REPORT

Tonkin+Taylor

PS 23 Assessment of Ecological Effects

Prepared for
Watercare Services Limited
Prepared by
Tonkin & Taylor Ltd
Date
October 2022
Job Number
1015172.1600 v1

Together we create and sustain a better world
www.tonkintaylor.co.nz

Document control

Title: PS 23 Assessment of Ecological Effects					
Date	**Version**	**Description**	**Prepared by:**	**Reviewed by:**	**Authorised by:**
20/08/22	1	PS 23 Assessment of Ecological Effects – draft for client review	S Heggie-Gracie K Rogers	L Curry D Miller	K Baverstock
4/10/2022	2	PS 23 Assessment of Ecological Effects – Final	S Heggie-Gracie	L Curry D Miller	K Baverstock

Distribution:

Watercare Services Limited	1 electronic copy
Tonkin & Taylor Ltd (FILE)	1 electronic copy

Table of contents

Executive summary

Watercare Services Ltd (Watercare) proposes to undertake ecological enhancement works at Pump Station 23 (PS 23), located on the edge of Hillsborough Bay in the Manukau Harbour, as part of the Central Interceptor (CI) environmental outcomes.

The proposed works will involve the replacement of an existing temporary construction platform used for the CI project with a permanent high-tide bird roost and associated saltmarsh habitat. An Assessment of Ecological Effects was undertaken (this report) to assess positive effects and any potential ecological effects as a result of the proposed enhancement.

Ecological values in and around PS 23 include natural wetlands, marine and coastal habitats, benthic and marine fauna and coastal avifauna. Potential adverse ecological effects include temporary disturbance and increased sedimentation run-off during the construction phase. These adverse effects can be appropriately managed through avoidance and mitigation measures, such as the implementation of an Erosion and Sediment Control Plan.

The project is anticipated to have long term positive effects. Effective roost sites free from disturbance are essential for coastal avifauna and are limited locally. The proposed artificial roost aims to benefit a number of nationally 'At Risk' and 'Threatened' coastal avifauna, and includes wide open shelly roosting sites as well as timber piles (to act as perching habitat) and saltmarsh habitat. Overall, it is expected this project will provide an overall Net Gain to coastal avifauna and coastal vegetation, while all other ecological effects are expected to be managed to an overall level of effect of low.

1 Introduction

Watercare Services Ltd (Watercare) proposes to undertake ecological enhancement works at Pump Station 23 (PS 23) as part of the Central Interceptor (CI) project.

PS 23 is located on the edge of Hillsborough Bay, in the Manukau Harbour. The PS 23 site (the Site) is on the main CI project tunnel alignment and is one of the various sites consented to facilitate construction for the installation of the CI, a 14.7 km-long wastewater tunnel that will run between the Māngere Wastewater Treatment Plant and Grey Lynn.

Watercare has sought and achieved accreditation from the former Infrastructure Sustainability Council of Australia[1] (ISCA) for the CI project through their Infrastructure Rating Scheme (IS). While the current design and site reinstatement plans are sufficient to meet the ISCA requirements, this proposal is an opportunity to go beyond compliance and improve the ecological environment around the PS 23 site. Specifically, Watercare is proposing to establish a permanent high-tide bird roost area for shorebirds (the Project),and establish an area of coastal saltmarsh vegetation.

This work has been undertaken in accordance with Tonkin & Taylor Ltd's (T+T) letter of engagement dated 9 September 2021 and variation order dated 20 June 2022.

1.1 Scope

This Assessment of Ecological Effects (AEcE) report provides a technical assessment of the wetland and marine ecological values present at the PS 23 site and surrounding areas and assesses the effects of construction on these values. This report is prepared to inform the Assessment of Effects on the Environment (AEE) which has been prepared to accompany the resource consent application.

The scope of this AEcE includes the following:

- A description of the existing site and the surrounding Coastal Marine Area (CMA).
- A desktop assessment of existing information and data relating to the ecology of the site footprint and immediate surrounds.
- Information from site visits relating to the high-level assessment of the existing habitat in accordance with ARC TP 127 (1999) and to identify ecological important features or species of significance with the CMA.
- A qualitative assessment of ecological values that are known or likely to be present within the site footprint and immediate surrounds.
- An assessment of the potential adverse ecological effects on these values associated with construction activities as well as anticipated long-term positive effects for coastal birds and/or any other ecological aspect of the environment. This assessment has followed the framework outlined in the Environment Institute of Australia and New Zealand (EIANZ) Ecological Impact Assessment Guidelines (EcIAG) (EIANZ, 2018).

2 Site location and descripton

PS 23 is located at 39 Frederick Street in Hillsborough, on an area of reclaimed land on the coastal edge of Hillsborough Bay, in the Manukau Harbour (Figure 2.1). The surrounding area is residential, and there are esplanade reserves on either side of the Site.

A piped watercourse runs along 35 Frederick Street and into an open watercourse, which discharges to the intertidal area immediately to the west of PS 23. Near to the Site within the CMA are two high voltage transmission lines with pylons located on the harbour bed.

As part of the CI project, a temporary working platform has been constructed within the CMA, adjacent to PS 23, which will be removed at the end of construction and the seabed levelled as part of the consented CI project.

The enhancement works include the construction of a rocky outcrop within the CMA along the edge of the PS 23 site during the removal of the temporary construction platform. Stormwater outlets will also be reinstated during construction of the seawall. The CI project works, including the works platform, form part of the existing environment which will be factored into the AEE. Furthermore, a boardwalk is proposed to be constructed across this site in 2026 by Auckland Council, and is also considered part of the 'existing environment'.

The intertidal area around the Site is mostly comprised of sand flats and soft gloopy mud, with cockle shell-covered flats surrounding the stream outflow across the foreshore. Some areas of exposed sandstone reef are present. The temporary working platform occupies the same footprint as the proposed enhancement project (Section 3). Refer to Section 5.1 for a more detailed ecological description of the site.

Figure 2.1: Aerial of PS 23 showing temporary structure (orange) surrounding PS 23 (red). An aritifical bird roost and saltmarsh is proposed at the location of the existing temporary structure.

3 Proposed works

The temporary construction platform (Appendix A Figure.1) will be replaced with an ecological enhancement area comprised of a high-tide bird roost, rocky outcrop, timber piles and establishment of indigenous saltmarsh habitat. The temporary construction platform will require disassembling and replacement with the proposed enhancements.

The proposed works will occur across the existing temporary construction platform footprint and therefore construction works are expected to largely avoid direct impacts to the wider environment. However, approximately 22 timber piles will be established outside of the temporary construction platform footprint and in the CMA in order to provide perching and roosting habitat for coastal avifauna. The total footprint is approximately 900 m^2, extending up to approximately 25 m from the coastal edge into the CMA and measures approximately 50 m in length.

It is anticipated that the Project will be constructed at low-mid tides only (during a 6-to-8-hour window) to avoid working in the wet or the need for a barge. Construction access would be gained from the PS 23 site to minimise disturbance to the inter-tidal environment.

No vegetation (on land or in the CMA) will be disturbed or removed.

3.1 Project description

Watercare aims to enhance the ecological values of the CMA through habitat creation. The Project involves ecological habitat construction within the footprint of the existing temporary platform, and in the CMA (with regard to timber piles), incorporating the following ecological enhancement features (as shown in Appendix A Figure.2):

- Constructed bird roost of approximately 170 m^2, to provide roosting habitat for coastal birds (including nationally 'At Risk' (Robertson *et al*., 2021) species (such as tarāpunga/red-billed gull (*Chroicocephalus novaehollandiae*)) and potentially 'Threatened' species (such as taranui/Caspian tern (*Hydroprogne caspia*)) at high tide. The roost is connected to land, in the location of an existing rock wash out where wading birds have been observed roosting. The roost would be comprised of shelly material and surrounded by a rock wall with geotextile to prevent wash-through and loss of fines. The roost will be flat and open so that coastal birds have an effective 'line-of-sight' to any potential predators.
- Indigenous, eco-sourced (if available) saltmarsh vegetation of approximately 320 m^2 to extend from the constructed bird roost along the coastal edge of the PS 23 Site. Saltmarsh vegetation is proposed to create habitat for indigenous coastal birds such as 'At Risk' moho pererū/banded rail (*Gallirallus philippensis*). Saltmarsh vegetation will also enhance the indigenous vegetation biodiversity occurring at the site, while also buffering the coastal environment from run-off.
- Rocky outcrop of approximately 410 m^2 attached to the outer edge of the saltmarsh rock sill, to provide roosting habitat for perching coastal bird species such as cormorants and to provide potential substrate for encrusting organisms.
- Approximately 22 timber piles clustered within adjacent mud flats, to provide roosting habitat for coastal avifauna, including nationally 'At Risk' species. Timber piles have been designed to account for both colony (such as tarāpunga) and solitary (such as kōtare/sacred kingfisher (*Todiramphus sanctus*) roosters. To prevent harassment from karoro/southern black-backed gulls (*Larus dominicanus*), timber piles will be established away from the proposed open hight-ide bird roost. Timber piles will also be established a minimum of 5 m away from the 'existing' boardwalk (proposed as part of a separate Auckland Council project not to be constructed until 2026 – however still considered part of the 'existing environment').

3.2 Maintenance

The constructed bird roost is expected to lose some shelly material during times of high wave action. As there is no natural supply, the material will likely need to be replaced following storm events. The geofabric required for the constructed roost will also need to be replaced periodically. The Site includes permanent works over an existing rising main and local sewer which may require maintenance by trenching in the future.

4 Methods

Our approach to the assessment of marine ecological effects of the proposed work has comprised:

- Collation and a desktop review of existing data relevant to the site and the project, including:
  - Benthic ecology reports (infauna and sediment data).
- Site specific survey of the marine receiving environment including:
  - High level habitat mapping
  - Wetland delineation assessments
  - Coastal bird surveys
- An assessment of effects on marine ecology based on the known or likely ecological values in the project footprint and surrounding area and the expected magnitude of effects on those values. We have used the Ecological Impact Assessment (EcIA) guidelines (vs.2) produced by the Environmental Institute of Australia and New Zealand (EIANZ, 2018) to frame our assessment of ecological effects.

4.1 Desktop review

A desktop assessment was undertaken to compile information and data relating to the ecology of the site footprint and surrounding area. This included the following key sources of information and additional references therein.

- Auckland Council. Geomaps viewer – Significant Ecological Areas layer.
- Auckland Unitary Plan – Operative in Part, Schedule 3 Significant Ecological Areas – Terrestrial Schedule.
- Auckland Unitary Plan – Operative in Part, Schedule 4 Significant Ecological Areas – Marine Schedule.
- Auckland Unitary Plan – Operative in Part, Schedule 6 Outstanding Natural Features Overlay Schedule.
- Boffa Miskell Limited (2012). Central Interceptor Project: Assessment of Ecological Effects Associated with the Central Interceptor Project.[1]
- Indigenous terrestrial and wetland ecosystems of Auckland (Singers et al. 2017).
- Ingley, R., J. Groom (2022). Coastal and estuarine water quality in Tāmaki Makaurau / Auckland: 2020 annual data report. Auckland Council technical report, TR2022/20.
- Ingley, R (2021). Coastal and estuarine water quality state and trends in Tāmaki Makaurau / Auckland 2010-2019. State of the environment reporting. Auckland Council technical report, TR2021/02.
- Drylie, T P (2021). Marine ecology state and trends in Tāmaki Makaurau / Auckland to 2019. State of the environment reporting. Auckland Council technical report, TR2021/09.
- National Aquatic Biodiversity Information System (http://www.nabis.govt.nz/) (Data retrieved 26/08/2021).
- E-bird, an open-source citizen science bird observation platform.
- iNaturalist database (iNaturalist.org).

[1] The benthic ecology and sediment quality results presented in this assessment of effects have been relied on for this assessment as field assessments were conducted within the PS 23 temporary works footprint and surrounding area. Field survey locations are presented in Appendix C.

- Tupe, M., C Woods, S Happy and C Boyes (2020). Manukau Harbour targeted marine pest survey May 2019. Auckland Council technical report, TR2020/003.
- Ministry for Primary Industries marine biosecurity porthole (www.marinebiosecurity.org.nz/).

The following additional resources guided the delineation of natural inland wetlands within 100 m of the project footprint:

- National Policy Statement for Freshwater Management 2020 (NPS-FM).
- National Environmental Standards for Freshwater 2020 (NES-F).
- Wetland delineation protocols (Ministry for the Environment, 2020).
- Draft Essential Freshwater Interpretation Guidance: Wetlands Definitions. *Draft 7 April 2021* (Ministry for the Environment, 2021).
- Defining 'natural wetlands' and 'natural inland wetlands'. (MfE, 2021).
- Wetland Types in New Zealand (J., Johnson, P. & Gerbeaux, P., 2004).
- A vegetation tool for wetland delineation in New Zealand. (Landcare Research, 2013).
- New Zealand wetland indicator status ratings (Clarkson *et al.*, 2021).
- Hydric soils – field identification guide (Landcare Research, 2018).
- Wetland delineation hydrology tool for Aotearoa New Zealand (MfE, 2022).
- Indigenous terrestrial and wetland ecosystems of Auckland (Singers *et al.*, 2017).
- Practice and Guidance note. Managing Natural Wetlands under the National Environmental Standards for Freshwater Regulations 2020. (Auckland Council, 2022).
- Auckland Council (formerly Auckland Regional Council) (1999). Intertidal and subtidal biota and habitats of the central Waitematā Harbour. Technical Report 127.

A full list of information sources is provided in the References section (Section 9).

4.2 Field assessment

Field assessments were undertaken to assess and map the ecological values in and around the Site.

A targeted coastal avifauna survey was undertaken during low tide and high tide on the 27 October 2021 (Table 4.1). Natural wetlands within 100 m of the site boundary (including within the CMA) were delineated and assessed on the 18 May 2022. A total of 5 mm of rain had fallen during the week leading up to the wetland assessment.[2]

Table 4.1: Coastal avifauna surveys at PS23

Date	Time	Conditions	Survey type	Tide time
27 October 2021	1000 – 1030	Some cloud cover	Low-tide survey	0908 low-tide
27 October 2021	1300 – 1400	Overcast	High-tide survey	1518 high-tide

4.3 Wetland assessment

Following desktop review, site investigations were undertaken to assess potential wetland areas within 100 m of PS 23 using the protocols described below and broadly following the Auckland Council (AC) practice note.

[2] Data accessed from Niwa Cliflo database. Station 41351 Auckland, Motat Ews.

The AC publication TP127 “Intertidal and subtidal biota and habitats of the central Waitematā Harbour” was used to identify non-vegetated wetlands in the CMA, with respect to the Auckland Council Practice and Guidance note on coastal wetlands.

