RiverLink

Notices of Requirement for Designations and Applications for Resource Consent

Volume Four: Supporting Technical Reports

Technical Report #8

Marine Ecology

IN THE MATTER OF	The Resource Management Act 1991
AND	
IN THE MATTER OF	Resource consent applications under section 88, and Notices of Requirement under section 168, of the Act in relation to the RiverLink project
BY	**Waka Kotahi NZ Transport Agency** Requiring Authority **Greater Wellington Regional Council** Requiring Authority **Hutt City Council** Requiring Authority

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RIVERLINK
TECHNICAL ASSESSMENT #8
Marine Ecology and Coastal Avifauna Assessment of Effects

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1 INTRODUCTION

1.1 Dr Jacqui Bell

1. My name is Dr Jacqui Bell. I am a Senior Marine Ecologist and Associate Principal at Boffa Miskell Ltd.

1.1.1 Qualifications and experience

2. My qualifications include a Bachelor of Marine Science and a Doctorate in Marine Ecology (both from Macquarie University). My PhD focused on facilitation cascades within subtidal rocky reef ecosystems in both Australia and New Zealand.
3. I have practiced as a Marine Ecologist for more than 12 years and have been involved in all aspects of assessing effects on marine ecological values from project lead including survey design, fieldwork, sample processing, statistical analyses, report preparation, as well as evaluating effects, recommending mitigation measures, evidence and appearing as an expert witness.
4. I have worked on a variety of projects focusing on the effects on marine ecology from sediment discharge, reclamation, stormwater and wastewater discharge, channel dredging and dredge disposal, marina monitoring, marine sediment contaminants and marine biosecurity.
5. I have provided technical advice on marine ecology matters relating to a number of roading and infrastructure projects including: SH16 Causeway Upgrade, Pūhoi to Warkworth, Warkworth to Wellsford, Auckland Eastern Busway, Mackays to Peka Peka, Transmission Gully, Queens Wharf Upgrade, Seaview Wharf Upgrade, Whangarei to Te Hana, Penlink, Riverlink and Te Ara Tupua - Ngā Ūranga ki Pito-one (Ngauranga to Petone) Shared Path.
6. I am a member of the New Zealand Coastal Society and the New Zealand Marine Sciences Society.
7. I am a certified Environmental Practitioner with the Environment Institute of Australia and New Zealand.

1.1.2 Code of Conduct

8. I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court Practice Note 2014. This assessment has been prepared in compliance with that Code, as if it were evidence being given in Environment Court proceedings. In particular, unless I state otherwise, this assessment is within my area of expertise, and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

1.1.3 Purpose and scope of assessment

9. The purpose of this assessment is to determine the construction and operational effects of the Project on marine ecology and how the effects will be managed under the RMA effects management hierarchy. My assessment:

    i. Describes the baseline existing environment including the ecological values of the receiving marine environment and existing sediment concentrations and volumes from Te Awa Kairangi/ Hutt River into Wellington Harbour;

    ii. Identifies and describes any sites of significant indigenous biodiversity values;

    iii. Describes the assessment methodology;

    iv. Identifies and assesses the level of effect of sediment on identified marine ecological values from construction and operation of the Project; and

    v. Identifies any necessary mitigation, offset or compensation measures.

10. Discussions were carried out with the following experts:

    i. Ed Breese and Alistair Gordon in construction water quality and erosion and sediment control,

    ii. Gary Williams and Kyle Christensen in river design and geomorphology,

    iii. Andrew Whaley in construction methodology,

    iv. Patrick Lees in aquatic ecology.

1.1.4 Assumptions and exclusions in this assessment

11. At the request of the client, this assessment is based on desktop information only. No fieldwork was carried out to characterise the value of the marine receiving environment.

12. The assessment was based on predicted Project related sediment volumes and concentrations provided by the Project Geomorphology and Construction Water Quality specialists.

1.2 Karin Sievwright

13. My name is Karin Sievwright. I am an ornithologist at Boffa Miskell Limited. I am the author of the coastal avifauna components of this report.

1.2.1 Qualifications and experience

14. My qualifications include a Bachelor of Science and a Master of Conservation Biology (both from Massey University). My Masters research focused on the post-release survival and reproductive success of little blue penguins rehabilitated after the 2011 CV Rena oil spill off the coast of Tauranga.

15. Since completing my studies, I have practiced as an ecologist for five years and have been involved in assessing effects on coastal avifauna values including designing and conducting field work, preparing reports and ecological effects assessments.

16. I have worked on projects focusing on the effects on coastal avifauna from habitat loss, potential injury or mortality, pollution and sediment discharge.

17. I have provided technical advice on coastal avifauna including the following projects/assessments: Seaview Wharf Upgrade, CentrePort Infrastructure Upgrades, Lyttelton Port of Christchurch Cruise Berth Assessment, Whangarei to Te Hana Expressway, updating ecological aspects of the Tasman Oil Spill Contingency Plan and Coastal Natural Character Assessments for Porirua, Wairarapa and the Kapiti Coast.

1.2.2 Code of Conduct

18. I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court Practice Note 2014. This assessment has been prepared in compliance with that Code, as if it were evidence being given in Environment Court proceedings. In particular, unless I state otherwise, this assessment is within my area of expertise, and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

1.2.3 Purpose and scope of assessment

19. The purpose of this assessment is to determine the construction and operational effects of the Project on coastal avifauna ecology and how the effects will be managed under the RMA effects management hierarchy. My assessment:

    i. Describes the baseline existing environment including the benthic environment where Project sediment is likely to deposit; avifauna values of the receiving marine environment; and existing sediment concentrations and volumes from Hutt River into Wellington Harbour;

    ii. Identifies and describes any sites of significant indigenous avifauna biodiversity values;

    iii. Describes the assessment methodology;

    iv. Identifies and assesses the level of effect of sediment on identified avifauna ecological values from construction and operation of the Project; and

    v. Identifies any necessary mitigation, offset or compensation measures.

20. Discussions were carried out with the following experts:

    i. Jacqui Bell, the co-author of this report (marine ecology expert);

    ii. Alistair Gordon in construction water quality and erosion and sediment control,

    iii. Kyle Christensen in river design and geomorphology.

21. Information was also used from conversations Jacqui Bell had with Ed Breese and Alistair Gordon in construction water quality and erosion and sediment control, Gary Williams in river design and geomorphology, Andrew Whaley in construction methodology, Patrick Less in aquatic ecology and Allen Ingles Stormwater and Operational Phase Water Quality.

1.2.4 Assumptions and exclusions in this assessment

22. At the request of the client, this assessment is based on desktop information only. No fieldwork was carried out to characterise the value of the avifauna species within the marine receiving environment. Instead desktop information from other survey work conducted in the area was relied on, particularly the Te Ara Tupua - Ngā Ūranga ki Pito-one (Ngauranga to Petone) Shared Path project and data from surveys conducted around Wellington Harbour over two-year periods. I also relied on local knowledge of the area.

23. The assessment was based on predicted Project-related sediment volumes and concentrations provided by the Project Geomorphology and Construction Water Quality specialists (Gary Williams and Ed Breese respectively).

2 EXECUTIVE SUMMARY

2.1 Project Description

24. The Project is to construct, operate and maintain RiverLink. The proposed works include:

    i. A revised river channel and stopbank design to accommodate a greater flood flow;

    ii. Flood resilience, amenity design works within Te Awa Kairangi to provide enhanced amenity outcomes and pedestrian/cycling connections;

    iii. A pedestrian bridge over Te Awa Kairangi;

    iv. An interchange on SH2 at Melling and a new Melling bridge;

    v. New local road connections and layouts;

    vi. A new Melling Train station; and

    vii. Enablement of future urban development of Hutt City centre along the river.

2.2 Assessment Methodology

25. For the purposes of this assessment, a desktop investigation was undertaken to review available databases, published and unpublished reports and assessments relating to the marine and coastal avifauna ecology in the receiving environment of the Project.

26. The extent of the desktop investigations included the estimated zone of influence[1] (ZOI) that covers the maximum likely extent of potential effects. This was assessed based on information on sediment transport from the Hutt River and existing areas of fine sediment substrate.

27. Methods used to undertake this effects assessment are consistent with the EIANZ guidelines for undertaking ecological impact assessments (Roper-Lindsay et al., 2018).

[1] Defined by Roper-Lindsay et al. (2018) as “the areas/resources that may be affected by the biophysical changes caused by the proposed project and associated activities”.

28. The Construction Water Quality assessment report by Ed Breese (Technical Assessment #3) explains that Project construction activities that involve disturbance of the riverbed material and adjacent earthworks will cause mobilisation of sediments into the flowing water column. Suspended sediments will be deposited downstream within the River itself or at the River mouth. Some fine particles may remain in suspension for longer and travel further into the marine environment during flood events before depositing on the seabed in subtidal areas where existing fine sediment deposition occurs (Construction Water Quality Technical Assessment (CWQTA - Technical Assessment #3)

29. The Stormwater and Operational Phase Water Quality Technical Assessment (SOWQTA) by Allen Ingles (Technical Assessment # 2) explains the proposed operational phase stormwater treatment and water quality.

30. Discharges of sediment and stormwater from the proposed in-river (wet) works and adjacent earthworks that becomes entrained in the River water will likely deposit in the same locations that sediment from the Hutt River currently deposits. The marine and coastal avifauna habitats potentially affected by the Riverlink Project could include the soft sediment habitats of the lower Hutt River Estuary, Korokoro Estuary, the Ngā Ūranga to Pito-one (Ngauranga to Petone) foreshore, Matiu/Somes Island foreshore and the subtidal soft sediment habitats within the wider Wellington Harbour.

2.2.1 Marine Ecological Value

31. The Hutt River Mouth consists of moderate to low benthic invertebrate species richness, diversity and abundance, with high numbers of opportunistic and tolerant taxa. Although some sensitive species exist (such as pipi), the marine sediments are moderately muddy, and oxygenation is limited to the shallow sediment layer. Furthermore, marine biota are impacted by extraction and scouring of the river during flood events (Robertson and Stevens, 2017). On balance, the ecological value of the Hutt River Mouth is assessed as low.

32. Korokoro Estuary is characterised by relatively (and naturally) low benthic invertebrate species richness and diversity. The benthic invertebrate community composition is dominated by tolerant taxa. Sediments grain size composition is mainly sand and gravels, with oxygenated surface sediments and low levels of contaminants. There is no macroalgae habitat. The Estuary has a high degree of habitat modification in parts(Boffa Miskell Ltd, 2020a). On balance, the ecological value of the Korokoro Estuary and intertidal Pito-One (Petone) foreshore is assessed as low.

33. The benthic invertebrate community along the Ngā Ūranga to Pito-one (Ngauranga to Petone) foreshore typically has high diversity, species richness and abundance (soft sediment subtidal communities in particular). This area contains many taxa that are sensitive, including bivalves, gastropods, ostracods. Marine sediments are typically comprised of <50% smaller grain sizes (i.e. fine sand, very fine sand, silt and clay). Surface sediment is oxygenated and contaminant concentrations in surface sediment rarely exceed Default Guideline Values (DGV) threshold (Australian and New Zealand Governments, 2018). Vegetation/macroalgae provides significant habitat for native fauna

(primarily the significant[2] macroalgae present in subtidal habitats). Based on these observed characteristics, on balance the value of the intertidal and subtidal habitats along the Ngā Ūranga to Pito-one (Ngauranga to Petone) foreshore is assessed as high.

34. Wellington Harbour has a moderate diversity, richness and abundance of benthic invertebrates, dominated by tolerant and opportunistic taxa (Oliver, 2014). Marine sediments typically comprise >50% smaller grain sizes (i.e. fine sand, very fine sand, silt and clay). Contaminant concentrations in surface sediment exceed ARC ERC (Auckland Regional Council, 2004) and DGV threshold concentrations (Australian and New Zealand Governments, 2018) at a number of sites. Due to the existing fine sediment deposition from the Hutt River, stormwater inputs and the degree of harbour shore that has been modified, the habitat is regarded as reasonably modified. On balance, the value of the subtidal soft sediment environment within Wellington Harbour is assessed as moderate.

35. Overall I have assessed that the marine ecological value of the receiving environment that is most likely to be influenced by the Project has an overall value of moderate.

2.2.2 Marine Ecology Assessment of Effects

36. Based on conservative estimates, provided by Gary Williams (geomorphologist) and Ed Breese (construction water quality), there is unlikely to be any Project-related fine sediment (<63µm) above the baseline of 90,000t/yr, that will reach the marine environment.

37. The contribution of the Project to the suspended sediment, deposition or long-term sedimentation of the harbour is negligible as there is unlikely to be more than a very small amount of fine (silt and clay sized) sediment particles within the proposed project footprint.

