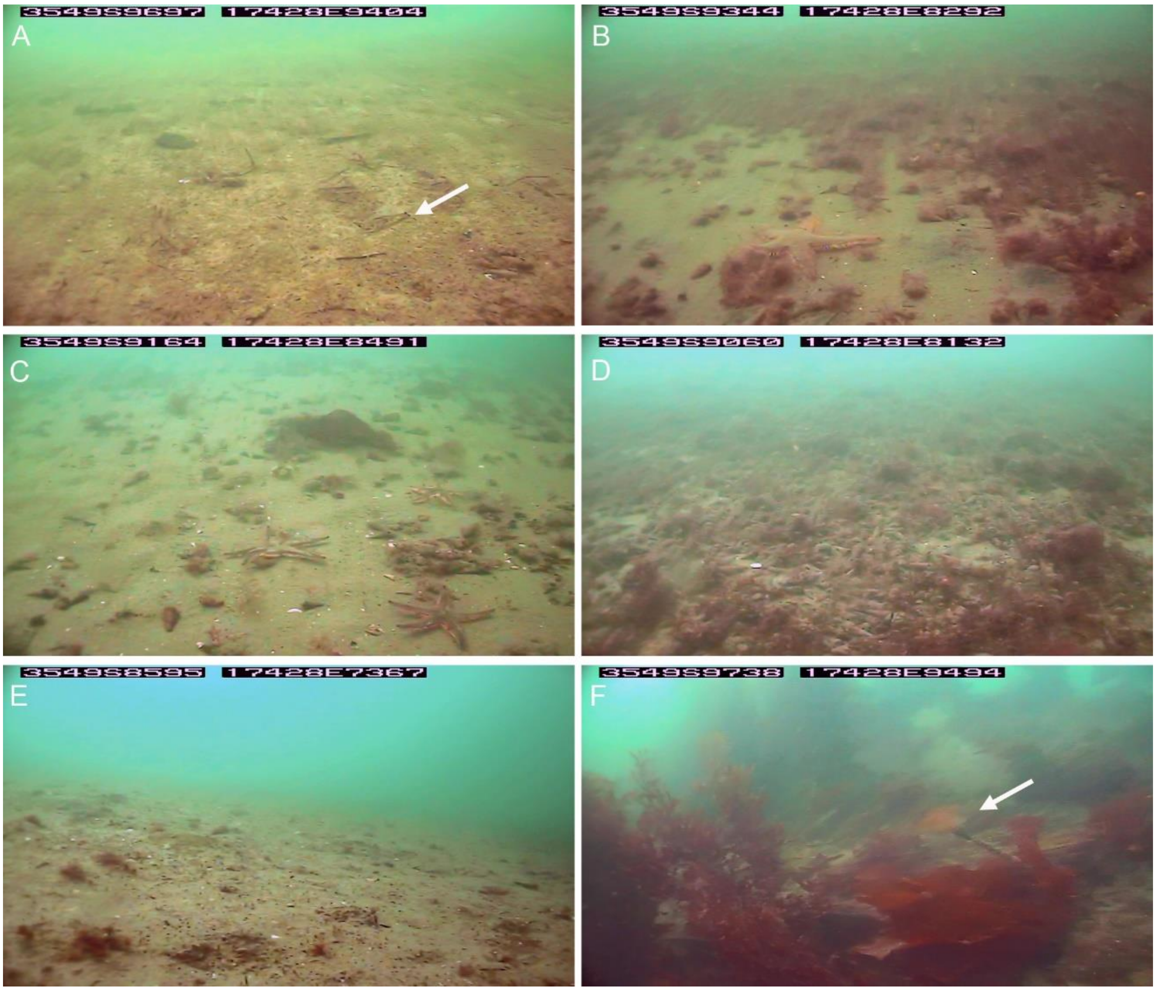

Figure 8. Video stills taken from the proposed batter west of Northport (Transect p. in Figure 5): A. Dense bed of red algae with anemones; B. Bed of scattered, large red or brown algae; C. Shell gravel with numerous tubes or burrows; D. Sand with numerous tubes or burrows and a comb star.