For vegetated wetlands, assessment and delineation was undertaken in accordance with the Wetland Delineation Protocols (WDP; Ministry for the Environment, 2020). The process is outlined in

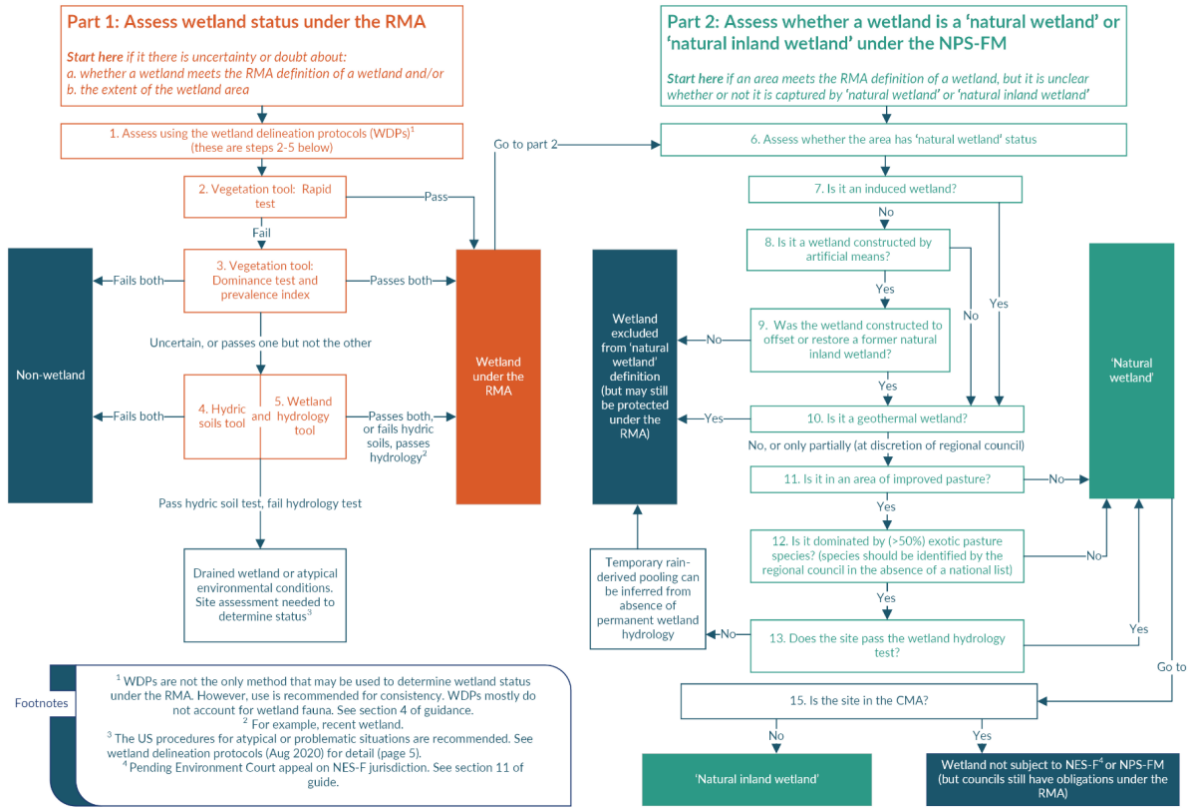


Figure 4.1 and includes a two-stage vegetation assessment, including the ‘Rapid Test’ (Step 1), ‘Dominance Test’ and ‘Prevalence Index’ (Step 2), after which a hydric soil test (Step 3) and wetland hydrology assessment (Step 4) may be undertaken where the vegetation tests are inconclusive. These processes were applied as per

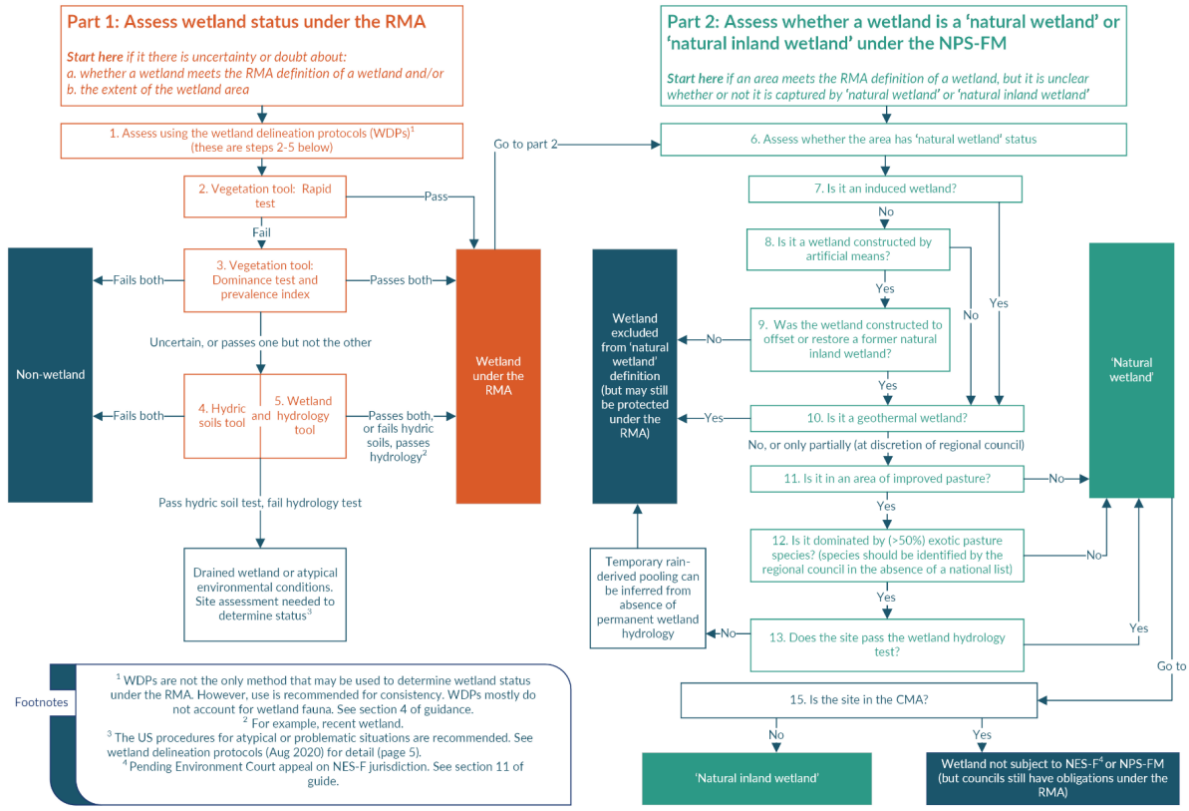


Figure 4.1.

The WDP assessment requires an understanding of each vegetation species' tolerance of wetland environments. The categories used to describe a plant species' dependence on wetland environments (set out in Clarkson *et al.*, 2013 and subsequent updates) are:

- Obligate (OBL): plant species that almost always occur in wetlands (estimated probability greater than 99% in wetlands).
- Facultative Wetland (FACW): plant species that occur usually in wetlands (67% to 99%).
- Facultative (FAC): plant species equally likely to occur in wetlands or non-wetlands (34% to 66%).
- Facultative Upland (FACU): plant species that occur occasionally in wetlands (1% to 33%).
- Upland (UPL): plant species that rarely occur in wetlands (less than 1%).

The proportional cover of vegetation over the entire potential wetland area was assessed due to their relatively small size (i.e. plots were not undertaken). The boundaries of each possible wetland were refined on the ground using visual clues such as changes in topography, hydrological indicators, and mapped using a GIS system (Arc Collector).

Where vegetation was dominated by (> 50%) of UPL or FACU species within each of the tree, shrub and herb tiers, and no obvious signs of wetland hydrology were present, vegetation was classified as terrestrial and not considered as a possible wetland.

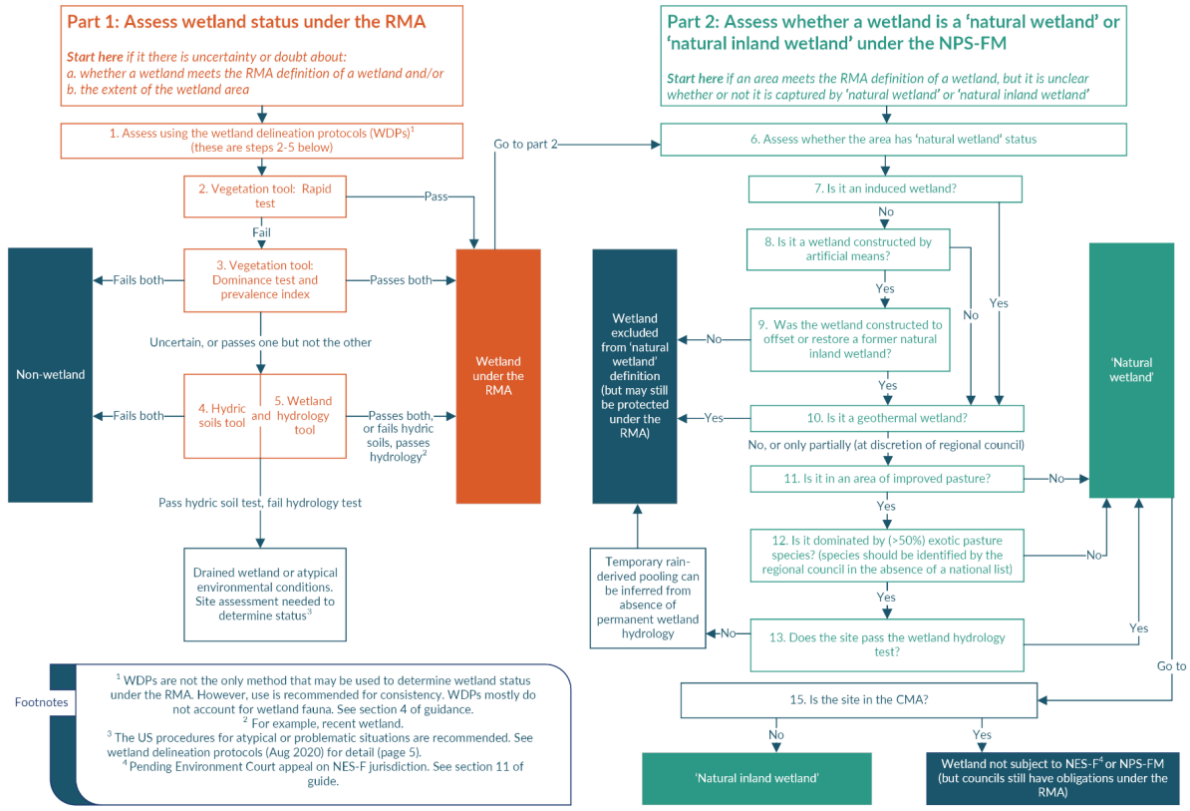


Figure 4.1: Assessing 'natural wetland' and 'natural inland wetland' status under the NPS-FM (MfE, 2021).

4.4 Assessment of ecological effects methodology

Our assessment of ecological effects follows the framework outlined in the Environmental Institute of Australia and New Zealand (EIANZ) Ecological Impact Assessment Guidelines (EcIAG) (EIANZ, 2018), which provides a transparent approach to effects assessments that can be replicated. These guidelines are designed for and directly applicable to freshwater and terrestrial systems. We have also broadly followed a version of the guidelines for marine systems developed by Boffa Miskell Limited (BML)[3], and modified those further to apply to the current application. The EIANZ guidelines state that the purpose of the document is to outline a framework to provide guidance on good practice, however practitioners may deviate from the guidelines where it is considered ecologically relevant and justifiable to do so. The basis of the EIANZ assessment comprises a series of tables that are included for reference in Appendix B.

The modified EcIAG approach follows these steps:

- Ecological *species* values are assigned a level on a scale of **negligible, low, moderate, high or very high** based on assessing the value of species identified against criteria set out in Appendix B.
- Terrestrial ecological *habitat* values are assigned a level on a scale of **negligible, low, moderate, high or very high** based on assessing the value of terrestrial habitats identified against criteria set out in Appendix B.

[3] The characteristics of marine and estuarine sites with 'Negligible' to 'Very High' ecological values were originally developed by Dr Sharon De Luca, Boffa Miskell Ltd, then modified further here to provide a transparent approach that can be replicated. The characteristics have been accepted by decision-makers in Environment Court and Board of Inquiry hearings, including a number of NZTA projects (Transmission Gully, MacKays to Peka Peka, Ara Tūhono Project Puhoi to Warkworth and Warkworth to Wellsford Sections). Table 2 in Appendix B is based on the approach taken in these projects, and has been further developed with additional available indices to improve its use for the current consent applications.

- Marine or estuarine ecological *habitat* values are assigned a level on a scale of **negligible, low, moderate, high or very high** based on assessing the value of marine habitats identified against criteria set out in Appendix B.
- The magnitude of the effect that the activities are expected to have on ecological values is evaluated as being either **positive**, **negligible, low, moderate, high or very high** (Appendix B Table 5). The magnitude of effect is based on factors including spatial scale or extent, temporal scale of effect and the direct or indirect nature of the effect.
- The overall level of effect is determined using a matrix based on the ecological values and the magnitude of effects on these values. Level of effect categories **positive, low, moderate, high or very high.**

The overall level of effect categories were used to determine if effects management is required. Usually, if the overall level of effect is assessed as being **moderate** or greater in Appendix B this warrants efforts to avoid, remedy and/or mitigate these effects. If the overall level of adverse effects is assessed as being **moderate** or greater after all practical efforts to avoid, remedy or mitigate effects have been exhausted, then measures to offset or compensate for effects are considered.

5 Ecological values

5.1 General environment

Manukau Harbour is one of the most important harbours for migratory wading species and other coastal birds in New Zealand and supports more than 20% of the total New Zealand wader population (Auckland Council, 2009). It is also known as a 'hotspot' for coastal bird diversity and nationally 'At Risk' and 'Threatened' (Robertson *et al.*, 2021) coastal avifauna. Intertidal habitats adjacent to PS 23 provide effective foraging habitat for coastal avifauna. Prior the creation of the temporary construction platform, tarāpunga/red-billed gulls (*Chroicocephalus novaehollandiae*) were identified as roosting on flat, open areas adjacent to PS 23.

PS 23 lies within the Tamaki Ecological District (ED). Historically the ED was characterised by taraire, tawa forest, but has since been modified by significant landuse change resulting in high urbanisation and low levels of vegetation cover. As a result of tree clearance and associated landuse change, increased sedimentation has resulted in an expansion of mangroves across Waitemata and Manukau Harbour, and a degradation of habitat quantity and quality for coastal avifauna.

PS 23 is located at 39 Frederick Street in Hillsborough, on an area of reclaimed land on the coastal edge of Hillsborough Bay, in the Manukau Harbour (Section 2). Esplanade reserves, including Taylors Bay Road Reserve can be found along the coast to the North and South of the site.

No Significant Ecological Areas (SEA) are within the site footprint or within the 100 m radius of PS 23. However, white bluff structures are located approximately 400 m south of the site which are classified as an Outstanding Natural Feature (ID 251) meeting four of the 11 criteria[4] outlined in the AUP (Schedule 6). They are described as 'one of the best exposures of complexly deformed Waitemata Group rocks, showing faults and folds in coastal cliffs and on the foreshore'. A class 2 Coastal Protection Area lies adjacent to this Outstanding Natural Feature.

The intertidal area is comprised of sand flats, soft gloopy mud and areas of exposed sandstone reef. No terrestrial habitats were identified within the potential project footprint, and therefore effects to bats, terrestrial avifauna and herpetofauna are not considered further.

The PS 23 site was identified as a high-tide roost site for tarāpunga/red-billed gulls prior to the development of the temporary construction platform. The original high-tide roost site was considered of limited value however due to its small extent, limited protection from disturbance and absence of effective perching habitat. Housing and tall exotic-dominated vegetation limits high-tide roosting opportunities in the local environment.

5.2 Freshwater environment

A permanent, first order stream flows into the Manukau Harbour approximately 17 m to the west of PS 23. The open stream channel is approximately 20 m long and drains a piped network. The sub-catchment contributing to the piped network and receiving stream includes Hillsborough Park, Hillsborough School and residential housing, as a result the sub-catchment has a high proportion of impervious surfaces.

[4] a) the extent to which the landform, feature or geological site contributes to the understanding of the geology or evolution of the biota in the region, New Zealand or the earth, including type localities of rock formations, minerals and fossils
c) the extent to which the feature is an outstanding representative example of the diversity of Auckland's natural landforms and geological features
e) the extent to which the landform, geological feature or site contributes to the value of the wider landscape
g) the potential value of the feature or site for public education

The open stream section had a defined channel, flowing water and an absence of terrestrial vegetation within the channel. The open stream section was soft bottomed (dominated by fine materials) and approximately one meter wide at the entrance to the CMA. The upstream portion of the open channel was shaded by large indigenous and exotic trees.

Freshwater fish species may be present in the open stream channel described above. No records related to the stream are present on the New Zealand Freshwater Fish Database, however, species observed nearby such as longfin eel (*Anguilla dieffenbachii*), shortfin eel (*Anguilla australis*), inanga (*Galaxias maculatus),* redfin bully *(Gobiomorphus huttoni)* and others may occasionally utilise the habitat as there is unimpeded connection between the freshwater and marine environment. Due to the limited open habitat, the stream is not likely to be supporting a large fish population.

The proposed works are not expected to impact the above freshwater habitat or species and therefore have been excluded from the effects assessment in Section 6.

5.3 Marine habitats

5.3.1 Sandstone reef

Approximately 4,500 m^2 of sandstone reef was estimated within the 100 m radius around PS 23, bordering the Mean High Water Springs (MHWS) to the North and South of the PS 23 (Appendix A Figure.1). The eastern transect surveyed in the 2011 field assessment by BML was located within the sandstone reef habitat (Appendix C). Sandstone reefs generally support a diverse species assemblage including sea snails, seaweeds, sponges, crabs and shrimps, bivalves, polychaete worms, amphipods, chitons, echinoderms, sea squirts, barnacles, anemones and fish.

Photograph 5.1: Photos showing the sandstone reef present in the area surrounding PS 23 footprint.