38. In my assessment, a moderate marine ecological value and a negligible magnitude of effect of construction activities will result in an overall very low level of effect of the Projects construction phase (Table 1).

39. Stormwater treatment will improve operational phase water quality and result in a net gain in ecological value resulting from the Projects operation phase (Table 1).

2.2.3 Coastal Avifauna Value

40. The coastal avifauna assemblage of the Hutt River mouth/estuary, Korokoro estuary, the Ngā Ūranga to Pito-one (Ngauranga to Petone) foreshore and wider Wellington Harbour is diverse and includes a number of At Risk and Threatened species. These habitats (a number of which are significant areas as identified in Schedule F2 of the Proposed Natural Resources Plan) provide foraging, nesting and roosting opportunities for coastal avifauna. Foraging habitat includes intertidal areas, near-shore and off-shore areas. Roosting and nesting habitat are above mean high water springs. The ecological value of these species ranges from low to very high.

[2] Recognised in Schedule 5 of the PNRP (Greater Wellington Regional Council, 2019)

2.2.4 Coastal Avifauna Assessment of Effects

41. Low to very high avifauna ecological values along with a negligible magnitude of effect of construction-generated deposited sediment on prey times will result in an overall very low to low level of effect on coastal avifauna (Table 1).

42. Low to very high avifauna ecological values along with a negligible magnitude of effect of construction-generated suspended sediment on the foraging ability of coastal avifauna will result in an overall very low to low level of effect (Table 1).

43. Low to very high avifauna ecological values along with a positive magnitude of effect of operational stormwater on coastal avifauna will result in an overall Net Gain level of effect (Table 1).

Table 1 Summary of construction and operational phase effects of marine ecology and coastal avifauna

Ecological Component	Type of Effect		Species	Ecological Value	Magnitude of Effect	Overall level of effect
Marine Ecology	Construction	Sediment discharges	-	Moderate	Negligible	Very Low
	Operation	Stormwater	-	Moderate	Positive	Net Gain
Coastal Avifauna	Construction	Sediment discharge effects on food supply and foraging ability	Black-billed gull	Very High	Negligible	Low
			Reef heron	Very High	Negligible	Low
			Caspian tern	Very High	Negligible	Low
			Little blue penguin	High	Negligible	Very Low
			Red-billed gull	High	Negligible	Very Low
			South Island pied oystercatcher	High	Negligible	Very Low
			White-fronted tern	High	Negligible	Very Low
			Australasian pied stilt	Moderate	Negligible	Very Low
			Royal spoonbill	Moderate	Negligible	Very Low
			Pied shag	Moderate	Negligible	Very Low

Ecological Component	Type of Effect		Species	Ecological Value	Magnitude of Effect	Overall level of effect
			Variable oystercatcher	Moderate	Negligible	Very Low
			Fluttering shearwater	Moderate	Negligible	Very Low
			Black shag	Moderate	Negligible	Very Low
			Little black shag	Moderate	Negligible	Very Low
	Operation	Stormwater discharge effects	Black-billed gull	Very High	Positive	Net Gain
			Reef heron	Very High	Positive	Net Gain
			Caspian tern	Very High	Positive	Net Gain
			Little blue penguin	High	Positive	Net Gain
			Red-billed gull	High	Positive	Net Gain
			South Island pied oystercatcher	High	Positive	Net Gain
			White-fronted tern	High	Positive	Net Gain
			Australasian pied stilt	Moderate	Positive	Net Gain
			Royal spoonbill	Moderate	Positive	Net Gain
			Pied shag	Moderate	Positive	Net Gain
			Variable oystercatcher	Moderate	Positive	Net Gain
			Fluttering shearwater	Moderate	Positive	Net Gain
			Black shag	Moderate	Positive	Net Gain
			Little black shag	Moderate	Positive	Net Gain

3 PROJECT DESCRIPTION

3.1 Overview of the Project

44. A full Project description is available in the Assessment of Environmental Effects Report ("AEE"). The following section relies on excerpts of the AEE relevant to the assessment of marine and coastal avifauna ecological impacts/effects.

45. The Project is the design, construction, operation and maintenance of RiverLink. Key components of the Project are as follows:

    i. Upgrade and raising of existing and construction of new stopbanks on both sides of Te Awa Kairangi/Hutt River between Ewen Bridge and Mills Street;

    i. Instream works between the Kennedy Good and Ewen Bridges to re-align, deepen and widen the active river channel;

    ii. The replacement of the two signalised at-grade intersections of SH2/Harbour View Road/Melling Link and SH2/Tirohanga Road with a new grade separated interchange;

    iii. Construction of an approximately 215 m long and up to 7 span road bridge with a direct connection across the River from the new interchange to Queens Drive;

    iv. Removal of the existing Melling Bridge;

    v. Changes to local roads;

    vi. Changes to the Melling Line rail network and supporting infrastructure;

    vii. Construction of an approximately 177 m long and 4 span pedestrian/cycle bridge over the River;

    viii. Construction of a promenade located along the stopbank connecting with future development, running between Margaret Street and High Street. This includes new steps and ramps to facilitate access between the city centre and the promenade;

    ix. Integration of infrastructure works with existing or future mixed-use development

    x. Associated works including construction and installation of culverts, stormwater management systems, signage, lighting, landscape and street furniture, pedestrian/cycle connections and landscaping within the Project area.

4 ASSESSMENT METHODOLOGY

4.1 Desktop Information

4.1.1 Marine Ecology

46. The following assessment methodology has been used to assess the construction and operational effects of the Project on marine ecology:

47. A desktop investigation was undertaken to review available databases, published and unpublished reports and assessments relating to the marine ecology in the receiving environment of the Project. The extent of the desktop investigations included the estimated zone of influence (ZOI) that covers the maximum likely extent of potential effects. This was assessed using existing information on sediment transport from the Hutt River (Ward, 2010), information on the proportion of fine sediment from samples taken from subtidal sites within Wellington Harbour (National Institute of Water and Atmospheric Research, 2019) and advice from the Project geomorphologist (Gary Williams).

48. Existing intertidal and subtidal data and information were compiled from work carried out for adjacent projects including Te Ara Tupua (Ngā Ūranga to Pito-one) (Ngauranga to Petone) Shared Path ((Boffa Miskell Ltd, 2015, 2020b) and Horokiwi Quarry (Boffa Miskell Ltd, 2009, 2013, 2015). We also sought information/data from GWRC.

4.1.2 Coastal Avifauna

49. The following assessment methodology has been used to assess the construction and operational effects of the Project on marine ecology:

50. A literature search was undertaken to obtain information about coastal and marine avifauna that use habitat in Wellington Harbour and the lower extent of the Hutt River within the coastal marine area (CMA; from Seaview Bridge to the river mouth); both of these areas are the receiving environment of potential sediment discharges during the construction phase of the Project (and the focus of this assessment with respect to avifauna). Note that potential effects of the Project on riverine birds and coastal bird species that use the river corridor upstream of the CMA are assessed in the "RiverLink Terrestrial Ecology Technical Assessment" prepared by Georgia Cummings.

51. Key resources reviewed and relied upon for this current assessment include the following:

    i. The Te Ara Tupua shared path project Ecological Impact Assessment (Boffa Miskell Ltd, 2020b). This project has been consented (but is yet to be constructed) and involves constructing a coastal pathway between Ngā Ūranga (Ngauranga) interchange and Pito-one (Petone). This project involved targeted coastal bird surveys, including the following:

        a. A search for nesting coastal birds along the Te Ara Tupua project footprint. The nesting bird survey (conducted on 14 January 2016) involved two suitably experienced ecologists walking and actively searching the coastal habitat along the project footprint on the seaward side of the rail lines. All nesting birds or sign of nesting activity (e.g. nesting material) were recorded. The survey commenced at the Pito-One (Petone) end of the project two hours prior to low tide, and any signs of nesting birds were recorded. The objective of the survey was to identify nesting coastal bird species along the project.

b. During the nesting coastal bird survey, all observations of coastal birds (species, numbers, flight patterns and behaviours) were recorded. The objective of recording these observations was to obtain an understanding of the species present and how they were utilising this coastal edge.

c. Point count surveys were conducted at the Korokoro Stream mouth in January and May 2016 during low and high tide events. An hour was spent on each occasion recording all avifauna species observed (and behaviours) utilising the foreshore and Korokoro Stream mouth. The objective of these surveys was to describe the range of species utilising the site at various stages of the tidal cycle.

ii. A scientific paper by Robertson (1992) reporting on avifauna data collected from 17 sections around the Wellington Harbour over two 2-year periods (1975-77 and 1986-88). In that study each section of coastline was walked or cycled once a month during each 2-year period. All birds seaward of the high-tide line were recorded.

iii. The Ornithological Society of New Zealand (OSNZ) atlas (C. J. R. Robertson et al., 2007). Data were collated from the four 10 km x 10 km grid squares (265, 599; 266, 599; 265, 598; 266, 598) which encompass the Hutt River mouth/estuary and Wellington Harbour receiving environment, as well as the terrestrial and marine habitat either side of the coastline (Appendix 1).

iv. The Greater Wellington Regional Council Proposed Natural Resources Plan (PNRP).

v. The New Zealand eBird database3. Data from hotspot areas around Wellington Harbour. and areas of the Hutt River within the CMA were explored on 23 March 2021.

52. Targeted field surveys were not conducted for this assessment, instead the desktop assessment findings were relied upon.

4.2 Supporting Information

53. In addition to the information collected through desktop investigation of relevant literature and databases, this assessment has been based on the information provided in the following supporting documents and plans:

i. Hutt River Environmental Strategy (2001) and Te Awa Kairangi / Hutt River Environmental Strategy Action Plan (2018)

[3] https://ebird.org/explore

ii. Hutt River Floodplain Management Plan – Hutt City Section Protection Improvements: Scoping Report (GWRC & Boffa Miskell Ltd, 2013 RiverLink)

iii. Hutt River Global Consent and Conditions

iv. Te Awa Kairangi Code of Practice

v. Hutt River Sediment Transport – source to beach (OPUS 2010)

vi. Quantification and validation of a sediment budget for the lower Hutt River, Wellington, New Zealand (McConchie, Webby, Morrow, Maas & Cox 2011)

vii. Hutt River Mouth – renewal of existing consents for extraction and deposition (GWRC 2010)

viii. Eutrophication indicators in the Hutt River Estuary, New Zealand (Fry, Rogers, Barry, Barr & Dudley 2011)

4.3 Assessment of Effects

54. The methods used to undertake this effects assessment are consistent with the EIANZ guidelines for undertaking ecological impact assessments (Roper-Lindsay et al., 2018), whereby ecological values are assigned (refer to Table 2 for species and Table 3 for marine ecology) and the magnitude of effects identified (Table 4) in order to determine the overall level of effect of the proposal (Table 5).

55. In New Zealand, no regional or national guidelines or criteria for the assessment of marine ecological values have been developed to date. In the absence of such guidelines, we have adopted the EIANZ guidelines (EIANZ, 2015; Roper-Lindsay et al., 2018) approach to assess marine ecological value (including species richness and diversity).[4] This approach has been used and accepted in previous Board of Inquiry and Environment Court consenting processes for major roads.[5]

56. We have described marine ecological values in this report as ranging from Very Low to Very High; Table 3 lists the characteristics we have used to guide our assessment of the ecological values of parts of the marine environment within the Project area. Due to the lack of marine assessment criteria and guidelines in New Zealand, our assessment of low, moderate and high benthic invertebrate species richness and diversity is based on our expert judgement and experience. However, the principles and approach to assessing level of effect are directly applicable to marine environments.

57. According to Roper-Lindsay et al. (2018), the overall level of effect can then be used to guide the extent and nature of the ecological management response required (including the need for biodiversity offsetting):

58. Very High adverse effects require a net biodiversity gain.6

59. High and Moderate adverse effects require no net loss of biodiversity values.

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[4] Dr Bell is currently part of a team of marine ecologists who are drafting revisions to the EIANZ guidelines to include marine ecology.

[5] See evidence of Dr De Luca in Board of Inquiry Hearings for NZTA Projects: Pūhoi to Warkworth, Waterview Connection, Transmission Gully, Mackays to Peka Peka, and East West Link.

[6] Though when ecological compensation is required because biodiversity offsetting is not possible, the principles of no-net-loss or net-gain do not apply (Maseyk et al., 2018).

60. Low and Very Low effects should not normally be a concern. If effects are assessed taking impact management developed during project shaping into consideration, then it is essential that prescribed impact management is carried out to ensure Low or Very Low effects.

Table 2 Criteria for assigning ecological value to species (Roper-Lindsay et al., 2018).

