Eastern Busway

EB2 and EB3 Residential

Marine Ecology and Coastal Avifauna Effects Assessment

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Eastern Busway

Quality Information

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List of Abbreviations and Definitions

Abbreviation and Definitions	Description
AEE	Assessment of Effects on the Environment
AUP(OP)	Auckland Unitary Plan (Operative in part) 2016
BPO	Best practicable option
CEMP	Construction Environmental Management Plan
CMA	Coastal Marine Area
DGV	Default Guideline Value
EB1	Eastern Busway 1 (Panmure to Pakuranga)
EB2	Eastern Busway 2 (Pakuranga Town Centre)
EB3 Commercial/ EB3C	Eastern Busway 3 (Pakuranga Creek to Botany)
EB3 Residential/ EB3R	Eastern Busway 3 (SEART to Pakuranga Creek)
EB4	Eastern Busway 4 (link between Ti Rakau Drive and Te Irirangi Drive, Botany Town Centre Station)
EBA	Eastern Busway Alliance
GV	Guideline Value
km	Kilometre(s)
m	Metre(s)
m^2	Square Metre(s)
m^3	Cubic Metre(s)
NES - FW	Resource Management (National Environmental Standards for Freshwater) Regulations 2020
NPS - FM	National Policy Statement for Freshwater Management 2020
NZCPS	New Zealand Coastal Policy Statement 2010
NoR	Notice of Requirement
AUP(OP)	Auckland Unitary Plan (Operative in part) 2016
RTN	Rapid Transit Network
RRF	Reeves Road Flyover
RMA	Resource Management Act 1991

Executive Summary

This report describes the assessment of marine ecology and coastal avifauna effects associated with the operation and construction of Eastern Busway 2 (EB2) and Eastern Busway 3 Residential (EB3R) sections of the Project.

Its purpose is to inform the AEE relating to the Notice of Requirement, and required regional consents and consents required under National Environmental Standards for Freshwater (NES-FW) EB2; and the AEE for the district and regional consents applications for EB3R and identify the ways in which any adverse effects will be mitigated.

This marine ecology and coastal avifauna assessment involves:

- Estuarine/marine sites identified for stormwater outfalls (including permanent and temporary occupation of CMA for construction of new outfall structures, habitat disturbance, remobilisation of sediment bound contaminants, vegetation (exotic and native) removal
- Coastal avifauna use of proposed stormwater discharge sites
- Quality of stormwater to be discharged.

Standard estuarine survey methods were used – benthic infauna and epifauna, sediment grain size and sediment stormwater contaminant samples were collected, and coastal vegetation and habitat modification was assessed.

An avifauna literature review was conducted, and site visits were undertaken to assess coastal avifauna habitat. Targeted surveys for banded rail were also conducted.

EIANZ guidelines were used (modified for marine ecology) to assess the ecological values, magnitude of effects and level of effects.

There are minimal direct effects on marine ecological values (apart from temporary and permanent occupation of the Coastal Marine Area (CMA).

Stormwater outfalls presently occur, or are newly proposed to occur, within the CMA or upstream of the CMA boundary in freshwater habitats prior to ultimate discharge to CMA.

Removal of vegetation (including mangroves) is required for some outfalls and temporary and permanent occupation of CMA for some outfalls/dissipation structures.

Survey of the CMA receiving environment and freshwater habitats upstream of the CMA (see Terrestrial and Freshwater Ecology Assessment) revealed low-moderate or low ecological values, with common benthic invertebrate infauna taxa, few epifaunal invertebrates, dominance of silt and clay sediment, elevated stormwater contaminants at some sites (e.g. most sites surveyed for sediment contaminants revealed concentrations of zinc above Default Guideline Value (DGV) (Australian and New Zealand Governments, 2018)), and coastal edge and riparian vegetation that is largely dominated by exotic weed species with minimal native vegetation present.

None of the stormwater outfall areas provide breeding or roosting habitat for coastal avifauna.

Some stormwater outfalls are located in mangrove habitat (considered a wetland in the CMA under NES-FW according to a recent High Court decision). The NES-FW covers wetlands in the CMA which has been interpreted by Auckland Council as including mangroves and saltmarsh. The NES-FW sets requirements and standards for activities that pose risks to freshwater and freshwater ecosystems, including wetland in the CMA (e.g. mangrove habitat). Given the presence of wetlands within the EB2 and EB3R works area, resource consent is required for the Project's earthworks and vegetation

clearance. The total area of CMA that is predicted to be adversely affected by temporary and permanent occupation is 3,556.5m^2, which is a small proportion of the abundant wetland habitat within the Tāmaki Estuary.

Mangroves provide foraging habitat (but not breeding or roosting habitat) for coastal avifauna, potentially including At Risk and Threatened native species.

Native coastal avifauna ecological values range from Low to High, with the high ecological values related to the unconfirmed presence of banded rail.

The Catchment Load Model (CLM) indicates that the Project will lead to an overall reduction in EB2 for copper, zinc and TPH. CLM indicates an overall reduction in metals and TPH in EB3R apart from outfall MCC108707 which has large increases in those contaminants.

Outfalls predicted to increase in zinc are likely to result in overall accumulation of metals (above DGV currently for most receiving environments and continued increase above GV at outfall 7). At these sites, there are likely is ongoing adverse effects on benthic invertebrate assemblage health from contaminants above DGV and GV.

The marine ecological values for EB2 and EB3R are Low at all outfalls, whereas coastal avifauna ecological values for all areas within EB2 and EB3R potentially range between Low and High at some outfalls.

The magnitude of effect of construction (permanent occupation of the CMA, vegetation loss in the CMA, and coastal avifauna foraging habitat disturbance / displacement) is assessed as Negligible to Low (Table 9 – *Negligible – Having negligible effect on the known population or range of the element / feature. Low – Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances/patterns; AND/OR having a minor effect on the known population or range of the element / feature).*

The magnitude of effect of operation on marine and coastal avifauna ecological values (discharge of treated stormwater) is assessed as Negligible to Low (Table 9 – *Negligible – Having negligible effect on the known population or range of the element / feature. Low – Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances/patterns; AND/OR having a minor effect on the known population or range of the element / feature).*

Mitigation is not required for any of the low or very low levels of adverse effects detected, but it is recommended that the temporary occupation of the CMA for construction is minimised, rubbish and debris in the stormwater outfall areas of the CMA is removed and pest plants are controlled and replaced with native vegetation.

1 Introduction

1.1 Overview of the Eastern Busway Project

The Eastern Busway Project (the Project) is a package of works focusing on promoting an integrated, multi-modal transport system to support population and economic growth in southeast Auckland. This involves the provision of a greater number of improved public transport choices and aims to enhance the safety, quality and attractiveness of public transport and walking and cycling environments. The Project includes:

- 5km of two-lane busway
- New bridge for buses across Pakuranga Creek
- Improved active mode infrastructure (walking and cycling) along the length of the busway
- Three intermediate bus stations
- Two major interchange bus stations.

The Project forms part of the previous Auckland Manukau Eastern Transport Initiative (AMETI) programme (the programme) which includes a dedicated busway and bus stations between Panmure, Pakuranga and Botany town centres. The dedicated busway will provide an efficient rapid transit network (RTN) service between the town centres, while local bus networks will continue to provide more direct local connections within the town centre areas. The Project also includes new walking and cycling facilities, as well as modifications and improvements to the road network.

The programme includes the following works which do not form part of the Eastern Busway Project:

- Panmure Bus and Rail Station and construction of Te Horeta Road (completed)
- Eastern Busway 1 (EB1) – Panmure to Pakuranga (completed).

The Eastern Busway Project consists of the following packages:

- Early Works Consents – William Roberts Road (WRR) extension from Reeves Road to Ti Rakau Drive (LUC60401706); and Project Construction Yard at 169 – 173 Pakuranga Road (LUC60403744).
- Eastern Busway 2 (EB2) – Pakuranga Town Centre, including the Reeves Road Flyover (RRF) and Pakuranga Bus Station **(this Assessment)**
- Eastern Busway 3 Residential (EB3R) – Ti Rakau Drive from the South-Eastern Arterial (SEART) to Pakuranga Creek, including Edgewater and Gossamer Intermediate Bus Stations **(this Assessment)**
- Eastern Busway 3 Commercial (EB3 Commercial) – Gossamer Drive to Guys Reserve, including two new bridges, and an offline bus route through Burswood
- Eastern Busway 4 – Guys Reserve to a new bus station in the Botany Town Centre, including a link road through Guys Reserve.

The overall Project alignment is shown in Figure 1 below.

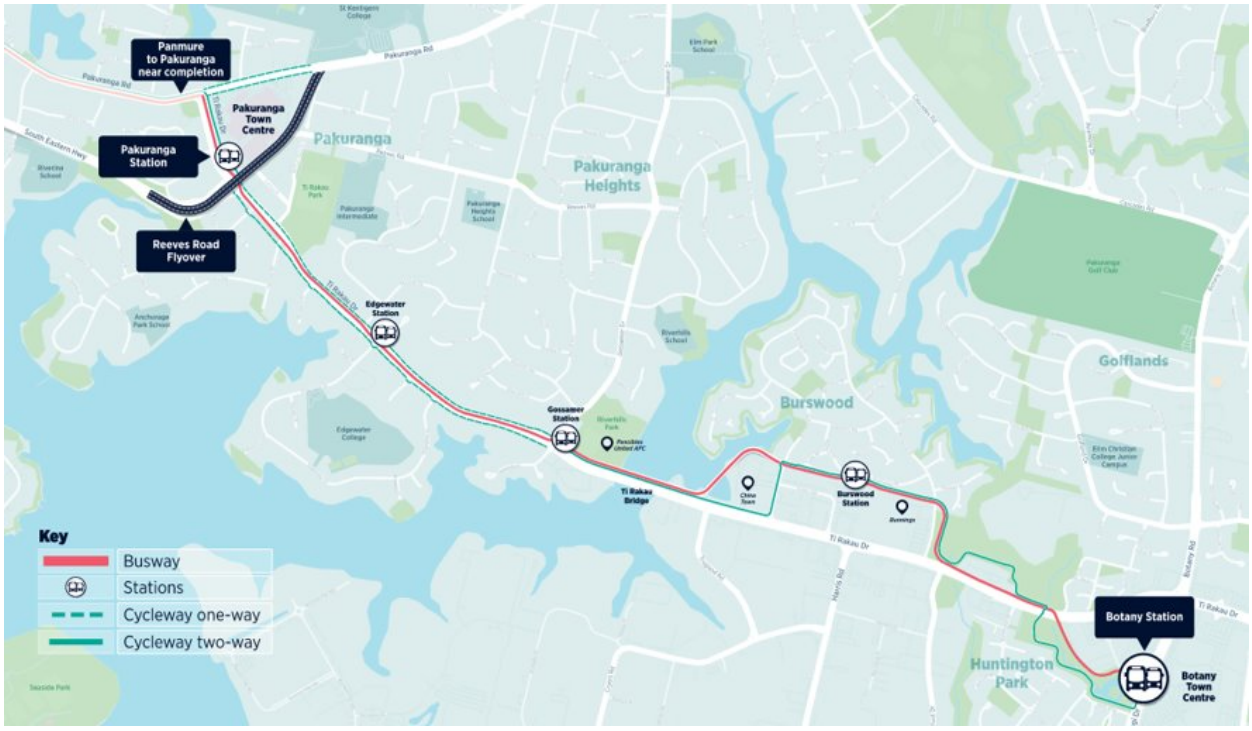


Figure 1. Project alignment

1.2 Project Objectives

The Project objectives are:

1. Provide a multi modal transport corridor that connects Pakuranga and Botany to the wider network and increases access to a choice of transport options
2. Provide transport infrastructure that integrates with existing land use and supports a quality, compact urban form
3. Provide transport infrastructure that improves linkages, journey time and reliability of the public transport network
4. Contribute to accessibility and place shaping by providing better transport connections between, within and to the town centre
5. Provide transport infrastructure that is safe for everyone
6. Safeguard future transport infrastructure required at (or in vicinity of) Botany Town Centre to support the development of a strategic public transport connection to Auckland Airport.

2 Proposal Description

The below is a summary of the works proposed within the EB2 and EB3R packages. Refer to the AEE for additional detail on the works proposed.

2.1 Eastern Busway 2

The EB2 section of the Project commences from the intersection of Ti Rakau Drive and Pakuranga Road, connecting with EB1, and traverses west along Ti Rakau Drive to the intersection of SEART. The north-south extent of EB2 is between SEART and Pakuranga Road along Reeves Road and William Roberts Road. The main components of EB2 are described below.

2.1.1 Busway and Pakuranga Town Centre Bus Station

A segregated dedicated two-way busway is proposed along Ti Rakau Drive to provide prioritised access for bus services between Pakuranga Town Centre and Botany. From Pakuranga Road to SEART, the busway will run on the northern side of Ti Rakau Drive.

The proposed Pakuranga bus station is a key facility for services running to and from the Panmure Station Interchange, Howick, Highland Park, Eastern Beach, Bucklands Beach and Sunnyhills. The bus station will be located along the northern side of Ti Rakau Drive, on land currently occupied for Pakuranga Plaza and 26 Ti Rakau Drive. The bus station will feature two platforms and will contain a mixture of street furniture and structures, including bus shelters, electronic messaging signage and seating. New proposed pedestrian crossings will provide connections to the bus station and Pakuranga Plaza. Modifications to the Ti Rakau Drive median strip, landscaping, and general traffic lane reconfiguration will enable safe and efficient bus movement for the busway once it becomes operative.