5.3.2 Firm muddy fine sand flats

Firm muddy fine sand flats dominated the CMA adjacent to the site footprint, approximately 8,400 m^2 was estimated within the 100 m radius around PS 23 (Appendix A). These sandflats transitioned to soft gloopy mud further seaward. The western and central transects surveyed in the 2011 field assessment by BML were located with the area of firm muddy fine sand flat habitat (Appendix C). Firm muddy fine sand flats are common in the Auckland region and are highly productive (TP127, 1999). Sand flats support high diversity of intertidal organisms dependent on tidal level, including bivalves (i.e. shellfish), gastropods and polychaete worms (TP127, 1999).

Photograph 5.2: Photos showing the firm muddy fine sand flats present in the area surrounding PS 23 footprint.

5.3.3 Soft gloopy mud

Intertidal soft gloopy mud is present within the CMA, beginning approximately 50 m offshore, approximately 4,800 m^2 was estimated within the 100 m radius around PS 23 (Appendix A). Soft gloopy mud habitat is typically found in the upper arms of estuaries. Fauna diversity is relatively low within intertidal soft gloopy mud habitats due to the shallow redox later; species inhabiting these areas are typically limited to mud crabs and mud snails. Soft gloopy mud habitats originate as a result of increased sediment inputs from upstream, typically related to earthworks, erosion, intensive land uses (such as horticulture) or vegetation clearance.

5.3.4 Pacific Oysters

Approximately 131 m^2 of encrusting pacific oysters were estimated within the 100 m radius around PS 23 (Appendix A). Pacific oysters were located offshore adjacent to soft gloopy mud habitat (Photograph 5.3). Pacific oysters are commonly observed encrusting onto dead or live shells and can cover the substrate in places. Pacific oysters are not native to New Zealand but are now considered to be 'introduced and naturalised'.

Photograph 5.3: Pacific oyster beds present in the area surrounding PS 23 footprint.

5.4 Water quality

The Manukau Harbour is generally classified as degraded by Auckland Council (Carbines *et al.,* 2013). While the majority of the Manukau Harbour is classed as 'Degraded 2' by Auckland Council (an area where monitoring data shows a moderate level of degradation), the site location is within the 'Degraded 1' area, which is an area where monitoring data shows a high level of degradation. This classification is usually based on marine water quality, sediment quality and benthic health, however in this case, the degraded status of Manukau Harbour is determined based only on degraded water quality status.

Auckland Council routinely monitors coastal and estuarine water quality at eight sites within the Manukau Harbour, including the 'Māngere Bridge' site which is approximately 1,500 m from the project site. The most recent coastal and estuarine water quality annual report (Inlgey and Groom, 2022) notes the following:

- The Māngere Bridge site is characterised as 'Poor' using the Auckland Council Water Quality Index. This site had the lowest WQI score (19.5 out of 100) for all routinely monitored sites in Auckland;
- The 'Poor' water quality rating at Māngere Bridge is due to the high frequency of exceedances for nutrient parameters and chlorophyll *a*; and
- Turbidity was also elevated at Mangere Bridge for multiple months over the 2018-2020 period.

5.5 Sediment quality

Composite surface sediment samples were collected by BML in 2012 for the initial assessment of effects, and analysed for contaminants (total copper, lead, zinc, high molecular weight polycyclic aromatic hydrocarbons (HMW PAHs) and total organic carbon (TOC) and grain size (Boffa Miskell Limited, 2012).

Contaminant and grain size results from the BML samples and from the nearest Auckland Council monitoring site 'Hillsborough', which is approximately 100 m from Taylors Bay Road Reserve, and 300 m from the PS 23 site are discussed in Sections 5.5.1 and 5.5.2 below.

The transect locations sampled by BML are presented in Appendix C.

5.5.1 Contaminants

Contaminant concentrations found in surface sediment samples collected from the site (during the BML 2011 assessment) and the 'Hillsborough' site were compared to Auckland Council (AC) Environmental Response Criteria (ERC) and the Australian and New Zealand Environment and Conservation Council (ANZECC) sediment Default Guideline Value (DGV) (Table 5.1). The AC ERC assessment provides thresholds for assessing environmental quality in relation to stormwater and wastewater discharges. Sites in the 'green' category are considered low impact sites, while 'amber' sites show some signs of degradation and 'red' sites are higher impact sites where significant degradation has already occurred.[5]

Metal contaminants (copper, lead, zinc, arsenic and mercury) were all detected at concentrations below the Interim Sediment Quality Guidelines (ISQG)-low effects threshold concentrations for both BML and Hillsborough samples. HMW PAH concentrations were elevated at western (Transect W) and central transects (Transect C) in the BML assessment. HMW PAH concentrations were within the

[5] Auckland Regional Council (2004). *Blueprint for monitoring urban receiving environments.* Technical report 168 revised edition.

Auckland Regional Council Environmental Response Criteria (ARC ERC) Amber threshold range but below the ISQG-low threshold.

Overall, these results indicate that the site shows some signs of degradation which is typical of urban receiving environments, particularly in relation to HMW PAHs. However, there is likely a low risk of toxicity-related adverse effects as metal concentrations are below the ISQG-low thresholds.

5.5.2 Sediment grain size

Sediment composition of the samples from the three transects sampled in the BML assessment appear relatively similar. All sites were dominated by finer sediment classes, particularly silt and clay (32.1 – 51.6 %) and very fine sands (18.8 – 34.1 %). The western transect (Transect W) had the lowest proportions of larger substrates, with only 5.4 % of sediment comprising of coarse sand, very coarse sand and gravel. The central transect (Transect C) had the greatest proportion of large material, with 17.2 % gravel and an additional 11.2 % of coarse/very coarse sand. The eastern transect (Transect E) had the highest proportion of silt and clay. The Auckland Council Hillsborough site recorded median mud content was 17.5 % in 2021, this was lower than all three sites sampled in the 2011 BML assessment.

Overall, sediment composition in the vicinity of PS 23 shows signs of degradation from land use change and sediment loading to the Manukau Harbour. Typically mud content near PS 23 is between 30 and 60 % which can lead to unbalanced macrofaunal communities with low resilience (Robertson, 2016).[6]

Table 5.1: Intertidal sediment quality results from Auckland Council Hillsborough site and 2011 Boffa Miskell Limited assessment with Auckland Council Environmental Response Criteria (ERC) and ANZWQG (2018) Default Guideline Value for comparison.

Insert heading	AC Hillsborough (2021)	Boffa Miskell 2011 assessment			AC ERC Green	AC ERC Amber	DGV
		Transect W	Transect C	Transect E			
Copper (mg/kg dry weight)	6.1	9.8	12	9.7	< 19	19-34	65
Lead (mg/kg dry weight)	10.5	10.2	19.3	14.1	< 30	30-50	50
Zinc (mg/kg dry weight)	65	50	70	72	< 124	124-150	200
Arsenic (mg/kg dry weight)	9.3	-	-	-	-	-	20
Mercury (mg/kg dry weight)	0.02	-	-	-	-	-	0.15
HMW PAHs (mg/kg dry weight)	-	0.757	1.349	0.157	< 0.66	0.66-1.7	1.7
Total PAHs (µg/kg dry weight, 1% TOC)	-	1.21	2.28	0.27	-	-	4
Mud content (%)	17.5	46.5	32.1	51.6	-	-	-

[6] Robertson BM, Stevens L, Robertson B, Zeldis J, Green M, Madarasz-Smith A, Plew D, Storey R, Oliver M 2016. NZ Estuary Trophic Index Screening Tool 2. Determining Monitoring Indicators and Assessing Estuary Trophic State. Prepared for Envirolink Tools Project: Estuarine Trophic Index.

Note: Mud content is characterised as any silt or clay particles.

5.6 Benthic ecology

Auckland Council routinely monitors benthic ecology at six sites in the Manukau Harbour (Figure 5.1).[7] Benthic ecology monitoring focuses on surface sediment characteristics and macrofauna to assess the ecological health of intertidal sand and mud flats.

Combined health scores for Manukau Harbour sites range from 'excellent' to 'poor' with poor sites representing a more degraded ecological health. The closest sites to the project site are Mangere Cemetery to the East and Blockhouse Bay to the West. Blockhouse Bay has low mud content and a 'Good' combined health score while Mangere Cemetery site has high mud content and a 'Poor' benthic health score (Figure 5.1). The benthic communities at Mangere Cemetery are therefore likely to be in a degraded state. Because of the close proximity to the PS 23 site, the benthic communities in the vicinity of PS 23 may also be degraded.

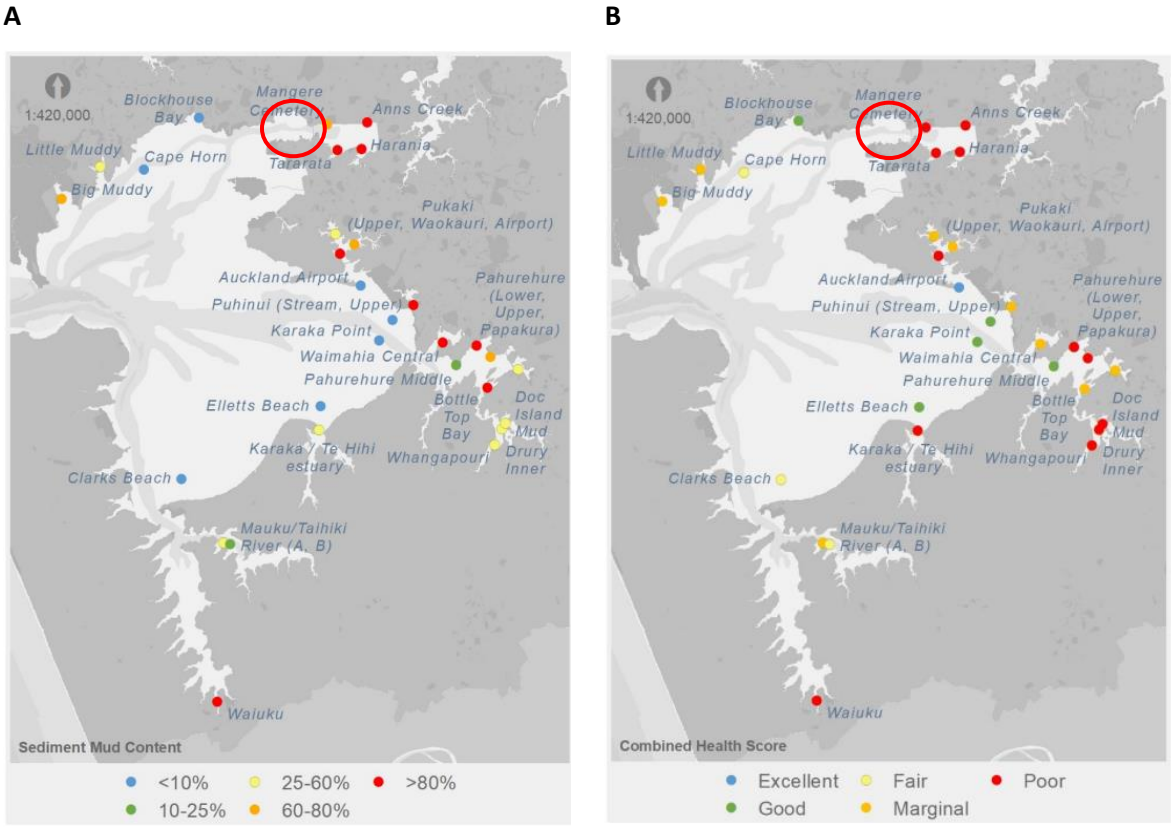


Figure 5.1: Most recent sediment mud content (2017-2019) (A) and combined benthic health score (2019) (B) for the Manukau Estuary benthic ecology sites (figure excerpt taken from Drylie (2021). The PS 23 site circled in red.

5.6.1 Infauna

BML collected infauna invertebrate samples at six locations in the CMA adjacent to the Site for the initial assessment of ecological effects (two samples were collected at each of the three transects

[7] An additional 24 Regional Sediment Contaminants Monitoring Programme (RSCMP) sites that have been monitored within the last five years are also presented on Figure 5.1.

presented on Appendix C) (Boffa Miskell Limited, 2012). The results from infauna cores suggested that the benthic community within the survey area was dominated by polychaetes, amphipods, gastropods and decapods. It is noted that the benthic community included both tolerant and sensitive organisms. No rare or threatened species were identified in the infauna samples.

The highest average abundance of taxa and mean species richness was recorded at the central transect (Transect C). The central transect samples were dominated by polychaetes (particularly the worm *Scolecolepides benhami* and juvenile *Nereidae*). No bivalve species were recorded in Transect C samples.

The lowest average abundance of taxa was recorded at the wester transect (Transect W). Species belonging to the decapoda, polychaeta and gastropoda groups dominated the samples from the western transect (Transect W). No bivalves or copepods were recorded in Transect W samples. Although average abundance was low at Transect W, mean species richness was high.

The eastern transect (Transect E) had slightly lower average abundance of taxa than Transect C. Dominant taxa included polychaetes, amphipoda and gastropoda. *Potamopyrgus estuarinus, Paracorophium* sp*., Scolecolepides behami* and *Neredidae* were the most common taxa in Transect E samples. Transect E recorded the lowest average species richness (5) yet the highest average Shannon Weiner Diversity Index (2.15).

Overall, the nearby AC sites and the BML results indicate that the benthic infauna community present in the vicinity of PS 23 is likely to be in a slightly degraded state.

5.6.2 Epifauna

Epifauna observations during Boffa Miksell Limited field surveys were dominated by *Zeacumantus lutulentus* (horn shell) and *Potamopyrgus estuarinus* (mud snail) (Boffa Miskell, 2012). Crab holes (a common proxy for crabs) were observed within several quadrats. Crab holes were absent in areas where the substrate was comprised of sandstone overlain by mud. No other epifauna observations were noted.

5.7 Fish

It is understood that the Manukau Harbour provides important habitat for fish species, including shelter and nursery grounds for bony fish, sharks and rays.

iNaturalist records from within Hillsborough Bay and nearby include Australasian snapper (*Chrysophrys auratus*), jack mackerel (*Trachurus symmetricus*), exquisite sandgoby (*Favonigobius exquisitus*) and yellow-eyed mullet (*Aldrichetta forsteri*) all of which ae commonly found species or recreationally consumed.

The Ministry for Primary Industries National Aquatic Biodiversity Information System (NABIS) database holds records of New Zealand species and indicative distribution and hot spots for fish species. The CMA adjacent to PS 23 was within the annual normal (90%) range of 41 fish species (Appendix D Table 1). Manukau Harbour was identified as a hot spot for grey mullet (*Mugil cephalus*), John dory (*Zeus faber*), rig (*Mustelus lenticulatus*), snapper (*Pagrus auratus*), spotted stargazer (*Genyagnus monopterygius*), yellow belly flounder (*Rhombosolea leporina*) and yellow-eyed mullet (*Aldrichetta forsteri*). The fish species identified spanned most categories (data deficient, unknown, not threatened, least concern, vulnerable) of the International Union for Conservation of Nature (IUCN) red list. Duffy *et al.* (2018) outlines the New Zealand threat classification for bony rays and sharks, within the Manukau Harbour one Threatened– Nationally Endangered species was identified (White Pointer Shark - *Carcharodon carcharias*).

In summary, a range of common fish species that are important ecologically and recreationally, are likely to utilise the coastal marine area in the vicinity of PS 23.

5.8 Biosecurity risk species

A targeted marine pest survey was conducted in Manukau Harbour by Auckland Council in 2019 (Tupe *et al.,* 2020). Surveys found the following species at/near the Port of Onehunga, which is closest survey location to the PS 223 site:

- Asian date mussel (*Arcuatula senhousia*);
- Spaghetti bryozoan (*Amathia verticillate*);
- Asian paddle crab (*Charybdis japonica*);
- Pink-mouthed hydroid (*Ectopleura crocea*);
- Pacific oyster (*Magallana gigas*);
- Ascidian (*Polyandrocarpa zorritensis*);
- Bivalve (*Theora lubrica*); and
- Burchard's dog whelk (*Tritia burchardi*).

These results indicate that several invasive and opportunistic species are likely to be present in the immediate vicinity of PS 23.

5.9 Coastal avifauna

The Manukau Harbour hosts a high diversity of coastal avifauna, including migratory waders. Numerous nationally 'At Risk' and 'Threatened' species rely on the Manukau Harbour for foraging resources and roosting habitat availability.

The variety of inter-tidal habitats surrounding PS 23 provide effective foraging habitat for coastal avifauna. Conversely, there is an absence of high-value high-tide roosting or nesting habitat availability at PS 23 due to housing or vegetation extending close to the MHWS. Prior to the development of the temporary platform at the Site, nationally At Risk – Declining tarāpunga/red-billed gulls were observed roosting in and around the built environment at PS 23 above the MHWS.