ECOLOGICAL VALUE	SPECIES CLASSIFICATION
NEGLIGIBLE	Exotic species, including pests, species having recreational value.
LOW	Nationally and locally common indigenous species.
MODERATE	Species listed as any other category of *At Risk* (Recovering, Relict, Naturally Uncommon) found in the ZOI either permanently or seasonally; or Locally (Ecological District) uncommon or distinctive species.
HIGH	Species listed as *At Risk – Declining* found in the ZOI either permanently or seasonally.
VERY HIGH	*Nationally Threatened* (Nationally Critical, Nationally Endangered, Nationally Vulnerable) species found in the ZOI either permanently or seasonally.

Table 3 Criteria for assigning ecological value to marine habitats.

ECOLOGICAL VALUE	CHARACTERISTICS
VERY LOW	• Benthic invertebrate community degraded with very low species richness, diversity and abundance. • Benthic invertebrate community dominated by tolerant organisms with no sensitive taxa present. • Marine sediments dominated by silt and clay grain sizes (>85%). • Surface sediment anoxic (lacking oxygen). • Elevated contaminant concentrations in surface sediment, above Guideline Value (GV) threshold concentrations (Australian and New Zealand Governments, 2018). • Invasive, opportunistic and disturbance tolerant species highly dominant. • Vegetation/macroalgae absent. • Habitat extremely modified.

ECOLOGICAL VALUE	CHARACTERISTICS
LOW	• Benthic invertebrate community degraded with low species richness, diversity and abundance. • Benthic invertebrate community dominated by tolerant organisms with few/no sensitive taxa present. • Marine sediments dominated by silt and clay grain sizes (>75%). • Surface sediment predominantly anoxic (lacking oxygen). • Elevated contaminant concentrations in surface sediment, above GV threshold concentrations (Australian and New Zealand Governments, 2018). • Invasive, opportunistic and disturbance tolerant species dominant. • Vegetation/macroalgae provides minimal/limited habitat for native fauna. • Habitat highly modified.
MEDIUM	• Benthic invertebrate community typically has moderate species richness, diversity and abundance. • Benthic invertebrate community has both tolerant and sensitive taxa present. • Marine sediments typically comprise less than 75% silt and clay grain sizes. • Shallow depth of oxygenated surface sediment. • Contaminant concentrations in surface sediment generally below GV threshold concentrations (Australian and New Zealand Governments, 2018). • Few invasive opportunistic and disturbance tolerant species present. • Vegetation/macroalgae provides moderate habitat for native fauna. • Habitat modification limited.
HIGH	• Benthic invertebrate community typically has high diversity, species richness and abundance. • Benthic invertebrate community contains many taxa that are sensitive. • Marine sediments typically comprise <50% smaller grain sizes. • Surface sediment oxygenated. • Contaminant concentrations in surface sediment rarely exceed DGV threshold concentrations (Australian and New Zealand Governments, 2018). • Invasive opportunistic and disturbance tolerant species largely absent. • Vegetation/macroalgae provides significant habitat for native fauna. • Habitat largely unmodified.
VERY HIGH	• Benthic invertebrate community typically has very high diversity, species richness and abundance. • Benthic invertebrate community contains dominated taxa that are sensitive. • Marine sediments typically comprise <25% smaller grain sizes. • Surface sediment oxygenated with no anoxic sediment present. • Contaminant concentrations in surface sediment significantly below DGV threshold concentrations (Australian and New Zealand Governments, 2018). • Invasive opportunistic and disturbance tolerant species absent. • Vegetation/macroalgae sequences intact and provides significant habitat for native fauna. • Habitat unmodified.

Table 4 Criteria for describing magnitude of effect (Roper-Lindsay et al., 2018)

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

Table 5 Criteria for describing the level of effect (Roper-Lindsay et al., 2018)

LEVEL OF EFFECT		ECOLOGICAL AND / OR CONSERVATION VALUE				
		Very High	**High**	**Moderate**	**Low**	**Negligible**
MAGNITUDE	**Very High**	Very High	Very High	High	Moderate	Low
	High	Very High	Very High	Moderate	Low	Very Low
	Moderate	High	High	Moderate	Low	Very Low
	Low	Moderate	Low	Low	Very Low	Very Low
	Negligible	Low	Very Low	Very Low	Very Low	Very Low
	Positive	Net gain	Net gain	Net gain	Net gain	Net gain

4.4 Effects Management Hierarchy

61. The order of priority for ecological impact management we have applied to this assessment is outlined in Table 6 and Figure 1. This process has followed the effects management hierarchy as described in Roper-Lindsay et al. (2018) and Maseyk et al. (2018).

Table 6 Effects management hierarchy and terminology (Maseyk et al., 2018)

EFFECTS MANAGEMENT HIERARCHY	DEFINITION
1) Avoidance	To modify a project proposal to prevent any environmental damage or loss of an ecological or environmental feature or function.
2) Remediation	To reverse or stop any environmental damage.
3) Mitigation	To alleviate, or to abate, or to moderate the severity of something (environmental damage), and typically occurs at the point of impact.
4) Biodiversity offset	A measurable conservation outcome resulting from actions designed to compensate for residual, adverse biodiversity effects arising from activities after appropriate avoidance, remediation, and mitigation measures have been applied. The goal of a biodiversity offset is to achieve no-net-loss, and preferably a net-gain, of indigenous biodiversity values. Biodiversity offsetting includes: • **Like-for-like offset -** The residual effect is offset to a no-net-loss or net-gain level by exchanging the same type of biodiversity in accordance with all of the offset principles. • **Trading-up offset -** An out-of-kind exchange of biodiversity that demonstrably exchanges biodiversity of a lesser conservation value for biodiversity of greater conservation value. Meets key offset principles except equivalence of type but is considered to overall deliver an equivalent or improved outcome, because the biodiversity gained is considered to be of greater conservation importance to the biodiversity lost. No standard metrics are currently available to evaluate the exchange so trading up involves an element of subjectivity and societal preference.
5) Environmental compensation	Non-quantified biodiversity benefits are offered to compensate for biodiversity losses. The compensation actions may benefit different biodiversity to that lost (out-of-kind compensation), including biodiversity of lesser conservation concern than that lost. Compensation is not quantified or balanced with losses and may involve subjective decision-making subject to socio-political influences.

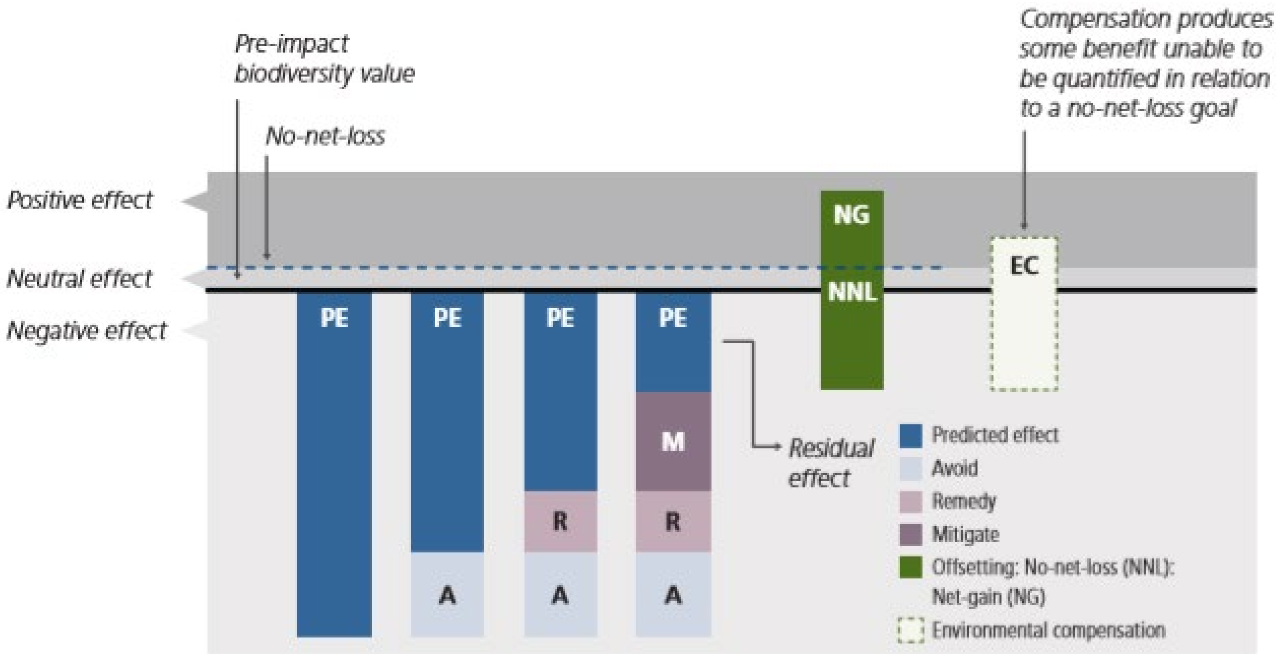

Figure 1: Conceptual illustration of effects management hierarchy progressing from avoidance to environmental compensation (Figure 2 from Maseyk et al. (2018))

5 EXISTING ENVIRONMENT AND ECOLOGICAL VALUES

5.1 Marine Ecology

5.1.1 Environmental context

62. The Project occurs approximately 3.5km upstream of the Hutt River mouth. The Hutt River mouth is a tidal estuary of approximately 47ha in size and is subtidally dominated[7] (Stevens, et. al., 2016). The Hutt River Mouth receives freshwater from the 655km^2 Hutt River catchment, containing five major tributaries. The flood travel time is approximately 7 hours from the onset of heavy rain in the ranges, to the Wellington Harbour. Saline water within the estuary extends up to 3km inland from the river mouth, to approximately 230 m downstream of Ewen Bridge outside of the Riverlink Project footprint. The actual position of the saline interface will vary with the tides and flood conditions in the River.

63. The Hutt River mouth has been transformed from a coastal estuary to a well-defined river channel due to straightening, reclamation and bed excavating for flood management purposes (Ward, 2010). A large area of reclamation on the true left bank of

[7] Most of the estuary remains covered by water at low tide.

the river mouth now forms the Seaview industrial area. Hydraulic channel shaping has occurred on the true right bank. Sand dredging occurs between the banks of the river, downstream of the Waione Street Bridge, excluding the western mudbank embayment and the area adjacent to the Hikoikoi Pa (Ward, 2010). A dredge disposal site is situated approximately 700m-900m southwest of the Hutt River mouth, in a 6ha zone, at approximately 10-14m depth. This area is consented for the disposal of the coarse dredging material, and fine material is stockpiled on the high tide of Pito-one Petone foreshore.

64. The Hutt Estuary receives silt, sand and gravel from the Hutt River. These materials are eroded from the floodplain or the slopes of the upper catchment (Ward, 2010). The substratum of the estuary is made up of intertidal flats of cobble and firm sandy mud, with fine sediment travelling to deeper subtidal sinks within the wider Wellington Harbour, where they eventually fall out of the water column and deposit (Stevens, et. al., 2016). Sediment within the Harbour tends to become finer with distance offshore (McConchie, 2010).

65. Pito-one (Petone) foreshore extends in an arc to the northwest of the Hutt River Mouth. Its main sediment source is the Hutt River (Greater Wellington Regional Council, 2010; Ward, 2010). The intertidal beach is high energy with waves in southerly conditions eroding fine material such as sands from the beach offshore to deeper subtidal sites (Greater Wellington Regional Council, 2010; Ward, 2010). By-product from sediment extraction (sands, gravel, shell) is artificially stockpiled on the hightide of Pito-one (Petone) foreshore and feeds back in to the system by coastal processes, contributing to accretion at the eastern end of Pito-one (Petone) beach (Ward, 2010).

66. Sediment supplied via the Hutt River is received in pulses associated with flood events (Ward, 2010). It is transported by southerly groundswell and wind and wave action, which moves sand into the harbour to shallow depths and finer material (silt and clay) alongshore and further offshore, leaving the heavier gravels behind on Pito-One (Petone) beach (Ward, 2010).

5.1.2 Planning and policy context

67. The following national statutory and non-statutory documents apply to this Project:

    i. Resource Management Act 1991 (“RMA”)

    ii. New Zealand Coastal Policy Statement, 2010 (NZCPS)

68. The following regional and district level statutory and non-statutory documents apply to this Project:

    i. Proposed Natural Resources Plan (PNRP)

    ii. Regional Coastal Plan, and

    iii. Hutt River Flood Management Plan.

69. The following marine habitats are present within or adjacent to the Project and identified in the respective schedules of the PNRP (Greater Wellington Regional Council, 2019):

i. Hutt River mouth/estuary (Schedule F4: Sites of significant indigenous biodiversity values in the coastal marine area);

ii. Korokoro Estuary (Schedule F4: Sites of significant indigenous biodiversity values in the coastal marine area);

iii. Seal haulouts (Schedule F5: Habitats with significant indigenous biodiversity values in the coastal marine areas);

iv. Macroalgae (Schedule F5: Habitats with significant indigenous biodiversity values in the coastal marine areas); and

v. Subtidal rocky reefs (Schedule F5: Habitats with significant indigenous biodiversity values in the coastal marine areas).