2.1.2 Reeves Road Flyover (RRF)

The RRF will provide two general traffic lanes in each direction connecting SEART to Pakuranga Road, to reduce local traffic congestion along Pakuranga Road and Ti Rakau Drive. The RRF will start opposite Paul Place Reserve, pass over Ti Rakau Drive and Reeves Road, before finishing at a new intersection with Pakuranga Road. Traffic lanes for the RRF will be elevated and run through the centre of SEART, requiring the relocation of the SEART off-ramp to the north of the existing off-ramp.

2.1.3 Walking and Cycling Facilities

EB2 includes improvements to active transport infrastructure and connections. This includes a new cycleway, improved footpaths, and new pedestrian crossings. These works will improve the safety and connectivity of walking and cycling links across Pakuranga Town Centre.

2.1.4 Supporting Works

A range of works will be undertaken in support of the EB2 package. This includes the relocation of network utility services, new street lighting, earthworks, removal of vegetation, landscaping, stormwater upgrades, environmental restoration and mitigation and temporary construction sites.

2.2 Eastern Busway 3 Residential

The EB3R section of the busway is a continuation of EB2 from the intersection of SEART and Ti Rakau Drive, with the proposed dedicated busway proceeding centrally along Ti Rakau Drive towards

Gossamer Drive and Riverhills Park in the east. EB3R will largely occur within land vested as road or land currently owned by Auckland Transport. The construction of EB3R will take a staged approach to minimize disruption to the existing road network and its users. The main components of EB3R have been described below.

2.2.1 Edgewater and Gossamer Intermediate Bus Stations

EB3R includes two intermediate bus stations on Ti Rakau Drive, located within the vicinity of Edgewater Drive and Gossamer Drive. Both stations will have separate platforms for eastbound and westbound bus movements. A range of street furniture and structures will also be constructed, such as modular bus shelters pedestrian linkages, electronic messaging signage, seating and cycling storage facilities.

2.2.2 Western Bridge Abutment

EB3R includes construction of the western bridge abutment for a new future bridge across Pakuranga Creek. The abutment will be located within the area that is currently the south-eastern section of Riverhills Park. Only the bridge abutment is included in the EB3R package of works. The remaining parts of the bridge will form part of the EB3C approval package.

2.2.3 Walking and Cycling Facilities

Provision has been made for walking and cycling along the route of EB3R. This includes footpaths and uni-directional cycleways located on either side of Ti Rakau Drive from SEART to Gossamer Drive. Signalised pedestrian crossings will be provided at key intersections along Ti Rakau Drive, including adjacent to the proposed Edgewater bus station.

2.2.4 Associated changes the road network

The proposed changes to the road network include lane arrangement and intersection reconfigurations and changes to the parking arrangement and access to Edgewater Drive Shops. Changes are also proposed to the access arrangements for residential properties along the EB3R alignment. New westbound lanes for general traffic will be established within the land which has been acquired by Auckland Transport and will be vested as road once it becomes operative, as the busway alignment replaces the existing westbound lanes.

2.2.5 Supporting Works

A range of works will be undertaken in support of the EB3R package. This includes the relocation of network utility services, new street lighting, removal of vegetation, earthworks, landscaping, stormwater upgrades, environmental restoration and mitigation and temporary construction sites.

3 Specialist Assessment

Chapter Summary
The potential effects on marine and coastal avifauna values in EB2 and EB3R relate to the construction of stormwater outfall and discharge dissipation structures, vegetation removal, permanent occupation of CMA, loss or and disturbance to breeding and foraging habitat for coastal avifauna.

3.1 Assessment Content

This report describes the assessment of marine ecology and coastal avifauna effects associated with the operation and construction of EB2 and EB3R sections of the Project.

Its purpose is to inform the AEE relating to the Notice of Requirement, and required regional consents and consents required under National Environmental Standards for EB2; and the AEE for the district and regional consents applications for EB3R and identify the ways in which any adverse effects will be mitigated.

This marine ecology and coastal avifauna assessment involves:

- Estuarine/marine sites identified for stormwater outfalls (including permanent and temporary occupation of CMA for construction of new outfall structures, habitat disturbance, remobilisation of sediment bound contaminants and vegetation (exotic and native) removal)
- Coastal avifauna use of proposed stormwater discharge sites
- Quality of stormwater to be discharged

3.2 Specific Project Elements

The potential effects on marine and coastal avifauna values in EB2 and EB3R relate to the construction of stormwater outfall and discharge dissipation structures, vegetation removal, permanent occupation of CMA and loss or/and disturbance to breeding and foraging habitat for coastal avifauna.

New outfalls are proposed (two new outfalls in EB2, one new outfall EB3R) and existing outfalls are to be modified (3 outfalls EB2, 5 outfalls EB3R) (Figure 2). A summary of works required for outfalls in EB2 and EB3R is included in Table 1 and typical stormwater design is shown in Figure 3.

Table 1: Stormwater outfalls, date surveyed, proposed works and existing catchments.

STORMWATER OUTFALL NUMBER	DATE SURVEYED	PROPOSED WORKS	
		EB2	
7 **(P98086C)**	10-12/2018	• Two new outfalls will be constructed, with energy dissipation and erosion control structures as per typical detail. Works in the CMA for both pipes is required. Approximately 430m^2 and 370m^2 vegetation removal for construction. • Existing catchment receives stormwater from a residential area to the north. • Currently receives no stormwater treatment	• Works in the CMA required.
8/11 **New outlets 06-05 and 89-18.** **MCC_108673.**	23/02/2022	• Existing catchment receives stormwater from residential areas to the northeast and east. • Construction involves 2,087m^2 of temporary occupation of the CMA. Permanent occupation of the CMA for the outlet involves 1,375m^2. • 370m^2 of vegetation will need to be removed outside of the CMA. • 3,462 m^2 of vegetation will need to be removed within the CMA.	• Works in the CMA required.
12 **MCC_108680**	Not surveyed	• Potential modification/connection to outfall. • Receives no formal stormwater treatment, although it discharges to a natural wetland outside of CMA. • Existing catchment includes commercial area between Reeves Road, William Roberts Road and Ti Rakau Drive and a small residential area to the southeast.	• No works in the CMA.
15 **MCC_108633**	Surveyed 22/03/2022	• No vegetation removal required. Site located outside of CMA • Within Bus Stop Reserve off Pakuranga Road receives existing stormwater from Pakuranga Plaza and residential areas to the west, east and southeast • Receives stormwater treatment from catchpits and an Ecosol unit providing gross pollutant removal. Maintained by Healthy Waters biennially	• No works in the CMA.
		EB3R	
1A	23/02/2022	• The outfall requires connection to existing pipe and upgrading the pipe to the outfall using the typical outfall detail. Approximately 460m^2 of	• No works in the CMA.

STORMWATER OUTFALL NUMBER	DATE SURVEYED	PROPOSED WORKS	
Outfall MCC_108703		vegetation will need to be removed outside of the CMA for construction of outfall. • Existing coastal outfall receives stormwater from Ti Rakau Road, Cardiff Road and surrounding residential area.	• Stream present - see Terrestrial and Freshwater Ecology Assessment.
1B **Outfall MCC_108707**	23/02/2022	• The Project is connecting to an existing pipe at this site. Approximately 940m^2 of vegetation clearance is required for construction. The outfall will be upgraded involving the typical detail. Construction is adjacent to, but outside of the CMA. • Existing outfall receives stormwater from Marriott Road, Opal Avenue and surrounding residential area.	• No works in the CMA. • Stream present - see Terrestrial and Freshwater Ecology Assessment.
1C **Outfall MCC-108673**	23/02/2022	• The Project will not discharge to this outfall, discharges from Ti Rakau Drive will be diverted out of this catchment away from Transpower cables located beneath ground	• No works in the CMA.
2 **MCC-108718 and 108719**	23/02/2022	• There will be a new connection to MCC-108718 and outfall upgrade. Vegetation outside the CMA over 400m^2 will be removed. Works for MCC-108718 are outside of the CMA[1] • MCC-108719 will also be upgraded to the typical detail, with works within CMA • Ecology survey in 2022 of outfall MCC 108719 only • Existing outfall MCC_108713 receives stormwater from Ti Rakau Drive and residential areas to the north and south of Ti Rakau Drive. Outfall MCC_108719 receives stormwater from a few residential properties on the southern side of Ti Rakau Drive • Construction involves temporary occupation of the CMA of approximately 42.5m^2 • Permanent occupation of the CMA for the outfall involves 16m^2. • Vegetation removal within the CMA involves 58.5m^2.	• Works within the CMA (MCC-108719).
3 **MCC_108738**	10/12/2018	• Connecting to last manhole without downstream pipe or outfall upgrade. Located outside of CMA. Vegetation clearance of 430m^2 is required for the outfall.	• No works within the CMA.

[1] Works for MCC 108719 are not approved.

STORMWATER OUTFALL NUMBER	DATE SURVEYED	PROPOSED WORKS	
4 **MCC_108748**	23/02/2022	• Connection is to the last manhole, without downstream pipe or outfall upgrade. No works will be in the CMA, but existing outfall within CMA. • Existing outfall receives stormwater from Ti Rakau Drive and residential areas to the south including Gossamer Drive.	• No works within the CMA.
5/6 **MCC_106746**	10/12/2018	• A new outfall will be constructed outside of the CMA. • Modification or connection to outfall MCC_108746. • Survey not required. • Existing outfall receives stormwater from Ti Rakau Drive just prior to Ti Rakau Bridge with the outfall discharging to Pakuranga Creek.	• No works within the CMA.
13/14 **MCC_108699**	Not surveyed	• Outlet is to be diverted out of this outfall, with no EB2 discharges occurring. • Vegetation outside of the CMA over 750m^2 will be required to be removed for the upgrade. • Existing outfall receives stormwater from residential areas to the northeast and east. • Receives no stormwater treatment.	• No works in the CMA. • Stream present - see Terrestrial and Freshwater Ecology Assessment.
Riverhills Waterway Outfall		• Construction involves temporary occupation of the CMA, and vegetation removal over approximately 90m^2. • Vegetation removal outside of the CMA will occur over 250m^2.	• Works within the CMA.