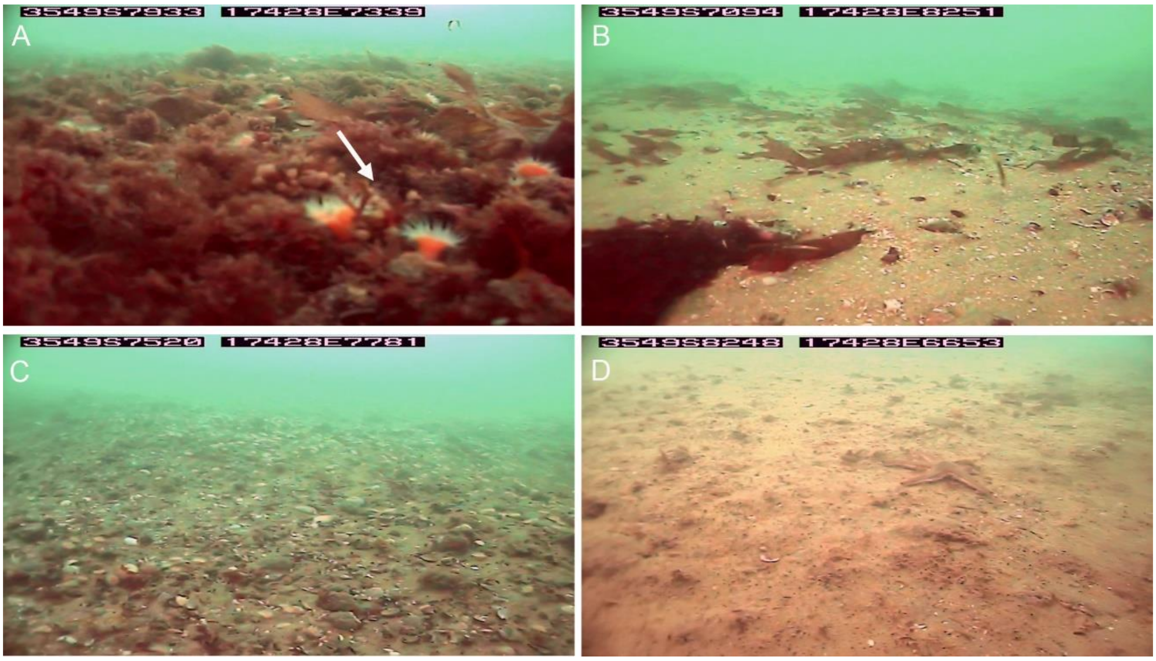

Figure 9. Video stills taken from within the consented dredge area to the northwest of Northport (Transects q & r in Figure 5): A. Sand and shell above the existing batter slope with red algae, an 11-armed starfish (white arrow), small sponge (red arrow) and anemone (green arrow); B. Dense shell with scattered sponges (arrows) above the batter slope; C. Octopus den (arrow) on sandy habitat with scattered algae above the batter slope; D. Scallops (arrows) on sandy habitat above the existing batter slope; E. The existing sandy batter slope; F. The boundary between the existing batter slope and the bottom of the dredged basin; G & H. Dense encrusting fauna on dense shell/gravel present at the bottom of the dredged basin.

