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
APPLICATION NO.	APP.005055.38.01 and LU 2200107

STATEMENT OF EVIDENCE OF JARED KARL PETTERSSON

ENVIRONMENTAL MANAGEMENT

24 August 2023

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INTRODUCTION

Qualifications and experience

1. My name is Jared Karl Pettersson.

2. I hold a Bachelor of Engineering (Hons) and a Masters of Engineering from the University of Canterbury, both in Civil Engineering.

3. I am a Chartered Professional Engineer and have 20 years of professional experience, largely in contaminated land, resource management, project management, environmental management and strategy.

4. I am a Director of Enviser Ltd, an environmental consultancy, based in Christchurch.

5. During my professional career, I have been involved with, or responsible for, the preparation and implementation of numerous environmental or site management plans. Most recently I was responsible for the regulatory approvals and environmental management of most of the Lyttelton Port Company's (LPC) post-earthquake rebuild. This included the preparation and implementation of the following [with advice from technical experts]:

   (a) The Environmental Monitoring and Management Plan and the Marine Mammal Management Plan for the Channel Deepening Project in Lyttelton (18 million m^3 consented, 6 million m^3 completed).

   (b) Consent stage Construction and Environmental Management Plan (CEMP) for the 30 ha Te Awaparahi Bay reclamation and associated 700m long container wharf.

   (c) The Marine Mammal Management Plan for the cruise berth construction.

6. I, and staff under my direction, were also responsible for the initiation and preparation of the Port-wide Construction and Environmental Management Plan Guidelines (CEMPG) for LPC. The CEMPG sets standard management practises for use in all construction activities, land and marine-based, at Lyttelton Port and provides guidelines and templates for creating site-specific CEMPs. I was also responsible for reviewing

Contractor prepared CEMP's under this framework and auditing the implementation of those plans during site works. Examples of these projects include:

(a) Stage 1b of the Te Awaparahi Reclamation (approximately 6ha) including associated dredging.

(b) Gollans Bay Quarry construction and operations.

(c) Cruise Berth construction.

(d) Installation of harbour-wide navigation aids.

(e) Remedial works to the Oil Berth (marine and landside works).

(f) Various landside infrastructure projects from pavement, roading and rail projects to container crane erection and alterations.

7. Other recent relevant experience includes:

(a) Preparation (with Cawthron and Styles Group) and implementation of the Marine Mammal Management Plan for the 2023 Christchurch SailGP event.

(b) Preparation and implementation of Environmental Management Plans (EMPs) for various marine projects for the Christchurch City Council, including remediation of coastal landfills and construction of wharf and jetty structures.

(c) Review of the turbidity management plan for the upgrade works to the Whitianga marina.

(d) Preparation of the CEMP for Christchurch International Airport's (CIAL) proposed 170 MW solar farm.

8. I am familiar with the application site and the surrounding locality. I have read the relevant parts of: the application; submissions; and the s42A Report. I have also read advance draft versions of the statements of evidence of **Professor David Fox**, **Dr Deanna Clement, Dr Shane Kelly**, and **Ross Sneddon**.

Code of Conduct

9. 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

10. In my evidence, I:

(a) Set out an executive summary of my key conclusions.

(b) Briefly summarise the proposal.

(c) Outline the management plan framework that will be implemented during the works and outline the role of each plan.

(d) Explain how those management plans apply to the main construction phases of the project and how they interact.

(e) Provide a summary of the Construction Environmental Management Plan (CEMP) and Marine Mammal Management Plan (MMMP).

(f) Summarise, in more detail, the Environmental Management Plan (EMMP).

(g) Respond to the s42A Report.

(h) Respond to submissions raised.

(i) Comment on the draft proposed conditions advanced by Northport.

EXECUTIVE SUMMARY

11. Based on my review of the expert assessments and experience with implementing management plans (CEMP, MMMP and EMMP) on similar marine projects, I consider that the proposed management plan framework – and the management approaches

contained within the management plans/proposed conditions, including with respect to real-time turbidity monitoring and management – represent best practice for this type of project.

12. In combination with the proposed conditions, in my opinion the proposed management plan framework will be effective at implementing the proposed management measures and allow Northport to effectively manage the potential effects of the construction phase of the project on the environment.

PROPOSAL SUMMARY

13. The proposed expansion of Northport's facilities includes:

(a) A reclamation of approximately 11.7 hectares within the CMA and additional earthworks above Mean High Water Springs (MHWS) of around 1.8 hectares. The reclamation extends an additional 250 metres eastward from the already consented Berth 4 extension. The works will include the construction of rock bunds/revetments, filling with dredge spoil and general earthworks activities.

(b) Dredging to deepen the berth and manoeuvring area. Approximately 1,720,000 cubic metres of dredge volume (in situ) is required to achieve the required navigable depth and provide the fill for the reclamation. Dredging will be achieved via a cutter suction dredge (CSD), Trailer Suction Hopper Dredge (TSHD) or Backhoe Dredge (BHD) or a combination of all three. The dredge spoil will be pumped ashore as a slurry for use in the reclamation.

(c) Construction of a 250m wharf on the northern face of the reclamation. Works will include driving piles, concrete placement and steelwork.

(d) Construction of pavements, utilities and container handling infrastructure on the wharf and reclamation.

MANAGEMENT PLAN FRAMEWORK

14. As the project involves several distinct, but interlinked, construction activities both on land and in the marine environment, an Environmental Management Framework has

been developed. The framework aims to provide the contractors with clear direction on the risks and management measures relevant to their work type and the operating environment in a concise manner.

15. To achieve this, a series of management plans were created. These plans either match a discrete part or phase of the project, or a particular effect common to multiple parts of the project.

16. The primary management plans that make up the framework are:

(a) Construction Environmental Management Plan (CEMP) – covering the reclamation and wharf construction.

(b) Environmental Management and Monitoring Plan (EMMP) – covering environmental effects of the capital dredging operation.

(c) Marine Mammal Management Plan – covering management of effects on marine mammals from all project parts/phases.

17. Several secondary plans are also to be prepared by the contractor, once appointed. These secondary plans will either document how the contractor will implement the primary management plans or detail how specific risks of their equipment (or methodology) will be managed. The secondary plans required are:

(a) CEMP

(i) Biosecurity Management Plan (BMP) for the vessels and methods used for the reclamation construction.

(b) EMMP

(ii) Biosecurity Management Plan (BMP) for the dredge and support vessels used during the dredging operation.

(iii) Capital Dredge Management Plan (Capital DMP) to document how the EMMP will be implemented with the contractor's equipment/method, and how they will manage the potential effects of the vessel's operation. A

Maintenance Dredge Management Plan (Maintenance DMP) is also proposed.

18. As the CEMP and MMMP were submitted (in draft) with the application, I will only briefly summarise those documents and explain in more detail the EMMP, which was not included in the application but is attached to my evidence as **Attachment 1**.

19. The CEMP, MMMP and EMMP are draft documents and will need to be updated once the detailed design is completed and specifics of the construction methodology are known.[1]

20. The conditions proposed by Northport, attached to the statement of evidence of **Brett Hood**, also require the implementation of an Air Quality Management Plan ("AQMP") which is outlined in the statement of evidence of **Andrew Curtis**.

CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

21. The purpose of the CEMP is to document the potential environmental risks and set out appropriate management measures, minimum standards and monitoring requirements. The CEMP covers the effects during the construction of the reclamation, wharf and associated structures. The effects of capital dredging are addressed in the Environmental Monitoring and Management Plan (EMMP) which I discuss later in this evidence.

22. The draft CEMP was informed by the other experts' effects assessments and my and my staff's knowledge and experience with similar construction projects.

23. The CEMP is structured into the following sections:

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[1] Northport has, informed by input from its independent expert team, continued to update its proposed conditions of consent since the application was lodged (and certain draft management plans were provided). In some cases this has involved refinement to the content or other requirements for the various management plans, including in many cases requirements for additional detail). The intention is that all draft management plans will be updated in line with final conditions imposed, should consent be granted and the project implemented.

(a) Introduction – Setting out the roles and responsibilities, site and project description, regulatory requirements and a summary of the environmental risk assessment for the project.

(b) Technical Chapters – each chapter deals with a specific environmental risk, evaluates the risk by work type, sets performance standards, required control measures, and monitoring and reporting procedures. The risks are evaluated for the two primary components of the project: the reclamation construction and the wharf and ancillary structures.

The following technical chapters are included in the CEMP:

(i) Dust

(ii) Hazardous Substances

(iii) Erosion and Sediment Control

(iv) Wildlife

(v) Marine works

(vi) Archaeology

(vii) Noise

(viii) Marine biosecurity

24. The CEMP also includes procedures for communications/complaints and updating the CEMP.

25. A summary of the key points from each section is described below.

Dust

26. Based on Northport's experience with the existing port's construction, distance to sensitive offsite receptors, predominant wind direction and topography, the dust risk is considered low. The primary receiving environment are people using the adjacent car park and beach and commercial activities to the south of Northport.

27. The primary control measures in the CEMP were drawn from a dust management plan prepared by Pattle Delamore Partners. These measures aim to limit dust-generating activities in windy conditions, limit vehicle speeds onsite, stockpile materials appropriately and keep surfaces damp. These are combined with requirements to monitor weather conditions, wind speed triggers, regularly monitor for fugitive dust and a procedure to respond to complaints.

28. These types of measures are routine and well understood by contractors, and in my experience are generally effectively implemented. Moreover, if dust is generated, additional measures can be applied (i.e. additional water application, halting activities) which generally have a relatively immediate effect on dust generation.

Hazardous substances

29. Hazardous substances will be used and stored on-site during the construction works. Typically, these include lubricants, hydraulic fluid, fuels associated with plant and equipment as well as cement and construction adhesives/sealants. These substances pose the highest risk where there is a risk of spill to the marine environment.

30. The storage, handling and use of hazardous substances are controlled by the Hazardous Substances and New Organisms Act 1996 (HASNO Act) and the Regional/District Plans. The CEMP sets out relevant controls for each type of hazardous substance likely to be used and requires the Contractor to implement the appropriate controls and procedures before bringing hazardous substances to the site, or during their use and storage.

Erosion and sediment control

31. The primary risk of sediment entering the marine environment during the reclamation works are:

    (a) Sediment-laden stormwater generated from flow across exposed ground.

    (b) Fines within the reclamation fill material being washed out or eroded by wave action.

32. In order to reduce the amount of sediment discharging into the marine environment, the CEMP details several mitigation measures. These measures are standard industry practice and include:

(a) Reducing up-catchment water flowing across the reclamation via the installation of perimeter cutoff drains.

(b) Reducing the source of sediment (minimising areas of un-stabilised ground, preventing offsite tracking of sediment, appropriate stockpile locations and controls).

(c) Treating water prior to discharge (via silt fences, soakage devices, etc.) to minimise sediment in the discharge.

(d) Appropriate materials and construction methodologies.

Marine works

33. The reclamation construction requires a range of marine works, including demolition and construction of structures (wharves, revetments etc), construction dredging, placement of reclamation fill and rock, discharge of decant water and piling.

34. These activities have a medium-high risk of resulting in discharges of sediments or other contaminants to the marine environment. Controls are needed to manage these discharges and minimise the potential effects.

35. In general terms, the controls require:

(a) Monitoring of weather forecasts to ensure works are undertaken in appropriate weather.

(b) Treatment of discharges to ensure the water quality performance standards are met.

(c) Using methodologies and materials that minimise the disturbance of sediment and the resulting entrainment in the water column.

(d) Placing erodible materials within a wave-protected structure and minimising open work areas subject to wave action.

(e) Controlling the runoff of concrete curing water and minimising the discharge of that water to the marine environment.

(f) Having, and using, debris booms and silt curtains where required.

36. The discharge of decant water is one of the higher-risk activities as it could result in large volumes of sediment-laden water being discharged into the marine environment if not managed appropriately. Northport has extensive experience with managing these discharges from the previous port reclamations and has successfully used a series of decanting paddocks to settle out the fine sediment prior to discharge. The CEMP assumes this same arrangement will be used and sets out the relevant controls. Of particular importance is making sure the decanting paddocks are appropriately sized for the expected dredging discharge rates and sediment characteristics.

37. Complementing proposed conditions of consent, the CEMP requires regular monitoring of the site and discharges, including water quality sampling of the decant discharge, to confirm the measures are effective and the performance standards are being complied with. Including due to the challenges of collecting receiving environment samples in all weather conditions, sampling is proposed to be undertaken at the point of discharge, not in the wider marine environment.

38. I also recommend that the decant discharge is monitored using a turbidity probe, rather than relying on laboratory-based Total Suspended Solids testing. The use of a turbidity probe allows for instantaneous monitoring of the discharge with faster implementation of additional measures if required.

Archaeology

39. Archaeology investigations by Clough and Associates concluded that no known archaeological features are present on the site. Consequently, the risk of disturbing archaeological features is considered low and no specific measures are proposed in the CEMP.

40. As a contingency measure, an Accidental Discovery Protocol (ADP) will be in place in case unexpected archaeological features are unearthed during the works.

Noise and vibration

41. Several noise-generating activities will occur during the construction activities, and whilst some can generate high levels of noise (i.e. percussive piling), the distance to sensitive receptors (for example residents of Reotahi) is large (approximately 900 m). Noise assessments by Marshall Day indicate the construction noise standards will be met and the risks are generally judged as low. Piling has been assigned a high risk, not because of the noise levels, but because of the noise character.

42. Notwithstanding the generally low risks, controls are still needed to minimise noise levels. Complemented by proposed conditions of consent, these include:

    (a) Piling activities during daytime hours (7:30 am-6 pm Monday - Saturday).

    (b) The use of quiet construction methodologies with well-maintained equipment.

    (c) Avoiding the use of beeping reversing alarms on mobile equipment.

    (d) Locating stationary equipment away from receptors and orientating to minimise noise.

43. Whilst the noise levels at sensitive receptors are expected to be low, as required in the CEMP, Northport will communicate with the local community about the Project, the noise they will hear, and ways to raise concerns with or seek further information from Northport.

44. Sunday piling may occur in exceptional circumstances (assuming compliance with the construction noise consent conditions can be achieved), and it would be Northport's usual practice to notify the community ahead of time if this was needed.

Wildlife

45. The CEMP identifies that effects on avifauna and marine mammals require controls during construction. The MMMP (addressed below) details the measures for marine mammals, with the CEMP setting out controls for avifauna. These are focused on

identifying and avoiding disturbing nesting/moulting penguins and nesting variable oystercatchers. Surveys of the rock revetments by an experienced avifauna specialist are required to identify potential nesting sites prior to the removal of that rock.

Marine biosecurity

46. The reclamation and wharf construction will involve the use of marine plant and vessels, some of which may be sourced from outside Whangarei. Due to the risks of importing unwanted marine pests, the CEMP requires that the contractor prepares a Biosecurity Management Plan (BMP) for all marine plant.

Summary

47. The draft CEMP sets out a robust framework that identifies risks associated with the construction works, and sets out the required controls and associated monitoring and reporting requirements.. In my experience, this type of CEMP is effective at conveying the environmental risks to those undertaking the work and clearly setting out the management controls needed. It is important the contractor, with Northport and its advisors, updates this CEMP once the final design is known and the construction methodologies are fully understood.

48. The updated CEMP should also consider any additional expert work, for example additional monitoring, undertaken in the intervening period and relevant consent conditions.

49. For completeness, the objectives and content requirements of the CEMP are detailed in the proposed conditions, which also include complementary standards or other requirements for matters within the scope of the CEMP.

Marine Mammal Management Plan

50. As detailed in the evidence of **Dr Deanna Clement**, the proposed works have the potential to affect marine mammals that can be present in the harbour.

51. These effects are predominantly related to the generation of underwater noise during pile driving and dredging, with lesser risks associated with vessel strike, entanglement in waste debris and negative impacts on habitat.

52. I, with technical input from **Dr Deanna Clement** and **Dr Matt Pine**, prepared a Marine Mammal Management Plan (MMMP) for the construction phase of the proposed works. This MMMP sets out a series of management practices to minimise potential effects on marine mammals during construction activities.

53. Most of the plan deals with the primary adverse construction phase effect: the generation of underwater noise during pile driving and to a lesser extent during dredging.

54. As set out in **Dr Matt Pine** and **Dr Deanna Clement's** evidence, if mammals are exposed to excessive levels of underwater noise for long enough, they can suffer behavioural effects or damage to their 'hearing'; either temporarily or permanently. The nature of the effect depends on how close the mammal is to the sound source, how loud it is and how long the animal is exposed for.

55. To reduce the risk of mammals being exposed to excessive levels of noise, the MMMP implements a framework to identify the presence of marine mammals and shut down the noisy activities before the animals are exposed to noise which could result in a temporary impairment to their hearing; known as a temporary threshold shift (TTS).

56. This framework comprises:

(a) Trained marine mammal observers[2] (MMOs) tasked to identify the presence of marine mammals in the harbour.