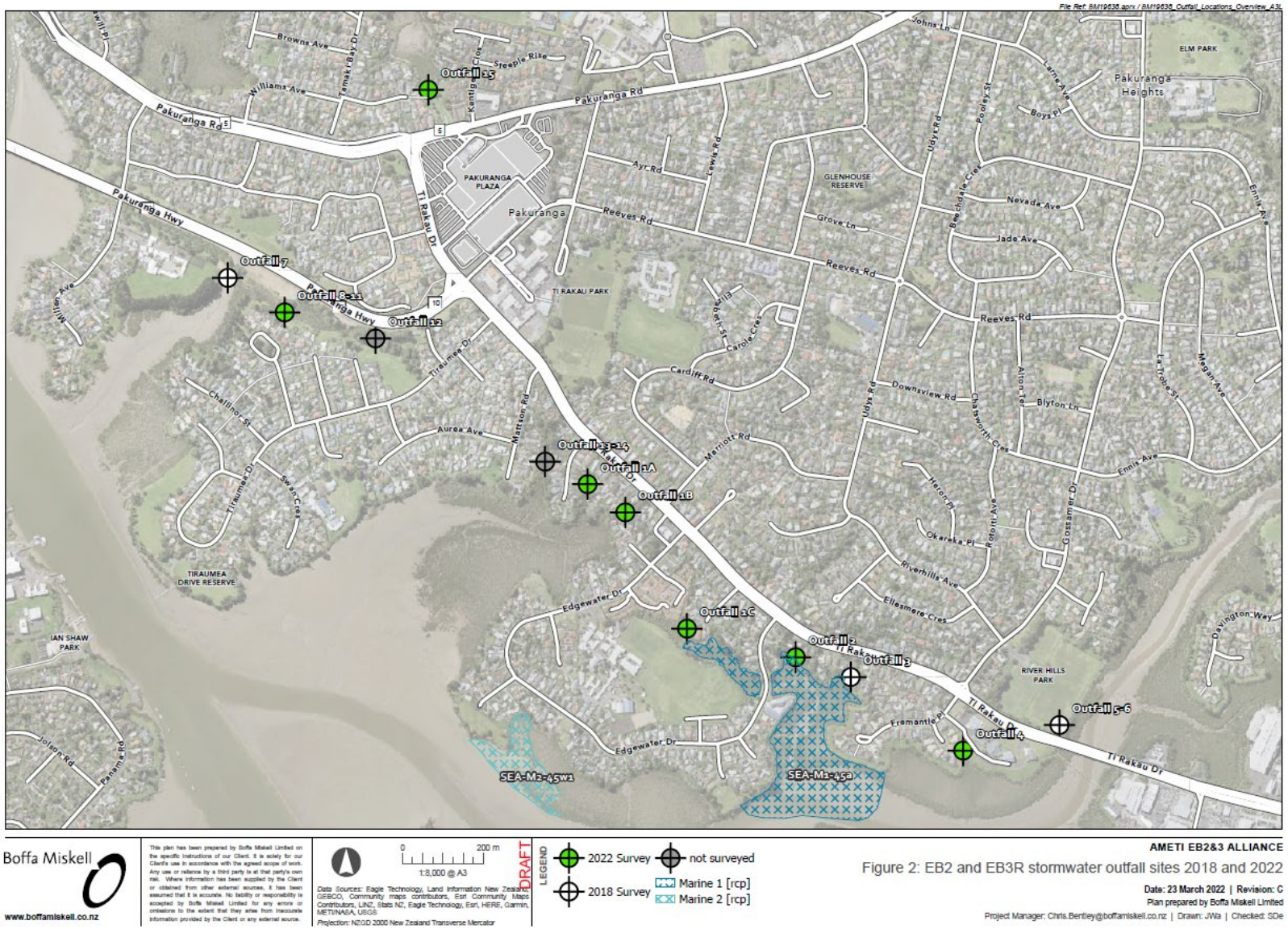


Figure 2: EB2 and EB3R stormwater outfall sites surveyed 2018 and 2022

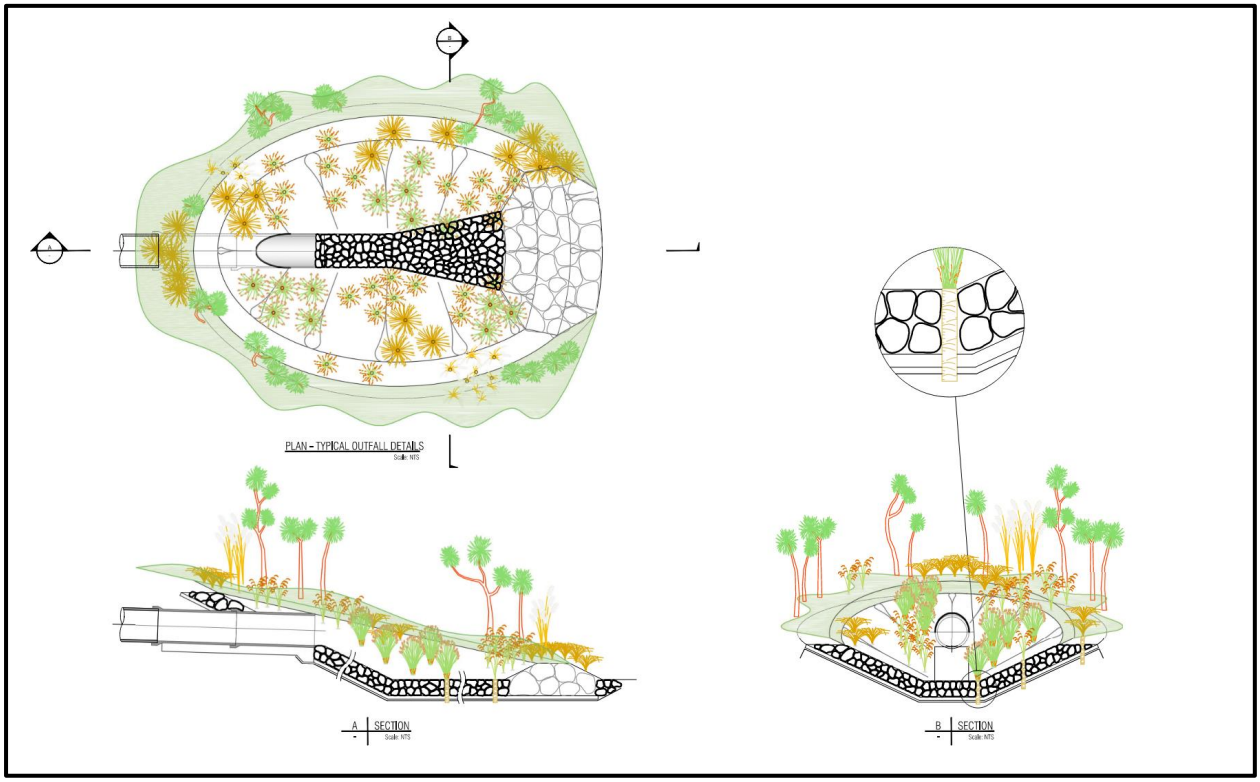


Figure 3: Typical Stormwater Outfall Design (Source: Stormwater Effects Assessment)

The potential effect of the construction is assessed in section 6.1.1 and the operational phase stormwater discharge quality in section 6.2.1.

3.3 Statutory and Planning Framework

This assessment and associated impact management has been developed with consideration of the following list of relevant legislation, policy, plans and strategies:

1. Resource Management Act 1991
2. National Policy Statement for Freshwater Management 2020
3. National Environmental Standards for Freshwater 2020
4. Auckland Unitary Plan (Operative in part) – Chapters B8, F2, F8
5. New Zealand Coastal Policy Statement 2010
6. Hauraki Gulf Islands Marine Park Act 2000.

4 Methodology and Analysis

Chapter Summary
Summary of key points/ findings • *Standard estuarine survey methods were used – collected benthic infauna and epifauna, sediment grain size and sediment stormwater contaminant samples, and assessed coastal vegetation and habitat modification.* • *An avifauna literature review was conducted, and site visits were undertaken to assess coastal avifauna habitat. Targeted surveys for banded rail were also conducted.* • *EIANZ guidelines were used (modified for marine ecology) to assess the ecological values, magnitude of effects and level of effects.*

4.1 Desktop and Field Investigations

Field surveys to assess marine ecology values at proposed stormwater outfall sites were carried out at low tide on 29 June 2018 and at the revised proposed stormwater outfalls (outfalls 3 and 5/6 and 7) December 2018 (refer to Figure 2 for the location of survey sites). Additional estuarine surveys were undertaken at low tide on 23 February 2022 to assess six newly identified stormwater outfalls not previously included as part of the Project (Outfalls 1A-1C, 2, 4, and 8-11) (Figure 2).

Avifauna surveys (identification of potential breeding and foraging habitat) were undertaken at two sites adjacent to stormwater outfall 3, outfall 5-6 and outfall 7 between October and December 2018 at low tide. Avifauna surveys were also undertaken on 23 February 2022 at the six newly proposed outfall sites.

Further avifauna information was also obtained through existing resources, including the Ornithological Society of New Zealand (OSNZ) atlas (C. J. R. Robertson et al., 2007).

Summary of stormwater outfalls involved in EB2 and EB3R, date surveyed, and proposed works are provided in Table 1.

While details are provided in the following sections, a summary of the marine and avifauna surveys undertaken, and samples collected is provided in Table 2.

4.1.1 Coastal Vegetation

Native and exotic flora present within and adjacent to each selected stormwater outfall survey location was noted while on site (in 2018 and 2022).

4.1.2 Benthic Invertebrate Assemblage

At each tidally influenced site surveyed (that contained sediment that could be sampled for infaunal invertebrates), three 13 cm diameter sediment cores (approximately 15 cm deep) were collected, sieved through a 5 mm mesh and the retained material and organisms preserved in 70% ethanol. Marine macroinvertebrates were extracted from the material, identified and counted by an independent expert taxonomist at a later date.

A 0.25 m^2 quadrat was placed on the undisturbed benthic sediment, photographed and all epifauna identified.

Data were analysed using descriptive statistics and multivariate analyses.

4.1.3 Sediment Quality and Grain Size

Two composite samples of surface (top 2 cm) sediment were collected at each site, where sediment was available to be collected (outfalls 1A, 1B, 1C, 2, 3, 4, 5/6, 7, 8/11 and 15). One sample from each of the

three sites was sent, on ice, to Hill Laboratories for the analysis of common stormwater contaminants (copper, lead and zinc). The other sample from each site sent, on ice, to the University of Waikato for analysis of sediment grain size distribution. Some outfalls were not surveyed for sediment quality nor grain size as there was no receiving environment sediment to collect.

4.1.4 Coastal Avifauna

Data for the 10 km x 10 km OSNZ atlas grid square (267, 647; Robertson et al. (2007)), which encompasses the Ti Rakau Drive bridge and surrounding environment (see Figure 9), was collated to provide a baseline list of species that have previously been recorded in that area. The primary and secondary habitats for each of the species recorded within this grid square were obtained from Heather & Robertson (2005), along with each species' New Zealand threat status according to Robertson et al. (2021).

A site visit was conducted on 3 October 2018 to the area below the Ti Rakau Drive bridge (proposed stormwater outfall 5/6), an area of the Project where there is potential for coastal bird species to be present and directly affected by the Project. The site visit commenced at 8:30 am to coincide with a low tide (8:01 am). Climatic conditions were fine and mild, with no cloud cover.

A second site visit was conducted on 6 December 2018 at proposed stormwater outfall 7, a location at which operational stormwater discharge will occur. The site visit commenced at 10:40 am to coincide with an outgoing tide. Climatic conditions were fine and mild, with passing showers.

A third site visit was conducted on 23 February 2022 to assess six additional stormwater outfall sites (1A-1C, 2, 4, 8-11). The site visit commenced at 6:40 am to coincide with low tide. Climatic conditions were fine, calm and mild.

On all survey occasions, an assessment of avifauna habitat quality was conducted, as well as targeted surveys for mioweka, banded rail (*Gallirallus philippensis assimilis*), a cryptic marshbird classified as *At Risk – Declining*. Banded rail can reside in mangrove habitat, such as that found in the riparian margins of Pakuranga Creek near Ti Rakau Drive bridge. Targeted surveys included banded rail playback calls at six locations during the October and December 2018 site visits and searching for footprints in the estuarine mud within the mangrove stands on all occasions. In addition, a roaming inventory was collated by recording all native coastal birds seen and heard during the site visit.

All site visits were undertaken by a coastal avifauna specialist[2].

Terrestrial (including land birds) and freshwater ecology were not included within this assessment and are covered in the Terrestrial and Freshwater Ecology Assessment.

[2]Dr Leigh Bull or Karin Sievwright.

Table 2: Marine and avifauna surveys undertaken, and samples collected.

STORMWATER OUTFALL NUMBER	DATE SURVEYED	VEGETATION ASSESSMENT	ESTUARINE BENTHIC INFAUNA CORES	ESTUARINE EPIFAUNA QUADRAT	SEDIMENT GRAIN SIZE	SEDIMENT SW CONTAMINANTS	AVIFAUNA BREEDING AND FORAGING HABITAT ASSESSMENT
EB2							
7 **P98086C**	10-12/2018	Yes	No (No suitable habitat for benthic invertebrates)	No (No suitable habitat for benthic invertebrates)	Yes	Yes	Yes
8/11 **06-05 and 89-18** **MCC_108673**	23/02/2022	Yes	3	1	Yes	Yes	Yes
12 **MCC_108680**	Not surveyed (not included in stormwater details document)	N/A	No (No suitable habitat for benthic invertebrates)	No (No suitable habitat for benthic invertebrates)	No (Insufficient sediment available for grain size analysis)	No (Insufficient sediment available for grain contaminant analyses)	N/A
15 **MCC_108633**	22/03/2022	N/A	No (No suitable habitat for benthic invertebrates)	No (No suitable habitat for benthic invertebrates)	No (Insufficient sediment available for grain size analysis)	No (Insufficient sediment available for grain contaminant analyses)	N/A
EB3R							
1A **Outfall MCC_108703**	23/02/2022	Yes	No (No suitable habitat for estuarine benthic invertebrates, freshwater habitat)	No (No suitable habitat for benthic invertebrates)	No (Insufficient sediment available for grain size analysis)	Yes	Yes
1B	23/02/2022	Yes	No	No	No	Yes	Yes

Outfall MCC_108707			(No suitable habitat for estuarine benthic invertebrates, freshwater habitat)	(No suitable habitat for benthic invertebrates)	(Insufficient sediment for grain size analysis)		
1C **Outfall MCC-108673**	23/02/2022	Yes	No (No suitable habitat for estuarine benthic invertebrates)	No (No suitable habitat for benthic invertebrates)	No (Insufficient sediment at receiving environment habitat for grain size analysis)	Yes	Yes
2 **MCC-108718 and 1087199**	23/02/2022	Yes	3	1	Yes	Yes	Yes
3 **MCC_108738**	10-12/2018	Yes	3	1	Yes	Yes	Yes
4 **MCC_108748**	23/02/2022	Yes	3	1	Yes	Yes	Yes
5/6	10-12/2018	Yes	3	1	Yes	Yes	Yes
13/14 **MCC_108699**	Not surveyed	N/A	No (No suitable habitat for estuarine benthic invertebrates, freshwater habitat)	No (Insufficient sediment available for grain size analysis)	No (Insufficient sediment available for grain size analysis)	No (Insufficient sediment available for grain contaminant analyses)	N/A
Riverhills Outfalls	Not surveyed	N/A	N/A	N/A	N/A	N/A	N/A

4.2 Supporting Information

In addition to the information collected through ecological field investigations (Figure 2) and desktop investigation of relevant literature and databases, this assessment has been based on the information provided in the following supporting documents and plans:

4.2.1 Stormwater Effects Assessment Report (May 2022)

The Stormwater Effects Assessment summarises the catchment load models (CLM) and expected outcomes for discharge quality for EB2 and EB3R as follows.

Section 4.2.1 of the Stormwater Effects Report states:

> *A Contaminant Load Model (CLM) analysis for EB2 has been developed to compare treatment options with existing contaminant load contributions from roads to each outfall that receives discharges or has its catchment changed (i.e. road source areas reduced) (see further detail in Appendix 1). The CLM estimates the percent change from the existing situation for TSS, zinc, copper and total petroleum hydrocarbons (TPH) as summarised in Figure 2.*

With the exception of Outfall MCC_108633, all outfalls that will receive EB2 stormwater (i.e. excluding Outfall P98086C) will have a reduction in contaminant loads for each contaminant. It is noted that for the purpose of the CLM, Outfall MCC_108673 is combined with new outfalls 06-05 and 89-18 as they are all located close to each other. As discussed in the design philosophy, the target is to reduce the existing contaminant load contributions from all roads to outfalls that interact with the project on an overall basis.