A total of ten coastal avifauna species were identified during field investigations, including nine indigenous species, of which four are classified as nationally At Risk (Table 5.2). Through desktop review, an additional eight species were considered likely to be utilising habitat in the vicinity of PS 23, including an additional two nationally 'Threatened' and six 'At Risk' species.

Coastal avifauna were primarily observed foraging within the inter-tidal habitats (Photograph 5.4), while both At Risk – Declining (Robertson *et al.*, 2021) tōrea/South Island oystercatcher (*Haematopus finschi*) and At Risk – Recovering tōrea pango/variable oystercatcher (*Haematopus unicolor*) were also observed roosting above the MHWS (during the high-tide avifauna survey). Avifauna were also observed roosting on existing structures in the inter-tidal zone (Photograph 5.5).

Table 5.2: Indigenous nationally 'At Risk' and 'Threatened' (Robertson *et al.,* 2021) coastal bird species likely to be present in the vicinity of PS 23.

Common name	Scientific name	Threat status	Observed on site*	iNaturalist	eBird
Tūturiwhatu/Northern NZ Dotterel	*Charadrius obscurus aquilonius*	At Risk - recovering		Y	Y
Tarāpunga/Red-billed gull	*Chroicocephalus novaehollandiae*	At Risk - declining	Y	Y	Y

Common name	Scientific name	Threat status	Observed on site*	iNaturalist	eBird
Matuku moana/Pacific reef heron	*Egretta sacra*	Threatened – Nationally Endangered			Y
Tōrea/South Island oystercatcher	*Haematopus finschi*	At Risk - declining	Y	Y	
Tōrea pango/Variable oystercatcher	*Haematopus unicolor*	At Risk - recovering	Y	Y	Y
Taranui/Caspian tern	*Hydroprogne caspia*	Threatened - nationally vulnerable			Y
Kuaka/Bar-tailed godwit	*Limosa lapponica baueri*	At Risk - declining			Y
Kawau tūī/Little black shag	*Phalacrocorax sulcirostris*	At Risk - Naturally uncommon		Y	Y
Kawaupaka/Little shag	*Phalacrocorax melanoleucos brevirostris*	At Risk - relict		Y	
Kāruhirhui/Pied shag	*Phalacrocorax varius varius*	At Risk - recovering		Y	
Kōtuku ngutupapa/Royal spoonbill	*Platalea regia*	At Risk - Naturally uncommon	Y	Y	Y
Tara/White-fronted tern	*Sterna striata striata*	At Risk - declining			Y

Note: * observed during site visits on 27 October 2021 and 18 May 2022.

Photograph 5.4: Nationally At Risk – Declining tarāpunga/red-billed gulls roosting and foraging in the inter-tidal zone during low tide in proximity to PS 23 (foreground). Juvenile Not Threatened poaka/pied stilt foraging in the background.

Photograph 5.5: Existing structure at PS 23 utilised by perching coastal birds karoro/southern black-backed gull (top of structure) and kōtare/sacred kingfisher (two individuals on the lower platform). Additional perching posts/vertical logs will be established to provide additional roosting sites for coastal avifauna at PS 23.

5.10 Wetland habitats

Vegetated wetlands were identified and delineated as per the Wetland Delineation Protocols (WDP). Vegetated wetlands and inter-tidal habitats are presented in Appendix A Figure.1. Vegetated

wetlands were located to the west of the 'Temporary structure'. The 'Temporary structure' footprint is the same as that of the proposed enhancement area. The 10 m and 100 m buffer zones are shown as they relate to consenting requirements in relation to the National Policy Statement for Freshwater Management (2020).

All identified wetlands passed both the Rapid Test and Prevalence Index. As per Step 3 of

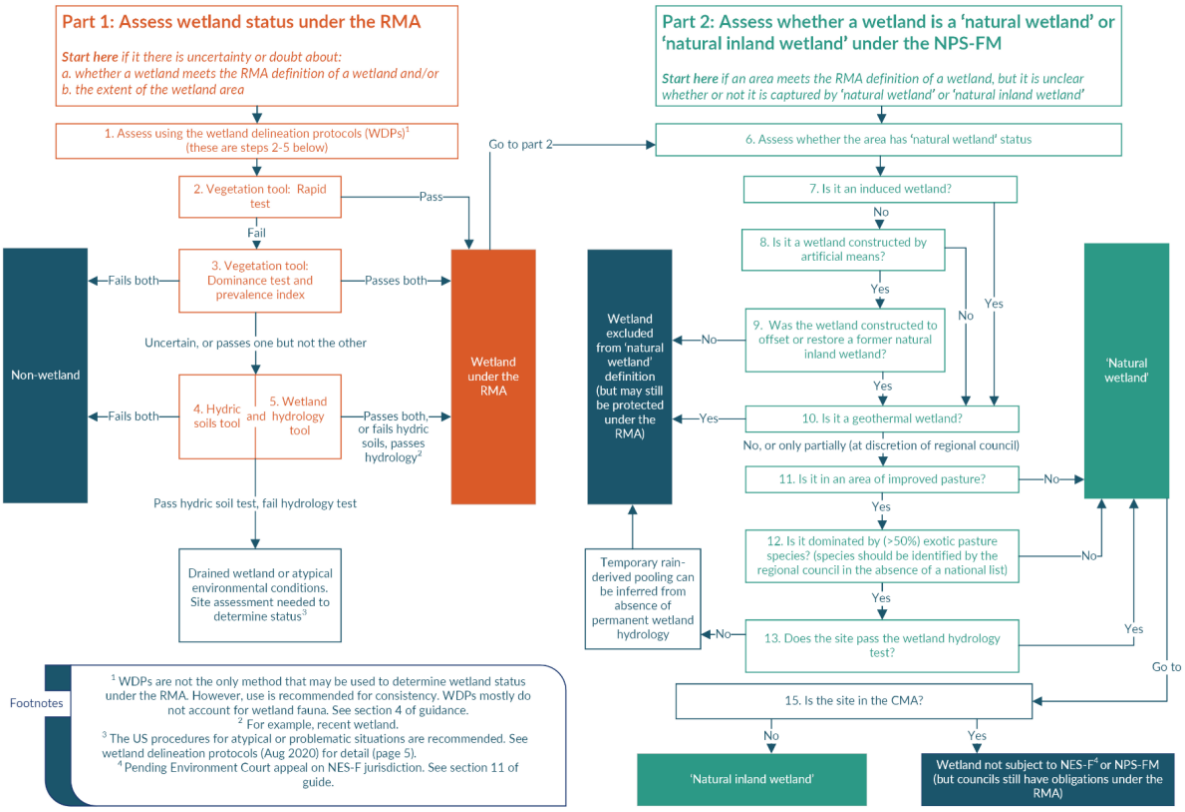


Figure 4.1, hydric soil and wetland hydrology tools were not necessary or undertaken on-site to determine potential wetland presence[8].

Due to the size of wetland extents, and due to vegetation density and height (most vegetation was of a short stature of approximately 1 m), wetlands were considered unsuitable for cryptic wetland avifauna (such as pūweto/spotless crake (*Porzana tabuensis*) or moho pererū/banded rail (*Gallirallus philippensis*)).

Refer to Appendix D for the WDP calculations and species summaries.

5.10.1 Mangrove (SA1.2)

A total of 16.4 m^2 of mangrove scrub (SA1.2)[9] occurred within 10 m and to the west of the proposed enhancement area, adjacent to a stream outfall and approximately at the Mean High Water Spring level (Appendix A Figure.1). Mangrove scrub comprised a monoculture of mangroves (*Avicinnia marina*) approximately 1 m tall. Mangrove scrub was situated adjacent to a herbfield (SA1.4 as described below). Mangroves are classified as Obligate wetland species (Clarkson *et al.*, 2021).

[8] Wetland hydrological primary indicators (surface water) were however noted in the SA1.2 mangrove scrub and SA1.4 herbfields, but absent from SA1.6 harakeke.

[9] Singers, N., Osborne, B., Lovegrove, T., Jamieson, A., Boow, J., Sawyer, J., Hill, K., Andrews, J., Hill, S., & Webb, C. (2017). Indigenous terrestrial and wetland ecosystems of Auckland. Auckland Council.

Due to a dominance of wet-adapted species (i.e. mangroves), this ecosystem passed the Rapid Test (and Dominance Test and Prevalence Index) indicating this area as a Natural Wetland with respect to Auckland Council's Practice and Guidance note.

Mangrove habitats are abundant throughout coastal environments across Manukau Harbour and are generally considered to be expanding in area. Mangrove scrub is classified as regionally 'Least Concern' (Singers *et al.*, 2017).

5.10.2 Herbfield (SA1.4)

Two discrete areas of coastal saline herbfields (SA1.4) were identified within 10 m and 100 m of the proposed enhancement area.

A total of 96.1 m^2 of herbfield occurred within 10 m of the proposed enhancement area, upslope of the SA1.2 mangrove scrub and atop a raised sand bed (Appendix A Figure.1). The herbfield was dominated by glasswort (*Salicornia quinqueflora*), sea primrose (*Samolus repens*), saltwater paspalum (*Paspalum vaginatum*) and sea rush (*Juncus kraussii subsp. australiensis*). These species are classified as Facultative Wetland (FACW) (Clarkson *et al.*, 2021) and likely to be found in wetlands (Appendix E Table 1 and Appendix E Table 2). Other species including bindweed (*Calystegia sepium* subsp*. roseata*), three-ribbed arrowgrass (*Triglochin striata*), buffalo grass (*Stenotaphrum secundatum*), orach (*Atriplex prostrata*), marsh clubrush (*Bolboschoenus fluviatilis*), *Isolepis sepulcralis,* cocksfoot (*Dactylis glomerata*) and mangrove seedlings.

Within 100 m of the proposed works approximately 4.8 m^2 of glasswort is also situated on constructed rock seawall (Appendix A Figure.1).

Due to a dominance of wet-adapted species, this ecosystem passed the Rapid Test (and Dominance Test and Prevalence Index) indicating this area as a Natural Wetland with respect to Auckland Council's Practice and Guidance note. Herbfields (SA1.4) are one of the variants of 'mangrove scrub' which is classified as regionally 'Least Concern'.

5.10.3 Harakeke (SA1.6)

Upslope of the larger herbfield a total of 25.9 m^2 of harakeke scrub occurred (Photograph 5.7, Appendix A Figure.1). This area was dominated by large (2.5 m) harakeke and introduced false papyrus (*Cyperus alternifolius* subsp*. flabelliformis*), with groundcovers including fire weed (*Haloragis erecta*), lotus (*Lotus pedunculatus*), oxalis (*Oxalis incarnata*), broad-leaved plantain (*Plantago major*), dock (*Rumex conglomeratus*) and vines including moth plant (*Arauijia sericifera*) and bindweed. A single Norfolk pine (*Araucaria heterophylla*) seedling was also present. The water source to this area is likely an overland flow path identified on Auckland Council GeoMaps[10] but also likely to be influenced by coastal processes (salt spray, and potentially tidal inundation during storms).

This ecosystem failed the Rapid Test (due to the presence of Norfolk pine seedling, an upland species) but passed the Dominance Test and Prevalence Index indicating this area as a Natural Wetland. Scrub or low forest of harakeke (SA1.6) are one of the variants of 'mangrove scrub' which is classified as regionally 'Least Concern'.

[10] https://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html

Photograph 5.6: Mangrove scrub, herbfield and harakeke wetland extents occur on the left-hand edge of the temporary platform in the above image.

Photograph 5.7: Glasswort and Samolus repens (foreground), transitioning to sea rush, with mangrove scrub to the right of the photograph, and harakeke and false papyrus in the background.

5.11 Ecological values assessment summary

The below ecological values assessment is based on the ecological characteristics and values described in Section 5.1 to Section 5.10 and according to EIANZ criteria (Appendix B Table 1 to Appendix B Table 4).

5.11.1 Marine habitats

Marine habitats for this assessment refer to those identified in Section 5.2 and values are assessed based on the collation of water quality, sediment quality, benthic ecology, fish and biosecurity risk species components. The footprint of construction works and the surrounding habitat have been assessed separately due to the differences in ecological values present.

As the current temporary structure occupies the construction footprint of the ecological enhancement works, previous marine habitats have been reclaimed and therefore the area is considered to have **negligible** ecological value.

With reference to Appendix B Table 4, which is used to assign values to estuarine and marine habitats based on a number of characteristics, the following characteristics of the CMA receiving environment surrounding PS 23 are noted:

- The benthic invertebrate communities at AC monitoring sites near the PS 23 site are classed as 'Good' (to the West) and 'Poor' (to the East), indicating that there is a range in benthic degradation in the Manukau Harbour. However, historic sampling at the site recognised diverse invertebrate community with high species richness (Boffa Miskell Limited, 2012).
- Marine sediments typically comprise < 50% silt and clay grain sizes.
- Contaminant concentrations in sediment rarely exceed low effects threshold concentrations.
- Few invasive opportunistic and disturbance tolerant species present.
- The habitat in the CMA receiving environment is largely modified, as the current temporary structure occupies the footprint of the ecological enhancement works.

When considering the above characteristics of the marine habitats in the CMA receiving environment, the habitat is considered to have **high** ecological value.

5.11.2 Coastal avifauna

The PS 23 coastal environment is considered to have a **very high** ecological value for coastal birds due to the presence of 18 species identified during site walkovers and through desktop assessment. Observations include two species that are classified as 'Threatened – nationally vulnerable' and ten species that are 'At Risk' (Robertson *et al.,* 2017). Table 5.3 further identifies ecological values for individual bird species present in the vicinity of PS 23.

Table 5.3: Ecological values assessment of coastal birds, based on Appendix B Table 1 for assigning value to species, for all coastal avifauna with a value of Moderate or higher.

Coastal bird species	Threat status	Ecological Value
Taranui/Caspian tern	Threatened - nationally vulnerable	Very High
Matuku moana/Pacific reef heron	Threatened – nationally endangered	Very High
Kuaka/Bar-tailed godwit	At Risk - declining	High
Tarāpunga/Red-billed gull	At Risk - declining	High
Tōrea/South Island oystercatcher	At Risk - declining	High
Tara/White-fronted tern	At Risk - declining	High
Kāruhiruhi/Pied shag	At Risk - recovering	Moderate
Tūturiwhatu/Northern NZ dotterel	At Risk - recovering	Moderate
Tōrea pango/Variable oystercatcher	At Risk - recovering	Moderate
Kawaupaka/Little shag	At Risk - relict	Moderate
Kōtuku ngutupapa/Royal spoonbill	At Risk - Naturally uncommon	Moderate
Kawau tūī/Little black shag	At Risk - Naturally uncommon	Moderate

5.11.3 Wetlands

Wetland habitat values have been assessed according to EIANZ criteria (Appendix B) for each wetland habitat identified within 100 m of the proposed works (Table 5.4):

- Mangrove (SA 1.2): Area rates Low for 3 of the assessment matters and Moderate for 1 of the assessment matters and is therefore considered of **low** ecological value.
- Herbfield (SA 1.4): Area rates Low for 2 of the assessment matters and Moderate for 2 of the assessment matters and is therefore considered of **moderate** ecological value.
- Harakeke (SA 1.6): Area rates Low for 3 of the assessment matters and Moderate for 1 of the assessment matters and is therefore considered of **low** ecological value.

Table 5.4: Wetland habitat assessment based on Ecological Impact Assessment guidelines (Appendix B).

Wetland habitat	Matters	Attributes considered	Value
Mangrove (SA 1.2)	Representativeness	Very small quantum of habitat availability, short stature mangroves provide limited cover for mangrove avifauna species.	Low
	Rarity/distinctiveness	Mangrove scrub is classified as regionally 'Least Concern' (Singers *et al.*, 2017). Not likely to provide permanent habitat to 'At Risk' or 'Threatened' species.	Low

	Diversity and pattern	Very small area of mangrove habitat available (16.4 m^2).	Low
	Ecological context	Contributes to a depauperate urban coastal environment, and buffers stream outlet.	Moderate
Herbfield (SA 1.4)	Representativeness	Typical structure and composition. Degradation due to invasive plant species. Nonetheless, indigenous herbfields are uncommon in highly urban coastal environments.	Moderate
	Rarity/distinctiveness	Ecosystem classified as regionally 'Least Concern' (Singers *et al.*, 2017). Not likely to provide permanent habitat to 'At Risk' or 'Threatened' species.	Low
	Diversity and pattern	Level of natural diversity low due to small size.	Low
	Ecological context	Contributes important ecological value to a depauperate urban coastal environment, and buffers stream outlet.	Moderate
Harakeke (SA 1.6)	Representativeness	Degraded structure and composition due to considerable invasion by exotic vegetation.	Low
	Rarity/distinctiveness	Ecosystem classified as regionally 'Least Concern' (Singers *et al.*, 2017). Not likely to provide permanent habitat to 'At Risk' or 'Threatened' species due to the small size of the area.	Low
	Diversity and pattern	Level of natural diversity low due to small size and abundance of introduced plant species.	Low
	Ecological context	Contributes important ecological value to a depauperate urban coastal environment, and buffers stream outlet.	Moderate

6 Assessment of ecological effects

This section presents an assessment of the actual and potential effects of the proposed works at PS 23 on wetland and marine ecological values as follows:

- Section 6.1: An overview of the potential positive effects as a result of the proposed works.
- Section 6.2: An overview of potential adverse effects of the proposed works.
- Section 6.3: Proposed effects management to address potential adverse effects.
- Section 6.4: An assessment of the magnitude of effects on ecology from the proposed works and the overall level of ecological effect. This is based on implementation of effects management as outline in Section 6.3.