(b) Establishment of Marine Mammal Observation Zones (MMOZ) based on underwater noise modelling.

(c) Verification of the underwater noise modelling by in-situ noise measurements and adjustment of the MMOZ as needed.

(d) Procedures to shut down the noisy activities if a marine mammal is spotted in the MMOZ.

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2 Trained means the Marine Mammal Observer has attended and passed a DOC approved MMO training course.

(e) Soft start piling startup procedures to ensure any unsighted mammals have time to vacate the MMOZ before the full energy is applied to the pile.

57. These primary management measures are combined with secondary management measures to further reduce the risk and manage other non noise related risks.

58. The secondary management measures include (among other things):

(a) Selection of the right equipment for the piling work. This should use the lowest energy necessary, be well maintained and if practicable use a sound-deadening dolly to avoid metal-on-metal hammering.

(b) Training of all staff and contractors involved in dredging, piling and marine works so they understand the risks, management measures and how to spot a marine mammal and convey that information to the appropriate party.

(c) Control of project vessel movements in proximity to marine mammals to minimise the risk of vessel strike.

(d) Requiring strict waste management practices on vessels and works near the water to prevent debris from being discharged to the harbour and creating an entanglement risk.

(e) Controls on the use of sediment curtains to prevent entrapment of entanglement.

59. Based on my experience implementing similar procedures at marine construction projects in Lyttelton, these measures are successful in identifying the presence of marine mammals and rapidly shutting down (or not starting) piling activities before mammals enter an area with unacceptable noise levels.

60. In my experience, key factors that enhance the success of the framework are:

(a) Engagement of the contractor in the marine mammal management via training and information sessions. This ensures the staff understand the risks and are well motivated to report ad-hoc sightings, rapidly implement machinery shutdowns and positively interact with the MMOs.

(b) Incorporation of noise reduction criteria in the detailed design process to ensure construction details and methods result in the lowest practicable noise levels.

(c) Elevated MMO observer positions that are well protected from the elements. More than one position is likely needed to provide optimum viewing in different conditions and to account for obstructions by construction equipment.

61. The proposed conditions of consent and the draft MMMP appropriately enable the above in my opinion.

62. Whilst I acknowledge the Whangārei Harbour is different from other projects I have been involved in, both in its physical characteristics and the type of marine mammals present, from a practical perspective I believe the framework presented in the MMMP will be similarly successful in preventing TTS effects and managing other non-noise related effects on marine mammals.

63. For completeness, the content requirements of the MMMP are detailed in the proposed conditions, which also include complementary standards or other requirements for matters within the scope of the MMMP.

ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

64. The draft EMMP is a management document that sets out a framework for the monitoring and management of potential effects from the proposed Capital Dredging. Comprehensive proposed consent conditions set out the objectives of – and content requirements for – the EMMP, along with a range of controls/requirements within the scope of the matters covered by the EMMP.

65. The EMMP is structured around three main monitoring and management approaches. They are:

(a) Dredge monitoring and management. This involves responsive management of the dredging operations informed by real-time turbidity monitoring. The primary purpose is to manage suspended sediment plumes resulting from the dredging activities;

(b) Assurance monitoring of the physical and ecological environments in Whangārei Harbour to monitor longer-timescale potential environmental effects; and

(c) Other management protocols to be implemented alongside the EMMP during the Capital Dredging, e.g. the landside CEMP, the MMMP, the Capital DMP (addressed above), the BMP, and reporting of complaints/incidents.

66. The proposed framework of real-time dredge management combined with longer-term assurance monitoring is best-practice for dredging projects in New Zealand. It has been successfully implemented during recent dredging projects in Lyttelton and Napier. During implementation of Lyttelton's channel deepening project, which I was involved with, no material issues of concern with respect to dredging related elevated turbidity levels were reported.

67. I outline the practical fundamentals of the proposed framework of real-time dredge management and associated assurance monitoring below.

Assessment of Potential Effects

68. The Applications include technical assessments of potential effects on a wide range of topics – including ecology, coastal processes, and recreation (among others) – that could result from the proposed Capital Dredging activities. These assessments are informed by hydrodynamic and sediment plume modelling, which provided information on the predicted extent and movement of suspended sediment plumes generated from dredging.[3] This modelling is discussed further in the evidence of **Dr Brett Beamsley**.

69. The technical assessments of effects conclude that there is potential for the project to affect ecological and physical environments. Key adverse ecological effects from sediment plumes and subsequent sediment deposition relate to the subtidal ecologies adjacent to the dredging areas. The actual level of effects will depend on the extent and amount of sediment deposition that results from dredging. The dredge management set out in the EMMP aims to minimise the dredge plumes and ensure the actual sediment plumes are equivalent to or less than the modelled scenario that the effects assessments are based on.

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3 Appendix 9 of the Application – MetOcean (2022).

Purpose and Objectives of the EMMP

70. The primary purposes of the EMMP, as set out in Section 1.2 of the EMMP, are to:

(a) Ensure the effects of the dredging are within the envelope predicted by the assessment of effects.

(b) Detail a framework for the monitoring and management of the dredging plumes to minimise the risk of sediment plumes causing adverse effects on sensitive receptors.

(c) Set out a framework for assurance monitoring to evaluate the actual and potential biological and physical effects of dredging.

71. The primary objectives (which are specified to meet the purposes of the EMMP) are to:

(a) Ensure dredging activities are controlled to manage environmental effects.

(b) Ensure stakeholder engagement is ongoing through all phases of capital dredging and provide procedures for handling complaints.

(c) Specify a framework for the management of the dredging activities based on the results of real-time turbidity monitoring to reduce the risk of unanticipated effects.

(d) Detail an assurance monitoring programme for appropriate and relevant monitoring of the physical and ecological environments in Whangārei Harbour.

(e) Detail reporting requirements and frequency for results of the management and monitoring.

(f) Specify the roles and responsibilities of groups involved in monitoring and management during and after the completion of dredging.

(g) Set out other relevant management plans required during capital dredging, including the Capital DMP, and the linkages and cross-references to those plans.

Dredge management

72. The EMMP adopts a style of dredge management with a continuous monitoring–evaluation–adjustment loop whereby management responses adjust based on the results of the monitoring of effects. The purpose of this style of dredge management is to provide a framework that ensures effects are managed (responsively) within predicted bounds. It complements, and does not *replace,* the rigorous effects assessments undertaken.

73. Dredging projects lend themselves well to a continually responsive management approach, primarily because the main mechanism of effect (sediment plumes) can be measured in real-time and the dredge operation can respond almost immediately to the information. In addition, the project comprises many very similar and repetitive dredging/pump-ashore cycles, allowing the operator to incrementally build their knowledge of how the environment reacts to the activity in a particular set of conditions and fine-tune operations accordingly.

74. The underpinning idea behind the proposed dredge management framework for the project is to manage the dredging operations cycle-by-cycle utilising real-time turbidity data from three monitoring locations in Whangārei Harbour, along with appropriate trigger levels.

75. Three trigger levels are proposed: two warning levels and a third ‘stop’ operations (or “compliance”) trigger.

76. The first two trigger levels provide the dredge operator with sufficient warning to enable operations to be adjusted and prevent the third ‘stop’ trigger level from being reached for that location.

Turbidity monitoring

77. The turbidity monitoring programme[4] is designed to provide:

(a) Baseline (pre-dredging) turbidity data to define the natural background turbidity conditions at the project site and surrounds.

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[4] Focusing on the real-time aspects, as opposed to the assurance monitoring aspects.

(b) Real-time turbidity data during dredging to ascertain whether total turbidity (natural and dredge-induced) is within predicted levels and whether additional management of the dredge operation is required.

(c) Post dredging, the monitoring will continue to evaluate turbidity response to cessation of dredging.

78. These objectives will be achieved by collecting continuous telemetered information (every 15 minutes) on the near-surface (approximately 0.75m below surface) at three locations throughout Whangārei Harbour.

79. Turbidity monitoring instruments have already been installed to gather preliminary background turbidity data. These turbidity monitoring locations were chosen with consideration of the following criteria:

(a) Located between the proposed activity and a sensitive receptor (or receptors)

(b) On the edge, but within, the predicted plumes to ensure the equipment collects data on the plumes, not just background turbidity

(c) Outside the commercial navigation channel and swing basin

(d) Outside the main navigation routes for recreational traffic

(e) Outside the Marine Reserve

(f) In areas of moderate to low current velocities to ensure the longevity of the instruments

(g) Not in locations that may conflict with existing navigation lights or markers

80. The chosen locations were selected based on the above criteria and with advice from **Dr Shane Kelly** (Marine Ecologist), the supplier of the instruments (Paul Barter, Cawthron Institute) and Northport's marine team.

81. The specific monitoring locations for the current deployment are shown in yellow in **Figure One** below and are designed to provide a network that covers the anticipated direction of sediment plumes during all tidal conditions.

Figure One: turbidity monitoring locations (marked in yellow)

82. The three locations provide:

(a) A monitoring station between the activity and the ecological values associated with the subtidal and intertidal areas to the west of the port off One Tree Point. This location is designed to monitor westward setting plumes during flood tide conditions.

(b) A monitoring station to the east of the port, between the activity, Channel Infrastructure facilities and Mair Bank. This location is located to monitor eastward setting plumes in ebb tide conditions.

(c) A monitoring station between the activity and the marine reserve on the northern side of the harbour. Whist plumes are not expected to be directed towards the marine reserve, this location is designed to monitor general turbidity conditions resulting from a potentially more dispersed plumes following mixing across multiple tidal cycles.

83. I note that for the actual dredging project, the location of Rua may need to be moved to account for the project footprint and vessel movement requirements. The specific

location of all instruments should be re-evaluated prior to commencement of the baseline monitoring period.

Tiered Trigger Levels

84. The proposed conditions require, and the draft EMMP includes, a framework of tiered trigger levels that the real-time turbidity data will be compared against.

85. The purpose of the tiered trigger levels is to provide initiation points for stepped management measures to ensure turbidity plumes (and any associated effects) are not greater than the modelled predictions. They do not describe the level of turbidity at which environmental effects will occur.

86. Three trigger levels are proposed at each monitoring site. The first two trigger levels provide an indication to the dredge operator that turbidity levels are higher than typical, and measures should be implemented to reduce dredge-generated turbidity plumes. The third trigger level is a compliance point and requires cessation of dredging in the vicinity of that location whilst the trigger conditions prevail.

87. The Modified IFD (intensity - frequency - duration) (M-IFD) method is proposed as the statistical basis for the trigger level framework. **Professor David Fox** sets out the statistical background to the M-IFD method, but in practical terms the M-IFD approach defines a trigger level with a turbidity intensity (i.e. a value of NTU)[5] and an allowable duration (in minutes or hours) the turbidity can be above the intensity in a set period. The method seeks to ensure that during dredging, the key characteristics of the background turbidity (i.e. the level and nature of the variability) are maintained.

88. A trigger event occurs when a monitoring location records turbidity above the intensity level for longer than the allowable duration. Tier 1 will have a low intensity and a relatively long allowable duration, whereas Tier 3 will have a relatively high intensity but a short allowable duration. The tiered approach provides an opportunity for the dredge contractor to manage their operations and the turbidity generated before a Tier 3 event occurs.

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[5] Nephelometric Turbidity Units.

89. In practice, the method allows the dredge contractor to monitor, in real-time, the turbidity levels in the harbour, understand how their operations impact that turbidity and if they are below, approaching or exceeding the predicted turbidity levels and allowable duration.

90. In my experience, dredge contractors rapidly adapt to working under this real-time management framework. The real-time data allows for almost immediate feedback on how adjusting the dredge operations impacts the harbour's turbidity. This allows the dredge contractor to rapidly learn how to manage their operations in different tide and weather conditions to manage the turbidity levels and avoid exceeding the trigger levels.

Establishment of trigger values

91. As detailed by **Professor David Fox** in his evidence, the actual values (intensity and duration) that make up the trigger levels can only be calculated following the completion of baseline monitoring, which requires a minimum of 12 months of turbidity data. A 12 month baseline duration is best practice and has been used in other projects in New Zealand (such as for LPC's recent dredging).

92. Once that baseline is established, the modelled dredging addition will be added to the baseline data. This is necessary to:

    (a) Reflect that the expert assessments (and the assumed effects) included in the application were based on the modelled additional turbidity caused by dredging, not a zero addition of turbidity.

    (b) Account for the different distances the monitoring points are from the activity, i.e. the closer an instrument is to the activity, the more likely it will record dredge-related turbidity increases. Without this addition an instrument 10m from the activity would need to achieve the same standards as an instrument a long distance from the activity.

93. This new time series of turbidity data will be used to calculate the various statistics needed to generate the intensity and duration trigger components for each monitoring location. **Professor David Fox** explains this in detail in his evidence.

94. During dredging, the validated, smoothed real-time turbidity data from the monitoring buoys will be continuously compared to the established trigger levels. The comparison will be automatic and will be built into the web-based portal. This will alert the dredging contractor and Northport, in real-time, if elevated turbidity levels are occurring in the project area and if trigger levels are being approached or exceeded.

95. It is important to note that due to the inherent design of the trigger levels (based on background data), the trigger levels may, on occasion, be exceeded purely due to fluctuations in natural turbidity. This will mostly occur in Tiers 1 and 2 but may also occur in Tier 3 in larger storm events. If the Tier 3 level is breached by natural fluctuations in turbidity, the dredging must cease unless the event is an extraordinary natural event (in accordance with the processes set out in proposed conditions).

Management responses to real-time monitoring

96. Upon breaching a trigger, the dredge operator will implement the management responses set out in Section 5.4 of the EMMP to reduce turbidity levels and avoid further trigger level exceedance.

97. A brief description of the response actions for each tier is as follows.

98. If the Tier 1 and 2 Trigger Event occurs, the Project Team will:

(a) Investigate the likely cause of exceedance (e.g. instrument failure, natural high turbidity event, location of recent dredging activities, meteorological conditions, satellite photos etc).

(b) If elevated turbidity is likely to have been caused by dredging, modify activities to reduce turbidity generation in that area. Modifications to dredging activities could include:

(i) Moving away from the location or operating in a different tidal state;

(ii) Altering the overflow regime (for TSHD);

(iii) Reducing speed or production rates during dredging;

(c) Keep records of the trigger event, including the exceedance, likely cause and actions taken.

99. If Tier 2 is triggered the measures set out above are repeated and the management measures are increased to further reduce dredge-related turbidity.

100. If a Tier 3 Trigger Event occurs, the Project Team will:

(a) Undertake immediate action to halt dredging and/or disposal in the vicinity of the monitoring location;

(b) Undertake further investigations into the likely cause of exceedance. This should cover all points covered in the Tier 1+2 levels;

(c) If the reason for exceedance is determined to be due to an extraordinary natural event[6] and not dredging-related, dredging may be able to continue (via the process set out in proposed conditions);

(d) Prior to re-commencing dredging during an extraordinary natural event, NRC must be notified (within 24 hours of a Tier 3 event) of the finding that natural events caused the trigger event, and a report provided. The report shall, at a minimum, contain:

(i) Monitoring data for the period leading up to, and during, the Trigger Event;

(ii) An evaluation of the natural causes of the event, including all supporting data and information;

(iii) Data to show that it is highly unlikely the event is caused by dredging activities;

(iv) Any changes to the dredge operations in an effort to reduce turbidity;

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6 An extraordinary natural event is a significant and self evident event that has clearly caused a tier 3 trigger event. This could include a long-return period storm, landslides in the catchment, tsunami etc.

(v) Any additional monitoring or observations carried out to investigate the elevated turbidity;

If the Council disagrees with the findings of the report the capital dredging must cease at the relevant location(s) and only recommence in accordance with specific proposed conditions of consent.

(e) Keep records of the trigger event, including the exceedance, likely cause and actions taken.

101. It is important to note that for a location to be "non-compliant", the duration and the intensity both have to be exceeded. It may be the case that early in the period a tier three event could occur, but turbidity returns to low levels shortly after. In this instance, dredging can continue if the turbidity remains below the specified intensity.

102. Groups

103. To ensure Northport receives ongoing advice from key stakeholders the EMMP suggests the establishment of a Technical Advisory Group (TAG). The TAG shall provide advice to Northport on the monitoring and management programmes, the results and the continued effectiveness of those programmes.

104. A Consent Holder Project Team (CHPT) will be established and have responsibility for the operational dredging activities, assessing real-time monitoring results and methodology and adapting dredge operations in order to prevent and respond to trigger level exceedances. The CHPT will be the core group responsible for the daily operations and initial response to trigger exceedance. The group will comprise of a project manager from Northport, dredging operator, hydrodynamic modeller, water quality expert and a statistician with other experts as and when required.

105. The Technical Advisory Group (TAG) will be similar to the group involved in the preparation of the EMMP. The composition of the group is yet to be determined, but it is expected to include members with relevant expertise in technical and cultural areas and these members are nominated by the stakeholders. The TAG would also include members of the CHPT.