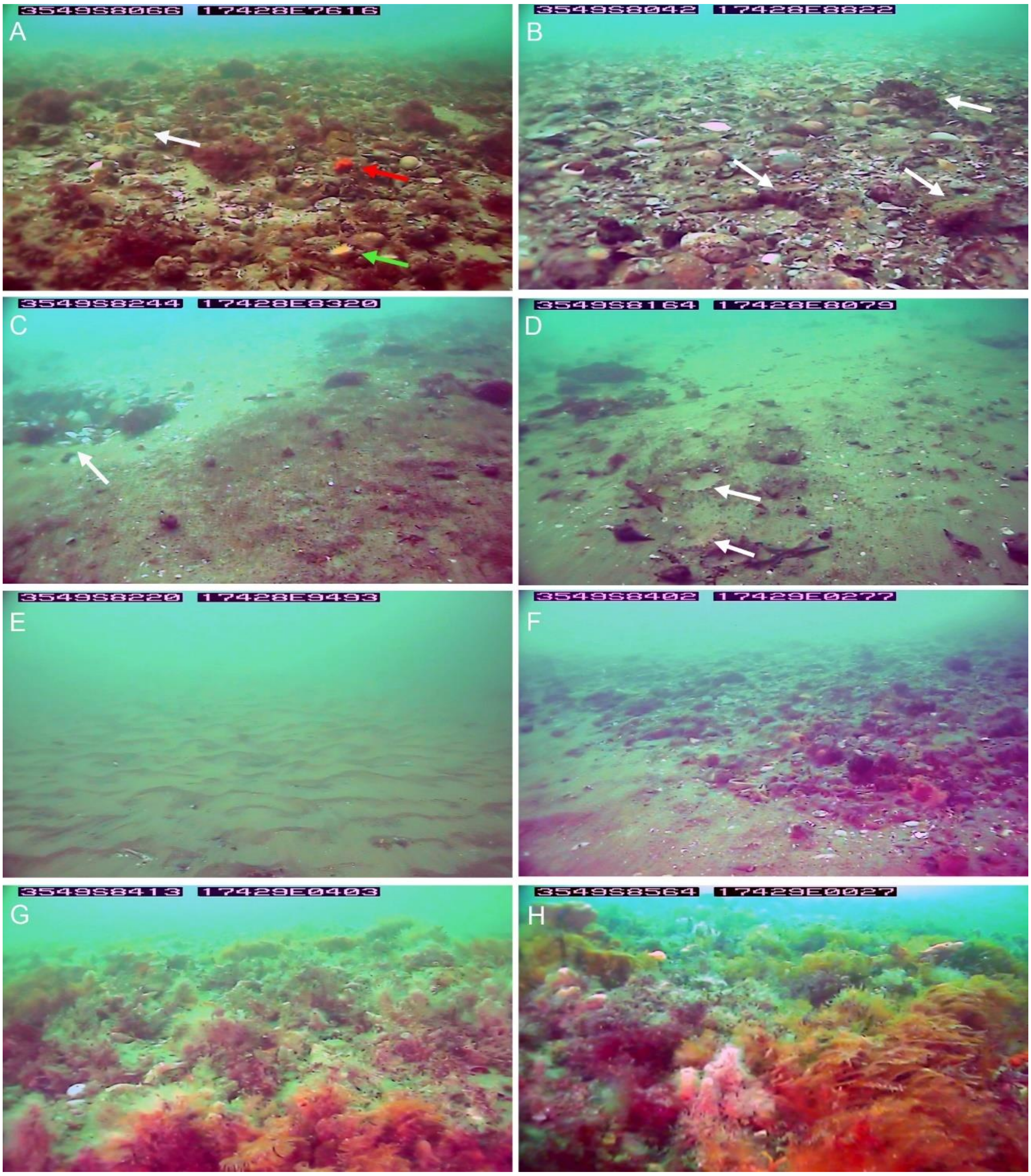

Figure 10. Video stills taken from within the existing dredge area to the north of Northport (Transects s to u in Figure 5): A. Bare sand; B. Sand with scattered shell; C. Dense shell gravel; D–E. Various small sponges; F. A leatherjacket (*Parika scaber*).