The CLM currently predicts EB2 as achieving an overall improvement for TSS, copper and TPH (see Table 3). Outfall P98086C currently has no change to its catchment and no discharge from EBA stormwater (including from SEART) as reflected in Table 3 by no change in contaminant loads. Outfall MCC_108633 is predicted to receive a very slight increase in contaminant loads for zinc, copper and TPP which is caused by an increase in road catchment area and constraints preventing the use of green infrastructure (i.e. treatment is only by a GPT designed for 50% removal of TSS)

Table 3: Stormwater Report - Summary of EB2 predicted change in contaminant loads

Outfall	TSS	Zinc	Copper	TPH
Outfall P98086C	**0%**	**0%**	**0%**	**0%**
Outfalls MCC_108673, 06,05, & 89-18	**-41%**	**-5.3%**	**-14%**	**-23%**
Outfalls MCC_108680	**-73%**	**-81%**	**-81%**	**-81%**
Outfall MCC_108699[3]	-54%	-43%	-46%	-50%
Outfall MCC_108633	-17%	0.4%	0.4%	0.4%
Total EB2 change	-39%	-14%	-18%	-23%

A CLM has also been developed for EB3R.

With the exception of Outfall MCC_108707, all outfalls that receive EB3R stormwater will have a reduction in the existing contaminant loads for each contaminant assessed. As discussed above and in the design philosophy, the target is to reduce the existing contaminant load contributions from all roads to outfalls that interact with the project on an overall basis. In addition, the final outcomes will be

[3] Discharges into freshwater habitat

influenced by ongoing joint EBA and Healthy Waters hui with mana whenua. The CLM currently indicates EB3R achieves an overall improvement for each of the contaminants assessed (see Table 4).

Table 4: Stormwater Report - Summary of EB3R predicted change in contaminant loads

Outfall	TSS (%)	Zinc (%)	Copper (%)	TPH (%)
Outfall MCC_108703[4]	-75%	-74%	-76%	-78%
Outfall MCC_108707[4]	-1%	74%	62%	49%
Outfalls MCC_108713	-100%	-100%	-100%	-100%
Outfall MCC_108718 & 108719	-30%	-15%	-19%	-23%
Outfall MCC_108738	-80%	-68%	-71%	-74%
Outfall MCC_108748	-61%	-40%	-45%	-51%
Outfall MCC_108746 and MCC_108749 and New Outfall	-65%	-59%	-66%	-72%
Total EB3R	-59%	-43%	-48%	-53%

Outfall MCC_108707 is predicted to have an increase in contaminant load due to a 100% increase in road catchment area, with 300 m of east and westbound carriageway being diverted to its network from the network of MCC_108713 (partly because of difficulties in upgrading parts of the network that are underneath or immediately adjacent to a number of houses).

The CLM indicates increases in zinc (74%), copper (62%) and TPH (49%) at outfall MCC_108707, with all other outfalls having a decrease in TSS, metals and TPH (Table 4).

Section 4.2.1 of the Stormwater Effects Report also states:

> *The consent design for EB2 currently collects stormwater in independent networks that connect to the existing networks near their outfalls and where necessary the consent design proposes to upgrade the existing pipe from the connection point to outfall. The outfalls proposed to receive Project discharges are summarised in Table 5.*

Table 5: Summary of Outfalls proposed to receive discharges from EB2 stormwater networks

Outfall	Existing Outfall	Discharges to CMA	Outfall in CMA	Comment
Outfall MCC_108633	✓	✓	✗	Connection Point is in Bus Stop Reserve, approximately 60 m upstream of outfall. The existing outfall is approximately 1 m from the AUP(OP) indicative CMA boundary. The EBA works are not within the CMA.
Outfall 06-05	✗	✓	✓	New outfall and pipe to be constructed approximately 24 m southeast of MCC_108673. The proposed outfall invert level is RL0.73 m which is very close to CMA bed level. The proposed outfall is either on or within the AUP(OP) indicative CMA boundary. The outfall requires CMA bed channel lowering works and erosion and scour protection. The EBA works are within the CMA.
Outfall 89-18	✗	✓	✓	New outfall and pipe to be constructed approximately 53 m southeast of MCC_108673. The proposed outfall invert level is RL0.58 m which is very close to CMA bed level. The proposed outfall is either on or within the AUP(OP) indicative CMA

[4] Discharge into a freshwater habitat

				boundary. The outfall requires erosion and scour protection within the CMA and potentially CMA bed channel lowering. The EBA works are within the CMA.
Outfall MCC_108699	✓	✓	✗	The outfall is approximately 133 m clear of the AUP(OP) indicative CMA boundary. The EBA outfall works are not considered to be within the CMA
Outfall MCC_108680	✓	✓	✗	The final detailed design is proposed to include modifications to reduce the number of complex and high-risk crossings of the Transpower high voltage cable (critical infrastructure) by stormwater pipes. This will require some project stormwater from westbound lanes of Ti Rakau Drive and the busway to be discharged to this network and some of the network's catchment on the eastern side of Ti Rakau Drive being diverted to another network during larger rainfall events (i.e. part of the peak during larger events will be diverted away from the wetland).

The consent design for EB3R currently collects stormwater in independent networks that connect to the existing networks near their outfalls and where necessary the consent design proposes to upgrade the existing pipe from the connection point to outfall. The outfalls proposed to receive Project discharges are summarised in Table 6.

Table 6: Summary of EB3R outfalls proposed to receive discharges

Outfall	Existing Outfall	Discharges to CMA	Works in CMA	Comment
Outfall MCC_108703 (1a)	✓	✓	✗	The connection point is the last manhole before the outfall. The last section of pipe from the connection point to the outfall is to be upgraded. The outfall is to be upgraded and is well clear of the AUP(OP) indicative CMA boundary which is 50 m away. Freshwater habitat.
Outfall MCC_108707 (1b)	✓	✓	✗	The connection point is the second to last manhole before the outfall. The last two sections of pipe from the connection point to the outfall are to be upgraded. The outfall is to be upgraded and is well clear of the AUP(OP) indicative CMA boundary which is 23 m away. Freshwater habitat.
Outfall MCC_108719 (2)	✓	✓	✓	The connection point is the last manhole before the outfall. The last section of pipe from the connection point to the outfall is to be upgraded. The outfall is to be upgraded and the AUP(OP) indicative CMA boundary is 5 m away. The outfall works are within the AUP(OP) indicative CMA boundary. The outfall works are within the CMA.
Outfall MCC_108738 (3)	✓	✓	✗	The connection point is the second to last manhole before the outfall. The last two sections of pipe from the connection point to the outfall are to be upgraded. The outfall is to be upgraded and the outfall and outfall works (scour protection) are outside of the AUP(OP) indicative CMA boundary outside of the AUP(OP) indicative CMA boundary.
Outfall MCC_108748 (4)	✓	✓	✗	Connection is to the last manhole (SAP ID 2000639538) before the outfall and the outlet pipe is approximately 10 m away from the AUP(OP) indicative CMA boundary. Therefore, proposed works are outside of the CMA.

New outfall adjacent MCC_108746 (Riverhills)	✗	✓	✗	A new outfall is required for a proposed overland flow path and discharge channel in the form of a naturalised stream channel along Riverhills Park. The outfall to Pakuranga Creek will be in a similar form to the outlet detail with modifications for a channel at the inlet. The permanent outfall will be located within Riverhills Park up to the AUP(OP) indicative CMA boundary (see Figure 6) subject to detailed survey and design.

The overall outcomes for EB3R stormwater treatment are a positive effect on existing contaminant loads from roads.

4.3 Ecological Assessment

The methods used to undertake this assessment are consistent with the EIANZ guidelines for undertaking ecological impact assessments (Roper-Lindsay et al., 2018), whereby ecological values are assigned (refer to Table 7 for coastal avifauna and Table 8 for marine ecology) and the magnitude of effects identified (Table 9) in order to determine the overall level of effect of the proposal (Table 10).

In New Zealand, no regional or national guidelines or criteria for the assessment of marine ecological values have been developed to date. In the absence of such guidelines, we have adopted the EIANZ guidelines (Roper-Lindsay et al., 2018) approach to assess marine ecological value (including species richness and diversity).[5] This approach has been used and accepted in previous Board of Inquiry and Environment Court consenting processes for major infrastructure Projects.[6]

The marine ecological values described in this report are based on criteria that range from very low to very high; Table 8 lists the characteristics we have used to guide our assessment of the ecological values of parts of the marine environment within the Project area. Due to the lack of marine assessment criteria and guidelines in New Zealand, our assessment of low, moderate and high benthic invertebrate species richness and diversity is based on our expert judgement and experience. However, the principles and approach to assessing level of effect are directly applicable to marine environments.

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

- Very high adverse effects require a net biodiversity gain[7]
- High and moderate adverse effects require no net loss of biodiversity values
- Low and very low effects should not normally be a concern. If effects are assessed taking impact management developed during Project shaping into consideration, then it is essential that prescribed impact management is carried out to ensure low or very low effects.

[5] Dr De Luca is currently leading a team of marine ecologists who are drafting revisions to the EIANZ guidelines to include marine ecology.

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

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

Table 7: Criteria for assigning ecological value to species (Roper-Lindsay et al., 2018).

ECOLOGICAL VALUE	SPECIES CLASSIFICATION
NEGLIGIBLE	Exotic species, including pests, species having recreational value.
LOW	Nationally and locally common indigenous species.
MODERATE	Species listed as any other category of *At Risk* (Recovering, Relict, Naturally Uncommon) found in the ZOI[8] either permanently or seasonally; or Locally (ED) uncommon or distinctive species.
HIGH	Species listed as *At Risk – Declining* found in the ZOI either permanently or seasonally.
VERY HIGH	*Nationally Threatened* (Nationally Critical, Nationally Endangered, Nationally Vulnerable) species found in the ZOI either permanently or seasonally.

Table 8: Criteria for assigning ecological value to marine habitats.

ECOLOGICAL VALUE	CHARACTERISTICS
VERY LOW	• Benthic invertebrate community degraded with very low species richness, diversity and abundance • Benthic invertebrate community dominated by tolerant organisms with no sensitive taxa present • Marine sediments dominated by silt and clay grain sizes (>85%) • Surface sediment anoxic (lacking oxygen) • Elevated contaminant concentrations in surface sediment, above GV threshold concentrations (Australian and New Zealand Governments, 2018) • Invasive, opportunistic and disturbance tolerant species highly dominant • Vegetation/macroalgae absent • Habitat extremely modified.
LOW	• Benthic invertebrate community degraded with low species richness, diversity and abundance • Benthic invertebrate community dominated by tolerant organisms with few/no sensitive taxa present • Marine sediments dominated by silt and clay grain sizes (>75%) • Surface sediment predominantly anoxic (lacking oxygen) • Elevated contaminant concentrations in surface sediment, above GV threshold concentrations (Australian and New Zealand Governments, 2018) • Invasive, opportunistic and disturbance tolerant species dominant • Vegetation/macroalgae provides minimal/limited habitat for native fauna • Habitat highly modified.
MEDIUM	• Benthic invertebrate community typically has moderate species richness, diversity and abundance • Benthic invertebrate community has both tolerant and sensitive taxa present • Marine sediments typically comprise less than 75% silt and clay grain sizes • Shallow depth of oxygenated surface sediment • Contaminant concentrations in surface sediment generally below GV threshold concentrations (Australian and New Zealand Governments, 2018) • Few invasive opportunistic and disturbance tolerant species present • Vegetation/macroalgae provides moderate habitat for native fauna • Habitat modification limited.
HIGH	• Benthic invertebrate community typically has high diversity, species richness and abundance • Benthic invertebrate community contains many taxa that are sensitive • Marine sediments typically comprise <50% smaller grain sizes

[8] The EIANZ guidelines define the zone of influence (ZOI) as "all land, water bodies and receiving environments that could be potentially impacted by the Project. It includes the Project Site and any environments beyond the Project Site where 'indirect effects' such as discharges may extend".

ECOLOGICAL VALUE	CHARACTERISTICS
	• Surface sediment oxygenated • Contaminant concentrations in surface sediment rarely exceed DGV threshold concentrations (Australian and New Zealand Governments, 2018) • Invasive opportunistic and disturbance tolerant species largely absent • Vegetation/macroalgae provides significant habitat for native fauna • Habitat largely unmodified
VERY HIGH	• Benthic invertebrate community typically has very high diversity, species richness and abundance • Benthic invertebrate community contains dominated taxa that are sensitive • Marine sediments typically comprise <25% smaller grain sizes • Surface sediment oxygenated with no anoxic sediment present • Contaminant concentrations in surface sediment significantly below DGV threshold concentrations (Australian and New Zealand Governments, 2018) • Invasive opportunistic and disturbance tolerant species absent • Vegetation/macroalgae sequences intact and provides significant habitat for native fauna • Habitat unmodified.