106. The TAG's role will be to review information and provide advice to Northport on the monitoring results and dredge responses in general. The TAG will not provide operational advice on the dredging programme.

Assurance monitoring

107. The dredge management approach aims to manage dredge-induced turbidity to within predicted levels and ensure that longer time scale effects of the dredging are not beyond that predicted.

108. The assurance monitoring will provide longer-term data on the actual effects of the dredging on the marine ecology and coastal environment. The assurance monitoring will not inform operational responses during the dredging phase.

109. The assurance monitoring covers ecological and coastal process monitoring. Both will be undertaken during the baseline, dredging, and post-dredging phases as follows:

(a) Ecological monitoring is a key part of the assurance monitoring and aims to identify any changes to the benthic intertidal and subtidal ecologies in the Harbour. Ecological assurance monitoring will be undertaken in the baseline, dredging and post-dredging phases in accordance with the methodologies set out in proposed conditions. **Dr Shane Kelly** details the proposed ecological assurance monitoring in his evidence.

(b) Beach profile and bathymetric surveys, in accordance with the methodologies set out in proposed conditions, are also proposed to monitor the physical aspects of the soft sediment shorelines adjacent to the Northport facility. **Richard Reinen-Hamill** describes the physical coastal monitoring in his evidence.

Other Management Protocols

110. The EMMP contains guidelines on the preparation of a number of management plans/protocols that are to be completed and provided to NRC before dredging commences. These include:

(a) Capital Dredge Management Plan (Capital DMP).

(b) Biosecurity Management Plan (BMP).

(c) Construction Environmental Management Plan (CEMP).

(d) Marine Mammal Management Plan (MMMP).

(e) Marine Based Accidental Discovery Protocol (ADP).

111. Both the Capital DMP and the BMP are specific to the equipment being used, how they are operated and, for the BMP, where the vessel(s) is coming from. As these details will not be known until a contract is awarded for the work, the BMP and Capital DMP will be prepared following contract award but prior to the commencement of works.

112. Both these documents will be prepared by the Dredge Contractor with advice from Northport and their expert advisors.

113. The CEMP and MMMP have been prepared in draft and will be updated once the detailed design is complete, a construction methodology is established and a contractor has been awarded the work. As for the BMP and Capital DMP, these plans will be submitted prior to the commencement of work.

114. The Marine ADP is part of the draft Construction Environmental Management Plan (CEMP). Modifications may be required to reflect the nature of the dredging equipment and methodology.

115. The EMMP also includes a requirement for Northport to ensure proper responses to and recording of any complaints lodged about the project. Northport has a well developed system to receive, record, and respond to complaints.

Reporting requirements

116. The following reporting requirements are proposed in conditions and/or the EMMP:

(a) Quarterly turbidity monitoring reports will be prepared in the dredging and post-dredging phases to document the turbidity results, trigger level exceedances and management actions.

(b) An ecological assurance monitoring report will be prepared each year to cover the two sets of 6-monthly monitoring rounds undertaken that year.

(c) A report covering the bathymetric and shoreline surveys will be produced following the first year of post-dredge surveys. This report will compare the baseline and post-dredge surveys and comment on the results. Another report will be prepared following the completion of the 5 years of post-dredge monitoring.

(d) An annual report will be provided to the NRC during the baseline, dredging and post-dredging phases. This will be a collation report and include the reports set out above, if produced in that year.

RESPONSE TO THE SECTION 42A REPORT

117. I reviewed the s42a Report with respect to issues raised relevant to the CEMP, MMMP, and EMMP (and associated practical aspects of Northport's proposed turbidity monitoring and management framework). I note that whilst no specific review of the CEMP was undertaken by Council, some of the technical experts made recommendations relevant to the CEMP. These, and my responses to the review of the MMMP by Ms Helen McConnell of SLR Consulting, and to certain comments in the s42A Report relevant to the EMMP/turbidity management, are set out in the following sections.

Noise management plan

118. Mr Peter Runcie recommends a Construction Noise Management Plan be produced, either as a stand alone plan or within the CEMP. It is unclear whether Mr Runcie reviewed the CEMP, which does include a noise chapter informed by technical input from **Craig Fitzgerald**. This chapter will be updated once the detailed design is complete and the specific construction methodology and equipment are confirmed. In my experience, a single collated management plan is easier/more effective to implement and my preference would be for all environmental management measures to be incorporated in the CEMP to the extent practicable, including the noise measures.

Avifauna and lizard management plan

119. Ms Clair Webb reviewed the avifauna and terrestrial ecology reports and recommended an avifauna management plan and lizard management plan be produced. I have discussed this with **Dr Leigh Bull** and **Dr Sarah Flynn**:

(a) The current CEMP includes a wildlife chapter that covers avifauna. I agree this section could be expanded to include more detail and cover the bird roost sandbank construction. I understand Dr Bull has recommended certain amendments to the relevant conditions and that these amendments have been incorporated into the conditions proposed by Northport.

(b) Ms Flynn has recommended a lizard management plan be required, and Northport's proposed conditions of consent have been updated to reflect this. In my view the lizard management plan should remain a separate document as it will be likely implemented as a separate process prior to construction.

Construction air quality

120. I have discussed Mr Matthew Noonan's air quality review with **Andrew Curtis** and acknowledge Mr Noonan's comments on the differences between the mitigations in the air quality assessment and those proposed in the CEMP. Whilst some of these differences were to account for the specific framework of the CEMP, I accept some aspects were not included. This was an inadvertent omission and will be corrected in the updated CEMP.

121. More generally, I agree with Mr Noonans' comment that the final CEMP should be reviewed by an appropriately qualified specialist. This was intended for all chapters of the CEMP and I have recommended a condition to clarify this.

Marine mammal management plan

122. Ms Helen McConnell generally agreed with the MMMP and considered the mitigation measures "comprehensive *and largely appropriate"*. Ms McConnell recommended some minor alterations to the MMMP and associated conditions. For the most part, I agree with these recommendations and the updated MMMP will include the following:

(a) A requirement that best practice soft-start procedures are implemented for both vibro and impact piling.

(b) A requirement that the noise verification monitoring is undertaken within 2 weeks of commencing piling.

(c) An extended watch of the Extended Marine Mamal Observation Zone for a period of 5 days following any baleen whale sighting.

(d) Appendix D of the MMMP sets out the requirements for the MMOs, including that they must have attended and passed a DOC-approved MMO training course. The MMO training requirements will be reinforced in the main body of the MMMP for the sake of clarity, and the conditions of consent are also proposed to be updated to allow the use of experienced MMOs who may not have been DOC trained.

(e) The pre-start observation zone will be extended up to the line between One Tree Point and Manganese Point.

(f) Include liaising with the Rock Lobster Industry Council on whale sightings.

(g) Include a requirement that project vessels follow the Hauraki Gulf Transit Protocols.

(h) Include monthly inspections of silt curtains, but allow that to be via lifting the curtain to avoid the use of divers and associated health and safety risks.

123. I **disagree** with the following recommendations of Ms McConnell:

(a) Bubble curtains are required during piling.

(b) Piling in successive seasons be prohibited.

(c) Piling to remain shut down whilst marine mammals are in the 'inner harbour' which I understood to be west of the port.

124. I have discussed the use of bubble curtains with **Dr Deanna Clement** and I understand her effects assessment concluded a level of effects based on the predicted underwater noise without any noise reduction mitigation added. My understanding is that the level

of effects are acceptable based on these unmitigated noise levels. Whilst a reduction in underwater noise is a desirable outcome to reduce risks and the size of the MMOZ (and the use of bubble curtains is not precluded), I disagree that a single method should be required without any understanding of its practicality or effectiveness in this situation. I agree that the applicant should be motivated, as a best practice, to reduce noise levels, but consider the applicant and their contractors should be able to achieve that using both design and construction methods or tools. There are challenges with implementing bubble curtains, particularly in a deep high-current environment like Northport. Specifically, it is difficult to maintain an encircling bubble curtain around the full length of the pile. Practically, this can only be achieved with a double pile system with the annulus space filled with aerated water. This has not yet been used in New Zealand and is unproven in its implementation or noise reduction effectiveness. I consider a more effective alternative for Northport is to reduce underwater noise levels through a combination of design choices, equipment selection and operational controls – which may include some type of enclosed bubble curtain. The proposed conditions require the applicant to research and incorporate noise reduction measures in both the design and construction of the wharf structures. This includes a remodelling exercise to demonstrate the detailed design solution and construction methodology will result in underwater noise levels at, or below, that predicted in the modelling provided with the Applications. The suggested condition is included in the set attached to the evidence of **Brett Hood**.

125. Additionally, as the effects assessment is based on a predicted noise level, it would be appropriate to include an underwater noise compliance point with associated noise criteria to ensure underwater noise is kept to, or below, the predicted levels of underwater noise. A condition to this effect is included in the set attached to the evidence of **Brett Hood**.

126. Based on discussions with **Dr Deanna Clement**, I agree that all practicable efforts should be made to deliver the piling programme in a way that minimises piling in successive winter seasons (July-September). Northport's proposed conditions of consent have always required this. However, there may be reasons that the piling programme needs to extend beyond a 21-month period. Including in response to the feedback from Ms McConnell, the proposed conditions of consent now include

increased controls regarding piling in successive seasons. Essentially, the consent holder can continue piling in the second winter, but only if the piling is undertaken in a manner that generates a reduced level of underwater noise to lessen the risk of avoidance behaviours in whales. Updated conditions are proposed to achieve this based on a reduced allowable underwater noise level at the compliance point.

127. Ms McConnell recommended that piling cease whilst a mammal is in the 'inner harbour', which I take as the portion of Whangarei Harbour to the west of Northport. Currently, the MMMP requires a cessation of piling only when the mammal is in the MMOZ (or EMMOZ). I discussed the potential effects of a mammal being prevented from exiting the harbour as a result of the underwater noise levels with **Dr Deanna Clement**. I understand this is a risk and provision needs to be made to prevent this occurrence. Due to the size of Whangarei Harbour, I and **Dr Deanna Clement** disagree that piling must be halted if a mammal is present anywhere in the inner harbour. As an alternative, in consultation with Dr Deanna Clement, Northport has proposed updating the MMMP to include measures to identify mammals in the inner harbour that are heading seaward and to shut down the piling before they are dissuaded from exiting past the piling activity. Proposed additional measures are:

(a) If a mammal is observed in the inner harbour, an additional MMO shall be stationed at a suitable viewing point on One Tree Point near the Marsden Yacht Club. That observer shall be tasked with identifying mammals in the inner harbour that are transiting seaward.

(b) If a mammal is observed travelling seaward, piling shall cease at a point where the mammal crosses a line between the One Tree Point observation location and Manganese Point on the north side of the harbour. This line is in excess of 3.5 kilometres from the piling activity.

(c) Piling can only recommence once the mammal has either crossed that line in a westward direction or travelled past the port and exited the MMOZ in an eastward direction.

Turbidity management

128. I have discussed Mr Drew Loher's concern that sediment plumes from dredging could compound the sediment effects (on ecology) of extreme storm events driven by climate change with **Dr Shane Kelly**.

129. Whilst the dredging will result in sediment plumes, the turbidity management framework has been designed to ensure the scale and intensity of those plumes are within those predicted by the modelling. The framework uses a tiered trigger system with metrics based on the background turbidity plus the predicted dredge turbidity. The real-time turbidity levels in the harbour are then compared to these tiered trigger levels. If the turbidity levels exceed the Tier 3 trigger level, irrespective of whether the cause is dredge related or due to a storm, the dredging must cease. Based on my experience implementing this style of dredge management, it would be highly unlikely that the dredge could operate during an extreme storm event as turbidity levels will be high and conditions sub-optimal for a dredge to operate. Therefore it is unlikely the dredging would add to the sedimentation effects during the event. Dredging could only recommence once turbidity levels were reduced to levels below the turbidity thresholds.

130. I have outlined above the position with respect to extraordinary natural events, where dredging may be allowed to continue in limited circumstances. However, the threshold of "extraordinary natural event", as set out in the proposed conditions, is a stringent one that would not apply to standard storm events.

RESPONSE TO SUBMISSIONS RAISED

131. I have not identified any submissions raising issues materially relevant to the matters addressed in my evidence that are not otherwise addressed by other experts for Northport.

COMMENT ON DRAFT PROPOSED CONDITIONS ADVANCED BY NORTHPORT

132. I have input into and reviewed Northport's proposed conditions of consent (attached to **Brett Hood's** evidence) within my area of expertise/experience, namely the management plan framework and the practical aspects of the proposed real-time turbidity monitoring and management approach. These proposed conditions establish

the overarching framework and content requirements for the management plans/monitoring approaches I have detailed in my evidence above.

133. These conditions have also had input from the relevant technical experts. For example, the proposed real-time turbidity monitoring and management framework and relevant EMMP conditions have received input from **Dr Shane Kelly** (marine ecology), **Dr Deanna Clemment**, **Professor David Fox** (establishment of turbidity monitoring), and **Ross Sneddon** (marine ecology peer review), among others.

134. In my opinion, the proposed conditions within my area of expertise (including the management plan framework and the practical aspects of the proposed real-time turbidity monitoring and management):

(a) represent best-practice;

(b) are comprehensive;

(c) will enable effective implementation of the conditions by those involved in implementing the consents; and

(d) are appropriate overall.

Jared Pettersson
Enviser Ltd

24 August 2023

ATTACHMENT 1 DRAFT ENVIRONMENTAL MONITORING AND MANAGEMENT PLAN

Enviser Ref:1116

July 2023

DRAFT ENVIRONMENTAL MONITORING AND MANAGEMENT PLAN

PROPOSED CAPITAL DREDGING

Northport Ltd

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Definitions

Whangārei Harbour: includes the waters west of the entrance between Marsden Point and Home Point.

Baseline Monitoring Period: 12-month period of monitoring undertaken over [XXXX – XXXX].

Dredging: encompasses all capital dredging activities associated with the project.

Consent Authority: Northland Regional Council.

Consent Holder: Northport Limited.

Extraordinary natural event: a significant and self-evident natural event that has clearly caused an Exceedance of the Tier-3 trigger at one or more of the turbidity monitoring stations. The high-concentration turbidity plumes would have been generated from events such as a tsunami, a weather event causing significant flooding, extreme swells, or a land slip.

Project Website: www.visionforgrowth.co.nz – contains a summary of the real-time turbidity monitoring data, monitoring reports, environmental management plans, trigger reports and other information as required under the Consent Conditions.

The Consent(s): refers to [insert consent reference numbers].

Abbreviations

ADP: Accidental Discovery Protocol

BHD: Backhoe Dredge

BMP: Biosecurity Management Plan

Capital DMP: Capital Dredge Management Plan

CD: Chart Datum

CEMP: Construction and Environmental Management Plan

CHPT: Consent Holder Project Team

CSD: Cutter Suction Dredge

EMMP: Environmental Monitoring and Management Plan

MMMP: Marine Mammal Management Plan

NTU: Nephelometric Turbidity Unit

TSHD: Trailer Suction Hopper Dredge

TSS: Total Suspended Sediments

1 Introduction

[This document is a draft version, prepared in support of resource consent applications. This document will be updated and refined following resource consent approval to incorporate specific resource consent conditions. This document will also be updated once the detailed design and dredging methodology is determined.]

This dredging Environmental Management and Monitoring Plan (EMMP) has been collated by Enviser Limited with technical input provided by the following consultants:

- Coast and Catchment Ltd – Shane Kelly
- Environmetrics Australia – Dr David Fox

1.1 Background

Northport Limited is undertaking dredging to deepen and extend the swing basin in Whangārei Harbour. The swing basin will be widened, deepened, and lengthened to accommodate larger vessels and the proposed new wharf. The resulting dredge spoil will be used as fill material to construct the proposed reclamation. Dredge spoil will be pumped to the reclamation site as a slurry and will require dewatering through a series of decant ponds.

The decant discharge from reclamation activities will be directed into outlets on the eastern or northern face of the new reclamation.[1] Activities associated with dredging are authorised under the Consents issued by the Northland Regional Council in [insert year]. Dredging will commence in [insert year] with an anticipated duration of 9 to 18 months, depending on equipment used.

A key component of the Consent conditions is the monitoring and management of the dredging, via operational responses to real time water quality monitoring, as well as associated environmental assurance monitoring before, during and after the dredging. This EMMP outlines all required monitoring and management measures to comply with both the Consent conditions and the best practice philosophy adopted by Northport Limited for the project.

1.2 Purpose

The purpose of this EMMP is to detail the environmental monitoring and management of the dredging works associated with the swing basin works at Northport, and to ensure consent compliance.

The EMMP is required as part of the Consents granted by Northland Regional Council for activities associated with dredging in Whangārei Harbour. Northport, as the Consent Holder, is responsible for the implementation of all monitoring and management requirements detailed in this plan. The Dredge Contractor must also comply with all relevant parts of the Consent conditions and this EMMP.