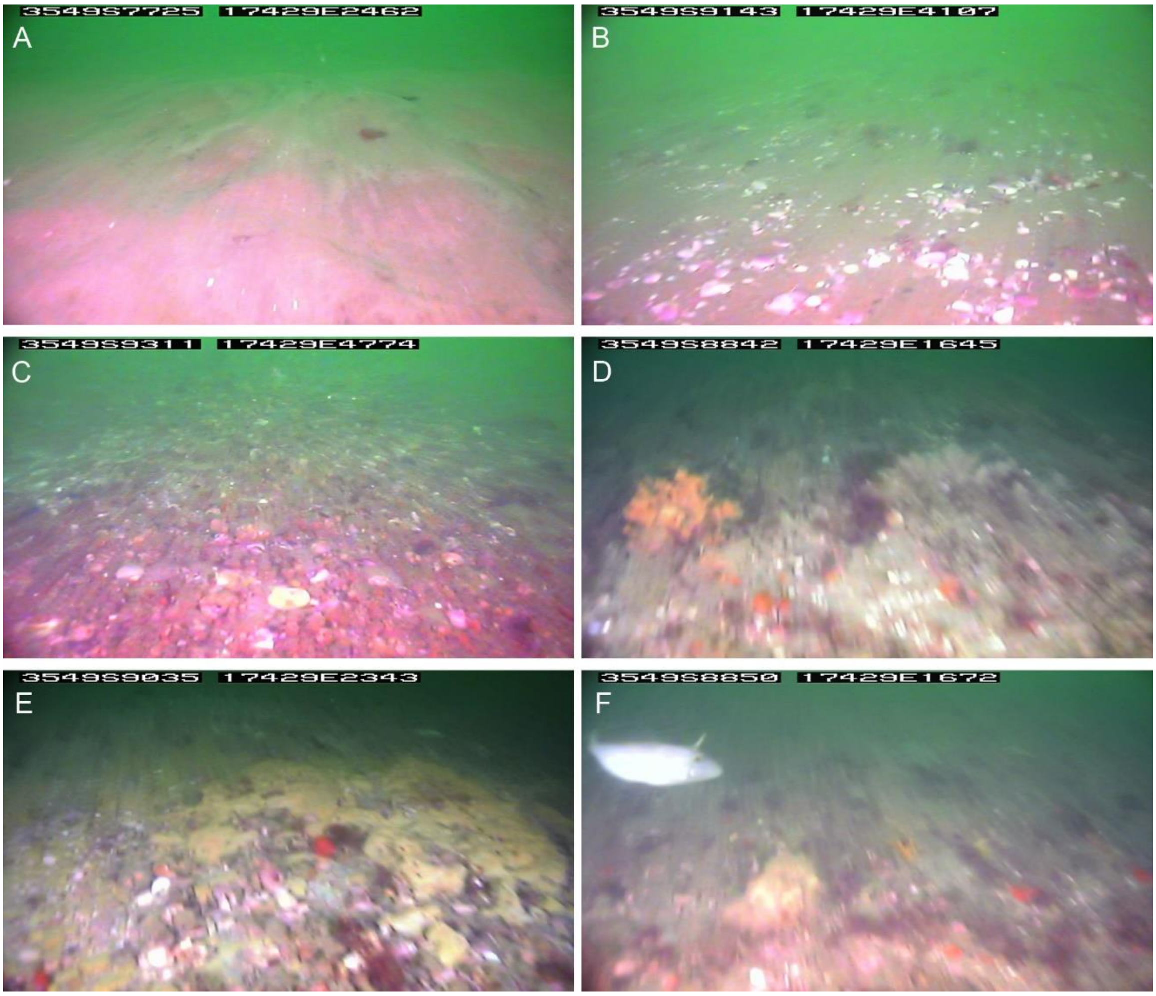

Figure 11. Video stills taken from potential seagrass areas showing sparse seagrass (Transects a & b in Figure 5).

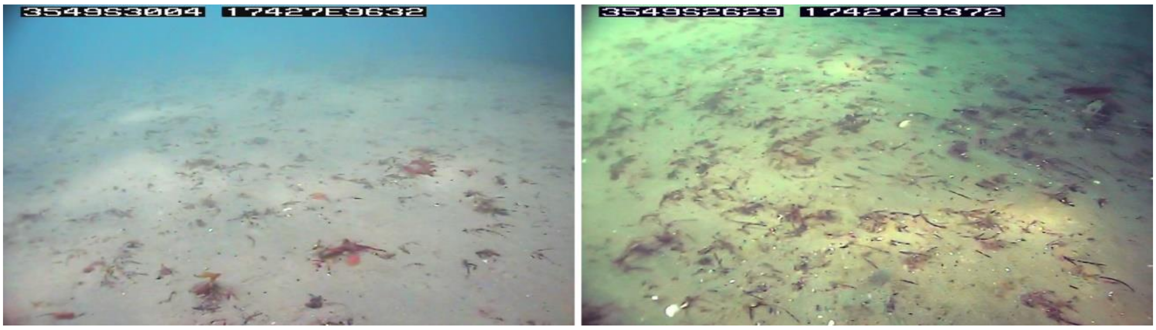

Figure 12. Video stills taken from within the reference areas (Transects c to i in Figure 5): A. Horse mussel (*Atrina zelandica*); B. Anemones growing on small rocks; C–F. Various sponges and macroalgae; G. Dense red macroalgae and a rigid bryozoan (arrow); H. Dense red macroalgae and a bushy hydroid (arrow).