5.1.3 Zone of Influence (ZOI)

70. Construction activities that involve disturbance of the riverbed material and adjacent earthworks will cause mobilisation of sediments into the flowing water column. Suspended sediments will be deposited downstream within the River itself or at the River mouth. Based on what we know of the sediment transport of the Hutt River, fine particles remain in suspension for longer and travel further into the marine environment during flood events, before depositing on the seabed in subtidal areas where existing fine sediment deposition occurs (CWQTA, 2021; Ward, 2010).

71. We have taken a conservative approach and assumed that sediment from the proposed in river and earthworks will deposit in the same locations that sediment from the entire Hutt River catchment currently deposits. The marine habitats potentially affected by the Riverlink Project therefore could include the soft sediment habitats of the lower Hutt River Estuary, Korokoro Estuary, the Ngā Ūranga to Pito-one (Ngauranga to Petone) foreshore and the subtidal soft sediment habitats within the wider Wellington Harbour.

5.1.4 Hutt River Mouth

72. The RMA definition of the Coastal Marine Area (CMA) is the line of MHWS except where that line crosses a river, in which case the landward boundary is the lessor of 1km upstream or 5 times the river width, making the CMA boundary at the Mouth of the Hutt River Seaview Bridge at Waione Street. For the purpose of this assessment, marine habitats within the Hutt River mouth have been assessed between the Seaview Bridge and the mouth of the River, 1km downstream of the Seaview bridge.

73. The Hutt River mouth can be broken in to three ecological areas: The western embayment mudflat, the intertidal protection wall along the true left bank and the area of current sediment extraction between the true left bank and the eastern hydraulic line (Greater Wellington Regional Council, 2010).

74. The western embayment mudflat is the only significant area of tidal mudflat and shallow brackish water in Wellington Harbour and, whilst it is not listed under the PNRP, it is considered an important ecological area in the Wellington Region (Greater Wellington Regional Council, 2010). The embayment is important for juvenile flatfish (Greater Wellington Regional Council, 2010). It receives high turbidity and fine sediment deposition from the Hutt River during and following flood events (Greater Wellington

Regional Council, 2010). Samples taken at the south western side of Seaview Bridge had mud content of 26% (likely due to the scouring of fine sediment here during flood events), low levels of surface sediment oxygenation (<25mm redox) and levels of heavy metal contaminants below ANZG DGV threshold values (Robertson and Stevens, 2017). The benthic macroinvertebrate community is comprised of mostly crustaceans (amphipods), polychaete worms, nematode worms, bivalves (pipi and cockle), gastropods and oligochaetes (most of which are tolerant to mud and organic enrichment) (Gibbs & Hewitt, 2004). The community composition has moderate richness and diversity and high abundance (Robertson and Stevens, 2017). Opportunistic macroalgal growth is present along the subtidal margins of the main river channel during high nutrient loads and warmer temperatures (Robertson. and Stevens, 2017).

75. The intertidal protection wall along the true left bank of the river mouth consists of masonry blocks, concrete slabs, demolition materials and natural rock. The species assemblage on intertidal protection wall is similar to natural rocky reef assemblages observed elsewhere in Wellington Harbour, with additional green algal (*Ulva intestinalis*) blooms in the summer months, likely due to high nutrient loadings and warmer temperatures at this site (Greater Wellington Regional Council, 2010).

76. Sediments of the extraction zone (between the true left bank and the eastern hydraulic line) are generally anoxic and depauperate of benthic biota (Greater Wellington Regional Council, 2010), likely due to very few marine organisms being tolerant to withstand the repeated disturbance due to rapid changes in salinity in this area associated with flash flooding and low river conditions (Greater Wellington Regional Council, 2010). There is an absence of burrowing animals within the extraction zone, which means that benthic sediments do not receive oxygenation through bioturbation and therefore have become anoxic (Greater Wellington Regional Council, 2010). Heavy metals and other contaminants associated with historical pollution input means that the benthic sediments are considered toxic (Greater Wellington Regional Council, 2010).

77. A variety of marine fish have been recorded at the Hutt River mouth, including spotties (Notolabrus celidotus), trigger fish (Balistes spp.), tarakihi (Nemadactylus sp), red cod (Pseudophycis bachus), red gurnard (Chelidonichthys kumu), sand and New Zealand flounder (Rhombosolea plebeian), monkfish (Kathetostoma giganteum), snapper (Chrysophrys auratus) and New Zealand sole (Peltorhamphus novaezeelandiae), all of which are commonly observed throughout Wellington Harbour (Greater Wellington Regional Council, 2010). Yellow-eyed mullet, sand flounder and kahawai are known to use the Hutt River Mouth to feed and breed (Greater Wellington Regional Council, 2010). The channel corridor is also important fish passage for brown trout, as well as a variety of indigenous freshwater fish, to migrate from the harbour to spawning habitat in the upper catchment (Greater Wellington Regional Council, 2010).

78. Overall, the Hutt River Mouth consists of moderate to low species richness, diversity and abundance, high numbers opportunistic and tolerant taxa, whilst sensitive species also exist (pipi), no *Threatened or At-Risk* species, marine sediments are moderately muddy, with shallow oxygenation and influenced by extraction and scouring of the river during flood events (Robertson and Stevens, 2017). On balance the ecological value of the Hutt River Mouth is **low**.

5.1.5 Korokoro Estuary

79. Korokoro Estuary is identified in the PNRP (Greater Wellington Regional Council, 2019) as a site of significant indigenous biodiversity values in the coastal marine area, in particular habitat for six threatened indigenous fish species: longfin eel, giant kokopu, kōaro, inanga, redfin bully and bluegill bully (Schedule F4). These values extent upstream of the zone of potential influence for this Project.

80. Todd et al. (2016) note that the estuarine system of this stream has been significantly modified, and is largely constrained by concrete culverts and channels as it passes under the Hutt motorway/rail corridor before discharging into Wellington Harbour. At the lowest reaches passing through the Honiana Te Puni Reserve, there is a section of partially restored saltmarsh.

81. The intertidal beach substrate comprises sand and gravel banks. Amphipods are the dominant taxa in the intertidal habitat of the Korokoro Estuary; polychaetes, as well as bivalves, isopods and gastropods which are present in low proportions. Abundance, diversity and richness of infauna was low and very few epifauna are present along the soft sediment foreshore (Boffa Miskell Ltd, 2020a). Concentrations of lead, copper, zinc and PAHs within the intertidal are below ANZG (2018) default guideline value (DGV) (Boffa Miskell Ltd, 2020a).

82. To the immediate east and outside of Honiana Te Puni Reserve, is another gravel / sand beach which spans the length of Pito-one (Petone) foreshore.

83. Korokoro Estuary is characterised by relatively (and naturally) low benthic invertebrate species richness and diversity, benthic invertebrate community composition dominated by tolerant taxa, sediments dominated by sand and gravels, low sediment contaminant concentrations, no macroalgae habitat, high degree of modification in parts, and oxygenated sediments (Boffa Miskell Ltd, 2020a). On balance, the ecological value of the Korokoro Estuary and intertidal Pito-One (Petone) foreshore is assessed as **low**.

5.1.6 Ngā Ūranga to Pito-one (Ngauranga to Petone) Foreshore

84. The intertidal habitats along the Ngā Ūranga to Pito-one (Ngauranga to Petone) foreshore comprise a mixture of rocky shore (both natural and constructed) with cobbles and soft sediment gravel/sand and shingle) beaches (Boffa Miskell Ltd, 2020b).

85. Intertidal rocky shore sites include barnacles (*Chaemosipho columna*), little black mussel (*Limnoperla pulex*), limpets (*Cellana ornata* and *Patelloida corticata*), whelk, sea lettuce (*Ulva lactuca*), *Carpophullum* maschalocarpum, and green turfing algae (Boffa Miskell Ltd, 2015).The greatest diversity of organisms is where the substrate is concrete/rock boulders and cobbles and bedrock respectively. The lowest range of organisms is where the greater proportions of gravel exist (Boffa Miskell Ltd, 2020b). Overall, there is a low diversity and abundance of organisms present at intertidal rocky shore sites. Organisms detected are common intertidal species, with a wide distribution throughout New Zealand with no *Threatened* or *At Risk* taxa observed (Freeman et al., 2014).

86. Intertidal soft sediment habitats along the Pito-one (Petone) foreshore are dominated by medium/coarse sand and gravel to varying degrees (Boffa Miskell Ltd, 2020b). Cobbles and boulders were also present (Boffa Miskell Ltd, 2020b). Silt and clay sized sediment

are not present (Boffa Miskell Ltd, 2020b), indicating that this is not a fine sediment depositional environment.

87. The community composition of the intertidal benthic soft sediment community is dominated by amphipods and polychaete worms, with gastropods, isopods and oligochaete worms present in lower abundance (Boffa Miskell Ltd, 2020b).

88. The subtidal marine habitat, similar to the intertidal habitat, is a mosaic of rocky reef, cobbles, gravel and sand (Boffa Miskell Ltd, 2020b). From north to south, the shore profile becomes steeper with a more compressed band of reef at the southern end, less fine sediment and greater water clarity (Boffa Miskell Ltd, 2020b). In general, the shallows have large, square-sided boulders used in the historic reclamation, which transition into a band of gravel/rounded boulders (often on bedrock) with short tufting algae (primarily *Ulva* spp.) (Boffa Miskell Ltd, 2020b). With greater depth, larger rounded boulders with encrusting species and a *Carpophyllum spp* canopy (often at 100% cover, with epiphytic growth and laden with fine silt) are common (Boffa Miskell Ltd, 2020b). Seaward, along the transects, in deeper water and a variable distance from the shore, the *Carpophyllum* forest gives way to a flatter profile of fine sediment and smaller cobbles that support low numbers of sea urchins and sea cucumbers (Boffa Miskell Ltd, 2020b). Between the shallow boulder habitats are gravel/cobble habitats. Gastropods (snails and whelks; primarily cat's eye, *Turbo smaragdus*) and echinoderms (sea stars and urchins; primarily cushion star, *Patirella regularis*) are present in abundance, whereas a small number of decapods (crabs; primarily *Petrolithes elongatus*) are also present (Boffa Miskell Ltd, 2020b). Abundance, richness and Shannon Weiner Diversity of mobile invertebrates is low in the subtidal and tended to remain low or decrease with distance from shore (Boffa Miskell Ltd, 2020b). All marine organisms detected are common throughout semi-exposed shores in New Zealand with no Threatened or At Risk marine invertebrate taxa (Cook, 2010; Freeman et al., 2014).

89. Incidental observations of fish and ray included the commonly observed species triplefin (*Forsterygion lapillum*), variable triplefin (*Forsterygion varium*), banded wrasse (*Notolabrus facicola*), blue cod (*Parapercis colias*), green wrasse (*Notolabrus inscriptus*) and eagle ray (*Myliobatis tenuicaudatus*) (Boffa Miskell Ltd, 2020b).

90. The macroalgae species present are markedly different between 10 m and the other distances from the shore, with the community at 10 m comprising more *Ulva lactuca*, *Bryopsis vestida* and *Carpophylum flexuosum*, and the communities at 20-50 m comprising mainly *Carpophyllum maschalocarpum* and pink corallina paint. *C. maschalocarpum* was the tallest macroalgae present, achieving heights of up to 1.5m at some locations.

91. Subtidal soft sediment sites along the Ngā Ūranga to Pito-one (Ngauranga to Petone) foreshore were dominated by gravel, whilst some had high proportions of sand. Fine sediment, such as silt and clay were present in very low proportions at all sites surveyed indicating that this is unlikely to be a fine sediment depositional environment (Boffa Miskell Ltd, 2020b).

92. The community composition of subtidal soft sediment was dominated by polychaete worms, a small number of other taxa groups including amphipods, gastropods (snails and whelks), bivalves (shellfish), decapods (crabs), ostracods and horseshoe worms

(Boffa Miskell Ltd, 2015). All taxa detected in the survey are common and generally found throughout New Zealand (Cook, 2010)[8] and no Threatened or At Risk or taxa were detected (Freeman et al., 2014). Abundance, species richness and Shannon Wiener Diversity was moderate to high.

93. All subtidal sites recorded concentrations of heavy metals, hydrocarbons and PAHs were significantly below Australian and New Zealand Government's Default Guideline Value (DGV) except for nickel (up to 30 mg/kg) (AECOM, 2019).

94. Sources of nickel in marine sediment could be both anthropogenic and/or natural. Anthropogenic sources potentially include fill material associated with the rail corridor (and associated sediment runoff), discharges of stormwater in the area of the Wellington/Port Nicholson Harbour, potentially hazardous activities and industries in the catchment that may discharge to the wider harbour.