Table 9: Criteria for describing magnitude of effect (Roper-Lindsay et al., 2018)

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

Table 10: Criteria for describing the level of effect (Roper-Lindsay et al., 2018)

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

5 Existing Environment

Chapter Summary
• *Minimal direct effects on marine ecological values* • *Stormwater outfalls occur or proposed to occur within CMA or above in freshwater habitat prior to discharge to CMA* • *Removal of vegetation for some outfalls and occupation of CMA for some outfalls/dissipation structures (Table 1)* • *Survey of CMA receiving environment and freshwater habitats upstream of CMA revealed low-moderate or low ecological values, which is common in upper estuary habitats, with common benthic invertebrate infaunal taxa, few epifaunal invertebrates, dominance of silt and clay sediment, elevated stormwater contaminants at some sites (e.g. most sites surveyed for sediment contaminants revealed concentrations of zinc above DGV, whereas outfall 7 had zinc above GV,) and coastal edge and riparian vegetation that is largely dominated by exotic weed species with minimal native vegetation present* • *Native coastal avifauna ecological values range from Low to High. High ecological values could be present with At Risk banded rail potentially foraging in mangrove habitat.*

5.1 Stormwater Outfall Vegetation and Coastal Avifauna Survey Results

Vegetation removal (coastal and riparian (freshwater)) is required to install some of the stormwater outfalls proposed. A total of 3,600m^2 of coastal/riparian vegetation (of the estimated >10,000m^2 of coastal and freshwater vegetation within the Tāmaki Estuary) is anticipated to be removed (sum of vegetation removal at outfalls 1A, 1B, 2, 3, 7, and 8/11) (Table 11).

The stormwater receiving environments were assessed for coastal avifauna breeding and foraging habitat, revealing no breeding habitat, but foraging habitat provided within mangrove stands were present (Table 11).

Coastal and riparian margins of stormwater receiving environments comprised predominantly exotic pest plant vegetation, with minimal indigenous vegetation at most sites (Table 12). Rubbish was common at many sites (Photograph 1 to Photograph 9).

Table 11: Vegetation and Coastal Avifauna Surveys

STORMWATER OUTFALL NUMBER	DATE SURVEYED	NATIVE VEGETATION PRESENT	EXOTIC VEGETATION PRESENT	AREA OF VEGETATION WITHIN CMA TO BE REMOVED	AREA OF VEGETATION OUTSIDE CMA TO BE REMOVED	COASTAL AVIFAUNA BREEDING HABITAT	COASTAL AVIFAUNA FORAGING HABITAT
EB2							
7 P98086C	Oct-Dec 2018		Yes	N/A	800m^2	No	No
8/11 New outfalls 06-05 and 89-18. MCC_108673	23/02/2022	Yes	Yes	Permanent occupation 1,375m^2 Temporary occupation 2,087m^2	370m^2	No	Yes
12 MCC_108680	Not surveyed (not included in stormwater details document)	N/A	N/A	N/A	N/A	N/A	N/A
15 MCC_108633	22/03/2022	Yes	Yes	N/A	N/A	N/A	N/A
EB3R							
1A Outfall MCC_108703	23/02/2022	Yes	Yes	N/A	460m^2	No	No
1B Outfall MCC_108707	23/02/2022	Yes	Yes	N/A	940m^2	No	No
1C Outfall MCC-108673	23/02/2022	Yes	Yes	N/A	N/A	No	No
2 MCC-108718 and 108719	23/02/2022	Yes	Yes	Permanent occupation 16m^2 Temporary occupation 42.5m^2	400m^2	No	Yes

STORMWATER OUTFALL NUMBER	DATE SURVEYED	NATIVE VEGETATION PRESENT	EXOTIC VEGETATION PRESENT	AREA OF VEGETATION WITHIN CMA TO BE REMOVED	AREA OF VEGETATION OUTSIDE CMA TO BE REMOVED	COASTAL AVIFAUNA BREEDING HABITAT	COASTAL AVIFAUNA FORAGING HABITAT
3 MCC_108738	Oct-Dec 2018	Yes	Yes	N/A	430m^2	No	Yes
4 MCC_108748	23/02/2022	Yes	Yes	N/A	N/A	No	Yes
5/6	Oct-Dec 2018	Yes	Yes	N/A	N/A	No	Yes
13/14 MCC_108699	Not surveyed	N/A	N/A	N/A	750m^2	N/A	N/A
Riverhills Waterway Outfall	N/A	N/A	N/A	Temporary occupation of CMA 90m^2	250m^2	N/A	N/A

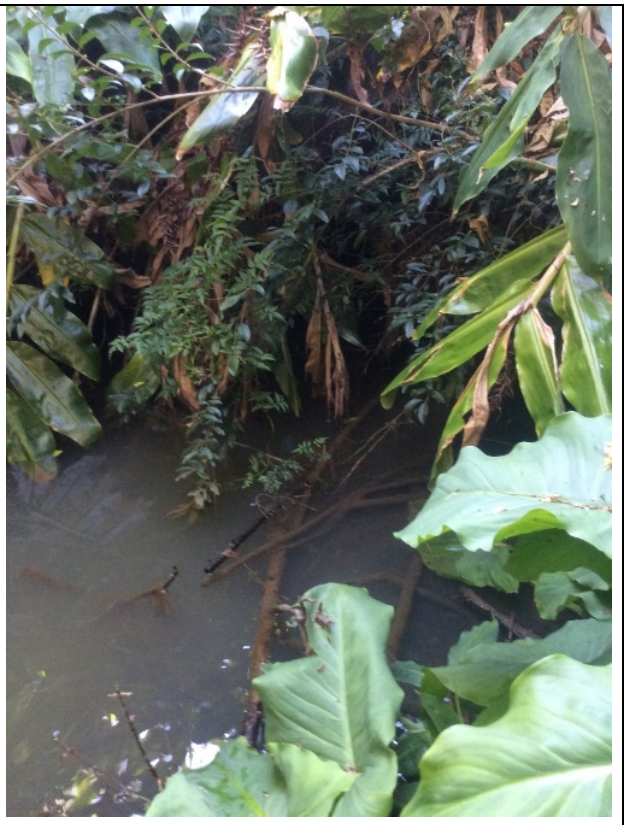
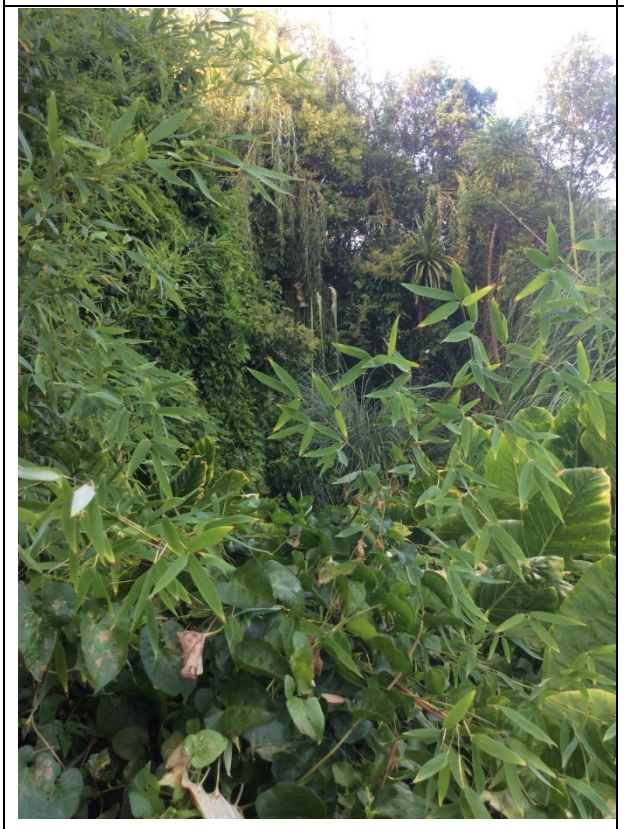
Table 12: Native and Exotic Vegetation Species Presence and Site Observations

STORMWATER OUTFALL NUMBER	DATE SURVEYED	NATIVE VEGETATION	EXOTIC VEGETATION	OUTFALL/SITENOTES
EB2				
7	Oct-Dec 2018	Mangroves (*Juncus krausii* var. *australiensis)* approximately (2-3 m tall). Shrubs and trees present included pohutukawa (*Metrosideros excelsa*), karamu (*Coprosma robusta*) with some flax (*P. tenax*), sea rush (*Juncus kraussii* ssp. *australiensis*), and saltmarsh ribbonwood (*Plagianthus divaricatus*) present.	Pampas (*C. selloana*) present.	N/A
8/11 New outfalls 06-05 and 89-18. MCC_108673	23/02/2022	No physical outfall found, due to redesign of outfall to avoid Transpower cables. Mangrove (*Juncus krausii* var. *australiensis)* habitat approximately 3 m tall, with no other vegetation present.	N/A	Channel approximately 1.5m wide at time of sampling. Grass reserve on one side of area surveyed and houses, motorway on other side.
12 MCC_108680	Not surveyed	N/A	N/A	N/A
15 MCC_108633	Surveyed 22/02/2022	Outlet discharges into freshwater stream, approximately 35m upstream estuarine habitat. Riparian margin includes kawakawa (*Macropiper excelsum*), flax (*P. tenax*), *Pittosporum* sp. Evidence of native planting previously.	Willow and silver inch plant (*Tradescantia* spp.) present.	Shortfin eels and banded kokopu present in the stream downstream of outfall.
EB3R				
1A Outfall MCC_108703	23/02/2022	Pohuehue (*Muehlenbeckia australis*), mahoe (*Melicytus ramiflorus*).	Wild ginger (*Hedychium gardnerianum*), jasmine (*Parsonsia heterophylla*) dense, convolvulus (*Calystegia sylvatica*), woolly nightshade (*Solanum mauritianum*).	Large perched culvert with a concrete headwall, pipe approximately 60 cm wide. Some rocks present at the base of the outfall. Not tidally influenced, freshwater habitat – occasional crab holes seen from approximately 10m downstream from the culvert, no mangroves in area and no other marine vegetation.

STORMWATER OUTFALL NUMBER	DATE SURVEYED	NATIVE VEGETATION	EXOTIC VEGETATION	OUTFALL/SITENOTES
				Abundant rubbish present.
1B Outfall MCC_108707	23/02/2022	N/A	Fig (*Ficus rubiginosa*). Approximately 1m diameter pipe under a thick swathe of jasmine (*P. heterophylla),* surrounded by arum lily (*Zantedeschia aethiopica*) and wild ginger (*Hedychium gardnerianum*).	Fig shading outlet pipe. Large pool (approximately 2m wide by 3m long) in front of the outlet pipe, 2 shortfin eels identified in the pool. Receiving environment not tidally influenced - freshwater habitat.
1C Outfall MCC-108673	23/02/2022	Cabbage trees (*C. australis*).	Heavily weed infested area (elephant's ear lily (*Alocasia brisbanensis*), bamboo (*Bambusa* spp.), pampas (*Cortaderia selloana*), convolvulus (*C. sylvatic*a), nasturtium (*Tropaeolum majus*), ivy like vine, willow (*Salix fragilis*), tree pivet (*Ligustrum lucidum*), and grapevine *(Vitis vinifera*).	Climbers and vines forming a very thick mat. Small pool found, assumed to be adjacent to the outlet area. Outlet area not tidally influenced (freshwater).
2 MCC-108718 and 1087199	23/02/2022	Mangrove (*Avicennia marina* subsp. *australiasica*) marine habitat – short stature, juvenile mangroves present in presumed outfall channel (approximately 20-50 cm high) then grades into large mangroves (2-4 m high). 4 cabbage trees (*C. australis*) in intertidal area near the bank.	Below houses, surrounded by weedy vegetation: privet *(Ligustrum lucidum)*, bamboo (*Bambuseae* family), convolvulus (*Calystegia soldanella*), velvet groundsel *(Roldana petasitis*), jasmine (*P. heterophylla*)	Abundant rubbish.
3 MCC_108738	Oct-Dec 2018	Mangrove (*A. marina*, sea rush (*Juncus krausii* var. *australiensis*), remuremu (*Selliera radicans*), slender clubrush (*Isolepis cernua* var. *cernua*), oioi (*Apodasmia similis*), and *Carex* sp. Surrounding native vegetation on the coastal fringe included pohutukawa (*Metrosideros excelsa*), cabbage tree (*C. australis*), bracken (*Pteridium esculentum*) mahoe (*M. crassifolius*), mapau (*Myrsine australis*), totara (*Podocrapus totara* var. *totara*), kiokio (*Parablechnum novae-zelandiae*) and kanuka	Weed species on the coastal fringe included gorse (*Ulex europaeus*), arum lily (*Z. aethiopica*), Chinese privet (*L. sinense*), velvet groundsel (*R. petasitis*), moth plant (*Araujia hortorum*), blackberry (*Rubus fruticosus* agg.), ivy (*Hedera helix)*, jasmine (*J. polyanthum*), woolly nightshade (*S. mauritianum*), nasturtium (*T. majus*) and agapanthus (*Agapanthus praecox).*	N/A

STORMWATER OUTFALL NUMBER	DATE SURVEYED	NATIVE VEGETATION	EXOTIC VEGETATION	OUTFALL/SITENOTES
		(*Kunzea ericoides*) and karamu (*Coprosma robusta*).		
4 MCC_108748	23/02/2022	Mangroves *Juncus krausii* var. *australiensis)* average approximately 2m high. Mangrove riparian vegetation includes manuka (*Leptospermum scoparium*), and (*Austroderia toetoe*), and a single umbrella sedge (*Cyperus ustulatus*) plant.	Gorse (*Ulex europaeus*) and some sprayed pampas (*C. selloana*) and paspalum (*Paspalum dilatatum*).	Outfall approximately 10m upstream of mangroves. Suburban land use surrounds the site (housing, school).
5/6	Oct-Dec 2018	Beneath and adjacent to the true right abutment of the existing Ti Rakau Drive bridge, over the Tāmaki Estuary, the native coastal vegetation comprised mangrove (*Juncus krausii* var. *australiensis).* Native vegetation beneath and immediately adjacent to the bridge abutment on the true right as absent, with rank grass abutting the coastal margin. Both planted native shrubs and exotic species are present along the wider coastal margins.	Exotic species present in the wider coastal margins.	N/A
13/14 MCC_108699	Not surveyed	N/A	N/A	No works in the CMA. Freshwater habitat.
Riverhills	Not surveyed	N/A	N/A	N/A

Table 13: Representative outfall location photographs

	
Photograph 1: Adjacent to Outfall 1A (Stream present - see Terrestrial and Freshwater Ecology Assessment).	*Photograph 2: Adjacent to Outfall 1B (Stream present - see Terrestrial and Freshwater Ecology Assessment).*
	
Photograph 3: Adjacent to Outfall 1C.	*Photograph 4: Adjacent to Outfall 2*

Photograph 5: Adjacent to Outfall 3

Photograph 6: Adjacent to Outfall 4.