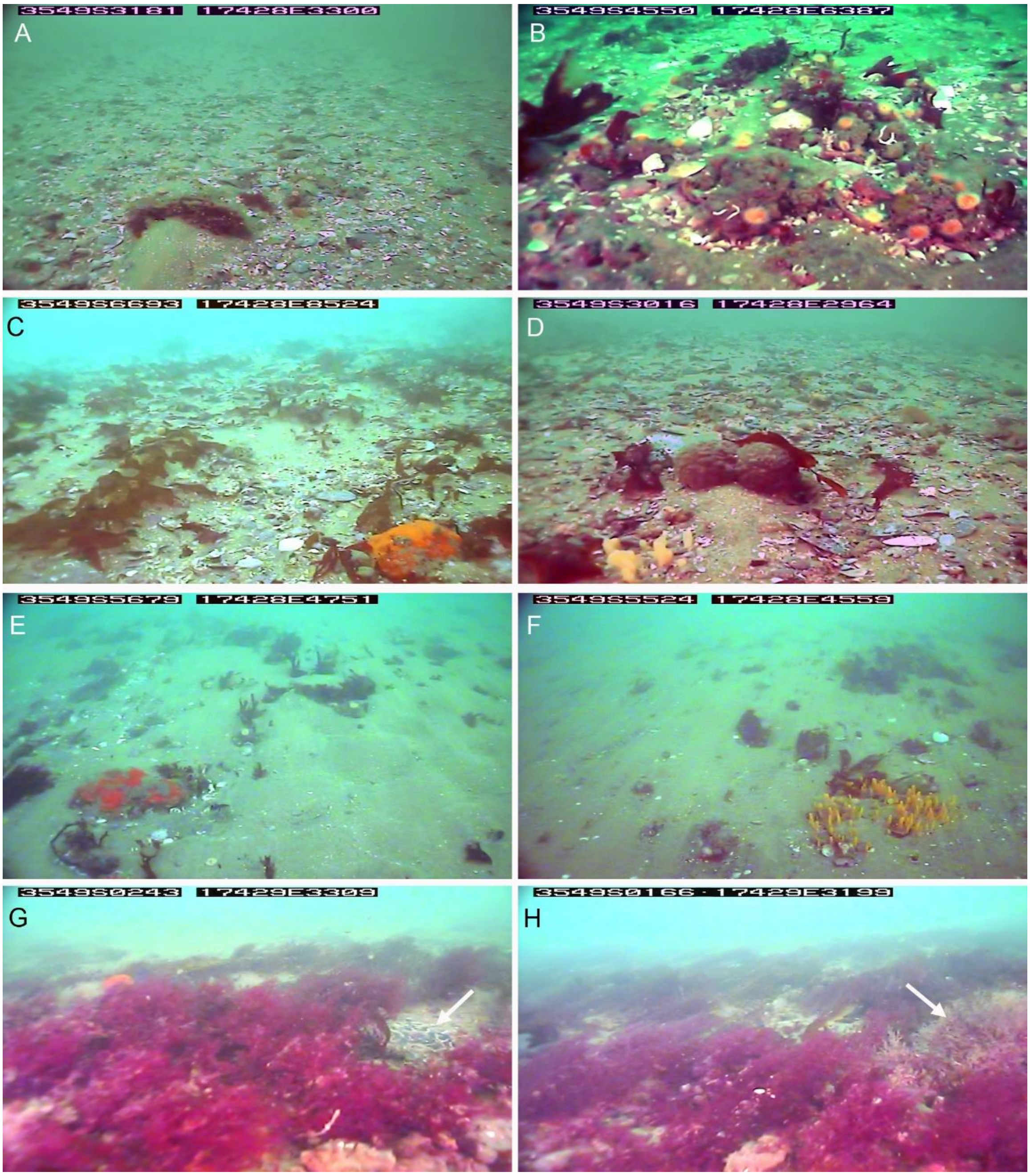

Figure 13: Variation in the abundance and size distributions of a. cockles and b. pipi in areas along Marsden Bay (see Figure 14 for the extents of each area).