6.1 Positive effects

Roosting sites in Auckland are under pressure from increased development, human-related disturbance and pest mammals, and the proposed roosting area aims to provision a roosting area for nationally 'At Risk' and 'Threatened' coastal avifauna. Furthermore, the PS 23 site retains little indigenous coastal vegetation – the creation of saltmarsh vegetation will provide improved coastal vegetation biodiversity values to the site.

Potential positive outcomes of the proposed enhancement include the following (subject to detailed design):

- An overall net gain in habitat value for coastal avifauna, including the establishment of foraging and roosting habitat for cryptic wetland birds (saltmarsh), and roosting habitat for coastal avifauna.

- The establishment of a high-tide roost site of approximately 170 m^2 which includes open spaces for waders and other shore birds, rocky outcrops of approximately 410 m^2 and approximately 22 standing timber log piles for perching avifauna (such as cormorants).
- The design of timber log piles includes both clustered piles for colony avifauna and individual piles for solitary avifauna. Logs have been designed away from the roosting platform and saltmarsh to prevent harassment of waders or rails by southern black-backed gulls.
- Saltmarsh vegetation will be comprised of indigenous eco-sourced (if available) vegetation and provide an additional seed-source for the uptake of indigenous vegetation in the wider environment.
- Saltmarsh habitat is expected to act as a buffer and filtering zone between the urban environment and the CMA.

The proposed construction works (except the timber log piles) will occur across the footprint of the existing 'Temporary structure' (Appendix A Figure.1) and therefore any adverse effects to the wider environment are largely avoided.

6.2 Potential adverse effects

The proposed ecological enhancement works at PS 23 are part of the Central Interceptor project and aims to restore the area where a temporary structure has been operating. The objective of the enhancements is to achieve coastal avifauna and coastal vegetation biodiversity gains within an urban environment.

While the aim of these works is to have an overall positive outcome for the wetland and marine receiving environment, it is acknowledged that during construction there may be adverse effects on ecology including:

- Potential construction phase discharges of sediment to the CMA and natural wetlands;
- Temporary noise and light-related disturbance effects on coastal birds during the construction phase; and
- Reduction in inter-tidal habitat quality for coastal avifauna as a result of sediment discharges to the CMA during construction phase.

6.3 Effects management

Measures to minimise the potential for adverse ecological effects will be implemented and may include:

- Implementation of an Erosion and Sediment Control Plan (ESCP) to prevent sedimentation effects. Erosion and sediment control will likely require the following measures:
  - Minimiinge areas of disturbance to those necessary to undertake construction.
  - Undertaking work in the intertidal zone "in the dry" around the lower stages of the tide window to avoid working within water.
  - Monitoring weather (tide, wind, wave) forecasts to ensure work areas are stabilised prior to any significantly inclement weather that may result in loss of sediment into the CMA.
  - Containing all supratidal (above MHWS) demolition and excavation within silt fence or behind rock sills.
- Construction equipment will access the site from the PS 23 entrance to avoid tracking over inter-tidal habitats.

- Access controls will be implemented to avoid, as far as practicable, personnel and/or equipment tracking over the foreshore. Where tracking over the foreshore is required to establish bird roosting log piles, measures outlined in the ESCP will be implemented to minimised disturbance to the environment.
- Construction works will avoid all direct impacts to existing vegetation extents (including vegetated wetland habitats).
- Timber piles have been placed to minimise southern black-backed gull disturbance to roosting waders and avifauna utilising the saltmarsh (such as moho pererū/banded rail (*Gallirallus philippensis*).
- Timber piles have been placed a minimum of 5 m from the boardwalk (to be implemented as part of a separate Auckland Council project) to minimise human-related disturbance to roosting avifauna.
- Signage may be established to minimise human-associated disturbance to the roost site.

Details of erosion and sediment controls will be finalised once the construction methodology is developed.

6.4 Magnitude and overall effects assessment

The 'Magnitude of Effects' on ecological values (Section 5.11) is assessed based on the extent, intensity, duration and timing of effects associated with the Project after efforts have been undertaken to avoid, remedy or mitigate effects.

6.4.1 Marine habitats

Potential adverse effects on the marine habitats (collating water quality, sediment quality, benthic ecology, fish and biosecurity risk species) surrounding PS 23 relate to the discharge of uncontrolled sediment to the CMA, during the construction phase, and subsequent effects on benthic ecology.

Construction works immediately adjacent to and within the CMA have the potential to cause uncontrolled discharge of sediment laden water if erosion and sediment controls are not implemented. This can have adverse effects on the marine receiving environment, including effects on filter feeding marine fauna, marine benthic communities and fish.

As detailed in Section 6.3, ESC measures will be implemented to minimise the discharge of sediment and/or other material to the CMA. It is expected that these management measures will be further outlined in the recommended ESCP. On this basis, the potential magnitude of effect on marine habitats from sediment discharge is expected to be **negligible** as has been the case with the current CI construction programme**.**

Potential **positive effects** on the marine habitats surrounding PS 23 include the creation of approximately 170 m^2 of high tide roost, approximately 410 m^2 of rock outcrop and approximately 320 m^2 of saltmarsh habitat (all subject to detailed design), to replace the temporary structure. The provision of saltmarsh habitat and a constructed roost will provide habitat for locally rare saltmarsh vegetation and roosting, perching and saltmarsh habitat for At Risk and Threatened bird species. Benefits to coastal birds is discussed further in Section 6.4.2 below.

With reference to the EIANZ framework, the magnitude of effect on marine habitats from the replacement of the temporary structure with a high tide roost and saltmarsh habitat is considered **positive.**

Based on the high value of marine habitats at the Site, the overall level of ecological effect, with reference to Appendix B Table 7, is **very low** to **net gain**.

6.4.2 Coastal avifauna

6.4.2.1 Potential adverse effects to coastal avifauna

Potential adverse effects on coastal birds in the vicinity of PS 23 from the proposed works include:

- Disturbance effects on coastal birds during construction (temporary effect), such as noise, light and mobilisation disturbance. Disturbance may increase escape flights and increased movement of coastal avifauna, resulting in increased energy demands on coastal birds;
- Reduction in foraging habitat quality and quantity for coastal avifauna as a result of increased sedimentation during construction; and
- Suspended sediment in the water column impacting on the visual foraging ability of birds feeding in the water column.

Disturbance effects on coastal avifauna are anticipated during the proposed ecological enhancement works at PS 23. The duration of these effects is expected to be temporary in nature, with the disturbance limited to the small project footprint (900 m^2). Works will take place at low – mid tide, at which point coastal avifauna will predominantly be found foraging in the intertidal soft mud habitat, close to the mean low water mark. The low water mark is approximately 250 – 300 m from the proposed footprint.

During the construction period, it is expected that birds will either be located far enough from the site that they will continue feeding, or that they will temporarily self-relocate to other intertidal feeding areas within the vicinity and wider Manukau Harbour if disturbed. On this basis, the magnitude of effect on coastal birds is considered to be temporary and **negligible.**

Potential effects on foraging habitat quality and quantity for waders might arise as a result of increased sediment discharges from the site during construction. The same can be said for impacts on birds feeding in the water column, where suspended sediment could potentially impact visual foraging ability. In both cases, ESCP implemented prior to works starting on site are expected to appropriately manage potential uncontrolled sediment discharges from the site. The magnitude of effect on foraging habitat for coastal birds is therefore **negligible.**

6.4.2.2 Potential positive effects to coastal avifauna

Potential **positive effects** on coastal avifauna in the vicinity of PS 23 from the proposed works include the provision of additional habitat which includes open roosting habitat, perching habitat and saltmarsh habitat.

Roosting habitat is expected to benefit numerous 'At Risk' and 'Threatened' coastal avifauna species (refer to Table 6.1) across a wide range of functional groups (Table 6.2). For instance, the open roost site will likely be used by waders such as tōrea/South Island pied oystercatcher, rocky outcrop and timber piles are expected to benefit perching species such as cormorants, while the saltmarsh habitat may encourage use by moho pererū/banded rail (*Gallirallus philippensis*). To date no cormorants have been observed during field investigations, but the creation of timber piles will encourage their return to the area.

Based on the **very high** value of coastal bird species potentially at the Site combined with a magnitude of effect between **negligible** and **positive**, the overall level of ecological effect on coastal birds, with reference to Appendix B Table 7, ranges from **low** to **net gain.**

Table 6.1: Nationally At Risk and Threatened species likely to benefit from the construction of the artificial roost, timber piles and saltmarsh habitat.

Coastal bird species	Threat status	Potential habitat use
Taranui/Caspian tern	Threatened - nationally vulnerable	Artificial roost, timber piles and rocky outcrop
Moho pererū/banded rail	At Risk – declining	Saltmarsh habitat
Kuaka/Bar-tailed godwit	At Risk - declining	Artificial roost
Tarāpunga/Red-billed gull*	At Risk - declining	Artificial roost, timber piles and rocky outcrop
Tōrea/South Island oystercatcher*	At Risk - declining	Artificial roost
Tara/White-fronted tern	At Risk - declining	Artificial roost, timber piles and rocky outcrop
Kāruhiruhi/Pied shag	At Risk - recovering	Timber piles and rocky outcrop
Tūturiwhatu/Northern NZ dotterel	At Risk - recovering	Artificial roost
Tōrea pango/Variable oystercatcher*	At Risk - recovering	Artificial roost
Kawaupaka/Little shag	At Risk - relict	Timber piles and rocky outcrop
Kōtuku ngutupapa/Royal spoonbill*	At Risk - Naturally uncommon	Artificial roost
Kawau tūī/Little black shag	At Risk - Naturally uncommon	Timber piles and rocky outcrop

Note: * observed roosting on-site and considered highly likely to utilise the artificial roost.

Table 6.2: Potential benefit of the proposed works to coastal avifauna functional groups.

Habitat enhancement	Functional group likely to benefit (*Order*/Family)
Artificial roost site	Waders (*Charadriiformes*), gulls/terns (Laridae), herons (Ardeidae), ducks (Anatidae), spoonbills (*Pelecaniformes*)
Timber piles and rocky outcrop	Gulls/terns (Laridae), cormorants (Phalacrocoracidae), kingfisher (Alcedinidae), herons (Ardeidae)
Saltmarsh vegetation	Rails (Rallidae). Most suitable for moho pererū/banded rail, but potentially other cryptic wetland rails such as pūweto/spotless crake (*Porzana tabuensis*).

6.4.3 Wetland habitats

Without avoidance, remedy or mitigation measures, the potential magnitude of effect on natural wetland habitats may be **moderate** due to an increase in sediment during construction phase resulting in a loss and/or change in vegetation composition.

However, the following measures will be implemented to reduce the magnitude of effect and potential sedimentation effects:

- Implementation of an Erosion and Sediment Control Plan (ESCP) to prevent sedimentation effects.
- The ESCP will include provisions to mitigate sediment run-off.
- Construction works will be undertaken at appropriate tide levels.

To date, the construction of a temporary works platform immediately adjacent to the wetland extents has not resulted in a noticeable adverse impact on these wetland habitats, and sediment

appears to have been successfully managed, Similar sediment management is expected to occur throughout the artificial roost construction works.

Therefore, the overall magnitude of effect on each wetland extent is considered to be **low** after efforts to avoid, remedy and mitigate potential adverse effects.

Furthermore, approximately 320 m^2 of constructed indigenous salt-marsh habitat will result in an overall **positive** effect with regard to the total quantum of indigenous vegetated wetland habitat in the local environment.

A **low to moderate** ecological value combined with a **low** to **positive** magnitude of effect results in an overall **very low** to **low** to **positive** overall level of effect.

6.5 Summary of effects assessment

Existing roosting values at the site are relatively low due to a limited extent of high-tide roosting habitat availability and perching habitat for coastal avifauna. Existing vegetated wetland habitats occur outside of the proposed enhancement works footprint and are degraded due to pest plant invasions.

The proposed works are expected to increase the quantum of open-space roosting habitat, rocky seawall roosting habitat, timber pile roosting and perching habitat, and indigenous coastal saltmarsh vegetation. Any potential adverse effects to the environment can be effectively managed as discussed in Section 6.3.

Proposed measures will not only provide habitat for existing coastal avifauna but may increase the carrying capacity of the site for coastal avifauna not detected at the site to date (such as cormorants and rails).

Overall, the proposed enhancement works are expected to result in an overall **net gain** in ecological values for marine habitats, coastal avifauna, and wetland habitats after efforts to avoid and mitigate effects.

7 Summary

Ecological enhancement works at PS 23 have the potential to result in long-term positive effects on wetland and marine habitats and particularly coastal birds with potential adverse effects to wetland and marine ecological values limited to the construction phase.

Ecological values in and around the proposed footprint range from **low** to **very high**. The ecological value, magnitude of effect and overall level of effects are outlined in Table 7.1.

The overall level of residual effects on ecological values ranges from **low** to **net gain** after efforts to avoid, remedy and mitigate adverse effects. Therefore, no further effects management measures over and above that outlined in this report are recommended. Overall, short term ecological effects have largely been avoided, remedied or mitigated and in the long-term the project is expected to result in a net gain.

Given the continued degradation of the coastal environment across the Tāmaki Makaurau/Auckland region, this project provides a unique opportunity to enhance the coastal environment to benefit a suite of coastal avifauna.

Table 7.1: Summary of ecological values, magnitude of effect and overall ecological effects on ecological values in the vicinity of proposed works at PS 23.

Habitat attribute / species	Ecological value	Magnitude of residual effect on ecological values*	Potential overall level of residual effect on ecological values*
Wetland habitats	**Low to moderate**	**Low**	**Very low to low, net gain**
Marine habitats of works footprint	**Negligible** based on the presence of the temporary structure occupying the works footprint	**Positive**	**Net gain**
Marine habitats of CMA receiving environment (collating water quality, sediment quality, benthic ecology and fish)	**High** based on: • Diverse benthic invertebrate community present; • Marine sediments comprise < 50 % silt and clay grain sizes; • Sediment contaminant concentrations low; • Few invasive and disturbance tolerant species present; and • Habitat in the site footprint is highly modified.	**Negligible to positive**	**Very low to net gain**
Coastal birds	**Very high** based on presence of Threatened and At Risk bird species (refer to individual threat status in Appendix F Table **1**).	**Negligible to positive**	**Low to net gain**

Note: * After measures to avoid, remedy or mitigate effects

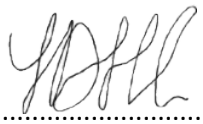
8 Applicability

This report has been prepared for the exclusive use of our client Watercare Services Limited, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client will submit this report as part of an application for resource consent and that Auckland Council as the consenting authority will use this report for the purpose of assessing that application.

Tonkin & Taylor Ltd
Environmental and Engineering Consultants

Report prepared by:



.....

Sam Heggie-Gracie
Ecology Consultant

Authorised for Tonkin & Taylor Ltd by:

P.P 

.....

Karen Baverstock
Project Director

.....

Kate Rogers

Ecology Consultant

Technical review by Dr Liz Curry (Senior Terrestrial Ecologist) and Dean Miller (Principal Environmental Scientist)

S Heggie-Gracie
\\ttgroup.local\corporate\auckland\projects\1015172\1015172.1600 - ps 23 bird roost\workingmaterial\aee\appendices\appendix d assessment of ecological effects report\20221004 final ecological asssessment - finalbis.docx

9 References

Auckland Council. Geomaps viewer – Significant Ecological Areas layer.

Auckland Council (2022). Practice and Guidance note. Managing Natural Wetlands under the National Environmental Standards for Freshwater Regulations 2020.

Auckland Regional Council (2004). Blueprint for monitoring urban receiving environments. Technical publication 168 (revised edition).