The broad purposes of the EMMP are to:

- Ensure the effects of dredging on the coastal environment are within the envelope predicted by modelling and the assessment of environmental effects.

[1] Reclamation decant water is subject to specific Consent conditions, including discharge quality and associated management requirements. The Construction and Environmental Management Plan is required to detail methods for the monitoring and management of reclamation decant water.

- Outline the turbidity monitoring and dredge management actions that shall be implemented by the Dredge Contractor and Northport Limited to minimise the risk of dredge-related elevated turbidity causing adverse effects on sensitive receptors.
- Provide a framework for the assurance monitoring, which shall be implemented by Northport Limited. The results of the assurance monitoring shall be used to evaluate any actual or potential biological and physical effects and compare them with:
  - The predicted effects outlined in the information filed in support of the application.[2]
  - The assurance monitoring data collected during the baseline monitoring period.
- Ensure compliance with consents.

1.3 Objectives

This EMMP implements an operational management approach based on the results of real-time turbidity monitoring at three locations within Whangārei Harbour. It also outlines a monitoring regime for the duration of dredging, and for the five years following completion of dredging. The post-dredging monitoring focuses on potential longer-term effects on key ecological habitats and communities and the physical environment, as well as quality control.

The objectives of the EMMP, as set out in the Consent conditions are:

- *Turbidity monitoring and management:* to detail how capital dredging turbidity monitoring and management actions are implemented to minimise the risk of elevated turbidity[3] that can be attributed to capital dredging causing adverse effects on sensitive receptors; and
- *Marine ecology assurance monitoring:* to facilitate the comparison of changes in the marine receiving environment caused by capital dredging with those predicted in the information filed in support of the resource consent application, including by:
  - Characterising the responses of surrounding sub-tidal and inter-tidal habitats and benthic communities to sediments suspended and deposited offsite during channel dredging, and subsequent changes after dredging is complete.
  - Confirming whether benthic habitats and communities similar to those currently existing re-establish on the dredged basin once dredging is complete.
- *Bathymetric and shoreline surveys:* to collect seabed and shoreline spatial data to assess any changes that may result from the Expansion Project.

In summary, the EMMP aims to:

- Ensure dredging activities are controlled to manage environmental effects, including the wider community's cultural and recreational interests.
- Ensure stakeholder engagement is ongoing through all phases of dredging and provide procedures for handling complaints.
- Specify a framework for management of the dredging activities based on results of real-time turbidity monitoring to reduce the risk of unanticipated effects.
- Detail an assurance monitoring programme for appropriate and relevant monitoring of the physical, biological and ecological environments in Whangārei Harbour.
- Detail reporting requirements and frequency for results of the management and monitoring.
- Specify roles and responsibilities of groups involved in monitoring and management during and after the completion of dredging.

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[2] Northport Limited (2022). *Northport Limited Eastern Expansion: Consent Applications. Whangārei.*

[3] Beyond that predicted by the modelling included in the consent applications

- Set out other relevant management plans required during dredging including the Capital DMP and the linkages between and cross references to those plans.

1.4 Regulatory requirements

This EMMP is a requirement of the consent conditions for the following resource consents granted to Northport Limited (the Consent Holder) by Northland Regional Council (the Consent Authority).

For the purposes of this report, [XXX and XXX] are collectively referred to as “the Consents”.

2 Environmental monitoring and management

Three monitoring and management approaches are proposed for the duration of dredging:

- Dredge Management – based on real-time turbidity monitoring
- Assurance Monitoring and Review – of physical and ecological environments
- Management Protocols – implemented during dredging

The following sections detail the requirements for each monitoring and management type.

2.1.1 Dredge management

Best practice dredge management (sometimes known in the dredge industry as adaptive management, which is how the term "adaptive management" is used in this EMMP) facilitates a continuous monitoring – evaluation – adjustment loop in which management responses are dictated by real-time monitoring and environmental conditions (refer Figure 1). The Central Dredging Association (CEDA) states:

"The need for integrating adaptive management into dredging projects is already becoming recognised but will probably increase in future, in reaction to an ever-growing awareness of the need for protection of the environments as well as in connection to the ecosystem services approaches" (CEDA, 2015).

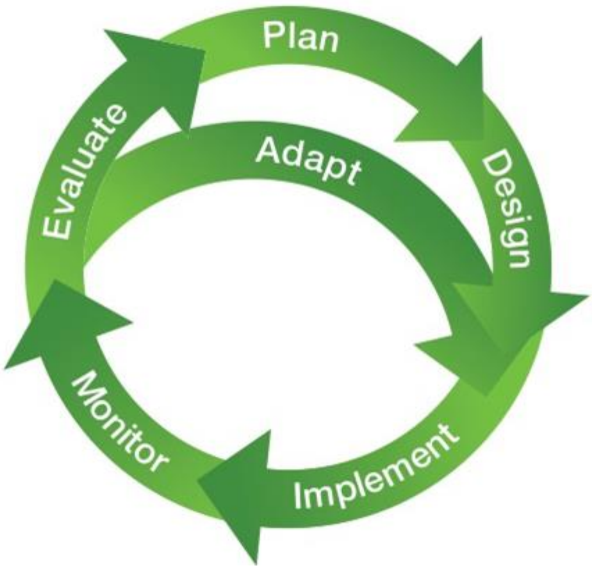

Figure 1: Adaptive management cycle.[4]

In the context of this project, the adaptations are proposed to be based on two different timeframes:

- Adapting day-to-day dredging operations in response to real-time measurements of the mechanism of effect, rather than the effect itself.
- Adaptation of the overall monitoring and management over the project lifetime.

4 CEDA. (2015). *Integrating Adaptive Environmental Management into Dredging Projects. Position Paper*. Retrieved from http://www.dredging.org/media/ceda/org/documents/resources/cedaonline/2015-02-ceda_informationpaper-environmental_monitoring_procedures.pdf

This management approach focusses on controlling the primary mechanism (turbidity plumes) that may cause the effects. To avoid confusion with the different RMA meaning of adaptive management, we have referred to this process as dredge management below. Dredge management is prescribed further in this EMMP and will ensure risks associated with the dredging are well managed.

Successful dredge management will include:

- The real-time water quality monitoring network.
- At least 12 months of baseline monitoring of existing water quality conditions collected prior to commencing dredging activities.
- Establishment of tiered trigger levels, based on baseline monitoring of the background turbidity as well as the modelled dredge plumes. (The Third Tier is a point of compliance under consent conditions. The First and Second Tier triggers are to inform management responses for the Dredge Operator.)
- Management responses and reporting at each of the three tiers to ensure appropriate responses to elevated turbidity levels.
- Involvement of key stakeholders throughout the project.

It is important to note that while the dredge management framework includes possible management responses, it does not specify prescriptive management actions for the dredge activities in response to trigger level exceedances. This is because the complexity of the coastal system means that a prescribed management response may be suitable one day (or in one tidal current scenario) and not the next.

Instead, the actual operational management measures implemented will be the responsibility of the Dredge Operator in coordination with the Consent Holder. This will allow management measures to be flexible and adapt to various conditions. It will also allow the Dredge Operator to refine the management responses as the project progresses.

2.1.2 Assurance monitoring

The purpose of assurance monitoring is to monitor the environment to observe if longer-timescale potential effects occur and, if so, confirm whether the effects are within anticipated levels. It is expected the monitoring will give confidence that the dredge management approach is achieving the objectives outlined above. The following constitutes the assurance monitoring (to the extent it is within the scope of this EMMP):

- Ecological monitoring:
    - Sub-tidal and inter-tidal benthic ecological surveys
    - Sub-tidal and inter-tidal sediment analysis
- Bathymetric surveys and shoreline surveys

As required by the Consents, the assurance monitoring will be undertaken for at least a year during the baseline monitoring period and will continue during and after dredging.

2.1.3 Wider project environmental management framework

The capital dredging, which this EMMP covers, is one component of the wider project to construct and develop a container terminal at Northport. The other components of the project include:

- Earthworks on land

- Reclamation construction
- Wharf and marine structure construction
- Construction and installation of on-land infrastructure (utilities, pavements, lighting, rail, container handling equipment, fences etc)

All components of the project are subject to environmental management measures which are outlined in series of management plans. These plans collectively form the environmental management framework for the project. Due to the specialised nature of the dredging operations and its spatial separation to the other components, the environmental management of the dredging is controlled by dredge specific management plans. However, there will be some crossover between the dredging and other project components, and it is important the Dredge Contractor understands where these interactions may occur and how the other management plans seek to control the associated effects.

The primary interaction between the dredging operation and the reclamation/wharf construction will be via the use of dredge spoil for reclamation fill and associated effects on turbidity. The Dredge Contractor and the Reclamation Contractor must have good communication to ensure either, or both operations can be managed in a way that ensures compliance with the turbidity criteria for each operation. This includes means to modify or halt both operations where necessary.

The following plans comprise the suite of environmental management plans for the dredging operations:

- This **EMMP** – which requires updating by Northport once the contractor is appointed and the baseline data is collected.
- The **Marine Mammal Management Plan** (MMMP) has been prepared and includes measures to manage the potential effects of all aspects of the project, including the dredging operations.
- A **Capital Dredge Management Plan** (Capital DMP) – documenting how the required measures in this EMMP and the MMMP will be implemented by the Dredge Contractor at an operational level.
- A **Biosecurity Management Plan** (BMP) – setting out how the potential biosecurity risks of establishing and operating the dredging equipment and associated vessels will be managed.

The Capital DMP and BMP will be prepared by the Dredging Contractor (once appointed) as they depend on the specifics of the dredge method and vessels used.

The following environmental management plans apply to the reclamation and wharf construction area and are detailed in Section 7:

- A **Construction Environmental Management Plan** which is the overarching management plan for the reclamation, wharf and associated infrastructure. A draft CEMP was prepared during the consenting process and will be updated by Northport with advice from the Contractor once appointed.
- A **Biosecurity Management Plan** (BMP) – setting out how the potential biosecurity risks of establishing and operating the marine construction equipment and associated vessels will be managed. This will be prepared by the Contractor.

The MMMP also applies to the reclamation and wharf construction, particularly the underwater noise producing activities, like piling.

Table 1 sets out the various plans involved in the overall project, where they apply and who is responsible for their preparation. All plans are available at the Project Website.

Table 1 Environmental management framework

Capital dredging	Reclamation and other landside activities
EMMP (prepared by Northport)	CEMP (prepared by Northport)
Capital DMP (prepared by Dredge Contractor)	BMP (prepared by Reclamation/Wharf Contractor)
BMP (prepared by Dredge Contractor)	
MMMP (prepared by Northport)	

2.1.4 Baseline Monitoring Period

Baseline monitoring commenced on [insert date]. A full 12 months of baseline data has been collected, in accordance with the methodologies and frequencies outlined in the Consents. This includes:

- Real-time turbidity monitoring
- Sub-tidal and inter-tidal and benthic ecological surveys
- Sub-tidal and inter-tidal sediment analysis
- Bathymetric surveys and shoreline surveys

A summary of the data collected during the Baseline Monitoring Period is contained in the reports available on the Project Website (www.visionforgrowth.co.nz).

2.2 Groups

To ensure this EMMP is implemented as intended, the associated consents are complied with and advice from stakeholders is received, two groups will be set up. The following summarises the two groups and their role in the project, further details on these groups is provided in Section 9:

- A **Consent Holder Project Team** (CHPT) who are responsible for the day-to-day delivery of the dredging project, the implementation of this EMMP (and other dredge related management plans), compliance with the relevant consent conditions and liaison with stakeholders where necessary.
- A **Technical Advisory Group** (TAG) [if desired by the stakeholders] to provide a forum for the CHPT to seek advice from stakeholders on technical and cultural aspects. Members of the group will have relevant technical or cultural expertise and knowledge and will meet as required. The TAG will not be involved in day-to-day operational dredge decisions.

Northport Limited is responsible for ensuring open communication with key stakeholders throughout the project, in particular with Patuharakeke Te Iwi Trust Board, Te Parawhau and Ngāti Wai Trust Board given the importance of cultural interests in the project area.

2.3 Key Personnel Contact Details

Table 1 summarises key project staff and contact details.

Table 1: Summary of key contacts, roles and responsibilities

Name	Role/Responsibility	Organisation	Contact details
	Project Director		
	Project Manager		
	Project Environmental Adviser		
	Dredge Contractor Works Manager		
	Project Coastal Process specialist		
	Project Marine Ecologist		
	Project Hydrodynamic Modeller		
	Project Environmental Statistician		

2.4 Report structure

This EMMP has been composed to set out the proposed monitoring and management plans for the duration of dredging (and pre- and post-dredging) and is structured as follows:

- Section 3 describes the proposed works and location and setting of the project.
- Section 4 provides an overview of the sensitivity of the existing ecological, social, cultural, and economic environments including a summary of the baseline water quality monitoring data.
- Section 5 details the monitoring and management approaches for the implementation of the dredge management approach.
- Section 6 outlines the assurance monitoring.
- Section 7 outlines the management plans prepared to manage the potential effects of the reclamation and wharf construction components of the project.
- Section 8 outlines the reporting requirements for each stage of management.
- Section 9 summarises the group makeup, roles and responsibilities.

3 Description of the proposed works

3.1 Requirement to deepen/extend swing basin

Northport is planning to expand the port's capacity by reclaiming land and building additional berths. Deeping the swing basin is a critical element of this plan and serves two primary functions – it will ensure larger vessels can turn safely within the harbour, and the dredge spoil provides a source of fill for the reclamation footprint.

3.2 Location and extent of deepening works

The existing swing basin is 450 m wide, 13 m deep and approximately 1.25 km in length. Dredging will see the swing basin increase in length to approximately 1.6 km and increase in depth by approximately 1.5-3 m (see **Figure 2**). This will involve dredging approximately 1.72 million cubic metres (m^3) of sediment.

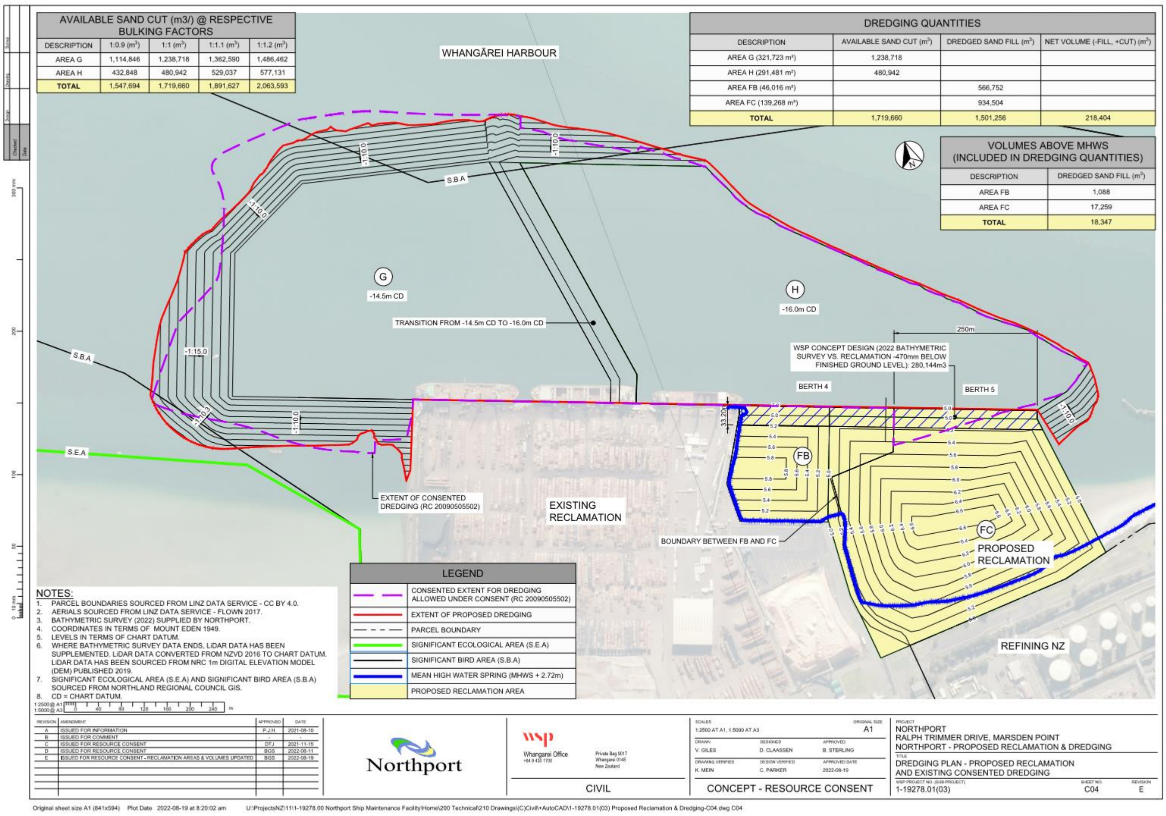

Figure 2: Dredge and reclamation areas (Source: WSP, 2022).