Photograph 7: Adjacent to Outfall 5/6

Photograph 8: Adjacent to Outfall 7.

Photograph 9: Adjacent to proposed revised location outside of Transpower cables adjacent to outfall 8/11.

Photograph 10: Outfall 15

5.2 Benthic Infaunal Invertebrate Community

The benthic invertebrate assemblages at all sites were largely dominated by oligochaete worms, estuarine gastropods (*Potamopyrgus estuarinus* and *Amphibola crenata*) and amphipods (Figure 4). These are typical species present in mangrove stands. Abundance of benthic invertebrates ranged between an average of approximately 20 individuals at stormwater outfall 5/6 to approximately 150 at stormwater outfall 3 (site 1) (Figure 4).

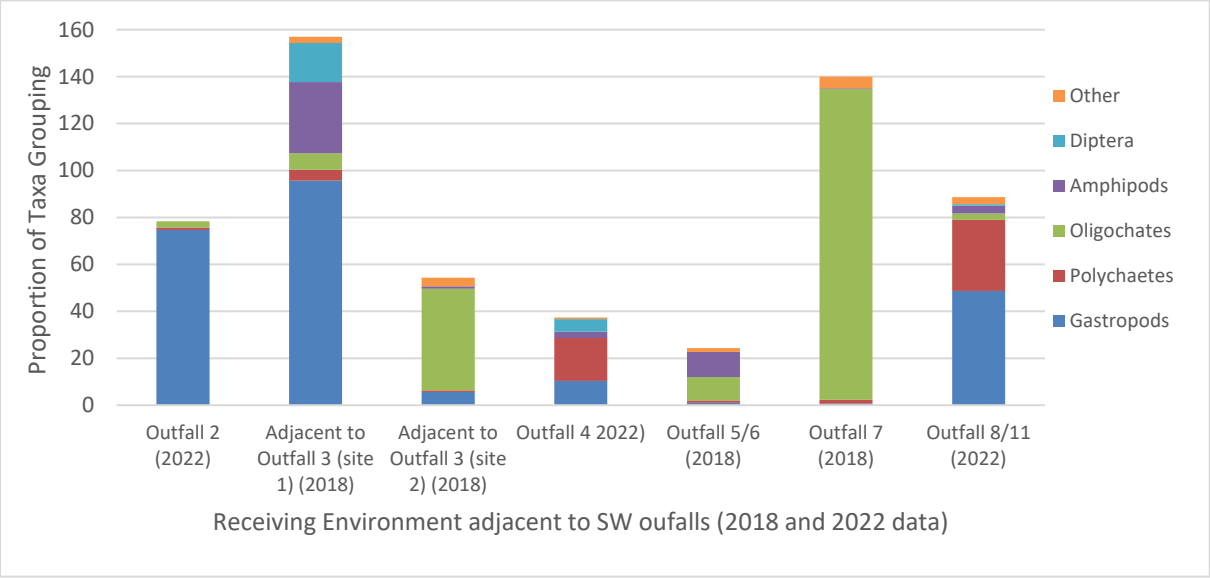


Figure 4: Proportions of main taxa groups by abundance at each selected stormwater outfall site.

The difference in benthic invertebrate assemblages at selected stormwater outfall sites is shown in the Multi-Dimensional Scaling (MDS) Plot[9] below, with most sites clustered separately, particularly outfall 2, 4 and outfall 3 (site 1) (Figure 5). Outfall 7 had similarities to outfall 5/6 and outfall 3 (site 2) (Figure 5).

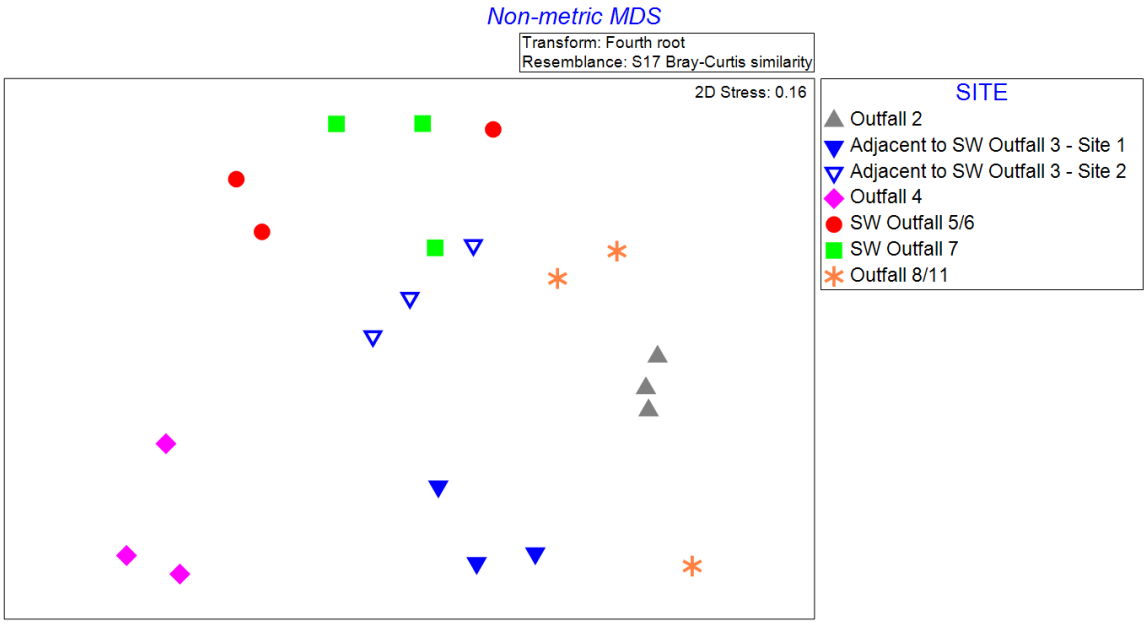


Figure 5: Multi-dimensional Scaling Plot of benthic invertebrate infaunal assemblages at proposed stormwater outfall sites.

Species richness was highest at outfall 8/11 (location of redesign of stormwater outfall to avoid underground Transpower cables) with approximately 12 species detected. Outfall 3 (site 2), outfall 5/6 and outfall 7 had the lowest number of species of around 4 taxa per site (Figure 6).

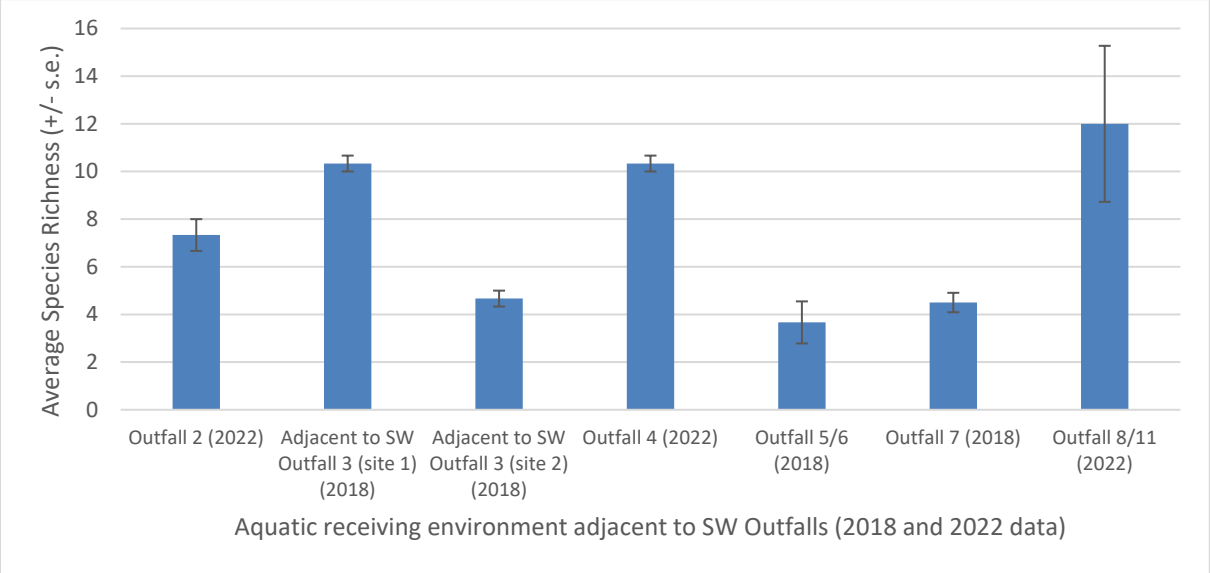


Figure 6: Average species richness of benthic invertebrates by site (2018) adjacent to SW outfalls.

Average Shannon-Wiener diversity varied from low (0.2 at stormwater outfall 2 and 7) to moderate diversity (just below 1.5) at stormwater outfall 3 (site 1) and outfall 4 (Figure 7).

[9] Using Primer E multivariate statistical software

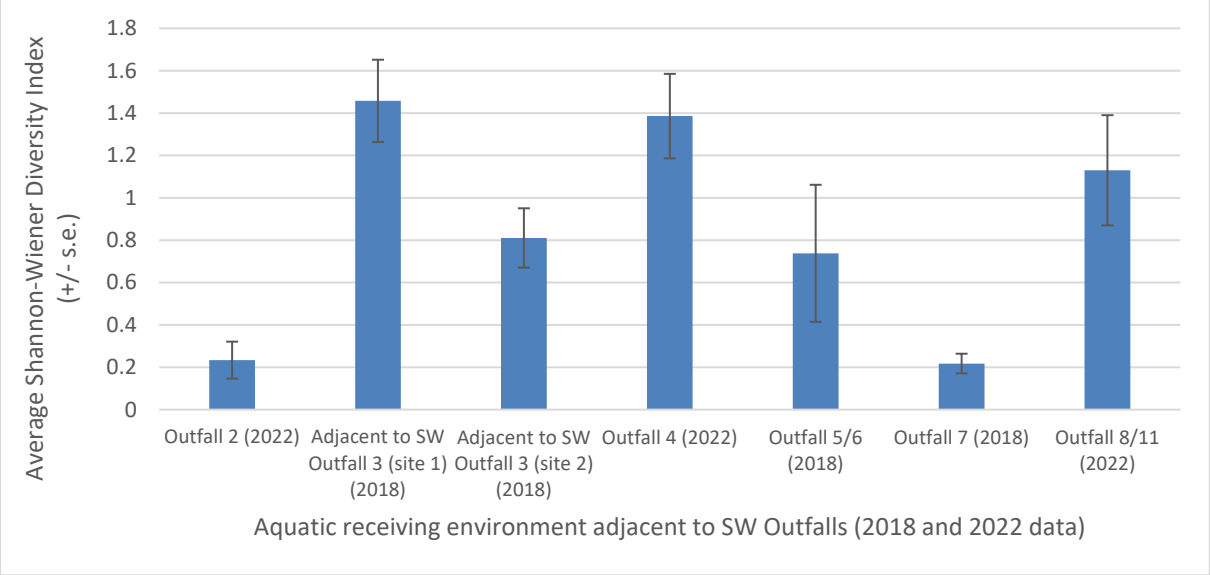


Figure 7: Average Shannon-Wiener Diversity Index by Site (2018) adjacent to SW outfalls.

5.3 Epifaunal Communities

Sunlight exposed sites exhibited extensive mangrove seedling and pneumatophores and some gastropods (*Potamopyrgus estuarinus*) (Photograph 11 to Photograph 17). Although, not captured in the quadrat photographs collected, *Amphibola crenata* (mud snail) were present at some sites along with mangrove stands.

Photograph 11: Stormwater Outfall 2 - Mangrove pneumatophores, seedlings and leaf litter.

Photograph 12: Stormwater Outfall 3 (site 1) - Mangrove pneumatophores and Potamopyrgus estuarinus.

Photograph 13: Stormwater Outfall 3 (site 2) - Mangrove pneumatophores and seedlings, and Potamopyrgus estuarinus.

Photograph 14: Stormwater Outfall 4) - Mangrove leaf litter.

Photograph 15: Stormwater Outfall 5/6- Mud crab burrows, no mangrove pneumatophores.

Photograph 16: Stormwater Outfall 7- Mud crab burrows, and mangrove pneumatophores

Photograph 17: Stormwater Outfall 8/11- Mangrove pneumatophores and seedlings.