95. Nickel occurring naturally in greywacke basement rock within the catchment may also contribute to the concentration of nickel in marine sediment (Natalie Rowe (AECOM) pers. comm. with Dr Sharon De Luca 6/3/20).

96. Overall, the intertidal and subtidal marine habitat along the Ngā Ūranga to Pito-one (Ngauranga to Petone) foreshore is characterised by coarse sediments (sand, cobbles, and boulders – both natural and man-made) and rocky reefs, generally sparse (yet variable) fauna in intertidal habitats but more diverse flora and fauna in subtidal habitats. There is variability within and between habitat types, but because the habitats are primarily mosaics, we have assessed marine values as an overall single feature, taking the highest value from intertidal soft sediment, intertidal rocky reef, subtidal soft sediment and subtidal rocky reef habitats.

97. The intertidal and subtidal benthic invertebrate community along the Ngā Ūranga to Pito-one (Ngauranga to Petone) foreshore typically has high diversity, species richness and abundance (soft sediment subtidal in particular), containing many taxa that are sensitive e.g. bivalves, gastropods, ostracods. Marine sediments typically comprise <50% smaller grain sizes (i.e. fine sand, very fine sand, silt and clay). Surface sediment is oxygenated and contaminant concentrations in surface sediment rarely exceed DGV threshold (Australian and New Zealand Governments, 2018). Vegetation/macroalgae provides significant habitat for native fauna (primarily the significant macroalgae present in subtidal habitats). Based on these observed characteristics, on balance the value of the intertidal and subtidal habitats along the Ngā Ūranga to Pito-one (Ngauranga to Petone) foreshore is assessed as **high**.

5.1.7 Wellington Harbour

98. The subtidal benthic habitat of most sites within Wellington Harbour is characterised as sandy mud with between 60-80% mud (<63μm) content (National Institute of Water and Atmospheric Research, 2019; Oliver, 2014). Sediment contaminants exceeded ARC ERC (Auckland Regional Council, 2004) and ANZECC DGV thresholds at almost all sites for mercury and DDT, and at sites within the western part of the harbour for copper,

[8] Where distribution data exists.

lead and PAHs (commonly found in stormwater) (National Institute of Water and Atmospheric Research, 2019).

99. The benthic community composition is comprised of polychaete worms, crustaceans, sipunculids and bivalves. Other dominant species include the heart urchin *Echinocardium codatum,* the bivalve *Dosina zelandica* and brittle star *Amphiura rosea* (Oliver, 2014). Sites generally had moderate species, richness, Shannon Wiener diversity and high abundance (National Institute of Water and Atmospheric Research, 2019; Oliver, 2014).

100. Deposit feeders (particularly sub surface) account for the majority of the benthic community (35-62%), with predators and scavengers accounting for 20-40% and suspension feeders representing the smallest proportion of between 9 and 24% (Oliver, 2014).

101. Changes in the physical and chemical sediment characteristics of Wellington Harbour over time have led to an opportunistic and pollution tolerant benthic invertebrate community, with opportunistic species such as some species of polychaetes and the invasive Asian bivalve becoming more dominant due to their preference for fine sediment habitats with high levels of contaminants (Oliver, 2014).

102. Overall, based on available data, the subtidal soft sediment sites in Wellington Harbour have a moderate diversity, richness and abundance of benthic invertebrates, dominated by tolerant and opportunistic taxa (Oliver, 2014). Marine sediments typically comprise >50% smaller grain sizes (i.e. fine sand, very fine sand, silt and clay). Contaminant concentrations in surface sediment exceed ARC ERC (Auckland Regional Council, 2004) and DGV threshold concentrations (Australian and New Zealand Governments, 2018) at a number of sites. Due to the existing fine sediment deposition from the Hutt River and stormwater inputs, the habitat is regarded as reasonably modified. On balance, the value of the subtidal soft sediment environment within Wellington Harbour is assessed as **moderate**.

5.1.8 Ngā Ūranga ki Pito-one (Ngauranga to Petone) Shared Path and Associated Offset Measures

103. The Ngā Ūranga to Pito-one (Ngauranga to Petone) section of Te Ara Tupua involves the construction of a 4.5 km-long, 5 m-wide, path from the Ngā Ūranga interchange (Ngauranga) to just south of the Pito-One (Petone) Railway Station (Petone). The Shared Path is located along the coastal edge of Wellington Harbour adjacent to the Hutt River and will be constructed on existing and new land and structures on the seaward side of the Hutt Valley Railway Line. A number of high marine ecological values and significant sites were identified along and adjacent to the Shared Path footprint (these values are discussed in more detail above). Efforts were made to minimise the area of marine habitat lost to the Shared Path and to avoid higher value areas of marine habitat (e.g. rocky reefs and shingle beaches). Nevertheless, there will be residual adverse effects associated with the Project following the implementation of the effects management hierarchy; these relate to permanent habitat loss. In order to address these residual effects, the installation of living seawalls at strategic locations around Wellington Harbour as well as intertidal rockpools within the revetment design will partially offset the

residual effects. Compensation measures will address the remaining residual effects of the Shared Path. These include deployment of 6ha of green-lipped mussels at a site, yet to be determined within Wellington Harbour. These measures reflected in the final conditions of consents.

Living Seawalls

104. Living Seawall tiles will be retrofitted to existing seawalls, enhancing the ecological value by providing habitat complexity and increasing the biodiversity associated with the structure. A number of potential sites were investigated, but many were deemed unsuitable based on ecological, engineering or heritage reasons. However, Frank Kitt's Park lagoon and Greta Point seawalls were identified as being acceptable from an ecological, engineering and heritage perspective, and as such were proposed as part of the offset package for the Ngā Ūranga to Pito-one (Ngauranga to Petone) Project.

105. Sediment does not tend to settle on to vertical structures such as seawalls, due to their orientation as well as exposure to currents and wave action within the intertidal environment. It is therefore unlikely that sediment related to the Hutt River and the Riverlink Project will impact on the Living Seawalls.

Rockpools

106. Rockpools will be placed within the intertidal area of the newly build rock revetment. These will be placed within areas that are reasonably exposed to wave action and are not considered fine sediment depositional environments. It is therefore unlikely that sediment from the Hutt river or the Riverlink project will impact on the rockpools within the newly built rock revetment.

Mussel beds

107. Preliminary investigations are currently underway to inform the site selection for the deployment of the proposed mussel beds within Wellington Harbour. This site is unlikely to be located within areas directly exposure to the existing high sediment load of the Hutt River during flood events and is therefore unlikely to be impacted by the RiverLink Project.

5.2 Summary of Marine Ecological Values

108. The ecological values are described in detail above. The below table (Table 7) summarises the values of the existing environment within the expected zone of influence from the proposed works.

Table 7 Summary of existing ecological values within the Project zone of influence

Ecological component		Values	Scheduled Significant (PNRP)	Overall Value
Marine Ecology	Hutt River Mouth and Estuary	Low		**Moderate**
	Korokoro Estuary	Low	Yes	
	Ngā Ūranga to Pito-one (Ngauranga to Petone) foreshore	High	-	
	Wellington Harbour	Moderate	-	

109. On balance the ecological value of the receiving environment, most likely to be influenced by the Project has an overall value of **moderate**.

5.3 Coastal Avifauna

110. At a broad scale, Wellington Harbour / Te Whanganui a Tara – inland waters (the downstream receiving environment of sediment discharges from the Riverlink Project site) is identified in Schedule F2c of the PNRP (Greater Wellington Regional Council, 2019) as significant habitat for indigenous birds in the coastal marine area. The values associated with the inland waters include the following factors:

    i. Five Threatened or At Risk species are known to be resident or regular visitors to Wellington Harbour (Port Nicholson): little penguin, fluttering shearwater, red-billed gull, Caspian tern and white-fronted tern.

    ii. The Harbour provides year-round foraging habitat for the majority of the regional population of spotted shags.

    iii. Large numbers (up to several thousand) of fluttering shearwaters enter the harbour during winter months to rest and feed.

    iv. The Harbour provides foraging habitat and access for little penguins to several large, secure nesting colonies on Matiu/Somes, Mokopuna and Makaro/Ward Islands.

111. At a finer scale, Schedule F2c identifies various components of the Wellington Harbour foreshore as providing significant habitat for indigenous birds in the coastal marine area (Table 8); those beyond the Harbour entrance have been excluded from the table due to the distance between these sites and the Project site e.g. Palmer Head to Lyall Bay and are considered to be outside of the potential zone of influence. In summary, across these sites, one Threatened and ten At Risk bird species are known to be resident or regular visitors.

Table 8 Significant habitats for indigenous birds in the coastal marine area in Wellington Harbour as identified in Schedule F2c of the Proposed Natural Resources Plan (Greater Wellington Regional Council, 2019).

Habitat Extent	Description
Pencarrow sewer outfall to Burdan's Gate	• Seven threatened or at risk indigenous bird species are known to be resident or regular visitors to this habitat: ○ banded dotterel, variable oystercatcher, red-billed gull, pied shag, black shag, little black shag and NZ pipit. • This habitat is one of less than half a dozen along the south Wellington coastline that supports a coastal breeding population of banded dotterels.
Northern end of Day's Bay to Point Howard	• Five threatened or at risk indigenous bird species are known to be resident or regular visitors to this habitat: ○ variable oystercatcher, red-billed gull, black shag, little black shag and pied shag.

Habitat Extent	Description
Point Howard to eastern shore of Te Awa Kairanga/Hutt River mouth	• Four threatened or at risk indigenous bird species are known to be resident or regular visitors to this habitat: ○ red-billed gull, variable oystercatcher, black shag and pied shag.
Western shore of Te Awa Kairanga/Hutt River mouth to Petone / Pito-one (Petone) Beach rowing club	• Five threatened or at risk indigenous bird species are known to be resident or regular visitors to this habitat: ○ red-billed gull, variable oystercatcher, NZ pied oystercatcher, black shag and white-fronted tern.
Petone / Pito-one (Petone) Beach rowing club to Ngā Ūranga railway station	• Six threatened or at risk indigenous bird species are known to be resident or regular visitors to this habitat: ○ variable oystercatcher, red-billed gull, black shag, little black shag, pied shag and white-fronted tern.
Ngā Ūranga (Ngauranga) railway station to Interislander ferry terminal	• Five threatened or at risk indigenous bird species are known to be resident or regular visitors to this habitat: ○ fluttering shearwater, variable oystercatcher, red-billed gull, black shag and pied shag.
Point Jerningham to Point Halswell	• Six threatened or at risk indigenous bird species are known to be resident or regular visitors to this habitat: ○ fluttering shearwater, variable oystercatcher, red-billed gull, little black shag, pied shag and white-fronted tern.
Point Halswell to Worser Bay boat club	• Five threatened or at risk indigenous bird species are known to be resident or regular visitors to this habitat: ○ little penguin, variable oystercatcher, red-billed gull, little black shag and white-fronted tern.
Worser Bay boat club to Point Dorset	• Four threatened or at risk indigenous bird species are known to be resident or regular visitors to this habitat: ○ variable oystercatcher, red-billed gull, pied shag and white-fronted tern.

112. Coastal avifauna habitats within the CMA downstream of the Project site (that may be affected by potential sediment discharge effects) are diverse and include the following:

i. Riverine habitat within the CMA extending from Seaview Bridge to the Hutt River mouth provides foraging opportunities for coastal avifauna.

ii. Hutt River mouth estuarine habitat. The western embayment mudflat, which is directly south of Waione Street bridge, is the only significant area of tidal mudflat and shallow brackish water in Wellington Harbour and, whilst it is not listed under the PNRP, it is considered an important ecological area in the Wellington Region (Greater Wellington Regional Council, 2010) that provides foraging habitat and a refuge area for coastal birds e.g. gulls, royal spoonbills.

iii. Korokoro estuary provides foraging habitat for a number of species such as gulls, variable oystercatcher and terns (Boffa Miskell Ltd, 2020b).

iv. Intertidal habitats (gravel / shingle beaches and rocky pools) around Wellington Harbour which are used as foraging habitat for a number of species such as gulls, white-faced heron, shags and variable oystercatcher. This includes foreshore habitat of Matiu/Somes, Mokopuna and Ward/Makaro Islands (these islands provide important habitat for little blue penguins and other coastal avifauna).

v. Near shore waters within Wellington Harbour provide foraging habitat for inshore feeders such as shags, terns and gulls.

vi. Offshore waters within Wellington Harbour provide foraging habitat for offshore feeders such as gannets and shearwaters.

vii. Avifauna nesting and roosting habitats within Wellington Harbour are above mean high water springs (e.g. Matiu/Somes Island, areas of rip-rap rock revetment and/or artificial structures).

113. The desktop review provided a base list of 85 bird species (Appendix 2) that use, or may use, habitat at the Project site and immediate surrounds (C. J. R. Robertson et al., 2007; Ryder Environmental Limited, 2019).