3.3 Dredging equipment and execution

Total dredged material volumes for the reclamation are anticipated to be approximately 1.72 million m^3 (in-situ).

Three potential dredging methods are anticipated – two methods to dredge the bulk volume in the swing basin and another to dredge close to berth pockets and construction-related dredging. The swing basin dredging will likely be undertaken by either a cutter suction dredger (CSD) or a trailer-hopper suction dredger (THSD) or both. All other dredging will likely be undertaken using a backhoe dredge (BHD).

The duration of the dredging programme is dependent upon the equipment used but is expected to be in the order of 9-18 months.

Dredge spoil (silty sands) will be used for the bulk reclamation fill. These materials will be pumped ashore as a slurry, comprising approximately 30% solids and 70% water. The slurry will be pumped from the dredge, through a series of pipes and booster pumps, and ultimately discharged into the reclamation area where the solids will settle out. The resulting silty sands will be distributed across the site using earthworks machinery.

The placement of dredge spoil will be done in a manner where the water (and entrained sediment) is contained and treated before discharge to the harbour. To achieve this, the dredge spoil must be pumped into a contained area that is not open to the harbour. This may be achieved by bunds/cut off walls, a sediment curtain, or a combination of the two.

At the commencement of the operation, bunds may need to be constructed from imported material. As the reclamation progresses, these bunds may be created out of the dredge won sediments.

To ensure the discharge water quality is appropriate, a series of internal paddocks will be needed to settle out the finer-grained materials prior to discharge. The spoil will be pumped into the first pond, the sediment settled, and the water decanted off the top into the next pond. This process is continued with a consequential reduction in the concentration of suspended solids in the decanted water at each step. Once the water reaches the desired quality it is discharged to the harbour. The CEMP includes measures to manage the quality of the decant discharge water and construction phase stormwater from the reclamation construction.

3.4 Timeframes

Dredging to deepen the swing basin will commence in [insert date] and is anticipated to take approximately 9-18 months to complete.

4 Site description

Northport is a deep-water commercial port located at Marsden Point in Northland. The port is located at the entrance to the Whangārei Harbour, between the Marsden Point Channel Infrastructure facility to the east, and One Tree Point to the west (see Figure 3).

Figure 3: Northport location (source: Google Earth).

Northport occupies approximately 50 ha of land, with most of this area used for cargo operations. Of the existing port operations, approximately 33.6 ha is reclaimed land.

4.1.1 Sediments

Inter-tidal sediments in the mid and outer harbour are predominantly sandy, with sediments becoming muddier in the upper harbour. Inter-tidal sediments around Northport are predominantly sand, except for the area immediately west of the port, which is a muddy sand.

Sub-tidal sediments around Northport are predominantly fine to medium sands with small amounts of silts and clays. Areas of shell hash exist in the sub-tidal areas, particularly within the deeper channels.

4.1.2 Waves

The immediate vicinity of Northport is sheltered from oceanic swells but does experience wind-driven chop during periods of sustained high winds. Particularly from the north-west through to the north-east directions where longer fetch distances exist.

4.1.3 Tides/Currents

Northport sits within the outer harbour and entrance zone of Whangārei Harbour – a physically complex zone subject to strong currents. Tidal velocities in the project area have been modelled and are expected to be in the order of 0.6-1 m/s.

4.1.4 Wind

The predominant wind direction is from the west and south-west sectors, but strong easterly conditions can also occur. Average wind speed is approximately 5m/s, the stronger winds (>10m/s) typically come from the Northeast.

4.2 Predicted turbidity plumes

Dredge plume modelling has been conducted by MetOcean Solutions to assess the predicted suspended sediment concentrations and plume pattern due to the dredging.

Modelling found that in general, dredging plume and deposition footprints are elliptical, typically centred on the release sites, with a clear north-west-south-east-axis consistent with the channel morphology and ambient hydrodynamics dominated by tides. Dispersion footprints are contained within the main harbour channel, with no significant branching towards the secondary northward channel arm (towards Shoal Bay), as shown in Figure 4.

During ebb, the current and hence the plume is directed south-east towards the harbour entrance. During flood, the current and plume are directed Northwest towards the upper harbour.

It is expected that suspended sediment plumes will be visible behind and around the dredge equipment during dredging. These plumes may extend hundreds of metres behind/around the dredge. The visual presence of a plume does not mean the suspended sediment concentration are above what is expected or predicted by the modelling.

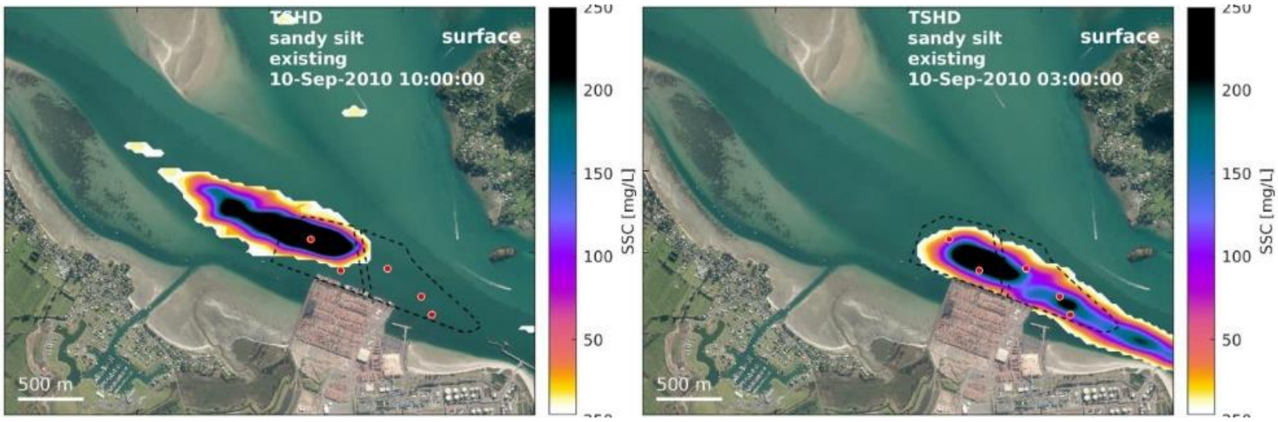

Figure 4: Modelled dredge induced suspended sediment concentrations at the surface flood flow (left) and ebb flow (right) (MetOcean Solutions Ltd., 2022). (Note this is a snapshot of the plume and concentrations <5mg/l have been masked.)

4.3 Ecological Habitats

The inter-tidal and sub-tidal ecological habitats surrounding the project area were surveyed to inform an Assessment of Marine Ecological Effects[5] and are summarised in the following sections.

Whangārei Harbour's ecological habitats vary between the depth contours and physical environments. The outer harbour and entrance zone where Northport is positioned 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).

[5] Coast & Catchment Environmental Consultants (2022). *Northport Expansion Project Assessment of Marine Ecological Effects.*

4.3.1 Inter-tidal

Extensive seagrass beds are present on the inter-tidal flats between One Tree Point and Northport, and small patches are present within, or near, the proposed reclamation area.

Finer scale inter-tidal sampling around Northport has shown that benthic macrofaunal diversity is relatively high, with variation along and down the shore, and community level differences between the western and eastern sides of Northport.

Cockles are widespread in Whangārei Harbour and are particularly abundant around the outer harbour (Marsden Bay, McLeod Bay, Snake Bank and MacDonald Bank).

Pipi are present at several sites in the mid to outer harbour. 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.

4.3.2 Sub-Tidal

Sub-tidal sampling indicated that infaunal and epifaunal macroinvertebrate diversity is very high around the port, with areas of dense shell, macroalgae meadows, and diverse communities of encrusting organisms. Those habitats are likely to provide shelter, refuge, and food for a large variety of invertebrates and fishes.

4.4 Biological Environment

4.4.1 Fisheries

A large variety of fishes utilise Whangārei Harbour, reflecting the range of habitats present. Leatherjackets, red moki, spotty, sweep, triplefins, kingfish, jack mackerel, two-spot demoiselle, and goatfish are commonly observed around Northport's rock revetments.[6]

Snapper, kahawai, trevally, and kingfish are all popular recreational fish species and are present in the vicinity of Northport's facilities.

Some commercial set netting occurs in the harbour. Flatfish (e.g. flounder) and mullet are targeted in the upper harbour and larger species like snapper, kahawai, trevally, and shark are caught in gill and set nets in the outer harbour.

4.4.2 Marine mammals

A diverse range of marine mammal species live or pass through the North Island's upper and central east-coast waters, with sighting data collected over the last several decades recording sightings of at least 27 cetacean (whales, dolphins and porpoises) and two pinniped (seals and sea lions) species along the north-eastern coastline[7].

According to an assessment of potential construction effects on marine mammals in Whangārei Harbour, the following species are identified as being present (albeit in a transitory manner) within the harbour and potentially influenced by the proposed construction activities:

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[6] Coast & Catchment Environmental Consultants (2022). *Northport Expansion Project Assessment of Marine Ecological Effects.*

[7] Clement D (2021). *Potential construction effects on marine mammals in the Whangārei Harbour region – Eastern Reclamation. Prepared for Northport Limited. Cawthron Report No. 3652. 54 p. plus appendices.*

- Bottlenose dolphin (*Tursiops truncatus*)
- Common dolphin (*Delphinus delphis*)
- Killer whale/orca (*Orcinus orca*)
- Bryde's whale (*Balaenoptera edeni bryde*)
- New Zealand fur seal (*Arctocephalus forsteri*)
- Leopard seal (*Hydrurga leptonyx*)
- Southern right whale (*Eubalaena australis*)
- Humpback whale (*Megaptera novaeangliae*)

The marine mammals most sighted near or within Whangārei Harbour are bottlenose and common dolphins, orca, and Bryde's whales, with sightings occurring mainly during spring and early summer. Other species of interest include New Zealand fur seals, leopard seals, and southern right and humpback whales, which are all seasonal visitors to the wider Bream Bay area.

A marine mammal management plan (MMMP) describing the management actions and monitoring that will be employed during the proposed works to minimise effects on marine mammal species has been prepared and is included on the Project Website.

4.4.3 Avifauna

Coastal avifauna surveys conducted from One Tree Point to the Channel Infrastructure jetty recorded a total of 19 species utilising the area, including five species classified as Threatened and nine classified as At Risk.[8]

Whilst no mitigation measures are required for the dredging operation, the CEMP includes a section on avifauna describing the management actions and monitoring that will be employed during the proposed reclamation works to minimise effects on avifauna, including Kororā (Little Penguin) and Tōrea pango (Variable oystercatcher). These measures may be relevant for the dredging operations where slurry pipelines cross the shoreline/existing batter slopes.

4.5 Cultural Environment/Mahinga Kai

[To be completed in consultation with hapu/iwi]

Engagement with iwi and hapu is ongoing and will continue throughout and after the dredging works.

4.6 Recreational values

Recreational activities occur on the beaches either side of Northport and on the water adjacent to Northport and the wider harbour. The beach to the east of the reclamation is used for walking, swimming, fishing, shellfish gathering as well as picnicking and launching of kayaks etc. It also provides an accessway to the popular fishing areas adjacent to the Channel Infrastructure wharf.

On-water recreational activities in (or adjacent to) the dredging area include fishing, sailing, kayaking and diving/snorkelling on the rocky northern shore. High numbers of recreational craft use the harbour which can result in relatively high numbers of recreational traffic transiting the project area, particularly on weekends.

[8] Boffa Miskell Limited (2022). *Northport Eastern Expansion: FINAL DRAFT Coastal Avifauna Assessment. Report prepared by Boffa Miskell Limited for Northport Limited.*

4.7 Archaeological Environment

No specific marine archaeological sites have been identified in, or adjacent to the dredge area. Notwithstanding this, accidental discovery protocol conditions are proposed in the event that subsurface archaeological evidence is unearthed during construction.

4.8 Navigation and Navigational Aids

Northport is navigable through a buoyed and lit channel, five nautical miles long leading from the Fairway Buoy to Marsden Point. The approach to Marsden Point has a shallowest depth of 14.7 m at chart datum between the Fairway Buoy and No. 1 buoy.

All vessel movements, pilotage and towage are coordinated through Whangārei Harbour Radio on VHF channel 16/11.

5 Dredge management

Two primary management methods will be employed throughout the operational phase of the project:

Proactive Operational Management: utilises forecast and real-time environmental information (i.e. tides, wind, waves, weather etc.) to guide operational management decisions during dredging. Undertaken as part of common dredging practice.

Dredge Management: based on real-time turbidity monitoring – implements a responsive dredge management approach in response to predetermined trigger levels.

5.1 Proactive operational management

The Dredge Contractor is responsible for proactive operational management of the dredge and reclamation activities. This will take into consideration the predicted meteorological and tidal conditions, predicted plume movement based on modelling[9],the real-time water quality information (turbidity, waves and currents) and will be refined as the dredge operator builds up experience on the project. The purpose of proactive operational management is to continuously assess the daily planned dredge operations to minimise the risk of a dredge-induced trigger exceedance.

The proactive operational management measures are detailed further in the Capital DMP, available on the Project Website.

5.2 Dredge management

During the dredging operations, the location and operational activities of dredging will be managed in response to real-time turbidity monitoring. Monitoring of the real-time turbidity at three locations throughout Whangārei Harbour has been undertaken as part of the Baseline Monitoring Period and will continue during the dredging.

[XX] [12 months or greater] months of baseline data was used to determine the two trigger values (Tier 1 and 2) and the compliance level (Tier 3). These are based on higher order percentiles (80^{th}, 95^{th} and 99^{th}) of the collected turbidity background data combined with modelled dredge turbidity and a cumulative time component.

Tier 1 and Tier 2 trigger levels serve as an early warning tool for the Dredge Operator and Consent Holder. If these are exceeded, dredging activities may need to be modified, taking into account the hydro-meteorological conditions and the predicted plume directions, in order to reduce the turbidity at the location of exceedance.

If the Tier 3 compliance level is exceeded (i.e. the turbidity threshold is exceed for more than the allowable hours), dredging activities must cease in the vicinity of the exceedance location, unless the exceedance is caused by an extraordinary natural event. Dredging can resume once turbidity levels reduce.

5.2.1 Real-time turbidity monitoring

The objective of the real-time turbidity monitoring programme is to provide continuous real-time information on turbidity levels to inform the management of the dredging operations. The dredge

[9] Dredge Plume Modelling, prepared for Northport by MetOcean Solutions Limited (2022).

operations will be managed in real-time by comparing the real-time turbidity data with pre-established trigger levels as defined in Section 5.3.

The real-time turbidity monitoring occurs 0.75-1 m below the surface (readings are taken and telemetered every [insert interval] minutes).

5.2.2 Locations of monitoring sites

In determining the locations of the monitoring sites the broad objectives were to:

- Locate the instruments between the dredging and the location of sensitive receptors.
- Ensure the plume can be monitored in all tidal conditions.
- Avoid creating navigation hazards for commercial or recreational traffic.

The three monitoring locations have been chosen based on these objectives, analysis of predicted plume dispersion based on hydrodynamic models, and locations of environmental and cultural significance. These locations are shown in Figure 5.

Each monitoring site consists of a buoy with a single instrument capable of monitoring turbidity (in NTU), as described in Section 5.2.3.

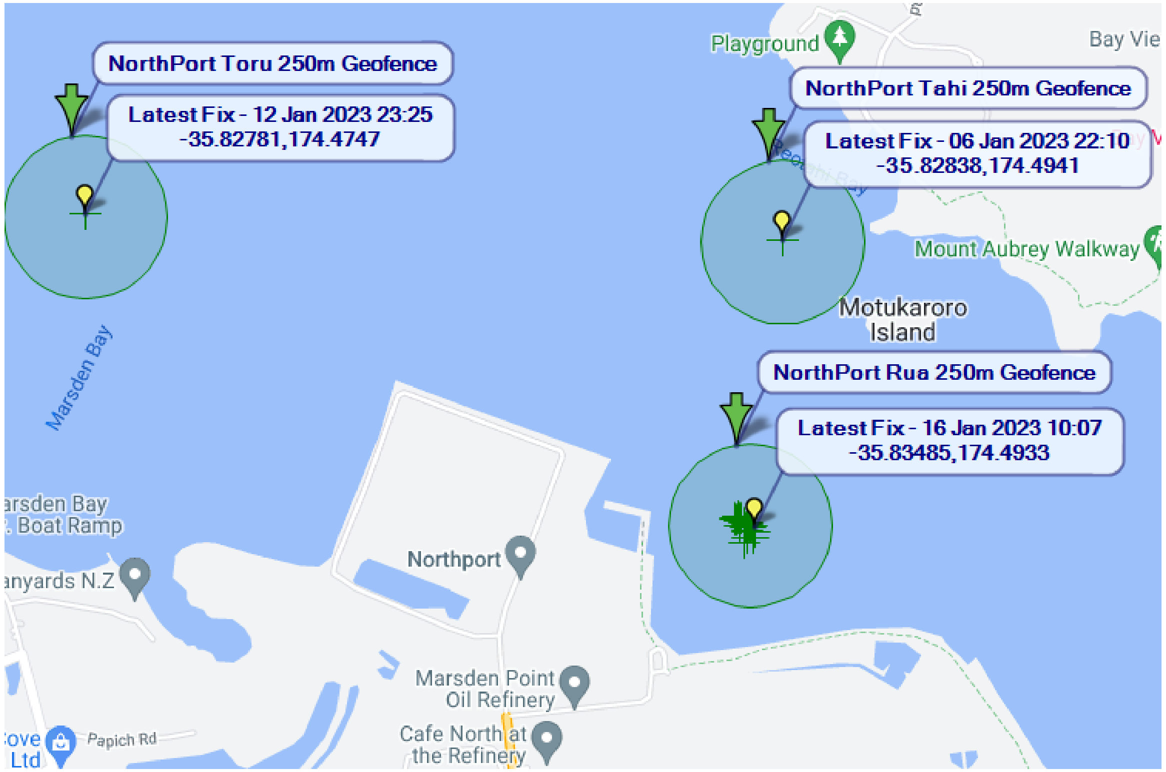

Figure 5: Monitoring locations [map to be updated once instrument locations confirmed for baseline].