5.3.1 Sediment Quality and Grain Size

Surface sediment at all sites was dominated by silt and clay and had shallow depth of oxygenated sediment. Silt and clay at all sites comprised greater than 50%, except for outfall 4 and 15. Stormwater outfall 3 (Site 2) had the highest proportion of silt and clay at approximately 85%. Outfalls 5/6, 7 and 8/11 had approximately 80% silt and clay (Figure 8). A high proportion of silt and clay is typical of upper estuarine depositional environments, such as many of the outfall sites surveyed (Figure 8).

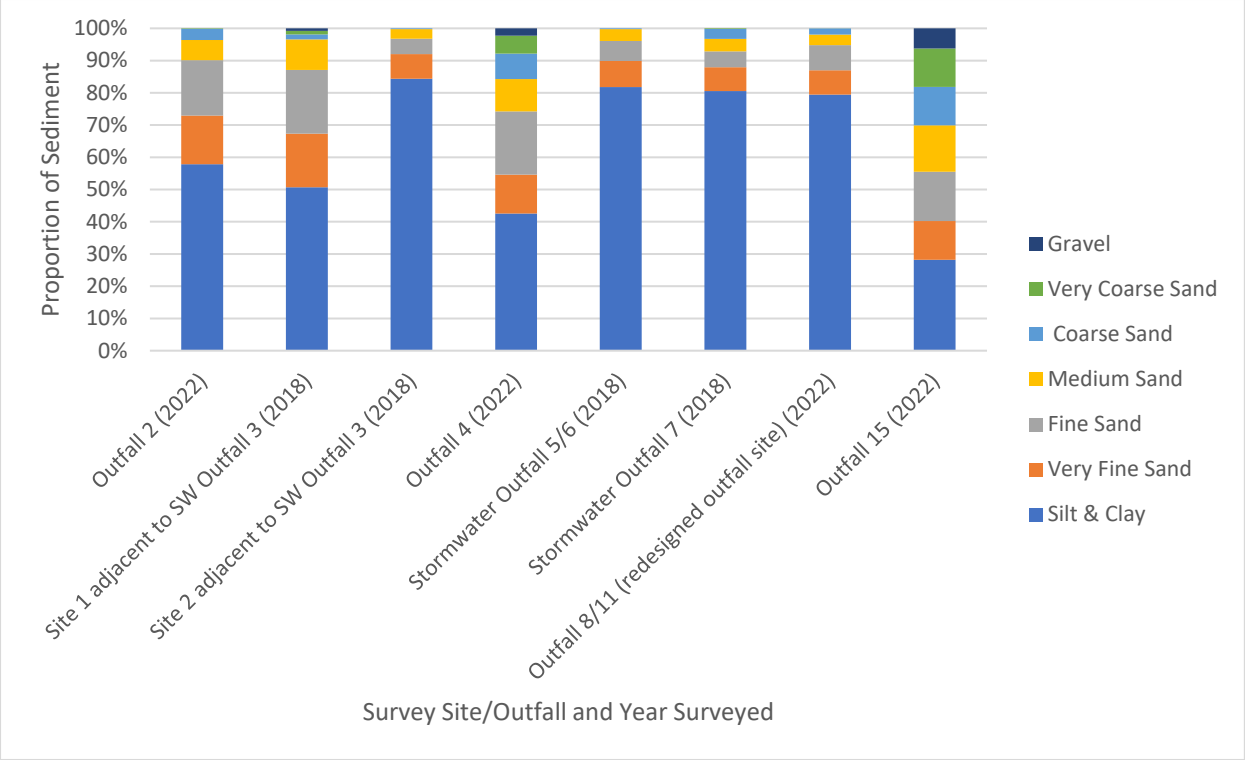


Figure 8: Proportion of grain size distribution in surface sediment.

Common stormwater contaminants in surface sediment samples were generally above the default guideline value (DGV, shown in orange) for zinc (excluding outfall 3 (site 2). Site 1 at outfall 3 had a concentration of zinc in sediment below DGV, indicating some spatial variability at this outfall/receiving environment. Zinc was detected above the GV of 420 mg/kg with sediment at outfall 7 recording 600 mg/kg and outfall 1C recording 1.150 mg/kg. Copper and lead were detected below DGV value at all sites, apart from lead at outfall 4 which was just above DGV value and outfall 1C where copper and lead were above the DGV value (Table 14).

An assessment of the current concentration of zinc in receiving environment sediment, combined with CLM zinc predictions, are included in Table 15. We have identified the likely effects of the zinc in outfall receiving environments and determined which are likely to increase due to the increase zinc load (Table 15). Outfalls 1B, 2 and 4 are likely to be affected by increased zinc load above DGV or GV values in the future.

Table 14: Common stormwater contaminants (metals) in surface sediment

Stormwater Contaminants	Outfall 1A (2022)	Outfall 1B (2022)	Outfall 1C (2022)	Outfall 2 (2022)	Adjacent to Stormwater Outfall 3 (site 1) (2018)	Adjacent to Stormwater Outfall 3 (site 2) (2018)	Outfall 4 (2022)	Stormwater Outfall 5/6 (2018)	Stormwater Outfall 7 (2018)	Outfall 8/11 (2022)	Outfall 15 (2022)	DGV[10]	GV[9]
Copper (mg/kg)	41	29	127	25	13.7	31	62	36	36	44		65	270
Lead (mg/kg)	23	16.2	128	21	15.6	32	51	40	32	41		50	220
Zinc (mg/kg)	210	280	1,150	220	162	220	270	270	600	270		200	410

Table 15: Assessment of CLM at individual outfalls against receiving environment sediment zinc concentrations in receiving environment sediment

Outfall	Zinc (mg/kg) (amber above DGV, red above GV) in receiving environment	CLM predicted zinc load increase/decrease	Possible effects on zinc concentration in sediment in receiving environment	Potential effects on benthic invertebrate organisms/community composition in receiving environment
EB2				
7	600	0%	Concentration likely to remain above GV value.	Adverse effects on species/communities[10].
8/11 **New outfalls 06-05 and 89-18.** **MCC_108673,**	270	5.3% decrease	Concentration likely to remain above DGV value.	Adverse effects on sensitive species[10].
12 MCC_108680	Not surveyed	81% decrease	N/A	
15 MCC_108633	1,160	0.4% increase	Concentration likely to remain above GV but not likely to increase significantly above present concentration.	Adverse effects on species/communities[10].
EB3R				

[10] Orange cells are above the DGV guideline value, whereas red cells are above the GV guideline value (Australian and New Zealand Governments, 2018).

Outfall	Zinc (mg/kg) (amber above DGV, red above GV) in receiving environment	CLM predicted zinc load increase/decrease	Possible effects on zinc concentration in sediment in receiving environment	Potential effects on benthic invertebrate organisms/community composition in receiving environment
1A MCC_108703	210	74% decrease	Concentration likely to remain above DGV value.	Adverse effects on sensitive species[11]. Discharge to freshwater habitat.
1B MCC_108707	280	74% increase	Concentration likely to increase over time, could approach GV value in future.	Adverse effects on sensitive species[10]. Discharge to freshwater habitat.
1C MCC_108673	1,150	100% decrease	Concentration likely to remain above GV but not likely to increase above present concentration.	Adverse effects on species/communities[10].
2 (site 1) MCC-108718 and 1087199	162	15% decrease	Concentration likely to remain below DGV	No adverse effects on invertebrate species.
2 (site 2) MCC-108718 and 1087199	220	15% decrease	Concentration likely to remain above DGV value.	Adverse effects on sensitive species[10].
4 MCC_108748	270	59% decrease	Concentration likely to remain above DGV value.	Adverse effects on sensitive species[10].
5/6	270	41% decrease	Concentration likely to remain above DGV value.	Adverse effects on sensitive species[10].
13/14 MCC_108699	Not surveyed	43% decrease	N/A	Discharge to freshwater habitat.

[11] Likely already occurring due to zinc concentration above DGV or GV in receiving environments.

5.4 Coastal Avifauna/Manu

The Tāmaki River is utilised by a range of New Zealand resident and migratory shore birds, with the mid-to-lower reaches being particularly important due to the availability of roosting and feeding areas (Kelly, 2008). The marine environment of the Tāmaki River includes Significant Ecological Areas (SEAs), which have been identified for their wading bird value (Figure 2). SEA-M1 45a (Pakuranga Creek roost) is a roosting site used by hundreds of wading birds that feed within the Tāmaki River (including adjacent to outfalls 1c, 2 and 3), while SEA-M2 45 w1 (which is beyond the ZOI for this Project) provides extensive areas of feeding habitat for wading birds along this coastline (Figure 2). For the majority of wading and shorebird species utilising the Tāmaki River, this will form part of a wider network of coastal and estuarine habitats that they use depending on the time of year and tidal sequence (Dowding & Moore, 2006).

A list of all species recorded in the OSNZ atlas square encompassing the Ti Rakau bridge and surrounding Project area (Figure 9) is provided in Appendix 2. This list also includes native coastal bird species observed during the site visits.

The coastal / estuarine environment within the ZOI[12] provides primary or secondary habitat for five of the species recorded in the atlas square, one of which is classified as *At Risk* (banded rail, Table 16). The mangrove-dominated ZOI does not provide foraging habitat for gulls, oystercatchers, shags, stilts, dotterels or terns as they forage in open areas such as channels and intertidal mudflats which have little to no vegetative cover. The dense mangrove habitat within the ZOI also does not provide roosting or nesting habitat for these species.

White-faced heron (*Not Threatened*) was the only coastal species observed within the ZOI during the site visits. Other native bird species recorded, which can be found in coastal habitats, included kingfisher, paradise shelduck and pukeko (all classified as *Not Threatened*). Black-backed gulls were also observed but beyond the ZOI. No shorebirds were observed during the site visits despite it being low tide on all survey occasions.

Searches were also carried out for banded rail footprints in the mangrove habitat where they would forage; no banded rail footprints were located.

Table 16: Threat status of species for which the coastal / estuarine ZOI in EB2 and EB3R combined provides primary or secondary habitat.

Species	Maori name	Threat status (H. A. Robertson et al., 2021)	Observed During Site Visits (Yes / No)
Banded rail	moho pererū	At Risk – Declining	No
White-faced heron	matuku	Not Threatened	Yes
Paradise shelduck	putangitangi	Not Threatened	Yes
Sacred kingfisher	kotare	Not Threatened	Yes
Pūkeko	pūkeko	Not Threatened	Yes

[12] The ZOI is the outer limit where stormwater contaminants deposit. For this Project the ZOI is the mangrove edge given that stormwater contaminants typically accumulate in cumulation at / around outfalls in fine organic / muddy sediments and decrease in contamination from the discharge point. The ZOI is not expected to extend beyond in open channels and other coastal / estuarine habitats.

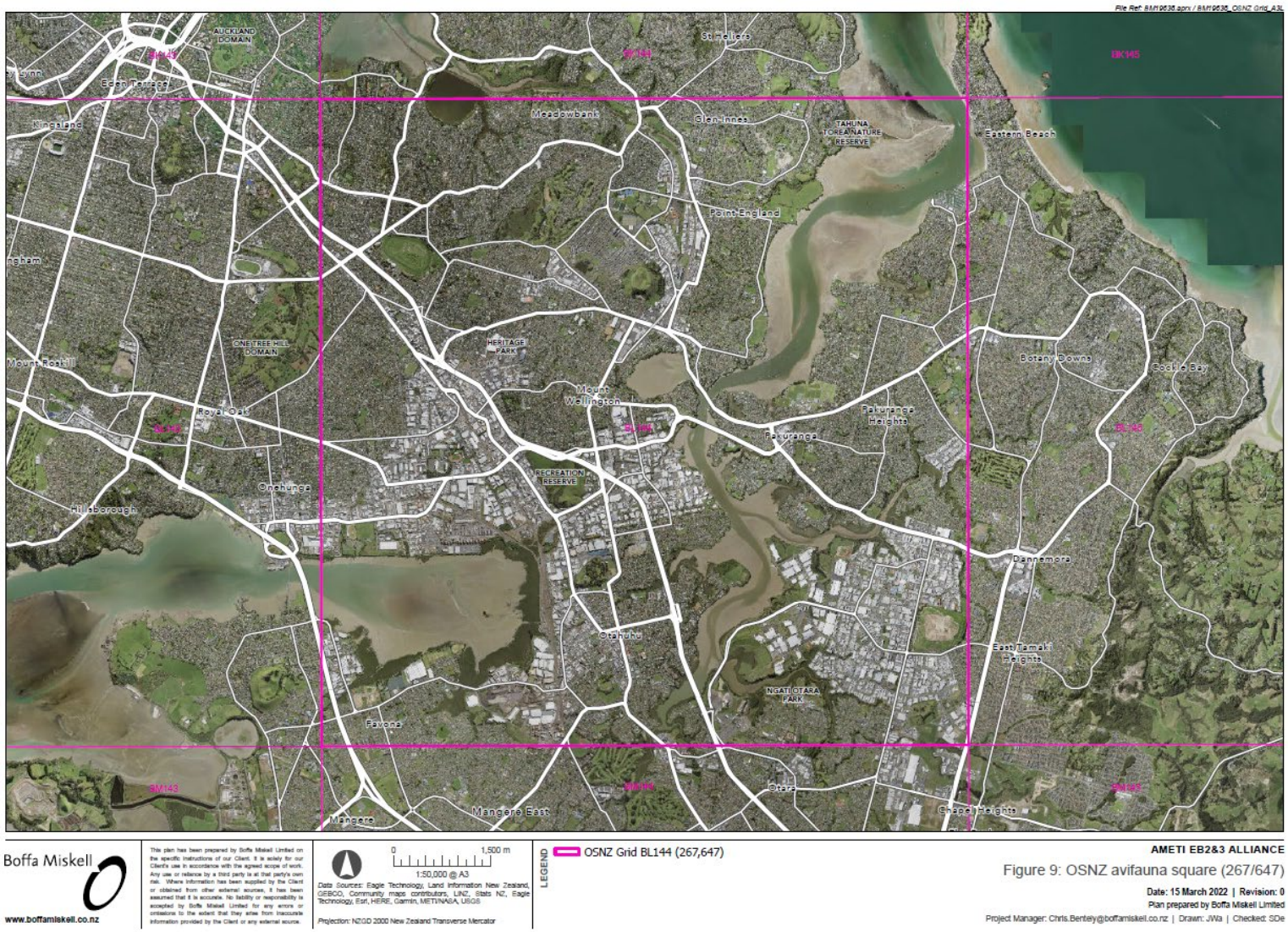


Figure 9: OSNZ avifauna square (267, 647) location

5.5 Summary of Ecological Values

Assessment of ecological value is guided by the parameters in Table 7 (coastal avifauna) and Table 8 (marine).