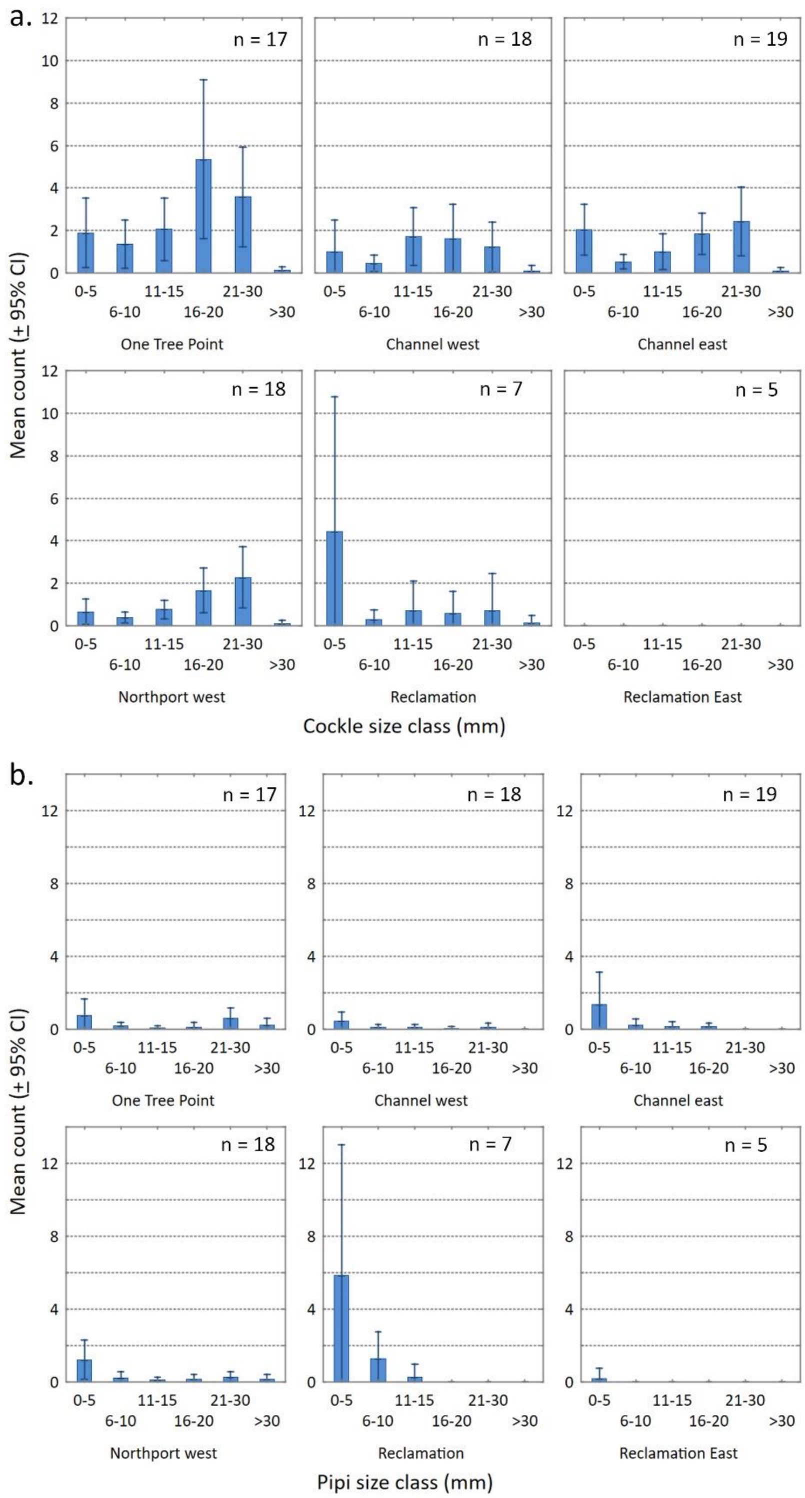

Figure 14. Stations sampled in the July 2022 quantitative survey of benthic macrofauna in Marsden Bay.