5.2.3 Instrument type

All locations have the same buoy and instrument deployed. The unit comprises a floating buoy housing the batteries, solar panels and telemetry equipment, with the turbidity instrument attached to a rigid steel bridle beneath the buoy. One of the buoys has an additional instrument installed allowing it to measure and record salinity. The buoy is moored via rope and chain to a mooring block placed on the seafloor.

5.2.4 Adjusting monitoring locations post-deployment

Due to the complexity of the coastal environment, it may be necessary to adjust the monitoring locations during dredging operations. If any adjustments are required, Northport is responsible for ensuring that new locations are close enough to where baseline data was collected to allow for the background data to be reliably used.

5.3 Tiered trigger system

Dredge management is to be implemented through a system of triggers which, when exceeded, require management responses (see Figure 6). This system is based on comparing the real-time (but manually validated) smoothed monitoring information against pre-established and agreed tiers of intensity (NTU)/duration (hours) combinations to ascertain the degree of management required.

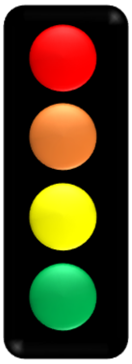

Figure 6: Tiered trigger system.

Each tier has management and reporting requirements to determine the cause of the trigger level exceedance and, where appropriate, take measures to reduce the exceedance and/or prevent turbidity from increasing. Reporting requirements are detailed in Section 8 and group roles and responsibilities in Section 9.

All real-time monitoring sites have been assigned turbidity trigger values. Throughout the dredging activities, the telemetered turbidity data recorded at these locations will be continuously assessed against the trigger limits.

It is important to note that the design of the trigger system means natural events (such as storms) will cause exceedances of the trigger and compliance levels. Consequently, an exceedance of the trigger or compliance levels may not be associated with dredging activities but due to naturally fluctuating turbidity levels.

5.3.1 Data processing and display

The real-time turbidity data collected by the monitoring buoys requires processing to ensure its validity and appropriateness for analytical purposes. These steps may include automated data validation and application of a smoothing filter as well as manual validation.

Automated data management is applied to the real-time data prior to display. Secondary manual validation will be required to identify and remove erroneous data points (e.g. due to fouling of the instruments).

A suitably experienced person is needed to complete the manual validation, and manual validation will occur only once every 24-48 hours in typical conditions. If the Tier 3 compliance limit is being approached, more frequent manual validation will occur (i.e. 6-hourly or shorter).

Final measurement of compliance with the Tier 3 compliance limits (intensity and duration) will be made against the manually validated data only.

5.3.2 Tiered Triggers

There are two turbidity triggers (Tiers 1 and 2) and one compliance level tier (Tier 3 Compliance Level) which have an associated turbidity intensity and allowable duration component.

The **turbidity intensity** is a measure of the cloudiness of the water (in NTU or Nephelometric Turbidity Units) while the **allowable duration** is the amount of time in a 30-day rolling window that the turbidity at any given monitoring site may exceed the turbidity intensity.

Once the allowable duration above the turbidity intensity has been exceeded at a monitoring location, a **trigger event** has occurred, requiring the management actions set out below to be implemented – dependent on the level of event occurring. The trigger event ceases when either the turbidity drops below the allowable turbidity intensity, or the allowable hours are no longer exceeded.

The Tier 1 and Tier 2 turbidity triggers are internal triggers, alerting the CHPT and Dredge Operator that the turbidity at the monitoring location has increased (either dredging or natural cause related). The Tier 3 Compliance Level trigger requires dredging (in the location of the trigger event) to cease. Dredging can recommence in that location once**:**

- recorded turbidity at that location has dropped below the intensity level, or
- the duration of exceedance at that location drops below the allowable duration, or
- the event causing the turbidity increase has been classed as an extraordinary event.

Exceedances of any of the trigger levels can occur due to natural events and may not always be directly related to the dredging activities. The causes of the trigger level/compliance level exceedances will be investigated as described in the following sections.

A brief summary of how the turbidity triggers are calculated is presented in the following sections. Details of the management actions required in response to each trigger are set out further below. The turbidity intensity and allowable duration associated with each tier are tabulated in the following sections.

5.3.3 Calculation of trigger levels

The calculation of trigger levels requires a series of steps, first to process the measured baseline turbidity data, and then to combine the processed baseline data with the modelled dredge turbidity.

Processing of the measured baseline turbidity data is required to ensure the gathered data is appropriate for analytical purposes. In summary, the data first receives manual validation to remove erroneous data. The data then runs through a statistical QA/QC process and missing data is imputed (if required). Next the data is smoothed using the approved smoothing method. The smoothed measured turbidity data is then combined with the model predicted turbidity (which has been converted from TSS to NTU) to create the complete 12-month baseline turbidity data set.

The 80^{th}, $95^{th}$and 99^{th} percentiles for each monitoring location are then calculated from the complete baseline turbidity data set. Some final adjustments may be needed to account for sample size effects.

The trigger values for each Tier and the subsequent management and reporting actions are set out in the following sections.

5.3.4 Tier 1 – Internal Trigger

Percentile: **80th**

Duration: **144 hours (6 days)**

Turbidity (NTU)			

Once a Tier 1 trigger event has occurred the CHPT will investigate the potential causes by utilising some or all of the following methods.

Investigate the following:

- Examine the monitoring equipment for any faults/defects/biofouling that may have influenced data collection.
- Analyse and compare the results against:
  - Background turbidity levels measured during baseline and trends at other monitoring sites.
  - Recent meteorological and current/wave/tide conditions (particularly any extreme events).
  - Turbidity levels and trends at all monitoring sites for at least 48 hours prior to exceedance.
- Consider sediment transport patterns in Whangārei Harbour using aerials/satellite imagery.
- If necessary, examine the environs of the monitoring site to ensure no natural processes (e.g. landslips, seaweed build up etc.) are contributing to the elevated turbidity level.
- If necessary, undertake manual soundings of turbidity in the area to verify instrument readings.
- Consider the location of dredging in the two days preceding exceedance.

Based on the above, the investigation shall determine the likelihood of the trigger event being due to the dredging to analyse how and why the event occurred. If it is determined likely that the dredging activities have contributed to the increased turbidity level, the Dredge Operator may, as soon as practicable, adjust the dredging operations in order to prevent turbidity further increasing at the location. Where the extent to which the dredging has contributed to the trigger event is uncertain, a precautionary approach shall be taken assuming the dredge has contributed to the exceedance.

Dredging operation modification to reduce plume extent/concentration may include the following, based on the discretion of the Dredge Operator and advice from other members of CHPT:

- Change the dredging location.
- Alteration of overflow regime (if a TSHD dredge is being used)
- Modification of dredge phase with respect to tide phase/meteorological conditions.

A monitoring location shall be deemed no longer in a trigger event immediately upon turbidity levels reducing to below the specified turbidity trigger level. It is important to note that whilst the trigger event has ceased when turbidity has dropped below the turbidity trigger level, the duration may still be at its limit. Therefore, any exceedance of the turbidity trigger may instantly cause a trigger event until the 30-day rolling window clears the last elevated turbidity occurrence and the amount of accumulated exceedance hours are reduced.

5.3.5 Tier 2 – Internal Trigger

Percentile: 95th

Duration: 36 hours (1.5 days)

Turbidity (NTU)			

Once a Tier 2 trigger event has occurred the CHPT will, as soon as practicable, investigate the potential causes and implement management measures by utilising some or all of the following methods as well as those set out in the Tier 1 trigger:

- Dredge Operator is to increase the management measures to further reduce the turbidity levels at the location of exceedance.
- Undertake further review of the monitoring data and environmental factors which may be causing a natural increase in turbidity (as set out for Tier 1).
- If deemed necessary, undertake additional monitoring in the area of exceedance to further investigate the turbidity plumes.

A monitoring location shall be deemed no longer in a trigger event immediately upon the turbidity levels reducing to below the specified intensity level, or the exceedance time dropping below the allowable duration. As for Tier 1, any exceedance of the turbidity trigger level may immediately cause a trigger event until the rolling 30-day period has cleared the last elevated turbidity occurrence and the amount of accumulated exceedance hours are reduced.

Records shall be kept of Tier 2 trigger events, number of trigger events and associated investigations or actions. For clarity, a trigger event report is not required for Tier 2.

5.3.6 Tier 3 Compliance Level

Percentile: 99th

Duration: 7.2 hours

Turbidity (NTU)			

Tier 3 Compliance Level is a compliance trigger level as specified in Consent Condition [insert condition number]. The CHPT/Dredge Contractor shall take all practicable steps to avoid dredge turbidity plumes causing a Tier 3 Compliance Level trigger event.

If a monitoring location records a Tier 3 Compliance Level exceedance (i.e. exceeding the turbidity intensity for more than 7.2 hours in any 30-day rolling period) the following shall occur:

- **Dredging must cease in the vicinity of the monitoring location**. The distance at which the dredge is no longer within the vicinity of the monitoring location is determined by the CHPT and should take into consideration the predicted suspended sediment plume extent from the dredging activities as well as the current and forecast Meteorological and current/wave conditions.
- The CHPT/Dredge Contractor shall undertake an investigation into the likely cause of Trigger Event and produce a short compliance level exceedance report. This should include the following points.
    - Condition of monitoring equipment and any faults/defects that may have influenced data collection.
    - Analysis and comparison of the results against:
        - Background turbidity levels
        - Recent meteorological and current/wave/tide conditions (particularly any significant events)
        - Turbidity levels and trends at all monitoring sites for at least 48 hours prior to exceedance
        - Sediment transport patterns in Whangārei Harbour aerials/satellite imagery.
    - Any coastal changes near the monitoring site (e.g. landslips, seaweed build up etc.) which may be contributing to the elevated turbidity level.
    - The dredging programme in the two days preceding exceedance.
- Dredging can only recommence if (in accordance with Conditions [insert condition number] through [insert condition number] of the Consents):
    - The number of Tier 3 exceedance hours has fallen below the 7.2 hours available at that station over a 30-day rolling period; or
    - The turbidity recorded at that station is less than the Tier 3 NTU Intensity value; or
    - The exceedance is deemed due to an extraordinary natural event (in accordance with condition [XX]).
- If Northport and the CHPT deem the exceedance is due to an extraordinary natural event (as defined in the advice note below condition [insert condition number]) then dredging can continue in the vicinity of the monitoring location provided that:
    - A written report, demonstrating the elevated turbidity is due to an extraordinary natural event and not dredging, is provided to the Northland Regional Council within 24 hours of the exceedance, AND
    - Northland Regional Council does not notify NPL, within two working days of the report being provided, that the report is NOT being accepted.
- The 'extraordinary natural event' report is to be made available to be viewed by the public on the Project Website.

6 Assurance monitoring

The purpose of the assurance monitoring programme is to gather data to confirm whether the effects of the proposal correspond with the effects predicted as part of the resource consent application process and to assess the monitoring/management approach in the context of the objectives of the EMMP. Assurance monitoring data will be collected before dredging (baseline) during dredging and after dredging.

Assurance monitoring within the scope of this EMMP comprises:

- Ecological monitoring:
  - Sub-tidal, and inter-tidal ecological surveys
  - Sub-tidal and inter-tidal sediment surveys
- Bathymetric and shoreline surveys

An outline of the monitoring and required monitoring frequency is given below.

6.1 Ecological monitoring

A detailed description of the ecological assurance monitoring methods is included in **Appendix A**. A summary is provided in the following sections.

Objectives:

1. Characterise the responses of surrounding sub-tidal habitats and benthic communities to sediments suspended and deposited offsite during channel dredging, and subsequent changes after dredging is complete.
2. Characterise the responses of surrounding inter-tidal habitats and benthic communities to sediments suspended and deposited offsite during channel dredging, and subsequent changes after dredging is complete.
3. Confirm whether benthic habitats and communities similar to those currently existing re-establish on the dredged basin once dredging is complete.

Upon completion of the ecological monitoring, the results shall be recorded and reported as part of the reporting schedule (see Section 8.2).

6.1.1 Sub-tidal

Ecological monitoring of the sub-tidal ecological environments will comprise:

- Collection of benthic grab samples for infauna analysis and determining the particle size distribution of the sediment.
- Characterisation of the sub-tidal habitats and communities via drop camera and video surveys.

The sampling design has been based on spatial categorisation of the sub-tidal areas with respect to their proximity to the dredging and expected level of impact. Figure 7 sets out the concept sample design for the sub-tidal monitoring.

The timing and frequency of the monitoring is set out in **Table 2**.

Figure 7: Sampling areas for sub-tidal monitoring.

Table 2: **Planned timing of each sub-tidal sampling round.**

	Within a one year period within 18 months prior to dredging commencing		**During dredging (except in the dredge basin)**		**One year after dredging is complete**		**Three years after dredging is complete**	
Area	Spring / summer	Autumn / winter	Spring / summer	Autumn / winter	Spring / summer	Autumn / winter	Spring / summer	Autumn / winter
Existing Dredge	✓	✓	×	×	✓	✓	✓	✓
West Impact	✓	✓	✓	✓	✓	✓	×	×
East Impact	✓	✓	✓	✓	✓	✓	×	×
North Impact	✓	✓	✓	✓	✓	✓	×	×
Reference	✓	✓	✓	✓	✓	✓	✓	✓

✓ means sampling is required; × means no sampling is required

6.1.2 Inter-tidal

Whilst little increase in suspended sediment concentrations (or deposition) is expected in the inter-tidal areas, the following ecological monitoring will be undertaken:

- Collection of grab samples for infauna analysis and determining the particle size distribution of the sediment.
- Low-tide drone surveys to map the extent of seagrass beds (see Figure 9).

Figure 8 sets out the concept sample design for the inter-tidal monitoring. The timing and frequency of the monitoring is set out in **Table *3*.**

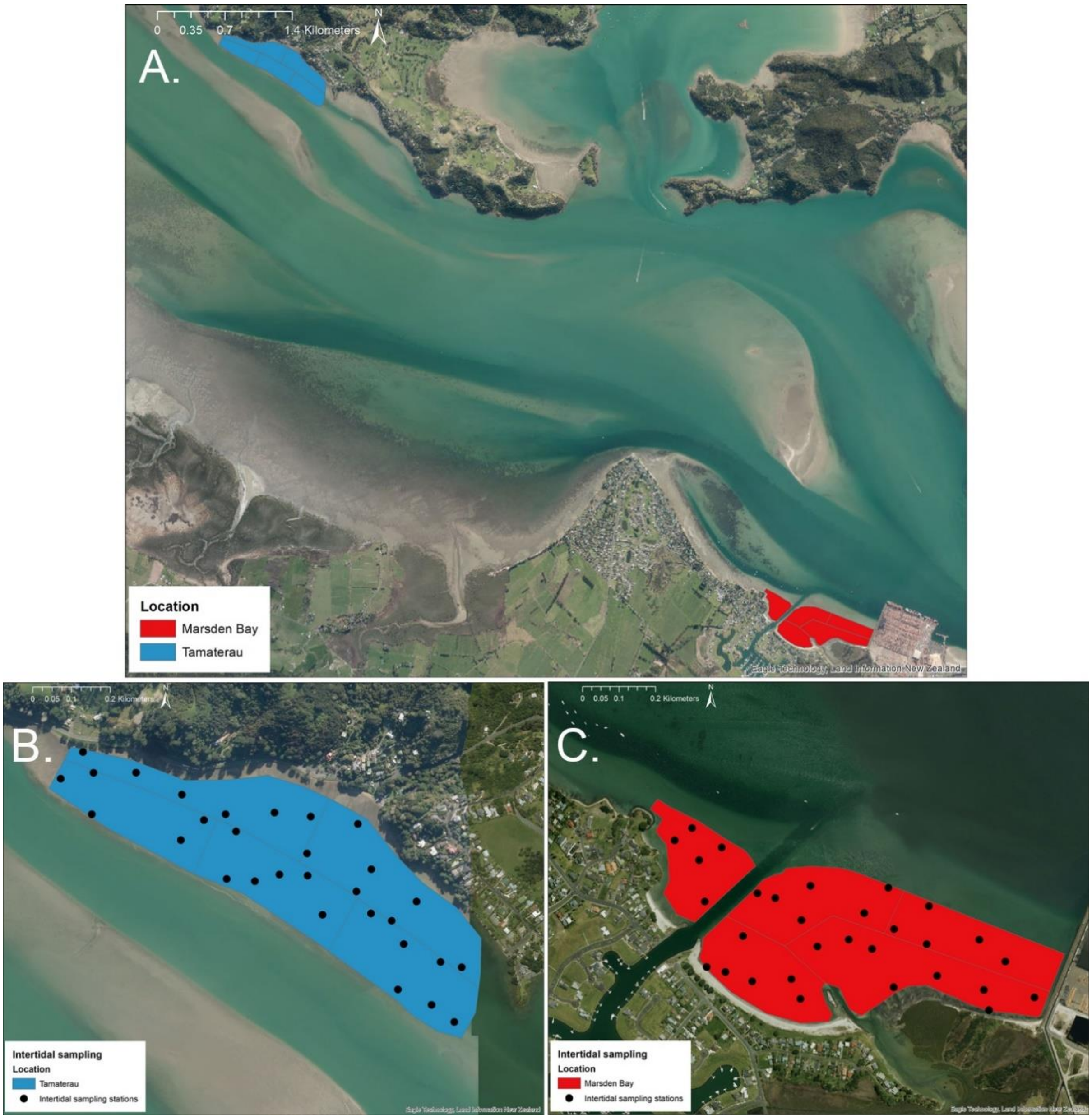

Figure 8: Indicative sample design for inter-tidal sediment and infauna monitoring, showing sites in Tamaterau and Marsden Bay and stratified-random sampling stations.