114. This list was narrowed down to 14 key species, when excluding introduced species, native Not Threatened species, native species whose primary habitats are not within the Project area, native species that use habitats that are unlikely to be affected by Project-related sediment and / or native species that are likely to be rare visitors to the site (e.g. white heron).

115. The key species include three Threatened species (reef heron, black-billed gull and Caspian tern) and 11 At Risk native species (fluttering shearwater, little blue penguin, black shag, pied shag, little black shag, royal spoonbill, South Island pied oystercatcher, variable oystercatcher, Australasian pied stilt, red-billed gull, white-fronted tern) (Table 9).

Table 9 Key native avifauna species present, or potentially present, within the Project site and downstream Wellington Harbour environment.

The four columns to the right are habitat categories. Dark green represents primary habitat for species, light green represents secondary habitat for species.

Common name	Species name	Conservation Status - Robertson et al. 2017			Farmland / open country	Freshwater / wetlands	Coastal / Estuary	Oceanic
Australasian Pied Stilt / Poaka	*Himantopus h. leucocephalus*	Native	At Risk	Recovering				
Black Shag / Kawau pū	*Phalacrocorax carbo novaehollandiae*	Native	At Risk	Naturally Uncommon				
Black-billed Gull / Karoro	*Larus bulleri*	Endemic	Threatened	Nationally Critical				
Little Blue Penguin / Kororā	*Eudyptula minor*	Native	At Risk	Declining				

Common name	Species name	Conservation Status - Robertson et al. 2017			Farmland / open country	Freshwater / wetlands	Coastal / Estuary	Oceanic
Caspian Tern / Taranui	*Hydroprogne caspia*	Native	Threatened	Nationally Vulnerable				
Fluttering Shearwater / Pakaha	*Puffinus gavia*	Endemic	At Risk	Relict				
Little Black Shag / Kawau tūī	*Phalacrocorax sulcirostris*	Native	At Risk	Naturally Uncommon				
Pied Shag / Kāruhiruhi	*Phalacrocorax varius varius*	Endemic	At Risk	Recovering				
Red-billed Gull / Tarapunga	*Larus novaehollandiae scopulinus*	Native	At Risk	Declining				
Reef Heron / Matuku-moana	*Egretta sacra sacra*	Native	Threatened	Nationally Endangered				
Royal Spoonbill / Kōtuku ngutupapa	*Platalea regia*	Native	At Risk	Naturally Uncommon				
South Island Pied Oystercatcher / Tōrea	*Haematopus finschi*	Endemic	At Risk	Declining				
Variable Oystercatcher / Torea	*Haematopus unicolor*	Endemic	At Risk	Recovering				
White-fronted Tern / Tara	*Sterna s. striata*	Native	At Risk	Declining				

116. Table 10 provides a summary of habitat use, foraging method, preferred prey, estimated national population and estimated regional population of these key species. In summary, preferred prey items variously include fish, crustaceans, shellfish, squid and invertebrates, and foraging methods include plunge diving, pursuit diving, coastal inshore foraging, wading, surface seizing and dipping.

Table 10 Habitat use, foraging method, preferred prey and national population and regional population estimates of key coastal avifauna species that use habitat within the coastal marine area of Wellington Harbour (including the coastal zone of influence within Hutt River).

Species	Habitat Use	Preferred Prey	Foraging Method	Estimated National Population	Estimated Regional Population
Australasian pied stilt	• Forages along the Hutt River.	• Insects and larvae	• Wader • Visual and probe forager in intertidal mudflats	~30,000[9]	
Black shag	• Forages in the Wellington Harbour, inshore and offshore. • Listed in the PNRP as known to be resident or regular visitors to this area. • Clumped distribution in the Days Bay to Point Howard area, Pito-one (Petone) to Ngā Ūranga (Ngauranga) areas, inner Harbour, Evans Bay. • Roosts on rip-rap rock revetment and on structures around Wellington Harbour. • Forages and roosts along Hutt River. • Small colony nests in exotic trees on the banks of Hutt River near Melling.	• Small and medium sized fish of a variety of species (both pelagic and benthic), also large invertebrates and molluscs	• Coastal inshore forager • Forage mainly in water <3m deep, dives average 21 seconds with 7 seconds between dives	5,000 – 10,000 breeding pairs (Taylor, 2000b)	250 breeding birds (McArthur et al., 2019)
Black-billed gull	• Forage and roost in low numbers around Wellington Harbour and along the Hutt River.	• Invertebrates, small fish	• Inshore pelagic forager • Surface seizing and dipping	~60,256 nests (Mischler, 2018)	
Caspian tern	• Listed in the PNRP as known to be resident or regular visitor to the Wellington Harbour.	• Small surface-swimming fish (e.g. yellow-eyed	• Inshore pelagic forager	1300-1400 breeding pairs[10]	45 birds

[9] Adams, R. 2013 [updated 2017]. Pied stilt. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz
[10] Fitzgerald, N. 2013. Caspian tern. In Miskelly, C.M. (ed.) *New Zealand Birds Online* www.nzbirdsonline.org.nz

Species	Habitat Use	Preferred Prey	Foraging Method	Estimated National Population	Estimated Regional Population
	• Forages throughout Wellington Harbour, although least common in the southwestern area.	mullet, piper, smelt, crustacean, squid).	• Plunge dive and dipping		(McArthur et al., 2019)

Species	Habitat Use	Preferred Prey	Foraging Method	Estimated National Population	Estimated Regional Population
Fluttering shearwater	• Forages in the inner harbour, mostly in sheltered waters rather than an at the harbour entrance. • Listed in the PNRP as known to be resident or regular visitor to the Wellington Harbour; mostly April to October (H. A. Robertson, 1992).	• Schooling fish e.g. kahawai, trevally • Small fish e.g. pilchards, sprats • Crustacea e.g. small euphausiids (krill)	• Pursuit dive for fish • Surface foraging for pelagic crustaceans	>100,000 birds (Taylor, 2000b)	~50 breeding birds (McArthur et al., 2019)
Little black shag	• Mainly visit Wellington Harbour from May to August, but a few present in all months (H. A. Robertson, 1992). • Forages inshore. • Roosts on rip-rap rock revetment and structures around Wellington Harbour. • Forages and roosts along the Hutt River. • Mainly found from Days Bay to the Hutt River, between Horokiwi and Ngā Ūranga and between Point Halswell and Point Dorset.	• Mainly small fish	• Coastal inshore forager • Pursuit diver	2,000 – 4,000 birds (Taylor, 2000b)	
Little blue penguin	• Forages in Wellington Harbour, commonly in waters in the eastern half of the Harbour (Poupart et al., 2017; Zhang et al., 2015). • Nests and moults on Matiu/Somes Island (the largest colony in Wellington Harbour with an estimated 300 pairs/700+ adults) (de Lisle 2014, Rumble 2018b, Taylor 2018 *in* Overmars (2019) and also within riprap rock revetment around Wellington Harbour.	• Small shoaling fish • Squid • Crustaceans	• Forage within 20km of the colony (near shore forager) • Forage primarily on the eastern side of Wellington Harbour • Pursuit dive for prey in waters <50m deep • Forage primarily within 15m of the surface	5,000 – 10,000 breeding pairs of Northern little blue penguin (Taylor, 2000b)	420 breeding pairs (McArthur et al., 2019)

Species	Habitat Use	Preferred Prey	Foraging Method	Estimated National Population	Estimated Regional Population
Pied shag	• Roost on coastal edge, rock outcrops and headlands around Wellington Harbour. • Forages in Wellington Harbour, inshore and offshore as well as along the Hutt River. • Most breed on Somes Island. • Found throughout Harbour with higher concentrations around the Hutt River mouth through to Ngā Ūranga, also along Evans Bay. • Listed in the PNRP as known to be resident or regular visitors to Wellington Harbour.	• Mainly fish, occasionally crustaceans.	• Coastal inshore forager • Generally forage in water <10m deep • Pursuit diver	~3,200 breeding pairs (WMIL, 2013)	474 birds (McArthur et al., 2019)
Red-billed gull	• Most common bird in Wellington Harbour from March to August, but few present rest of the year. • Unevenly distributed within the Harbour, higher numbers on Pito-one (Petone) Beach. • Roosts on coastal edges and forages on shingle beaches around Wellington Harbour. • Forages inshore and onshore. • Listed in the PNRP as known to be resident or regular visitors to this area.	• Invertebrates, small fish	• Inshore pelagic forager • Surface seizing and dipping	~28,000 breeding pairs (Frost & Taylor, 2018)	2,478 breeding birds (McArthur et al., 2019)

Species	Habitat Use	Preferred Prey	Foraging Method	Estimated National Population	Estimated Regional Population
Reef heron	• Forages in intertidal rocky shore habitats around Wellington Harbour. • Current breeding population in Wellington harbour is less than half the 1975 estimate of six breeding pairs (i.e. currently less than three breeding pairs) (McArthur et al., 2019). In Wellington Harbour, breeding attempts have occurred on Matiu/Somes and Makaro/Ward Islands in recent years.	• Fish and crabs	• Wader • Visual forager in shallow waters along rocky coastal margins • Also probes in intertidal mudflats	300-500 birds[11]	15 birds (McArthur et al., 2019)
Royal spoonbill	• Observed foraging in low numbers in the western embayment of Hutt River.	• Shrimp, crustaceans, invertebrates	• Wader • Forages in intertidal mudflats by repeatedly scything its spoon-shaped bill back and forth • Forages in water <40cm deep over sand, mud or clay	2,360 birds[12]	
South Island pied oystercatcher	• Forages in intertidal habitat within Wellington Harbour and along the Hutt River.	• Molluscs, worms, bivalves, crustaceans, cnidarians, fish	• Wader • Intertidal probe forager in mudflats	~112,000[13]	
Variable oystercatcher	• Forages in intertidal zone and roosts on coastal edge, rock outcrops and headlands of Wellington Harbour. • Forage along the Hutt River.	• Littoral invertebrates, molluscs, crustaceans,	• Wader • Intertidal forager in mudflats	~4,000 birds (Southey, 2009)	728 breeding birds (McArthur et al., 2019)

[11] Adams, R. 2013. Reef heron. In Miskelly, C.M. (ed.) *New Zealand Birds Online* www.nzbirdsonline.org.nz
[12] Szabo, M.J. 2013 [updated 2017]. Royal spoonbill. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online.*
[13] Sagar, P.M. 2013. South Island pied oystercatcher *in* Miskelly, C.M. (ed.) *New Zealand Birds Online.* www.nzbirdsonline.org.nz

Species	Habitat Use	Preferred Prey	Foraging Method	Estimated National Population	Estimated Regional Population
	• Listed in the PNRP as known to be resident or regular visitors to this area.	annelids, occasionally fish			
White-fronted tern	• Most recorded in harbour between the months of March and May (H. A. Robertson, 1992). • Observed roosting on coastal edge and foraging offshore within Wellington Harbour. Main roost sites are Pito-one (Petone) Beach, the Kaiwharawhara reclamation and along Chaffers Dock marina • Forages in the Wellington Harbour, inshore and offshore.	• Coastal shoaling fish e.g. smelt, pilchard, crustacean, squid	• Plunge dive and dipping	12,000 – 15,000 breeding pairs (Taylor, 2000a)	298 breeding birds (McArthur et al., 2019)

5.4 Ngā Ūranga ki Pito-one (Ngauranga to Petone) Shared Path and Associated Offset Measures

5.4.1 Offshore Roosting Habitat

117. Creation of offshore habitats to avoid / minimise effects of disturbance on roosting birds. These habitats will be constructed prior to the construction of the shared path to provide roosting avifauna with an area of undisturbed habitat (during and after construction).

118. The offshore habitat will have a surface area above MHWS of approximately $10m^2$ and be constructed at a minimum of 40 m from the path (which has been determined by the flight initiation distances of the various species along the length of the route).

119. As required by the consent conditions, two of the offshore habitats will be constructed prior to the path construction works commencing to provide an alternative avifauna habitat during the construction period.

5.5 Summary of Coastal Avifauna Values and Significance

120. Following the EIANZ guidelines (Roper-Lindsay et al., 2018), we have assigned ecological value to key coastal avifauna species based on their New Zealand Threat Classification (refer to Table 2). As listed in Table 11, the native coastal avifauna associated with the Project range from **Low** to **Very High** ecological value.

Table 11 Summary of key coastal avifauna ecological values and significance (PNRP) associated with the Project.