Auckland Regional Council (2009). *Environmental condition and values of Manukau Harbour* (No. 112, pp. 1179-0512). Technical report.

Auckland Unitary Plan – Operative in Part, Schedule 3 Significant Ecological Areas – Terrestrial Schedule.

Auckland Unitary Plan – Operative in Part, Schedule 4 Significant Ecological Areas – Marine Schedule.

Auckland Unitary Plan – Operative in Part, Schedule 6 Outstanding Natural Features Overlay Schedule.

Boffa Miskell Limited (2012). Central Interceptor Project: Assessment of Ecological Effects Assoicated with the Central Interceptor Project.

Carbines, M., Walker, J., Cameron, M., and Vaughan, M. (2013) Identification of degraded marine receiving environments – Draft report

Clarkson B.R, Fitzgerald N.B, Champion P.D, Forester L, Rance B.D (2021). New Zealand wetland plant list 2021. Manaaki Whenua - Landcare Research contract report LC3975 for Hawke's Bay Regional Council.

Drylie, T P (2021). Marine ecology state and trends in Tāmaki Makaurau / Auckland to 2019. State of the environment reporting. Auckland Council technical report, TR2021/09

E-bird, an open-source citizen science bird observation platform.

iNaturalist database (iNaturalist.org).

Ingley, R., J. Groom (2022). Coastal and estuarine water quality in Tāmaki Makaurau / Auckland: 2020 annual data report. Auckland Council technical report, TR2022/20

Ingley, R (2021). Coastal and estuarine water quality state and trends in Tāmaki Makaurau / Auckland 2010-2019. State of the environment reporting. Auckland Council technical report, TR2021/02

Johnson, P. & Gerbeaux, P. (2004). Wetland Types in New Zealand. Department of Conservation.

Landcare Research (2013). A vegetation tool for wetland delineation in New Zealand. Beverly R Clarkson. Prepared for Meridian Energy Limited.

Landcare Research (2018). Hydric soils – field identification guide. Enivrolink Grant: C09X1702.

Ministry for the Environment (2020). Wetland delineation protocols. Wellington: Ministry for the Environment.

Ministry for the Environment (2021). Draft essential freshwater interpretation guidance: wetlands definitions. Draft 7 April 2021.

Ministry for Primary Industries marine biosecurity porthole (www.marinebiosecurity.org.nz/).

Ministry for the Environment (2021). Defining ‘natural wetlands’ and ‘natural inland wetlands’. Wellington: Ministry for the Environment.

National Aquatic Biodiversity Information System (http://www.nabis.govt.nz/) (Data retrieved 26/08/2021).

Ministry for the Environment. (2021). Wetland delineation hydrology tool for Aotearoa New Zealand. Wellington: Ministry for the Environment.

Robertson BM, Stevens L, Robertson B, Zeldis J, Green M, Madarasz-Smith A, Plew D, Storey R, Oliver M 2016. NZ Estuary Trophic Index Screening Tool 2. Determining Monitoring Indicators and Assessing Estuary Trophic State. Prepared for Envirolink Tools Project: Estuarine Trophic Index.

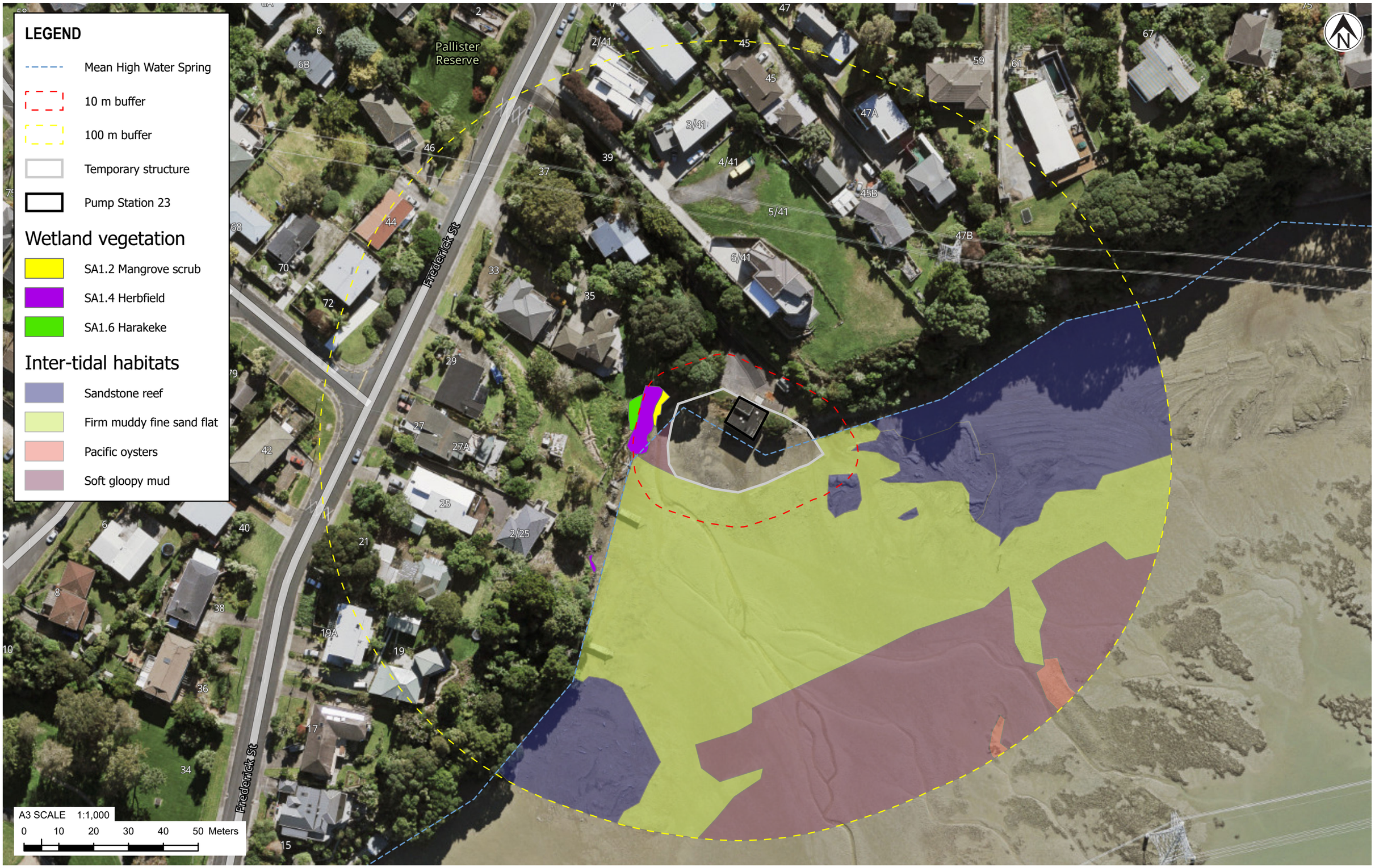
Singers, N., Osborne, B., Lovegrove, T., Jamieson, A., Boow, J., Sawyer, J., Hill, K., Andrews, J., Hill, S., & Webb, C. (2017). Indigenous terrestrial and wetland ecosystems of Auckland. Auckland Council.

Tupe, M., C Woods, S Happy and C Boyes (2020). Manukau Harbour targeted marine pest survey May 2019. Auckland Council technical report, TR2020/003

Appendix A Site Figures

Appendix A Figure.1: Habitat Map

P:\1015172\1015172.1600 - PS 23 Bird roost\WorkingMaterial\01 Ecological assessment\03 GIS\00 Mapspace\Fig 1 P1015172.1600 PS23 Wetland Map.aprx Layout: PS23 bird roost wetland map 2022-Jun-27 12:18 pm Drawn by SHEG



Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

NOTES:

Basemap NZ Hybrid Reference (Vector): Eagle Technology, LINZ, StatsNZ, NIWA, Natural Earth, © OpenStreetMap contributors.. NZ Navigation Map: Eagle Technology, LINZ, StatsNZ, NIWA, Natural Earth, © OpenStreetMap contributors.. NZ Imagery: Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors

REV	DESCRIPTION	GIS	CHK	DATE
0	First version	SHEG	ANTH	20/5/22

LOCATION PLAN

PROJECT No.	1015172.1600	
DESIGNED	SHEG	JUN.22
DRAWN	SHEG	JUN.22
CHECKED	ANTH	JUN.22
APPROVED		DATE

CLIENT **WATERCARE SERVICES LIMITED**

PROJECT **CI - PS23 BIRD ROOST DESIGN**

TITLE WETLAND DELINEATION

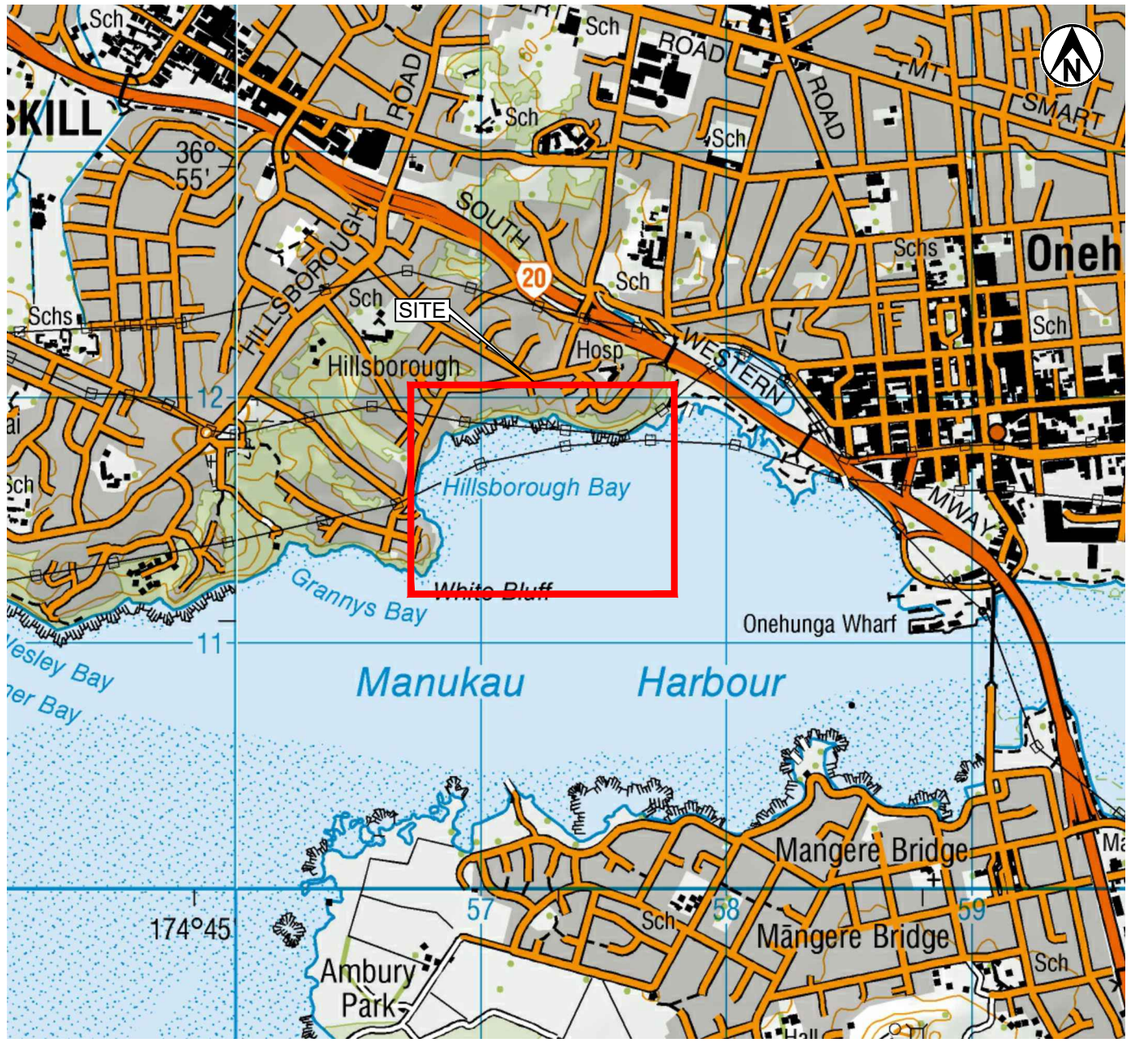
SCALE (A3) 1:1,000 FIG No. FIGURE 1. REV 0

Appendix A Figure.2: Artificial roost design

\\ttgroup.local\files\AKLProjects\1015172\1015172.1600 - PS 23 Bird roost\WorkingMaterial\Stage 2 - resource consenting (concept 3)\Task 1 - CAD\new\1015172.1600-000.dwg 2022-Oct-07 10:53:50 am Plotted By: CHARLIE LI

WATERCARE SERVICES LIMITED
PUMP STATION 23 ECOLOGICAL ENHANCEMENT
Draft Consent Level Design Issue

DRAWING	Rev	Title
• 1015172.1600-000	1	DRAWING LIST AND LOCALITY PLAN
• 1015172.1600-001	1	EXISTING LAYOUT
• 1015172.1600-002	1	PROPOSED LAYOUT
• 1015172.1600-003	1	PROPOSED SECTIONS - SHEET 1 OF 2
• 1015172.1600-004	1	PROPOSED SECTIONS - SHEET 2 OF 2



TOPOMAP SOURCED FROM LINZ DATA SERVICE <https://data.linz.govt.nz/layer/50767-nz-topo50-maps/> , LICENSED BY LINZ FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 NEW ZEALAND LICENCE (CC BY 4.0). ACCESSED 09/08/2022.

LOCALITY PLAN
SCALE 1:25,000

• Denotes drawing this issue: 07/10/2022

A3 SCALE 1:25000
0 0.5 1.0 1.5 (km)
ORIGINAL IN COLOUR

Tonkin+Taylor
Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE
1	DRAFT CONSENT LEVEL DESIGN ISSUE	CHLI	PWQ	07.10.22

DESIGNED	COVA	Aug.22
DRAWN	CHLI	Aug.22
DESIGN CHECKED	PWQ	Oct.22
DRAWING CHECKED	JC	Oct.22

DRAWING STATUS: DRAFT CONSENT LEVEL DESIGN

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

APPROVED DATE

CLIENT WATERCARE SERVICES LIMITED
PROJECT PUMP STATION 23 ECOLOGICAL ENHANCEMENT
TITLE ECOLOGICAL ENHANCEMENT WORKS
DRAWING LIST AND LOCATION PLAN
SCALE (A3) 1:25000 DWG No. 1015172.1600-000 REV 1

\\ttgroup.local\files\AKLProjects\1015172\1015172.1600 - PS 23 Bird roost\WorkingMaterial\Stage 2 - resource consenting (concept 3)\Task 1 - CAD\new\1015172.1600-001.dwg 2022-Oct-07 10:54:31 am Plotted By: CHARLIE LI

NOTES:
1. COORDINATE SYSTEM IS IN NEW ZEALAND TRANSVERSE MERCATOR (NZTM2000).
2. LEVELS ARE IN METRES RELATIVE TO AUCKLAND VERTICAL DATUM 1946 (AVD46).
3. CONTOURS EXISTING SERVICES SOURCED FROM LAND AND SURVEY LTD (N.D.).
4. AERIAL SOURCED FROM GOOGLE EARTH (2022).