Figure 9: Indicative area for inter-tidal seagrass monitoring.

Table 3: Timing requirements of each inter-tidal sampling round.

	Within a one year period within 18 months prior to dredging commencing		During dredging		One year after dredging is complete		Three years after dredging is complete	
Area	Spring / summer	Autumn / winter	Spring / summer	Autumn / winter	Spring / summer	Autumn / winter	Spring / summer	Autumn / winter
Marsden Bay benthic sediments and ecology	✓	✓	✓	✓	✓	✓	⋆	⋆
Tamaterau benthic sediments and ecology (reference location)	✓	✓	✓	✓	✓	✓	⋆	⋆
Marsden Bay seagrass	✓	✓	✓	✓	✓	✓	⋆	⋆

✓ means sampling is required; ⋆ means sampling is required if the previous monitoring round shows that scientifically significant adverse effects have occurred.

6.2 Coastal processes: bathymetric and shoreline surveys

Objective: Collect spatial data on the seabed and shoreline to assess any physical changes to the coastline and seabed that may result from the dredging and reclamation works.

Methodology:

Sub-tidal bathymetric surveys shall be undertaken using multibeam sonar, ideally at high tide to enable an overlap with the inter-tidal/beach surveys. Survey transects shall be carried out at a maximum of 50 m. The surveys will include the access channel to Marsden Cove to main marina area.

Inter-tidal and shoreline surveys shall be undertaken using either an aerial photogrammetry or LIDAR based survey (i.e., via drone) or by a land based traditional survey method. If a land-based method is used, a series of vertical beach transects can be used, in combination of standard orthorectified drone aerial photographs. The transects must run from up to 10 m landward of the vegetation line and/or dune crest at the landward end, down to mean low-water springs and shall be undertaken in the locations shown in Figure 10. The transects shall be spaced a maximum of 50 m apart.

Figure 10: Western and Eastern extents of shoreline surveys.

Monitoring frequency

The bathymetric shoreline surveys shall be undertaken during the baseline, during dredging and for a period of 5 years post cessation of capital dredging. **Table 4** sets out the required frequency.

Table 4: Bathymetric and shoreline monitoring frequencies.

Project Phase	Frequency
Baseline	Two full surveys over the 12-month baseline period
During Dredging and in the first year post-dredging	6 monthly surveys
1-5 years post-completion of a dredging	One full survey annually

7 Other management protocols

As set out in Section 2, a Capital DMP and BMP will be prepared by the Dredge Contractor to manage specific risks associated with the equipment and methodology that will be used to deliver the Capital Dredging. Further management plans will be prepared to manage the potential effects of the reclamation and wharf construction components of the project. The Construction Environmental Management Plan (CEMP) has controls that will interact with the landside placement of dredge spoil. A brief description of each of these plans is set out in the following section and all plans are available on the Project Website.

7.1 Dredge Management Plan

A Capital DMP is to be prepared by the Dredge Contractor prior to the commencement of dredging. The objective of the Capital DMP is to describe the capital dredging plant, work methodologies, and environmental management systems to be used for the delivery of the capital dredging to ensure that potential adverse effects associated with operation of the capital dredging equipment are appropriately managed and are in accordance with the assessments accompanying the resource consent applications.

The Capital DMP includes the following information:

- Number and type of dredgers to be used.
- Methodology and operation of the dredger(s).
- Details of spatial control and recording for dredging activities.
- Maintenance of equipment and systems.
- Storage and handling of hazardous substances.
- Liaison with water sports clubs to identify potential conflicts between the dredging program and organised sporting events and identify measures to resolve these conflicts.
- Utilisation of a 'green valve' (also referred to as 'environmental valve') for TSHD dredgers.
- Details of the training for a person involved in the operation of the dredge so that he/she may recognise any potential archaeological material including koiwi tangata or taonga.

A description of all other necessary measures to manage adverse effects on the receiving environment during the operation of the dredge vessel, including measures relating to biofouling, management of waste, and refuelling.

7.2 Biosecurity Management Plan (BMP)

The purpose of the BMP is to specify how the risk of a biosecurity incursion via the dredge and related vessels is to be minimised and managed.

The BMP shall include the following:

- Description of the dredge and associated vessel(s) and their attribute(s) that affect risk (e.g. voyage speed, maintenance history, prior inspection, voyage history since last dry-docking and antifouling).
- Description of the key sources of potential marine biosecurity risk from ballast water sediments and biofouling.
- Findings from previous inspections.
- If from overseas, a description of the risk mitigation taken prior to arrival in New Zealand, including:

  - Routine preventative treatment measures and their efficacy, including the age and condition of the antifouling coating, and marine growth prevention systems for sea chests and internal sea water systems.
  - Any specific treatments for submerged and above-water surfaces that will be undertaken to address Import Health Standard (IHS) and Craft Risk Management Standard (CRMS) requirements prior to departure for New Zealand. These could include, for example, in-water removal of biofouling, or above-water cleaning to remove sediment.
  - Any additional risk mitigation planned during transit to New Zealand, including expected procedures for ballast water management.
  - Expected desiccation period of above-water surfaces on arrival to New Zealand (i.e. period of air exposure since last dredging operations).
- The nature and extent of pre-border inspection that will be undertaken to verify compliance with IHS and CRMS.
- Record keeping and documentation of all mitigation undertaken to enable border verification if requested by Ministry of Primary Industries and to facilitate final clearance.

7.3 Construction and Environmental Management Plan

The CEMP covers the reclamation and wharf construction activities and will interact with the dredging operations via the use of dredge spoil for reclamation fill. This includes the infrastructure (i.e. pipelines) used to pump the dredge spoil ashore.

The objectives of the CEMP are:

- to detail the environmental monitoring and management procedures to be implemented during the proposal’s construction phase to ensure that appropriate environmental management practices are followed and adverse construction effects are minimised to the extent practicable; and
- to ensure construction effects of the proposal are in accordance with the assessments accompanying the resource consent applications.

The CEMP must include the following sections:

- Construction phase roles and responsibilities protocols
- Environmental Risk Assessment
- Dust
- Hazardous Substances
- Erosion and Sediment Control
- Marine Works
- Wildlife, including:
  - Avifauna (as identified above, the avifauna section is required to describe the management actions and monitoring that will be employed to minimise effects on avifauna, including Kororā Little Penguin and Tōrea pango Variable oystercatcher); and
  - Marine Mammals (including the MMMP – see below)
- Archaeology
- Noise
- Marine Biosecurity
- Communications Protocols, including Complaints Procedures

7.4 Marine Mammal Management Plan (MMMP)

A Marine Mammal Management Plan (MMMP) has been prepared to manage the risks to marine mammals posed by the construction activities (including dredging), and to effectively monitor effects of the proposal. The purpose of the MMMP is to describe the management actions and monitoring that will be employed during the proposal to minimise effects on marine mammal species, specifically the risk of vessel collision and the risk of impacts from dredge noise on marine mammals. The MMMP shall be implemented alongside this EMMP.

7.5 Accidental Discovery Protocol (ADP)

Accidental Discovery Protocol (ADP) applies to the works.

The ADP includes the following processes for accidentally discovering a material of archaeological significance during the dredging works:

- In the event of any discovery of archaeological material, the consent holder shall immediately:
    - Cease Dredging operations in the affected area, and mark off the affected area using GPS coordinates on the dredge vessel.
    - Advise the Consent Authority of the disturbance.
    - Advise the Regional Office of Heritage New Zealand Pouhere Taonga (HNZPT) of the disturbance.
- If the archaeological material is determined to be koiwi tangata (human bones) or taonga (treasured artefacts) by HNZPT, the consent holder shall immediately advise the office of the Kaitiaki rūnunga of the discovery.
- If the archaeological material is determined to be koiwi tangata (human bones), the consent holder shall immediately advise HNZPT, the New Zealand Police, relevant iwi/hapu, and Northland Regional Council.
- Dredging may only recommence within the marked location if the Consent Authority provides a written statement to the consent holder that it is appropriate to do.

7.6 Complaints

Records of any complaints logged relating to the dredging activities shall be maintained by the Consent Holder.

The records shall cover the following:

- Name of complainant, if offered.
- The issue raised.
- The location of the issue raised.
- The date and time of the complaint.
- A description of the weather conditions at the time of complaint, if relevant.
- Any possible cause of the issue raised.
- Any management actions undertaken to address the cause of the complaint.

Northport shall follow their standard complaint response protocol to ensure these are adequately responded to.

The record of complaints shall be provided to NRC on request.

7.7 Incidents / spills

In the event of a spill or leak of oil, fuel or other hazardous substance to water, the following actions shall be taken immediately:

- Take action to prevent further spills and contain any spilled material.
- Notify the Northland Regional Council of the spill via *0800 504 639.*
- Take all reasonable steps to remedy or mitigate any adverse effects on the environment resulting from the discharge/spill.
- Contact [insert local iwi and hapu] so whanau who may use the area for mahinga kai can be advised of the spill.

8 Reporting requirements

8.1 Tier 3 Compliance Level Exceedance Report

As specified in the Consents, where a Tier 3 Compliance Level trigger has occurred and it is considered due to an extraordinary natural event and not dredging, Northport may provide a report to Northland Regional Council within 24 hours of the trigger exceedance demonstrating this is the case. If accepted, Northport may continue dredging in the vicinity of the triggered monitoring location. If, within 2 working days of receiving the report, Northland Regional Council notify Northport that it does not accept the event was extraordinary, dredging must cease in the vicinity of the monitoring location until a trigger event is no longer occurring.

The report shall include:

- Results of investigations occurring as part of the management responses detailed in Section 5.
- Determination of whether the event was likely to be dredge related or not.
- Management actions taken in response to the event and the result of the action i.e. changes in location of the dredge and turbidity levels as a result of this.
- Graph summarising the turbidity at the exceedance location over the monitoring period.

The report is to be published on the Project Website for public viewing.

8.2 Monitoring Reports

8.2.1 Quarterly turbidity monitoring reports

A quarterly report shall be prepared by the CHPT every three months during and after dredging. These reports shall include the turbidity monitoring results during the three-month period, and details of any triggers that have been exceeded, the management response measures carried out and the results of monitoring after the management response measures have been completed.

At least two quarterly reports shall be prepared covering the post-dredging phase.

8.2.2 Ecological assurance monitoring report

After the completion of each set of annual (i.e. spring/summer and autumn/winter) marine ecology assurance monitoring, a report detailing the assurance monitoring undertaken during that period shall be prepared. That report shall include reference to any previous assurance monitoring to illustrate any relevant trends over time.

8.2.3 Bathymetric and shoreline assurance monitoring

A monitoring report will be prepared after the first year of post-dredging surveys and after the five years of post-completion surveys (i.e., two reports). These will be prepared within three months of survey completion.

The reporting will include a comparison of the baseline and the two post-dredging surveys. Observations based on the results of the analysis will be made, including results and discussions on the ambient conditions, such as wind speed and direction, water level variations and any significant climate events. Recommendations on changes to the monitoring programme (if required) will be made in the first report.

8.2.4 Annual report

Annually, during the baseline, dredging and post-dredging phases, the following monitoring reports (if produced in that period) shall be collated and provided to the NRC:

- Quarterly turbidity monitoring
- Ecological assurance monitoring
- Bathymetric and shoreline assurance monitoring

The annual report shall be provided to Northland Regional Council no later than three months after the completion of the relevant set of annual assurance monitoring.

8.3 Dredging Stage Completion Report

Within nine months of the completion of capital dredging, a Dredging Completion Report shall be prepared by the CHPT. The report shall contain a summary/collation of the following:

- Dredging activities
- Final bathymetry survey results and analysis
- Monitoring undertaken during the period and a comparison of results to the baseline monitoring
- Trigger exceedances, investigation results and management responses
- Evaluation of the general performance of the EMMP including:
  - Evaluation of the dredge management approach and management responses undertaken by the EMMP and whether or not the objectives and purpose of the plan were met
  - Evaluation of the monitoring methodology and results

A copy of the completed report shall be provided to the NRC.

9 Group roles and responsibilities

Successful dredge management relies on good communication, liaison, and input from a number of key parties throughout the monitoring and management stages. To ensure all relevant technical experts and stakeholders are appropriately involved in the dredge management process, the Consent Holder Project Team (CHPT) and Technical Advisory Group (TAG) shall be established prior to commencing dredging.

9.1 Consent Holder Project Team

The CHPT is to be established by Northport and may include any expertise deemed necessary. However, at a minimum, the Consent Holder shall ensure the CHPT includes employees, or persons engaged by Northport, with at least the following expertise:

- An assigned (contractor or employee) project manager for Northport
- Dredge operator
- Hydrodynamic modeller
- Water quality scientist

The roles of the CHPT will include:

- Daily operations and proactive management of the dredge taking into consideration:
    - Real-time turbidity monitoring
    - Water quality monitoring
    - MetOcean conditions and forecasts
- Preparation of the monitoring reports and circulation to the various parties as required (refer Section 8).
- Continually examine the monitoring data to ensure the appropriate information is being gathered.
- Ensure the Dredge Contractor has the required monitoring information and the appropriate management responses are completed in a timely manner.

9.2 Technical Advisory Group (TAG)

This purpose for this group is to give technical advice to the CHPT on matters of individual member expertise. The group shall consist of no more than 12 members as follows:

- To be decided following consultation

The role of the TAG is to:

- Review the reports prepared by the CHPT and where necessary provide advice to the CHPT in writing.
- Provide advice on any technical matters as sought by the Consent Holder.
- The TAG will not direct the nature or specifics of dredge management responses.
- Where the TAG does not have the expertise in any of the areas it is required to report on, it may engage the services of an appropriate expert on a relevant matter to the TAG.

The Consent Holder shall provide any administrative support necessary for the TAG to carry out its functions. The Consent Holder shall establish the TAG at least 2 months prior to the first commencement of dredging. The Consent Holder shall offer to hold meetings at a frequency appropriate for the dredging programme and reporting intervals.

9 Applicability

Enviser Ltd has prepared this report for Northport Limited in accordance with the agreed scope. No other party, aside from Northport and its contractors, may rely on this report, or any conclusions or opinions within it, for the management of dredging effects without the express written permission of Enviser Ltd.

The opinions and conclusions within this report are based on the information that was viewed during preparation of the report.

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Appendix A: Ecological assurance monitoring methods

Ecological Assurance Monitoring Plan: Northport

1 Background

The objectives of ecological assurance monitoring are to:

1. Characterise the responses of surrounding subtidal habitats and benthic communities to sediments suspended and deposited offsite during channel dredging, and subsequent changes after dredging is complete.
2. Characterise the responses of surrounding intertidal habitats and benthic communities to sediments suspended and deposited offsite during channel dredging, and subsequent changes after dredging is complete.
3. Confirm whether benthic habitats and communities similar to those currently existing re-establish on the dredged basin once dredging is complete.