Ecological Component		Ecological Value	Scheduled Significant (PNRP)
Coastal Avifauna	**Habitat**		
	Wellington Harbour / Te Whanganui a Tara – inland waters	-	Yes
	Wellington Harbour foreshore - Pencarrow sewer outfall to Burdan's Gate	-	Yes
	Wellington Harbour foreshore - Northern end of Day's Bay to Point Howard	-	Yes
	Wellington Harbour foreshore - Point Howard to eastern shore of Te Awa Kairanga/Hutt River mouth	-	Yes
	Wellington Harbour foreshore - Western shore of Te Awa Kairanga/Hutt River mouth to Petone / Pito-one (Petone) Beach rowing club	-	Yes
	Wellington Harbour foreshore – Petone / Pito-one (Petone) Beach rowing club to Ngā Ūranga (Ngauranga) railway station	-	Yes
	Wellington Harbour foreshore - Ngā Ūranga railway station to Interislander ferry terminal	-	Yes
	Wellington Harbour foreshore - Point Jerningham to Point Halswell	-	Yes
	Wellington Harbour foreshore - Point Halswell to Worser Bay boat club	-	Yes
	Wellington Harbour foreshore - Worser Bay boat club to Point Dorset	-	Yes

Ecological Component		Ecological Value	Scheduled Significant (PNRP)
	Species		
	Black-billed gull	Very High	-
	Reef heron	Very High	-
	Caspian tern	Very High	-
	Little blue penguin	High	-
	Red-billed gull	High	-
	South Island pied oystercatcher	High	-
	White-fronted tern	High	-
	Australasian pied stilt	Moderate	-
	Royal spoonbill	Moderate	-
	Pied shag	Moderate	-
	Variable oystercatcher	Moderate	-
	Fluttering shearwater	Moderate	-
	Black shag	Moderate	-
	Little black shag	Moderate	-

6 ASSESSMENT OF CONSTRUCTION EFFECTS

6.1 Marine Ecology

121. Construction activities involve land-based earthworks and disturbance of the riverbed material within flowing water causing mobilisation of natural sediments into the water column. The potential effects on the marine receiving environments from construction are related to sediment discharged from the earthworks and works in the river.

122. Suspended sediment will deposit downstream either within the river itself or at the river mouth, where the influence of saline water will flocculate fine particles, causing them to fall out of suspension (CWQTA, 2021). Currently, fine particles carried downstream from further up the catchment are transported further and deposit in Wellington Harbour.

123. This assessment assumes that best practice land-based erosion and sediment controls (ESC) are an inherent part of the construction (ESCP, 2021).

124. The Project Construction Water Quality Report and the draft Erosion and Sediment Control Plan prepared by Ed Breese outline the sediment control measures for the Project in detail and assesses their effectiveness (attached as Appendices B and C to Technical Assessment #3).

125. The assessment of effects on marine ecology and coastal avifauna is not generating the need for any restricted works.

126. Discharges are likely to cause elevated total suspended sediment (TSS) within the water column and deposition of sediment on the riverbed and potentially the seabed. Deposited sediment and TSS may, in turn, adversely affect sensitive marine organisms through smothering and clogging of filter-feeding structures and gills. Effects on organisms are a factor

of volume of fine sediment (concentration of suspended sediment and depth of deposited sediment) and duration of exposure. The level of these effects also depends on the nature and values of the existing receiving environment.

127. High loads of suspended sediments for a long period of time can have negative effects on the physiological condition of filter feeding taxa, such as some bivalves (which are sensitive to elevated suspended sediment), and areas of higher sediment deposition will most likely exclude colonisation of, or remove, these species. Marine taxa have differing sensitivities to suspended sediment concentration and duration of exposure. Thus, our approach to the assessment of effects of sediment discharges has been:

i. to gain an understanding of the estimated area affected by suspended sediment at minimum biological effects threshold concentrations and duration of exposure; and

ii. then determine whether the areas affected are likely to contain organisms that are sensitive to suspended sediment.

6.1.1 Marine Ecology Effects Thresholds

128. Laboratory trials on the tolerance of marine invertebrates to TSS have shown measurable adverse effects on marine organisms at a range of TSS concentrations and a range of extended periods (Hewitt et al., 2001; Nicholls et al., 2003; Thrush et al., 2003). Sensitive organisms (e.g. horse mussel, pipi and a tubeworm) suffer sublethal effects, such as behavioural or physiological effects on individuals after three or more days' exposure to TSS concentrations around 75-80 g/m3 (Nicholls et al., 2003; Thrush et al., 2003, 2003).

129. Of the organisms upon which research has been carried out those that are known to be present within the Wellington harbour are listed in Table 12 below.

Table 12 Laboratory trial results of the effect of TSS on marine invertebrates that are present in Wellington Harbour

Species	Effect detected	TSS concentration and duration of exposure at which effects were measured	Reference	Wellington Harbour
Pipi - (*Paphies australis*)	Reduced condition	75 g/m³ (exposure >13 days)	Hewitt et al., 2001	Uncommon. Unlikely to be present in the muddy upper harbour.
Wedge shell - (*Macomona liliana*)	Reduced survival	300 g/m³ (exposure >9 days)	Nicholls et al., 2003	Common
Cockle - (*Austrovenus stutchburyi*)	Reduced condition	400 g/m³ (exposure >7 days)	Hewitt et al., 2001	Common

130. Deposition of fine grain sediment (<63µm) derived at a depth of greater than 5 mm on top of muddy benthic sediment can have adverse effects on small, less mobile marine invertebrates (Nicholls et al., 2009). Deposition of fine sediment (~5mm thick) to an estuarine environment, can result in lower invertebrate densities and a significant change in community structure (LaFrance et al., 2014; Pratt et al., 2014). A thin layer of fine sediment is shown to reduce the supply of oxygen to underlying sediment leading to a reduction in burrowing behaviour of bivalves and decomposition within deeper layers (Cummings et al., 2009). Thicker deposits of

fine grain sediment affect an increasing number of species, with most bivalves and gastropods affected at 5-10mm deposition. Layers greater than 30 mm significantly affect most organisms that inhabit muddy sediment which in turn affects food supply for fish and birds that utilise the marine habitat. Adverse effects are also experienced at shallower depths of fine sediment deposition when the receiving environment sediment is coarse grained. For instance, mud deposited on coarser grained sediment such as sand has effects at shallower depths of deposition compared to mud deposited on mud (Lohrer et al., 2006).

131. Most marine invertebrates can tolerate the deposition of sediment for up to three days by isolating themselves from environmental stressors (e.g. bivalves close their valves, other invertebrate cease feeding and may burrow) (Nicholls et al., 2009). Many organisms are able to slow their metabolism and temporarily reduce their reliance on oxygen by changing their metabolic pathway from aerobic to anaerobic during this time. If the sediment deposition persists for longer than three days, sublethal and lethal effects begin to occur in the most sensitive taxa. Less sensitive organisms may tolerate sediment deposition for a longer period before adverse effects begin to occur (Lohrer et al., 2006).

132. The modification of estuarine habitats due to sedimentation above effects threshold levels can reduce ecological heterogeneity (variation). Benthic sandflat and mudflat taxa have differing sensitivities to the deposition of fine sediment. Different life stages of single taxa can also have differing sensitivity to deposited sediment. Thus, deposition of fine sediment can result in a shift towards tolerant organisms dominating the invertebrate community composition. For example, oligochaete worms, mud crab (*Helice crassa*) and the amphipod *Paracorophium excavatum* are known to prefer mud habitats comprising 95-100% mud grain sizes, whereas cockles and pipis prefer 5-10% mud (Gibbs & Hewitt, 2004).

133. Many marine invertebrates are susceptible to the discharge of sediment as most taxa have limited mobility, whereas fish, especially upper harbour species that are used to a muddy depositional environment, are highly mobile and will move to areas that are less affected for foraging.

134. The Hutt River Mouth and the subtidal areas of Wellington Harbour, where sediment from the Hutt River currently deposits, is characterised by mostly tolerant, opportunistic organisms that prefer moderate to high proportions of silt and clay in benthic sediment. The intertidal area immediately adjacent to the Hutt River are characterised by a more diverse community, containing some sensitive organisms that are intolerant of high proportions of silt and clay (Robertson and Stevens, 2017). These areas currently do not receive large proportions of sediment deposition from the Hutt River, due to their exposure to wave action and are unlikely to be affected by high suspended sediment loads above the existing conditions and sediment deposition associated with the proposed works.

6.1.2 Sediment Discharges

135. The riverbed material has been characterised by Gary Williams within the Geomorphology Technical Assessment (Technical Report #5)). In his report, Mr Williams describes the material within the river bed as *“relatively coarse, with the median size reducing from a D_{50} of approximately 50 mm at the upstream end of the Project reach to a D_{50} of 25 mm in the middle and lower reaches”*[14]Mr Williams also refers to the work by Cameron (2018) and concludes that “*the dominant sediment particle size that is expected to be in the water column as a result of in-river works is sand (0.06 – 2 mm diameter). This material is likely to make up approximately 10% of the total bed sediment within the Project reach. Although it will be highly dependent on the flow in the river at the time, this material would not be expected to be transported more*

[14] Geomorphology Technical Assessment (Technical Report #5) – paragraph 87

than 500 m downstream"[15]. Furthermore *"the particle size distribution of the material in the river channel is likely be similar to that of the adjacent floodplain, with the floodplain having been built up from river deposits when the river was free to migrate across the wider valley floor"*[16].

136. Overall, the amount of silt and clay sized particles likely to be present within the entire project footprint represents less than 0.5% of the natural supply of the entire catchment .

137. Based on these results and the advice from the Project experts we can assume that there will be negligible disturbance and transport of fine (<63μm) material to the marine environment throughout the earthworks phase of this Project.

138. Elevated levels of TSS based on disturbance of sand sized particles within the water column are unlikely to reach effects thresholds for sensitive marine organisms of greater than 80mg/L for a duration of more than 3 days, as turbidity is likely to clear within an hour of works finishing or the conclusion of a flood event (Construction Water Quality Technical Report - Technical Assessment #3).

139. Likewise, sediment deposition is unlikely to reach effects thresholds for sensitive species of more than 5-10mm for more than 3 days as the courser sized particles will most likely fall out of suspension before it reaches the marine environment (Gary Williams Pers. Comm 22/3/2021).

140. There will be negligible cumulative effect of fine sedimentation in the harbour, as there is unlikely to be any more than a negligible amount of fine sediment associated with the works.

141. Overall, the magnitude of effect of Project related sediment discharged to the marine environment is therefore negligible, Change will be barely distinguishable, approximating to the "no change" situation (Table 4).

142. **Moderate** ecological value along with a **negligible** magnitude of effect will result in an overall **very low** level of effect.

6.2 Coastal Avifauna

143. The only potential construction effects of the Project on native coastal avifauna in the coastal marine area receiving environment (from Seaview Bridge to the Hutt River mouth and wider Wellington Harbour) that have been considered for this assessment are impacts of Project-generated sediment on the foraging ability of coastal avifauna and their food supply. These effects are only of relevance during the construction phase of the Project.

144. Coastal avifauna nesting habitats within Wellington Harbour (e.g. Matiu/Somes Island and areas of rip-rap rock revetment) are above mean high water springs. Consequently, nesting habitat will not be impacted by potential construction-associated sediment effects and are not considered further in this assessment.

145. Potential effects on the consented, but yet to be implemented, coastal avifauna mitigation measures (refer to paragraphs 96 to 98 above) for the Te Ara Tupua project have also been considered.

146. The assessment of effects on coastal avifauna has been undertaken at a regional scale based on information obtained regarding species use of the Wellington Harbour CMA and in the context of their estimated regional populations.

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[15] Ibid – paragraph 87

[16] Ibid – paragraph 90

6.2.1 Potential impacts on food supply and foraging ability

147. During construction, land-based earthworks and disturbance of riverbed material within flowing water will result in mobilisation of natural bed sediments into the water column and deposition within receiving environments.

148. Potential adverse effects on marine water quality may result through increased suspended sediment loads impairing the ability of visual foragers to locate prey.

149. Furthermore, increased sediment deposition on benthic habitats can smother and potentially kill (depending on the depth of deposition) benthic invertebrates and reduce prey availability for coastal avifauna. Availability of prey fish may also be reduced as a result of suspended sediments clogging gills.

150. Any potential effects on coastal avifauna are dependent on the amount of construction-associated sediment generated over and above baseline sediment levels, as well as the substrate grain sizes of the sediments. Potential effects are also dependent on the duration of exposure.

151. As explained above, given the sediment grain size composition of the river bed, we can assume that there will be negligible disturbance and transport of fine (<63 μm) material to the marine environment throughout the earthworks phase of this Project.

152. Elevated levels of suspended sediments will occur for no longer than 12 hours at a time (in any 24-hour period) and will return to baseline levels within one hour of the works finishing (Construction Water Quality Technical Report (Technical Assessment #3)). Works will take place over the indicative four-year construction period, from downstream to upstream during seasonally allowed periods (approximately 120 days/year) as per Appendix 7 of the GWRC Code of Practise for River Management Activities (2019) (Technical Assessment #)).