LEGEND

- EXISTING MAJOR CONTOURS FROM LANDS AND SURVEY LTD (1m INTERVALS)
- EXISTING CONTOURS FROM LANDS AND SURVEY LTD (0.1m INTERVALS)
- EXISTING CONTOURS (LINZ LiDAR (2013)
- WATERCARE DESIGNATIONS
- TOP OF BATTER OF TEMPORARY CONSTRUCTION PLATFORM
- BOTTOM OF BATTER OF TEMPORARY CONSTRUCTION PLATFORM
- PROPERTY BOUNDARIES
- STORMWATER WATER COURSE
- MHWS LINE (1.9 m AVD46)
- EDGE OF ROCK
- BUILDING EXTENT
- EXISTING STORMWATER MANHOLE
- EXISTING WASTEWATER MANHOLE
- EXISTING CESSPIT
- EXISTING STAKES
- EXISTING DRAINAGE CULVERT
- SS SS EXISTING SANITARY SEWER LINES
- SW SW EXISTING STORMWATER LINES

PUMP STATION 23

WASTEWATER CHAMBER TRANSMISSION

EDGE OF ROCK

WATER COURSE - INDICATIVE ALIGNMENT

A3 SCALE 1:500
0 5 10 15 20 25 (m)

ORIGINAL IN COLOUR

Tonkin+Taylor
Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE
1	DRAFT CONSENT LEVEL DESIGN ISSUE	CHLI	PWQ	07.10.22

DESIGNED	COVA	Aug.22
DRAWN	CHLI	Aug.22
DESIGN CHECKED	PWQ	Oct.22
DRAWING CHECKED	JC	Oct.22

DRAWING STATUS: DRAFT CONSENT LEVEL DESIGN

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

APPROVED DATE

CLIENT WATERCARE SERVICES LIMITED

PROJECT PUMP STATION 23 ECOLOGICAL ENHANCEMENT

TITLE ECOLOGICAL ENHANCEMENT WORKS EXISTING LAYOUT

SCALE (A3) 1:500 DWG No. 1015172.1600-001 REV 1

\\ttgroup.local\files\AKLProjects\1015172\1015172.1600 - PS 23 Bird roost\WorkingMaterial\Stage 2 - resource consenting (concept 3)\Task 1 - CAD\new\1015172.1600-002_01.dwg 2022-Oct-07 10:55:58 am Plotted By: CHARLIE LI

NOTES:
1. COORDINATE SYSTEM IS IN NEW ZEALAND TRANSVERSE MERCATOR (NZTM2000).
2. LEVELS ARE IN METRES RELATIVE TO AUCKLAND VERTICAL DATUM 1946 (AVD46).
3. CONTOURS SOURCED FROM LAND AND SURVEY LTD (N.D.).
4. AERIAL SOURCED FROM GOOGLE EARTH (2022).

LEGEND

- EXISTING STORMWATER MANHOLE
- EXISTING WASTEWATER MANHOLE
- EXISTING CESSPIT
- LOG PILES (INDICATIVE)
- PROPOSED SALT MARSH VEGETATION
- PROPOSED ROCK SILL
- PROPOSED BIRD ROOST

LEGEND

- EXISTING MAJOR CONTOURS FROM LANDS AND SURVEY LTD (1m INTERVALS)
- EXISTING CONTOURS FROM LANDS AND SURVEY LTD (0.1m INTERVALS)
- EXISTING CONTOURS (LINZ LiDAR (2013)
- WATERCARE DESIGNATIONS
- TOP OF BATTER OF TEMPORARY CONSTRUCTION PLATFORM
- BOTTOM OF BATTER OF TEMPORARY CONSTRUCTION PLATFORM
- PROPERTY BOUNDARIES
- STORMWATER WATER COURSE
- MHWS LINE (1.9 m AVD46)
- EDGE OF ROCK
- BUILDING EXTENT
- PROPOSED ROCK CREST EXTENT
- PROPOSED ROCK TOE EXTENT
- PROPOSED ROCK REVETMENT (CI WORKS)
- EXISTING SANITARY SEWER LINES
- EXISTING STORMWATER LINES

PROPOSED DIVERSION CHAMBER (CI WORKS)

PROPOSED SHAFT (CI WORKS)

PROPOSED ROCK REVETMENT CREST (CI WORKS)

BIRD ROOST PLANTING PROTECTED BY ROCK SILL (REFER DRAWING 1015172.1600-004, SECTION 3)

TIE IN DETAILS TBC IN DETAILED DESIGN

TIE IN DETAILS TBC IN DETAILED DESIGN

FUTURE BOARDWALK - BY OTHERS

ROCK SILL SURROUNDING BIRD ROOST (REFER DRAWING 1015172.1600-003, SECTION 1)

1.5m MINIMUM OFFSET DISTANCE BETWEEN SERVICE AND ROCK PLACEMENT

ROCK SILL SURROUNDING SALT MARSH PLANTING (REFER DRAWING 1015172.1600-003, SECTION 2)

INDIVIDUAL LOG PILES FOR SOLITARY ROOSTING SPECIES. DEMOLITION HARDWOOD TO BE USED FOR PILES. PILE SIZE AND LENGTH TBC IN DETAILED DESIGN. CAST IN OVERSIZED HOLE WITH CONCRETE SURROUND.

CLUSTERED LOG PILES FOR COLONY ROOSTING SPECIES. DEMOLITION HARDWOOD TO BE USED FOR PILES. PILE SIZE AND LENGTH TBC IN DETAILED DESIGN. CAST IN OVERSIZED HOLE WITH CONCRETE SURROUND.

SALT MARSH PLANTING PROTECTED BY ROCK SILL (REFER DRAWING 1015172.1600-004, SECTION 3)

SOLID PIPE EXTENSION OF STORMWATER OUTFALL THROUGH SALT MARSH. PIPE TO BE INTEGRATED THROUGH ROCK SILL.

WATER COURSE - INDICATIVE ALIGNMENT

A3 SCALE 1:500
0 5 10 15 20 25 (m)
ORIGINAL IN COLOUR

Tonkin+Taylor
Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE
1	DRAFT CONSENT LEVEL DESIGN ISSUE	COVA	PWQ	07.10.22

DESIGNED	COVA	Aug.22	DRAWING STATUS: DRAFT CONSENT LEVEL DESIGN
DRAWN	COVA	Aug.22	
DESIGN CHECKED	PWQ	Oct.22	
DRAWING CHECKED	JC	Oct.22	

NOT FOR CONSTRUCTION

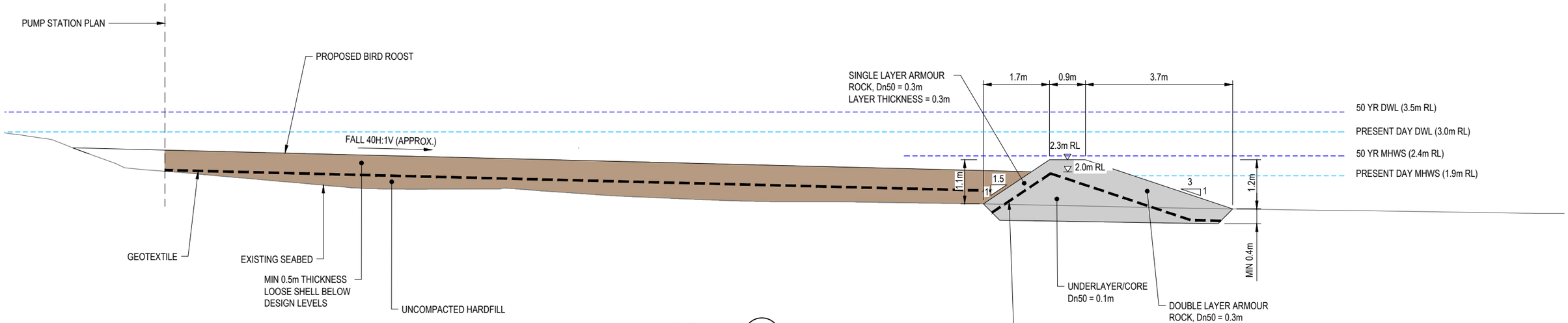
THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

APPROVED DATE

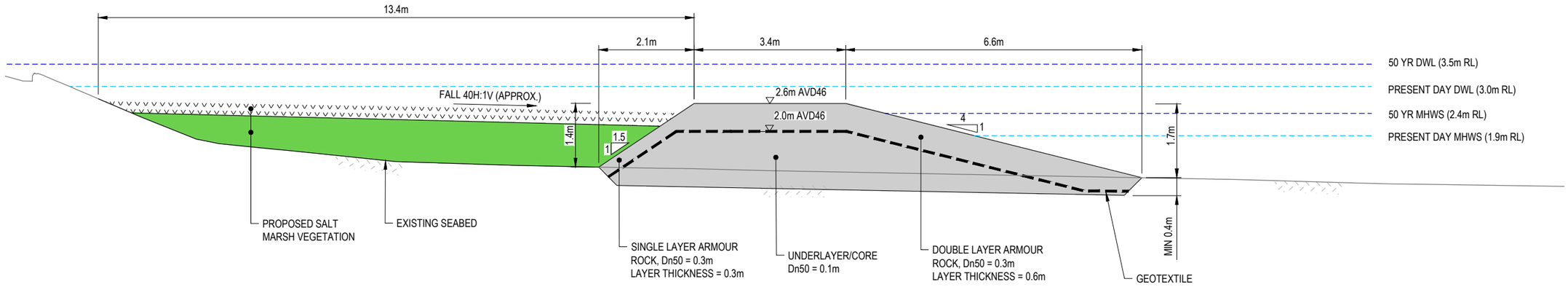
CLIENT: WATERCARE SERVICES LIMITED
PROJECT: PUMP STATION 23 ECOLOGICAL ENHANCEMENT
TITLE: ECOLOGICAL ENHANCEMENT WORKS PROPOSED LAYOUT
SCALE (A3): 1:500 DWG No. 1015172.1600-002 REV 1

\\ttgroup.local\files\AKLProjects\1015172\1015172.1600 - PS 23 Bird roost\WorkingMaterial\Stage 2 - resource consenting (concept 3)\Task 1 - CAD\new\1015172.1600-003-004_02.dwg 2022-Oct-07 10:57:12 am Plotted By: CHARLIE LI

NOTES:
1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. LEVELS ARE IN METRES RELATIVE TO AUCKLAND VERTICAL DATUM 1946 (AVD46).
3. ECOLOGICAL ENHANCEMENT EXTENTS AND LOCATION CONCEPT ONLY, SUBJECT TO CHANGE DURING DETAILED DESIGN.



SECTION 1/002
SCALE 1:100



SECTION 2/002
SCALE 1:100

A3 SCALE 1:100
0 1 2 3 4 5 (m)

ORIGINAL IN COLOUR

Tonkin+Taylor
Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE
1	DRAFT CONSENT LEVEL DESIGN ISSUE	COVA	PWQ	07.10.22

DESIGNED	COVA	Aug.22
DRAWN	COVA	Aug.22
DESIGN CHECKED	PWQ	Oct.22
DRAWING CHECKED	JC	Oct.22

DRAWING STATUS: DRAFT CONSENT LEVEL DESIGN

NOT FOR CONSTRUCTION

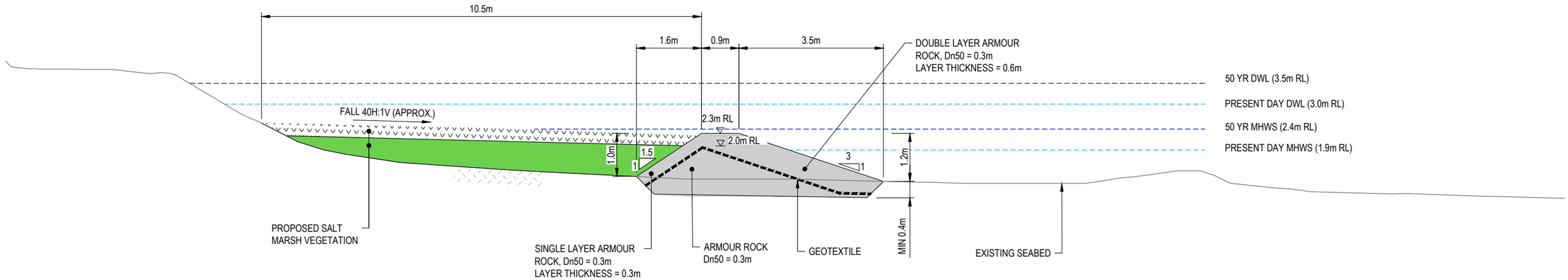
THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

APPROVED DATE

CLIENT **WATERCARE SERVICES LIMITED**
PROJECT **PUMP STATION 23 ECOLOGICAL ENHANCEMENT**
TITLE ECOLOGICAL ENHANCEMENT WORKS PROPOSED SECTIONS - SHEET 1 OF 2
SCALE (A3) 1:100 DWG No. 1015172.1600-003 REV 1

\\ttgroup.local\files\AKLProjects\1015172\1015172.1600 - PS 23 Bird roost\WorkingMaterial\Stage 2 - resource consenting (concept 3)\Task 1 - CAD\new\1015172.1600-003-004_02.dwg 2022-Oct-07 10:57:24 am Plotted By: CHARLIE LI

NOTES:
1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. LEVELS ARE IN METRES RELATIVE TO AUCKLAND VERTICAL DATUM 1946 (AVD46).
3. ECOLOGICAL ENHANCEMENT EXTENTS AND LOCATION CONCEPT ONLY, SUBJECT TO CHANGE DURING DETAILED DESIGN.



SECTION 3/002
SCALE 1:100

A3 SCALE 1:100
0 1 2 3 4 5 (m)

ORIGINAL IN COLOUR

Tonkin+Taylor
Exceptional thinking together www.tonkintaylor.co.nz

REV	DESCRIPTION	CAD	CHK	DATE
1	DRAFT CONSENT LEVEL DESIGN ISSUE	COVA	PWQ	07.10.22

DESIGNED	COVA	Aug.22
DRAWN	COVA	Aug.22
DESIGN CHECKED	PWQ	Oct.22
DRAWING CHECKED	JC	Oct.22

DRAWING STATUS: DRAFT CONSENT LEVEL DESIGN

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

APPROVED DATE

CLIENT **WATERCARE SERVICES LIMITED**
PROJECT **PUMP STATION 23 ECOLOGICAL ENHANCEMENT**
TITLE ECOLOGICAL ENHANCEMENT WORKS
PROPOSED SECTIONS - SHEET 2 OF 2
SCALE (A3) 1:100 DWG No. 1015172.1600-004 REV 1

Appendix B Ecological Impact Assessment Guideline Tables

Appendix B Table 1: Criteria for assigning ecological value to species

Ecological Value	Species
Very High	Nationally Threatened species (Nationally Critical, Nationally Endangered, Nationally Vulnerable) found in the ZOI either permanently or seasonally.
High	Nationally At Risk – Declining, found in the ZOI either permanently or seasonally.
Moderate	Species listed as any other category of At Risk, found in the ZOI either permanently or seasonally.
Low	Nationally and locally common indigenous species.
Negligible	Exotic species, including pests, species having recreational value.

Note: *In this case the Zone of Influence (ZOI) refers to all estuarine and marine water bodies and receiving environments that could be potentially impacted by the Project.

Appendix B Table 2: Ecological values assigned to habitats (adapted from EIANZ, 2018).

Attributes to be considered when assigning ecological value or importance to a site or area of vegetation/habitat/community.	
Matters	**Attributes to be considered**
Representativeness	Attributes for representative vegetation and aquatic habitats: • Typical structure and composition • Indigenous species dominate • Expected species and tiers are present Attributes for representative species and species assemblages: • Species assemblages that are typical of the habitat Indigenous species that occur in most of the guilds expected for the habitat type
Rarity/distinctiveness	Attributes for rare/distinctive vegetation and habitats: • Naturally uncommon, or induced scarcity • Amount of habitat or vegetation remaining • Distinctive ecological features • National priority for protection Attributes for rare/distinctive species or species assemblages: • Habitat supporting nationally Threatened or At Risk species, or locally uncommon species • Regional or national distribution limits of species or community • Unusual species or assemblages Endemism
Diversity and Pattern	• Level of natural diversity, abundance and distribution • Biodiversity reflecting underlying diversity • Biogeographical considerations – pattern, complexity Temporal considerations, considerations of lifecycles, daily or seasonal cycles of habitat availability and utilisation
Ecological context	• Site history, and local environmental conditions which have influenced the development of habitats and communities • The essential characteristics that determine an ecosystem's integrity, form, functioning, and resilience (from "intrinsic value" as defined in RMA) • Size, shape and buffering • Condition and sensitivity to change • Contribution of the site to ecological networks, linkages, pathways and the protection and exchange of genetic material • Species role in ecosystem functioning – high level, key species identification, habitat as proxy

Appendix B Table 3: Scoring for sites or areas combining values for four matters in Appendix B Table 1.

Value	Description
Very High	Area rates High for 3 or all of the four assessment matters listed in Table 4. Likely to be nationally important and recognised as such.
High	Area rates High for 2 of the assessment matters, Moderate and Low for the remainder, or Area rates High for 1 of the assessment maters, Moderate for the remainder. Likely to be regionally important and recognised as such.
Moderate	Area rates High for one matter, Moderate and Low for the remainder, or Area rates Moderate for 2 or more assessment matters Low or Very Low for the remainder Likely to be important at the level of the Ecological District.
Low	Area rates Low or Very Low for majority of assessment matters and Moderate for one. Limited ecological value other than as local habitat for tolerant native species.
Negligible	Area rates Very Low for 3 matters and Low or Very Low for remainder.