For clarity, the purpose of this monitoring is not to provide real-time (or near real-time) detection of effects, nor is it designed to trigger real-time management responses to the detection of ecological of habitat changes. However, it will complement the real-time turbidity monitoring and associated response measures, by providing feedback on the efficacy of those measures and will also verify the actual extent and magnitude of key effects.

The monitoring design provides for:

- the detection of gradients in effects on key receptors, which are expected to reduce with distance from dredging activity and over time;
- the collection of reference data that supports the temporal and spatial analysis of dredging effects.

Key physical and ecological indicators include:

- water turbidity and suspended solids concentrations (which tend to be correlated);
- sediment grain size;
- the composition of subtidal and intertidal infaunal communities (e.g. diversity, abundance, evenness);
- the distribution and cover of seagrass and macroalgae beds;
- the presence (and/or abundance) and distribution of subtidal epifauna (or indicator species).

Turbidity monitoring is covered elsewhere, and therefore, is excluded from the following ecological assurance monitoring methods.

2 Monitoring methods

2.1 Subtidal monitoring

Spring-summer and autumn-winter[1] subtidal monitoring surveys will be carried out:

- In a one year period within a 18 month window prior to dredging commencing;
- during dredging (except in the dredge basin);
- one year after dredging is complete; and,
- three years after dredging is complete (Table 2-1).

2.1.1 Subtidal infauna and sediments

Grab samples will be obtained to characterise, map and track changes in infaunal communities and sediment grain size. The subtidal sampling design is shown in Table 2-2 and Figure 1, and includes:

1. Sampling along the main (western impact and east impact sites) and northern (north impact and reference sites) channels of the harbour and the existing dredge basin (Figure 1).
2. Splitting the main and northern channels into three separate areas (lower, mid and upper) to provide for graphical and statistical comparisons among areas, and distances from the dredging area.
3. Systematic random sampling to avoid bias and provide good coverage of each sampling area. Random samples will be obtained from eight sub-areas within each sampling area[2].
4. The ability to pool all data and analyse the results spatially in GIS, using heat maps, bubble plots and similar presentation methods to visualise ecological patterns and changes (see the example in Figure 2).

Six-litre, Van Veen grab samples (or a suitable alternative) will be obtained from eight randomly allocated stations within each of nine sampling areas. At each station, ecological samples will be obtained from one half of the grab, and samples of the top 2 cm of sediment will be obtained from the other half, for the analysis of:

1. Species composition, with each sample being sieved to 0.5 mm onsite and preserved in isopropyl alcohol. Samples will be sent to a suitably qualified and experienced taxonomist for sample sorting, taxa identification and enumeration.
2. Sediment grain size using wet sieving to determine percentages of the following fractions: mud (<63 micron), very fine sand (63–125 micron), fine sand (125–250 micron), medium sand (250–500 micron), coarse sand (500–1 mm), very coarse sand (1–2 mm) and gravel (> 2 mm).

Sediment grain size and infaunal communities will be analysed by graphical and spatial plots, and through univariate and multivariate statistics. Four indices of ecological abundance and diversity shall be assessed (number of taxa, number of individuals, Shannon's diversity and Pielou's Evenness).

[1] Sampling rounds to be 6-months apart.

[2] Randomisation was done in QGIS, with each sampling area divided into eight sub-areas, with one random station generated for each sub-area (minimum distance of 100 m between stations). The sub-areas were generated from Voronoi polygons derived from the centroids of 160 aggregated random points within each sampling area. Random points were aggregated using k-means clustering.

Table 2-1: Planned timing of each subtidal sampling round (✓ sampling, × no sampling, sampling if previous round shows adverse effects have occurred[3]).

	Within a one year period within 18 months prior to dredging commencing		During dredging		One year after dredging is complete		Three years after dredging is complete	
Area	**Spring: Summer**	**Autumn: Winter**	**Spring: Summer**	**Autumn: Winter**	**Spring: Summer**	**Autumn: Winter**	**Spring: Summer**	**Autumn: Winter**
Existing Dredge	✓	✓	×	×	✓	✓	✓	✓
West Impact	✓	✓	✓	✓	✓	✓	×	×
East Impact	✓	✓	✓	✓	✓	✓	×	×
North Impact	✓	✓	✓	✓	✓	✓	×	×
Reference	✓	✓	✓	✓	✓	✓	✓	✓

Table 2-2: Planned distribution of subtidal sampling effort during each round of sampling

Area	Number of video transects	Number of drop camera stations	Number of grab samples
Existing Dredge	2	8	8
West Impact	2	24	24
East Impact	2	8	8
North Impact	2	8	8
Reference	2	24	24
Total	**10**	**72**	**72**

[3] Scientifically significant means something that is statistically and ecologically significant.

Figure 1: Sample design for subtidal sediment and infauna monitoring.

Figure 2: Example of a heat map showing total counts of all benthic macroinvertebrates obtained in core samples collected from Marsden Bay.

2.1.2 Video and drop camera surveys of habitats and epifauna

Subtidal habitats and communities will be characterised and mapped using a combination of video tows and drop camera images. These two survey methods are complimentary, with video transect data providing high resolution data on the distribution of biota along the video run lines and drop camera images covering a broader area at a lower spatial resolution. Drop camera data is particularly useful for mapping physical characteristics and habitat complexity, but the small area covered by each image means that patchily distributed species are easily missed. Video camera data provides a continuous record along transect run-lines. It is particularly useful at determining the distribution of habitats and emergent[4] species (or species groups) along the run-lines and discriminating transitions between habitats.

2.1.2.1 Drop camera

Drop camera photographs will be obtained from each grab sample station using two high resolution cameras fixed to a drop camera stand — one camera facing downward, and one aligned horizontally.

Drop camera images will be analysed for:

- substrate type and evidence of sediment deposition based on visual appearance;
- habitat complexity based on a subjective ranking from uniform (1) to highly complex 6) (see Table 2-3);
- any biota observed in the images.

Drop camera data will be imported into GIS and mapped as raw point data and as a complexity heat map generated through kriging.

Table 2-3: Proposed criteria used to rank subtidal habitat complexity (the suitability of these criteria will be confirmed after the first round of sampling).

Complexity ranking	Description
1	Uniform sand/mud, may contain low densities of small burrows.
2	Sparse shell debris, high density burrows, and/or sparse cover of low-lying indeterminant biota.
3	High shell density but large emergent biota absent.
4	The presence of a few large emergent biota or scallops.
5	Moderate density of large emergent biota or scallops.
6	High density of biological organisms creating complex three-dimensional structures.

2.1.2.2 Video

Video data will be recorded along two 2.5 km transects in each of the main channel west of the dredge basin and northern reference channel, and two 1.8 km transects through the dredge basin and west impact area (Figure 1). Two camera systems will be used to obtain the video footage:

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[4] In this report emergent species refers to epifaunal animals and macroalgae.

- A remote high-resolution camera, with its time synchronised to track data recorded on a GPS. This allows run-line, coordinates, time, heading, and speed information to be embedded during post-processing.
- A surface-fed camera system that allows video to be viewed in real time, and coordinates from a GPS to be stamped directly onto the video image.

Video footage will be analysed by playing it in a darkened room and recording the coordinates for the occurrence of, or transitions between, major physical (e.g., sand, shell gravel) and biological habitats (e.g., macroalgal meadows, horse mussel beds, scallop beds and sponge gardens). Observations of other species, such as unwanted organisms (e.g., Mediterranean fan worm, *Sabella spallanzanii*) will also recorded.

Records obtained from the video data will be imported into GIS and mapped using points for individual observations and lines to show the distribution of biogenic and physical habitats. Spatial data will be analysed to detect changes such as the loss of emergent species, or shifts in the physical or biological characteristics of the seabed.

Note that:

1. Densities of some species may be subjectively ranked into the following categories of increasing abundance: e.g. scattered; scattered patchy bed; patchy bed; and bed.
2. Species such as scallops partially bury themselves in sediments, making them difficult to distinguish in video footage shot from a moving camera. Dead shells can also be hard to distinguish from living specimens. Given that, observations of such species may be recorded as “possible” and “probable”.

2.2 Intertidal monitoring

Little increase in suspended sediment concentrations or sediment deposition is predicted in to occur in intertidal areas. However, should intertidal effects occur, then modelling results and biodiversity values suggest that the area most likely to be affected is the lower shore either side of the Marsden Cove entrance channel. Intertidal, infaunal monitoring is therefore proposed for those areas, along with a reference location at Tamaterau Bay, which NRC monitoring suggests contains a benthic community with similar composition to Marsden Bay[5]. Seagrass throughout Marsden Bay will also be monitored via drone survey.

Spring-summer and autumn-winter[6] intertidal monitoring surveys will be carried out:

- In a one year period within a 18 month window prior to dredging commencing;
- during dredging; and
- one year after dredging is complete, and subject to adverse effects being detected in that survey, three years after dredging is complete (Table 2-4).

2.2.1 Intertidal infauna and sediments

Samples will be obtained to characterise, map and track changes in intertidal infaunal communities and sediment grain size. The intertidal sampling design is shown in Table 2-5 and Figure 3, and includes:

[5] See marine ecological assessment in the AEE.
[6] Sampling rounds to be 6-months apart.

- Repeat sampling of a potential impact site in Marsden Bay and reference site at Tamaterau.
- Sampling along the upper and lower shore east of Marsden Cove access channel, and on the western side of the channel in Marsden Bay, and along the upper and lower shore at Tamaterau.
- Stratified random sampling (with 30 samples per site with effort stratified by the size of each sub-area) to avoid bias and provide good coverage of each sampling location. Random samples will be obtained from five sub-areas at both locations (Figure 3).
- The ability to pool all data and analyse the results spatially in GIS, using heat maps, bubble plots and similar presentation methods to visualise ecological patterns and changes (see the example in Figure 2).

At each random station, ecological samples will be obtained using a 13 cm diameter by 15 cm deep core, and samples of the top 2 cm of sediment will be obtained for the analysis of grain size at every second station. Each ecological sample will be sieved to 0.5 mm onsite and preserved in isopropyl alcohol. Samples will be sent to a suitably qualified and experienced taxonomist for sample sorting, taxa identification and enumeration. Sediment grain size samples will be set to a recognised laboratory and analysed using wet sieving to determine percentages of the following fractions: mud (<63 micron), very fine sand (63–125 micron), fine sand (125–250 micron), medium sand (250–500 micron), coarse sand (500–1 mm), very coarse sand (1–2 mm) and gravel (> 2 mm).

Sediment grain size and infaunal communities will be analysed by graphical and spatial plots, and through univariate and multivariate statistics. Four indices of ecological abundance and diversity shall be assessed (number of taxa, number of individuals, Shannon's diversity and Pielou's Evenness).

2.2.2 Seagrass

Seagrass will be mapped using georeferenced and orthocorrected photogrammetry obtained through annual low tide drone surveys. The ongoing monitoring area will be defined following an initial survey of the area shown in Figure 4. Key considerations will be:

- The amount of seagrass present in Marsden Bay when monitoring begins.
- The size of the area that can be reasonably covered by drone within a single low-tide cycle.
- The tidal elevation of seagrass on the shore, noting that the boundaries of submerged seagrass beds may not be clearly distinguishable.

Imagery obtained will be spatially processed by an experienced surveyor. Seagrass and other biological features apparent in the imagery will then be imported into GIS and mapped by an experienced ecologist. Changes in seagrass extent within the defined survey area will be assessed through spatial and graphical plots of cover and extent.

Table 2-4: Planned timing of each intertidal sampling round (✓ sampling, × no sampling, ★ sampling if previous round shows that scientifically significant adverse effects have occurred[3]). A monitoring report will be prepared for each year of sampling.

	Within a one year period within 18 months prior to dredging commencing		During dredging		One year after dredging is complete		Three years after dredging is complete	
Area	**Spring: Summer**	**Autumn: Winter**	**Spring: Summer**	**Autumn: Winter**	**Spring: Summer**	**Autumn: Winter**	**Spring: Summer**	**Autumn: Winter**
Marsden Bay benthic sediments and ecology	✓	✓	✓	✓	✓	✓	★	★
Tamaterau benthic sediments and ecology	✓	✓	✓	✓	✓	✓	★	★
Marsden Bay seagrass	✓	✓	✓	✓	✓	✓	★	★
Reporting		✓		✓		✓		★

Table 2-5: Planned distribution of subtidal sampling effort during each round of sampling (✓ sampling, × no sampling).

Area	Number of benthic sediments and macrofauna samples	Seagrass mapping
Marsden Bay benthic sediments and ecology	30	✓
Tamaterau benthic sediments and ecology	30	×
Total	**60**	

Figure 3: Indicative sample design for intertidal sediment and infauna monitoring, showing sites in Tamaterau and Marsden Bay and stratified-random sampling stations.

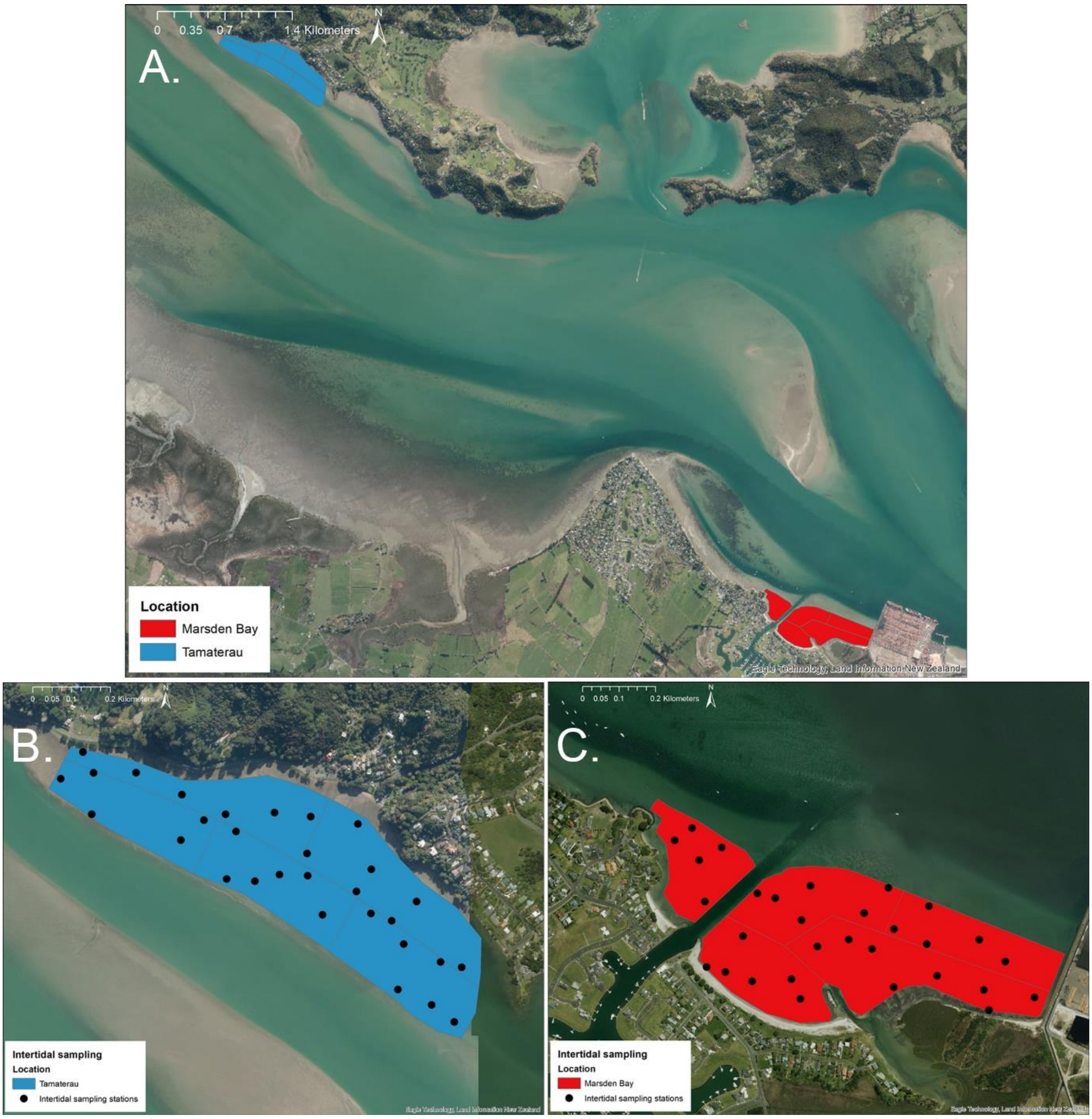
A.
0 0.35 0.7 1.4 Kilometers
N
Location
Marsden Bay
Tamaterau
Eagle Technology, Land Information New Zealand
B.
0 0.05 0.1 0.2 Kilometers
Intertidal sampling
Location
Tamaterau
Intertidal sampling stations
C.
0 0.05 0.1 0.2 Kilometers
Intertidal sampling
Location
Marsden Bay
Intertidal sampling stations

Figure 4 Indicative area for intertidal seagrass monitoring.