153. The locations where suspended sediment will deposit include Hutt River itself and the river mouth.

154. The assessment of effects on marine ecology above has determined that elevated levels of total suspended sediments based on disturbance of sand-sized particles within the water column are unlikely to reach effects thresholds for sensitive marine organisms.

155. Likewise, sediment deposition is unlikely to reach thresholds for sensitive marine organisms.

156. Accordingly, the overall magnitude of effect of Project-related sediment discharged to the marine environment has been assessed as negligible (i.e. change barely distinguishable approximating to the “no change” situation (Table 4)). That is to say that there will be a negligible magnitude of effect (in terms of abundance, diversity and quality) on the benthos or shoreline ecology of the Wellington Harbour CMA.

157. As such, we consider that the impact of construction-generated sediment, which is a temporary effect spanning the four-year construction period, will have a negligible effect on coastal avifauna within the Wellington Harbour coastal marine environment (Table 9) (with respect to impacts on benthic food availability).

158. A negligible magnitude of effect on low to very high value coastal avifauna species results in a Very Low to Low Overall Level of Ecological Effect (refer to Table 5).

159. Construction-generated suspended sediments may influence the foraging ability of visual foraging species within the Wellington Harbour CMA including several species of terns, shags, petrels, penguins and shearwaters that are classified as At Risk or Threatened species (Table 10).

160. However, given the small amounts of Project sediment volume that will be generated above baseline levels; very little of which will include fine material (<63μm), the methods in place to

manage suspended sediments, the fact that materials will settle out in Hutt River itself and the river mouth, and the short-term nature of the elevated TSS levels, we consider that negative effects on coastal avifauna foraging ability will be negligible.

161. Furthermore coastal avifauna species foraging in the lower extent of Hutt River within the CMA (where some project-generated sediments will settle), are already subject to sedimentation in the River, and associated elevated TSS levels as a result of rain and flood events in the catchment and as such should be habituated to changes in visual clarity while foraging.

162. The key species of interest are all mobile (i.e. have the ability to move to other areas of foraging habitat) and have extensive foraging networks in Wellington Harbour and Cook Strait environment (i.e. are not range restricted in foraging locale) that they can move to if visual clarity reduces as a result of Project-generated sediment loading.

163. Accordingly, we consider that the impact of construction-generated suspended sediment loads will have a negligible magnitude effect on key coastal avifauna considered in this assessment.

164. A negligible magnitude of effect on low to very high value avifauna species results in a Very Low to Low Overall Level of Ecological Effect.

6.2.2 Potential effects on the Te Ara Tupua coastal avifauna mitigation measures

165. The coastal avifauna mitigation measures for the consented Te Ara Tupua project include the construction of offshore island roosting habitat in Wellington Harbour, predator control and the installation of little blue penguin nest boxes. None of these measures will be impacted by sediment discharge effects from the Riverlink project.

7 ASSESSMENT OF OPERATIONAL EFFECTS

7.1 Marine Ecology

7.1.1 Stormwater

166. Currently, stormwater contaminants in surface sediment of the receiving environment are generally high. The Hutt River Mouth have high background sediment discharges which will dilute the residual contaminants in treated operational phase stormwater. Stormwater treatment will be provided for in the Project where space and gradient allows for it to be built in to the design. Stormwater treatment will include treatment ponds and rain gardens (SOWQTA, 2021). It is unlikely that contaminants from the Project will influence the overall sediment contaminant concentrations given that high baseline of sediment contaminants and the low residual contaminant load in treated stormwater discharges.

167. Accordingly, we expect that the magnitude of effect any long-term change in sediment quality as a result of the Project will have a **positive** magnitude of effect in the receiving environment and therefore will have a **Net Gain** in marine ecological values.

7.2 Coastal Avifauna

7.2.1 Stormwater

168. The only potential operational effect considered for coastal avifauna are changes in sediment quality (i.e. stormwater contaminants) and associated bioaccumulation effects in prey as a result of the project.

169. The above marine assessment determined that the magnitude of effect of any long-term change in sediment quality as a result of the project's stormwater treatment will have an overall net gain on marine ecological values in the receiving Wellington Harbour CMA environment.

170. Accordingly, it is considered that the magnitude of effect changes in sediment quality associated with the project will be positive for coastal avifauna within the receiving environment.

171. A positive magnitude of effect on low to very high value avifauna species results in a Net Gain Level of Effect on coastal avifauna.

8 SUMMARY OF EFFECTS

172. Table 14 summarises both the construction and operational effects of the proposed project on the marine receiving environment.

Table 13 Summary of construction and operational effects on the marine ecology and coastal avifauna

Ecological Component	Type of Effect		Species	Ecological Value	Magnitude of Effect	Overall level of effect
Marine Ecology	Construction	Sediment discharges	-	Moderate	Negligible	Very Low
	Operation	Stormwater	-	Moderate	Positive	Net Gain
Coastal Avifauna	Construction	Sediment discharge effects on food supply and foraging ability	Black-billed gull	Very High	Negligible	Low
			Reef heron	Very High	Negligible	Low
			Caspian tern	Very High	Negligible	Low
			Little blue penguin	High	Negligible	Very Low
			Red-billed gull	High	Negligible	Very Low
			South Island pied oystercatcher	High	Negligible	Very Low
			White-fronted tern	High	Negligible	Very Low
			Australasian pied stilt	Moderate	Negligible	Very Low

			Royal spoonbill	Moderate	Negligible	Very Low
			Pied shag	Moderate	Negligible	Very Low
			Variable oystercatcher	Moderate	Negligible	Very Low
			Fluttering shearwater	Moderate	Negligible	Very Low
			Black shag	Moderate	Negligible	Very Low
			Little black shag	Moderate	Negligible	Very Low
	Operation	Stormwater discharge effects	Black-billed gull	Very High	Positive	Net Gain
			Reef heron	Very High	Positive	Net Gain
			Caspian tern	Very High	Positive	Net Gain
			Little blue penguin	High	Positive	Net Gain
			Red-billed gull	High	Positive	Net Gain
			South Island pied oystercatcher	High	Positive	Net Gain
			White-fronted tern	High	Positive	Net Gain
			Australasian pied stilt	Moderate	Positive	Net Gain
			Royal spoonbill	Moderate	Positive	Net Gain
			Pied shag	Moderate	Positive	Net Gain
			Variable oystercatcher	Moderate	Positive	Net Gain
			Fluttering shearwater	Moderate	Positive	Net Gain
			Black shag	Moderate	Positive	Net Gain
			Little black shag	Moderate	Positive	Net Gain

9 MEASURES TO AVOID, REMEDY OR MITIGATE ACTUAL OR POTENTIAL ADVERSE EFFECTS

9.1 Proposed mitigation measures

9.1.1 Construction

173. Mitigating sediment discharge effects from open earthworks during acute rainfall events will be achieved by using best practice erosion and sediment control management, to reduce the amount of sediment that leaves the earthworks site and implementing adaptive management and continuous improvement principles.

174. Discharges from land will likely undergo reasonable mixing in stormwater networks before discharge into the Hutt River. Measurement of water quality will take place at the sediment pond outlet, an upstream location and downstream of reasonable mixing before the river. If discharge exceeds 100 mg/L at the sediment pond, additional investigation/mitigation (more stabilisation, flocculation, reducing footprint etc) will take place. In the consent this will be describe as a 'management trigger' (Construction Water Quality Assessment - Technical Report #3).

175. Notwithstanding these best practice erosion and sediment controls, the scale of the earthworks, the length of time that the construction works will take place over, and natural variability in the climate and rainfall events mean that the predicted contributing events and levels of effect may not be the exactly the same as those which occur in reality. This is why the assessment undertaken for the Project and the erosion and sediment control measures recommended adopt a conservative approach (assumptions related to the amount of sediment generated from the Project and resultant downstream marine ecology effects). This conservative approach suggests that the actual effects from the Project will be no worse than predicted.

176. In order to determine the actual effects during the Project itself, we typically recommend monitoring of the receiving environment after acute events be imbedded in the project management and mitigation, to ensure any unexpected effects are properly assessed and managed. However, this is very challenging and is not considered appropriate for this Project. This is because the deposition areas of the Hutt River Mouth and Wellington Harbour have high baseline sediment loads. This makes it very difficult to distinguish freshly deposited sediment from the existing sediment that has built up over time.

177. Baseline sediment discharges comprise natural erosion from land and stream banks (exacerbated by various land use practices) and runoff from activities in the upper catchment that disturb the land e.g. open earthworks, vegetation removal, grazing of steep land, felling of forestry.

178. During construction of the Project, runoff from land-based earthworks will be treated via a range of erosion and sediment control measures which will be designed to best practice at the time. However, during large rainfall events, the effectiveness of the erosion and sediment control is diminished such that in those large rainfall events, sediment-laden water will be discharged to the River and ultimately to the harbour receiving environments.

179. Project sediment will be mixed with natural runoff and other catchment sediment. It will not be possible to distinguish sediment from each of those sources in the muddy, depositional receiving environment.

180. Thus, attempting to monitor Project sediment deposition arising from acute rainfall events in the receiving environment is not effective. Such monitoring is highly unlikely to provide useful information to determine the actual effect of the Project on marine ecological values. Detection of freshly deposited sediment is much less problematic where baseline sediment loads are low.

181. The implication is that:

i. a large rainfall event could occur during the Project's open earthworks period;

ii. sediment could be discharged to the harbour from the Project and other sources;

iii. an assessment of effect of deposited sediment on benthic invertebrate community composition could be triggered by a rainfall event and undertaken; and

iv. even if a significant adverse effect on the benthic community is detected, it is very difficult, if not impossible, to tease apart natural and catchment-related effects from Project-related effects. It would be very difficult to determine whose sediment is whose and develop mitigation measures relating to the effects of the Project.

182. We consider that in the receiving environments for this Project, given their existing high background load of sediment naturally discharged and from other catchment activities, carrying out triggered (by acute large rainfall events) assessments of effect on benthic ecological values would not provide meaningful data. Similarly, carrying out routine 6-monthly assessments of the ecological values of the estuarine receiving environment is unlikely to be useful in distinguishing baseline and catchment effects from Project effects.

183. Minimisation of the deposition of fine sediment in the marine environment should be the goal. That is why on large earthworks projects such as this Project, significant effort is put into development and management of erosion and sediment control devices, site management, monitoring upcoming weather, training of contractors on site etc.

184. If fine sediment is deposited in the marine environment, it would be very difficult if not impossible to remedy. Once sediment has deposited, attempts to remove that sediment would increase the level of effect on marine ecological values and increase the period over which natural recolonisation of organisms would occur. Therefore, even if it was possible to distinguish Project sediment from catchment sediment and existing sediment, any ecological response to the deposition of Project-related sediment would need to be in the form of mitigation (or offset if mitigation was not possible), as I do not recommend attempts to remediate.

185. For the reasons above, as well as the very low likelihood of fine sediment discharging from the project site (based on advice from Gary Williams, Project Geomorphologist) I have not recommended monitoring of construction-related sediment discharges for this Project.

186. We have based our assessment of effects on the technical advice provided by Gary Williams and Kyle Christianson (Geomorphology Technical Report - Technical Assessment #5), that describes the material within the riverbed and adjacent floodplains of the project footprint containing negligible fine (<63µm) particles. This assumption will be verified by the Erosion and Sediment Control monitoring immediately prior to and throughout the construction period.

9.1.2 Conditions

187. As per those specified in the Construction Water Quality Report (CWQTA, 2021).

10 CONCLUSION AND RECOMMENDATIONS

188. The marine ecological values within receiving environment of the Hutt River are moderate. The upper reaches of the Harbour comprise fine sandy/mud and receive a high baseline load of sediment currently.

189. The coastal avifauna ecological values within the Wellington Harbour CMA receiving environment range from low to very high.

190. Potential effects of the Project on the marine and coastal avifauna ecological values may occur from the discharge of construction phase fine sediment and the discharge of operational phase stormwater. Recommended measures to minimise sediment runoff include erosion and sediment control designed to GWRC and Waka Kotahi guidelines and standards, staging of works and storm event weather forecasting in order to stabilise open areas prior to the storm event occurring.

191. Based on sampling undertaken from Cameron (2018) and advice from the Project's geomorphologist, sediment associated with the proposed river and land based works is unlikely to contain any silt and clay sized particles and is therefore unlikely to have significant adverse effects in the marine receiving environment benthic habitats and on the coastal avifauna food supply and foraging ability.

192. We have assessed the discharge of treated operational phase stormwater as resulting in a net gain for marine and coastal avifauna ecological values.

193. Overall, with appropriate mitigation, it is considered that adverse effects would be very low.

Date 23 July 2021

Names: Dr Jacqui Bell and Karin Sievwright

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