Appendix B Table 4: Characteristics of estuarine and marine areas/habitats and associated ecological values[11]

Ecological Value	Characteristics
Very High	• Benthic invertebrate community typically has very high diversity, species richness and abundance. • Benthic invertebrate community is dominated by taxa that are sensitive to organic enrichment and mud. • Marine sediments typically comprise < 25% silt and clay grain sizes (mud). • Surface sediment oxygenated with no anoxic sediment present. • Annual average sedimentation rates typically less than 1 mm above background levels. • Contaminant concentrations in surface sediment significantly below ISQG-low and AC ERC-Orange effects threshold concentrations[12]. • Water column contaminant values typically at or better than ANZWQG 99% species protection level. • Fish community typically has very high diversity, species richness and abundance. • Invasive opportunistic and disturbance tolerant species absent. • Vegetation likely to be nationally important and recognised as such. • Macroalgae sequences intact and provides significant habitat for native fauna. • Habitat unmodified.
High	• Benthic invertebrate community typically has high diversity, species richness and abundance. • Benthic invertebrate community contains many taxa that are sensitive to organic enrichment and mud. • Marine sediments typically comprise < 50% silt and clay grain sizes. • Surface sediment oxygenated. • Annual average sedimentation rates typically less than 2 mm above background levels. • Contaminant concentrations in surface sediment rarely exceed ISQG-low and AC ERC-Orange effects threshold concentrations. • Water column contaminant values typically between ANZWQG 95% and 99% species protection levels. • Fish community typically has high diversity, species richness and abundance. • Invasive opportunistic and disturbance tolerant species largely absent. • Vegetation likely to be regionally important and recognised as such. • Macroalgae provides significant habitat for native fauna. • Habitat largely unmodified.
Moderate	• Benthic invertebrate community typically has moderate species richness, diversity and abundance. • Benthic invertebrate community has both tolerant and sensitive taxa to organic enrichment and mud present. • Marine sediments typically comprise < 75% silt and clay grain sizes.

[11] Note that the characteristics of marine and estuarine sites with ecological values have been developed by Dr Sharon De Luca, Boffa Miskell Ltd, to guide valuing estuarine environments, and to provide a transparent approach that can be replicated. The characteristics have been applied in Environment Court and Board of Inquiry hearings, including a number of NZTA projects (Transmission Gully, MacKays to Peka Peka, Puhoi to Warkworth) and the Ara Tūhono Project, Warkworth to Wellsford Section; Marine Ecology Report on which Table 2 is based.

[12] ANZWQG (2018) Interim Sediment Quality Guideline (ISQG) contaminant threshold concentrations or Auckland Regional Council's Environmental Response Criteria contaminant threshold concentrations (Auckland Regional Council, 2004).

Ecological Value	Characteristics
	• Shallow depth of oxygenated surface sediment. • Annual average sedimentation rates typically less than 5 mm above background levels. • Contaminant concentrations in surface sediment generally below ISQG-high or AC ERC-Red effects threshold concentrations. • Water column contaminant values typically between ANZWQG 90% and 95% species protection levels. • Fish community typically has moderate species richness, diversity and abundance. • Few invasive opportunistic and disturbance tolerant species present. • Vegetation likely to be important at the level of the ecological district. • Macroalgae provides moderate habitat for native fauna. • Habitat modification limited.
Low	• Benthic invertebrate community degraded with low species richness, diversity and abundance. • Benthic invertebrate community dominated by organic enrichment tolerant and mud tolerant organisms with few/no sensitive taxa present. • Marine sediments dominated by silt and clay grain sizes (>75%). • Surface sediment predominantly anoxic (lacking oxygen). • Annual average sedimentation rates typically less than 10 mm above background levels. • Elevated contaminant concentrations in surface sediment, above ISQG-high or AC ERC-Red effects threshold concentrations. • Water column contaminant values typically between ANZWQG 80% and 90% species protection levels. • Fish community depleted with low species richness, diversity and abundance. • Invasive, opportunistic and disturbance tolerant species dominant. • Vegetation has limited ecological value other than as local habitat for tolerant native species • Macroalgae provides minimal/limited habitat for native fauna. • Habitat highly modified.
Negligible	• Benthic invertebrate community degraded with very low species richness, diversity and abundance. • Benthic invertebrate community dominated by organic enrichment tolerant and mud tolerant organisms with no sensitive taxa present. • Marine sediments dominated by silt and clay grain sizes (>85%). • Surface sediment anoxic (lacking oxygen). • Annual average sedimentation rates typically greater than 10 mm above background levels. • Elevated contaminant concentrations in surface sediment, above ISQG-high effects threshold concentrations. • Water column contaminant values typically at or worse than ANZWQG 80% species protection levels. • Fish community depleted with very low species richness, diversity and abundance. • Invasive, opportunistic and disturbance tolerant species highly dominant. • Vegetation/macroalgae absent or so sparse as to provide very limited ecological value. • Habitat extremely modified.

Appendix B Table 5: Criteria for describing magnitude of effect (EIANZ, 2018).

Effect	Description
Very high	Total loss of, or very major alteration to, key elements/features/ of the existing baseline[1] conditions, such that the post-development character, composition and/or attributes will be fundamentally changed and may be lost from the site altogether; AND/OR Loss of a very high proportion of the known population or range of the element/feature
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 the post-development character, composition and/or attributes will be partially changed; AND/OR Loss of a moderate proportion of the known population or range of the element/feature
Low	Minor shift away from existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances or patterns; AND/OR Having a minor effect on the known population or range of the element/feature
Negligible	Very slight change from the existing baseline condition. Change barely distinguishable, approximating the 'no change' situation; AND/OR Having negligible effect on the known population or range of the element/feature

Note: [1]Baseline conditions are defined as 'the conditions that would pertain in the absence of a proposed action' (EIANZ, 2018).

Appendix B Table 6: Timescale for duration of effects (EIANZ, 2018)

Timescale	Description
Permanent	Effects continuing for an undefined time beyond the span of one human generation (taken as approximately 25 years)
Long-term	Where there is likely to be substantial improvement after a 25 year period (e.g. the replacement of mature trees by young trees that need > 25 years to reach maturity, or restoration of ground after removal of a development) the effect can be termed 'long term'
Temporary[1]	Long term (15-25 years or longer – see above) Medium term (5-15 years) Short term (up to 5 years) Construction phase (days or months)

[1] Note that in the context of some planning documents, 'temporary' can have a defined timeframe.

Appendix B Table 7: Criteria for describing overall levels of ecological effects. If the overall level of effect is assessed as being 'Moderate' or greater (grey shade), this warrants efforts to avoid, remedy and/or mitigate these effects.

Magnitude of effect	Ecological Value				
	Very High	High	Moderate	Low	Negligible
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

Appendix C Boffa Miskell Limited Survey Location Figure

File Ref: A08301B.mxd

Boffa Miskell
www.boffamiskell.co.nz

N

0 0.02 km

1:750 @ A3

Projection: New Zealand Map Grid
Data Sources: Aerial Photography Auckland Council

Legend

— Transect line

CENTRAL INTERCEPTOR PROJECT

Figure 3: Sampling Locations at AS6 - PS23

| Date: 22 July 2011 | Revision: 0 |

Plan Prepared by Boffa Miskell Limited

Author: Lucy.Manning@boffamiskell.co.nz | *Checked:* Sharon De Luca

Appendix D Fish species

Appendix D Table 1: Fish species likely to be present in the Manukau Harbour based on NABIS records. Species hot spots are shaded grey.

Common name	Maori name[1]	Scientific name	New Zealand threat status (NZTCS)[2]	International threat status (IUCN)[3]
Grey Mullet	Kanae, Hopuhopu	*Mugil cephalus*	-	Least concern
John dory	Pukeru	*Zeus faber*	-	Data deficient
Rig	Pioke, Manga, Mango	*Mustelus lenticulatus*	-	Least concern
Snapper	Karati, Tamure	*Pagrus auratus*	-	Least concern
Spotted stargazer	Kourepoua	*Genyagnus monopterygius*	-	Least concern
Yellow Belly Flounder	Patiki-totara	*Rhombosolea leporina*	-	Unknown
Yellow-Eyed Mullet	Aua, Awa, Matakawhiti	*Aldrichetta forsteri*	-	Least concern
Anchovy	Korowhaawhaa	*Engraulis australis*	-	Least concern
Barracouta	Mangaa, Makaa	*Thyrsites atun*	-	Unknown
Blue Mackerel	Tawatawa	*Scomber australasicus*	-	Least concern
Brill	Patikinui	*Colistium guntheri*	-	Unknown
Bronze Whaler Shark	Toiki, Matawhaa, Mau ngengero, Tuatini	*Carcharhinus brachyurus*	Not Threatened	Vulnerable
Frostfish	Hikau, Paara, Taharangi	*Lepidopus caudatus*	-	Unknown
Garfish	Ihe, Takeke	*Hyporhamphus ihi*	-	Unknown
Golden mackerel	Haature, Hauture	*Trachurus novaezelandiae*	-	Least concern
Hammerhead shark	Mangoopare	*Sphyrna zygaena*	Not Threatened	Vulnerable
Hapuku	Haapuku, Kapua, Whapuku	*Polyprion oxygeneios*	-	Unknown
Horse Mackeral	Haature, Hauture	*Trachurus declivis*	-	Least concern
Kahawai	Kahawai	*Arripis trutta*	-	Unknown
Kingfish	Kuparu	*Seriola lalandi lalandi*		Unknown
Koheru	Koheru, Hature	*Decapterus koheru*	-	Least concern
Leathrjacket	Hiriri, Kookiri	*Meuschenia scaber*	-	Unknown
Lemon sole	-	*Pelotretis flavilatus*	-	Least concern
Murphy's Mackerel	-	*Trachurus murphyi*	-	Data deficient
New zealand sole	Paatikirori	*Peltorhamphus novaezeelandiae*	-	Unknown
Parore	Parore	*Girella tricuspidata*	-	Unknown

Pilchard	Mohimohi	*Sardinops sagax*		Least concern
Porae	Pōrae	*Nemadactylus douglasii*	-	Unknown
Red gurnard	Kumu, Kumukumu	*Chelidonichthys kumu*	-	Unknown
Red snapper	Kaorea	*Centroberyx affinis*	-	Unknown
Rough skate	Uku	*Zearaja nasuta*	Not Threatened	Unknown
Sand flounder	Paatiki, Karche	*Rhombosolea plebeia*	-	Least concern
school shark	Kapeta, Mangoo, Manga, Tupere	*Galeorhinus galeus*	Not Threatened	Critically endangered
Sea Perch	-	*Helicolenus barathr*	-	Unknown
Silver warehou	-	*Seriolella punctata*	-	Unknown
Spiny Dogfish	Kaaraerae, Koinga, Mangohapu, Makohuarau, Mangoo-tara, Okeoke	*Squalus acanthias*	Not Threatened	Vulnerable
Sprats	Kuupae	*Sprattus muelleri*		Least concern
Thresher shark	Mangō ripi	*Alopias vulpinus*	Not Threatened	Vulnerable
Trevally	Araara	*Pseudocaranx dentex*		Least concern
Turbot	Patiki	*Colistium nudipinnis*	-	Unknown
White pointer shark	Mangō ururoa	*Carcharodon carcharias*	Threatened–Nationally Endangered	Vulnerable

Notes:

1. Based on species annual normal range distributions from the National Aquatic Biodiversity Information System (NABIS) (retrieved 07/07/2022)

2. Maori name sourced from https://www.mpi.govt.nz/dmsdocument/194/direct

3. Threat Status - NZTCS of NZ for chondrichthyans (chimaeras, sharks and rays)* or IUCN list status of threatened species for sharks, rays and bony fishes (https://www.iucnredlist.org/)

Appendix E Wetland Delineation Protocol summary tables

The following tables present the results from the Wetland Delineation Protocol used to identify and delineate vegetated wetlands within 10 m and 100 m of the proposed enhancement works.

Appendix E Table 1: Results from the wetland delineation process at each vegetated wetland at PS23.

	Rapid test	Dominance test		Prevalence test		
Site	Pass/ Fail	Index	Pass/ Fail	Index	Pass/ Fail	Classification
SA1.2 Mangrove scrub	Pass	100%	Pass	1	Pass	Wetland
SA1.4 Herbfield	Pass	100%	Pass	2	Pass	Wetland
SA1.6 Harakeke	Fail	67%	Pass	2.2	Pass	Wetland

Appendix E Table 2: Plant species and proportional cover across each vegetated wetland extent.

Site	Stratum	Vegetation species	Common name	% cover	Rating
SA1.2 Mangrove scrub	Herb	*Avicennia marina subsp. australasica*	Mānawa, Mangrove	100%	OBL
SA1.4 Herbfield	Sapling/ shub	*Avicennia marina subsp. australasica*	Mānawa, Mangrove	20%	OBL
	Herb	*Salicornia quinqueflora*	Glasswort	11%	FACW
		Calystegia sepium subsp. roseata	Pink bindweed	2%	FAC
		Paspalum vaginatum	Saltwater paspalum	15%	FACW
		Samolus repens	Sea primrose	10%	FACW
		Triglochin striata	Arrow grass	7%	OBL
		Stenotaphrum secundatum	buffalo grass	6%	UPL
		Atriplex prostrata	Orache	1%	FACU
		Juncus kraussii subsp. australiensis	Sea rush	20%	FACW
		Bolboschoenus fluviatilis		2%	OBL
		Isolepis sepulcralis		2%	FAC
		Dactylis glomerata	Cocksfoot	4%	FACU
SA1.6 Harakeke	Sapling/ shub	*Araucaria heterophylla*	Norfolk Island pine	1%	UPL
	Herb	*Araujia sericifera*	Moth plant	1%	UPL
		Calystegia sepium subsp. roseata	Pink bindweed	1%	FAC
		Lotus pedunculatus	Lotus	1%	FAC
		Haloragis erecta	Shrubby haloragis, Toatoa	1%	FACU
		Oxalis incarnata	Oxalis	1%	UPL
		Plantago major	Broad-leaved plantain	1%	FACU
		Rumex conglomeratus	Clustered dock	1%	FAC
		Cyperus alternifolius subsp. flabelliformis		35%	FACW

Phormium tenax	Harakeke, New Zealand flax	55%	FACW

Appendix F Coastal avifauna species list

Appendix F Table 1: Indigenous coastal bird species likely to be present in the vicinity of PS 23 and their associated threat status (Robertson *et al.,* 2021).

Common name	Scientific name	Threat status (Robertson et al., 2021).	Observed on site*	iNaturalist	eBird
Tūturiwhatu/Northern NZ Dotterel	*Charadrius obscurus aquilonius*	At Risk - recovering		Y	Y
Tarāpunga/Red-billed gull	*Chroicocephalus novaehollandiae*	At Risk - declining	Y	Y	Y
Matuku moana/White-faced heron	*Egretta novaehollandiae*	Not threatened	Y	Y	Y
Matuku moana/Pacific reef heron	*Egretta sacra*	Threatened – Nationally Endangered			Y
Poaka/Pied Stilt	*Himantopus himantopus leucocephalus*	Not threatened	Y	Y	Y
Tōrea/South Island oystercatcher	*Haematopus finschi*	At Risk - declining	Y	Y	
Tōrea pango/Variable oystercatcher	*Haematopus unicolor*	At Risk - recovering	Y	Y	Y
Taranui/Caspian tern	*Hydroprogne caspia*	Threatened - nationally vulnerable			Y
Karoro/Southern black backed gull	*Larus dominicanus dominicanus*	Not threatened	Y	Y	Y
Kuaka/Bar-tailed godwit	*Limosa lapponica baueri*	At Risk - declining			Y
Tākapu/Australasian gannet	*Morus serrator*	Not threatened			Y
Kawau tūī/Little black shag	*Phalacrocorax sulcirostris*	At Risk - Naturally uncommon		Y	Y
Kawaupaka/Little shag	*Phalacrocorax melanoleucos brevirostris*	At Risk - relict		Y	
Kāruhiruhi/Pied shag	*Phalacrocorax varius varius*	At Risk - recovering		Y	
Kōtuku ngutupapa/Royal spoonbill	*Platalea regia*	At Risk - Naturally uncommon	Y	Y	Y
Pūtangitangi/Paradise shelduck	*Tadorna variegata*	Not Threatened			Y
Kōtare/Sacred kingfisher	*Todiramphus sanctus vagans*	Not threatened	Y	Y	Y

Common name	Scientific name	Threat status (Robertson et al., 2021).	Observed on site*	iNaturalist	eBird
Spur-winged plover	*Vanellus miles novaehollandiae*	Not threatened	Y		Y
Tara/White-fronted tern	*Sterna striata striata*	At Risk - declining			Y

Note: * observed during site visits on 27 October 2021 and 18 May 2022.

www.tonkintaylor.co.nz