5.5.1 Marine

All marine environments associated with the stormwater outfalls within EB2 and EB3R had an overall ecological value of low-moderate to low.

5.5.1.1 EB2

- Stormwater outfall 7 is mangrove habitat with native shrubs on margins, moderate benthic invertebrate abundance (dominated by oligochaetes), low species richness (4) and Shannon-Wiener diversity (0.2), sediments comprising >80% silt and clay, the concentration of zinc above GV (600 mg/kg), habitat modified. Overall, low ecological values.
- Stormwater outfall 8/11 is a mangrove habitat with no other vegetation, benthic invertebrate abundance low (dominated by gastropods and polychaetes), species richness approximately 12, Shannon-Wiener moderate at 1.1, silt and clay approximately 80%, zinc above DGV, less modified site compared to other outfalls. Overall, low-moderate ecological values.
- Outfall 15 is a freshwater receiving environment, therefore cores for benthic invertebrates not collected. Zinc concentration in sediment is above GV value (1,160 mg/kg). Riparian vegetation (mostly exotic and some native) and no avifauna breeding/foraging habitat. Overall, low ecological values.

5.5.1.2 EB3R

- Outfall 1A – only assessed for stormwater contaminants (zinc above DGV), vegetation (mostly exotic and some native), habitat modified discarded rubbish and debris and avifauna breeding/foraging habitat (neither present). Discharge into freshwater habitat. Overall, low ecological values.
- Outfall 1B – only assessed for stormwater contaminants (zinc above DGV), vegetation (mostly exotic and some native), habitat modified discarded rubbish and debris and avifauna breeding/foraging habitat (neither present). Discharge into freshwater habitat. Overall, low ecological values.
- Outfall 1C – only assessed for stormwater contaminants (zinc above DGV), vegetation (mostly exotic and some native), habitat modified discarded rubbish and debris and avifauna breeding/foraging habitat (neither present). Overall, low ecological values.
- Outfall 2 – mangrove habitat with weedy margins, abundant discarded rubbish and debris, no avifauna breeding habitat but some foraging habitat present, gastropods dominant in the benthic invertebrate infaunal community, species richness moderate (7), Shannon-Wiener Diversity low (0.2), sediment contains greater than 50% silt and clay, zinc concentration in sediment above DGV, habitat modified. Overall, low ecological values.
- Adjacent to stormwater Outfall 3 (site 1) has moderate ecological value based on moderate benthic invertebrate abundance (dominated by gastropods, amphipods and diptera), species richness (10) and Shannon-Wiener diversity (1.4), sediments comprising <50% silt and clay, and

contaminant concentrations in surface sediment less than DGV thresholds, habitat modified. Overall, moderate ecological values.

- Adjacent to stormwater Outfall 3 (site 2) has low ecological value based on low benthic invertebrate abundance (dominated by oligochaetes), species richness (4), and Shannon-Wiener diversity (0.8), sediments comprising >80% silt and clay, low levels of surface sediment oxygenation and the concentration of zinc in surface sediment above DGV threshold, habitat modified. Overall, low ecological values.
- Outfall 4 – mangrove habitat with exotic and native surrounding vegetation, low benthic invertebrate abundance (dominated by polychaete worms and gastropods), species richness (10), Shannon-Wiener diversity approximately 1.4, silt less than 50%, zinc above DGV and lead slightly above DGV values, habitat modified. Overall, low-moderate ecological values.
- Outfall 5/6 comprises mangrove habitat with predominantly exotic vegetation on the margins, low benthic invertebrate abundance (20), species richness (<4) and Shannon-Wiener diversity (0.7), sediments comprising >80% silt and clay, concentration of zinc in surface sediment above DGV threshold, habitat modified. Overall, low ecological values.

5.5.2 Avifauna

While the Project (EB2 and EB3R) lies within a small part of a SEA identified for wading bird values (and is in close proximity to another), no such species were observed foraging or roosting in that area during site visits at low tide. However, *Threatened* and *At Risk* coastal species have been recorded in the wider marine environment (Table 16).

Potential breeding habitat for banded rail was identified along the estuarine margin of Sites 7-8 and a search was undertaken for banded rail footprints in this area. However, no banded rail footprints were observed. Based on this species having an *At Risk – Declining* classification, it is assigned a High Ecological Value according to the EIANZ guidance (Table 7). It is likely that this species forages widely in the mangroves in the wider area, but the only potential nesting habitat found was outside the Project footprint for EB2 and EB3R and no banded rail have been observed during site visits.

Accordingly, the Project provides potential foraging habitat for native coastal avifauna species with species ecological values ranging from low (*Not Threatened*) to high (*At Risk – Declining*), noting that banded rail were not observed during surveys, but given their cryptic nature, still could be occasionally present in the ZOI.

6 Assessment of Effects on Marine Ecology and Coastal Avifauna Ecology

Chapter Summary

Potential Effects of Construction:

- *Occupation (temporary and permanent) of CMA, coastal vegetation removal and habitat disturbance for EB2 and EB3R is considered to have a low to very low overall effect level on marine ecology.*
- *Remobilisation of contaminants in EB2 and EB3R currently bound in sediment during earthworks or vegetation removal is an environmental risk that can be managed through using best practice erosion and sediment control devices including coffer dams or bunds.*
- *Loss of coastal avifauna foraging habitat (mangroves) as a result of vegetation removal for some outfalls and occupation of CMA for some outfalls / dissipation structures, is considered to have a very low overall level of effect on avifauna values given the small quantities of vegetation being removed relative to the vast amount of mangrove habitat present, and that will remain, in the wider area (EB2 and EB3R).*
- *Potential avifauna habitat disturbance and displacement during construction works is considered to have a very low overall levels of effect on avifauna given the small and temporary nature of the works as well as the abundance of alternative, nearby habitat available for avifauna to utilise if disturbed or displaced during works for EB2 and EB3R.*
- *CLM indicates overall a reduction in EB2 for copper, zinc and TPH.*
- *CLM indicates overall reduction in copper, zinc and TPH in EB3R but an increase at outfall MCC-108077.*

Potential Effects of Operation:

- *The discharge of stormwater contaminants will reduce across the EB2 and EB3R overall catchments due to treatment with gross pollutant traps and raingardens. However, there are several individual outfalls (1B, 2, 4 and 15) where the receiving environment sediment concentrations (particularly zinc) and the CLM indicates contaminant loads will increase. These concentrations are likely to continue to adversely affect benthic organisms and this will increase with future loads predicted. The level of effects on marine ecological values is considered to be low for all outfalls except 1B, 2, 4 and 15 where the level of effects is assessed as moderate*
- *Discharge of stormwater contaminants from EB2 and EB3R to potential avifauna foraging habitat during operation is considered to have a low to very low overall level of effect on coastal avifauna*
- *In terms of marine ecology, the contribution of the Project to the cumulative effects of contaminant discharge and deposition, has a low magnitude of effect for most outfalls (excluding 1B, 2, 4 and 15 of EB3R, which have a moderate magnitude of effect). Based on low ecological values, the level of effect on marine ecology is assessed as low and mitigation is not required for contribution to cumulative effects*
- *For coastal avifauna, the contribution of the Project to the cumulative effects of contaminant discharge and deposition on prey availability and contaminant body burden of prey has a negligible magnitude of effect for all outfalls given that only a small proportion of prey items may be contaminated relative to food availability in the wider Tāmaki River foraging network. Based on low to high coastal avifauna species ecological values, the level of effect on coastal avifauna is assessed as very low and mitigation is not required for contribution to cumulative effects for EB2 or EB3R.*

6.1 Effects of Construction

6.1.1 Stormwater Discharge Structures

Construction of stormwater discharge structures and energy dissipation controls may involve permanent and temporary habitat loss within the CMA and habitat disturbance. Approximately 3,600m^2 of vegetation removal within the CMA across EB2 and EB3R will be required to install/modify stormwater outfalls and dissipation structures.

6.1.1.1 Permanent Occupation of CMA

Eastern Busway 2
Outfalls 06-05 and 89-19 involves 1,375m^2 permanent occupation of the CMA, vegetation is primarily mangrove habitat and exotic species.

Eastern Busway 3 Residential
Outfall MCC-108719 involves 16m^2 of permanent occupation of the CMA, with some mangrove and exotic vegetation present.

6.1.1.2 Temporary Occupation of CMA during construction

Coffer dams or bunds will be used to isolate earthworks areas in the CMA that could discharge to the wider estuary. The ESC approach is detailed in the Erosion and Sediment Control Plan (ESCP) with the design approach to diversion of clean and dirty water located in section 4.14 of that report.

The temporary occupation of the CMA detailed below in this section includes occupation for ESC devices during construction.

Eastern Busway 2
Outfalls 06-05 and 89-19 involves 2,087m^2 temporary occupation of the CMA, vegetation is primarily mangrove habitat and exotic species.

Eastern Busway 3 Residential
Outfall MCC-108719 involves 41.5m^2 of temporary occupation of the CMA, with some mangrove and exotic vegetation present.

Construction of Riverhills Waterway Outfall involves 90m^2 of temporary occupation of the CMA, with some mangrove and exotic vegetation present.

6.1.1.3 Remobilisation of contaminants in sediment through earthworks.

Earthworks associated with the construction of new outfalls, modification of existing outfalls and vegetation remove may result in the remobilisation of some contaminants currently bound in receiving environment sediments.

Best practice erosion and sediment control (ESC) methods will be implemented, in accordance with Auckland Council Guideline Document 2016/005 *Erosion and Sediment Control Guideline for Land Disturbing Activities in the Auckland Region* (GD05) (Erosion and Sediment Control Effects Assessment, 2022). Dirty and clean water will be separated through the use of temporary coffer dams or bunds (ESCP Report).

It is concluded that the proposed works methodology will minimise actual and potential adverse construction effects to an acceptable and negligible level.

The magnitude of effect following best practice methods are minimised and managed to an acceptable and low/negligible magnitude. The level of effect, combining low-moderate ecological values with low/negligible magnitude of effect results in a very low level of effect.

6.1.1.4 Vegetation Removal within CMA

Eastern Busway 2
Vegetation removal associated with outfall 7 is estimated at 800m^2. Vegetation removal for the redesign of outfall 8/11 is estimated at 370m$^{2.}$

With respect to coastal avifauna, vegetation removal will result in the loss of up to 1,170 m^2 (0.117 ha) of potential foraging habitat in the CMA (800 m^2 at stormwater outfall 7 and 370 m^2 at stormwater outfall 8-11). The dominant coastal avifauna habitat type that will be lost at both sites is mangroves. Small quantities of sea rush and saltmarsh ribbonwood may also be lost at outfall 7. Given the small area of mangrove removal relative to the large amount of mangrove habitat available in the wider Tāmaki River area and the mobile nature of the birds potentially foraging in these areas (i.e. ability to forage elsewhere upon habitat removal), it is considered that the loss of potential foraging habitat for species with ecological values ranging from Low (*Not Threatened*) to High (*At Risk – Declining*) will have a Negligible magnitude of effect on coastal avifauna potentially utilising habitat in the Project area (Table 9) and a Very Low overall level of effect (Table 10).

Eastern Busway 3 Residential

There is vegetation removal within the CMA associated with construction works at Outfall 2 (MCC-108719) and Riverhills Outfalls, 58.5m^2 and 90m^2 respectively. Given the small area of potential mangrove loss (if at all) relative to the large amount of mangrove habitat available in the wider Tāmaki River area and the mobile nature of the birds potentially foraging in these areas (i.e., ability to forage elsewhere upon habitat removal), it is considered that the potential loss of mangrove foraging habitat will have a Negligible magnitude of effect on coastal avifauna potentially utilising habitat in the Project area. A Negligible magnitude of effect on Low to High value species, results in very low overall levels of effect.

6.1.1.5 Habitat Disturbance and Displacement

Eastern Busway 2 and Eastern Busway 3 Residential

With respect to coastal avifauna, stormwater outfall vegetation clearance and construction works may result in effective foraging habitat loss as a result of disturbance and displacement. Given the small, discrete locations of work (and that some areas are not in the CMA), the temporary nature of the work, the extensive alternative areas of foraging habitat available in the wider Tāmaki River area, and the highly mobile nature of species potentially affected (i.e. ability to move to suitable, alternative habitat if disturbed or displaced), it is considered that potential habitat disturbance and displacement during construction works will have a negligible magnitude of effect on coastal avifauna potentially utilising habitat in the Project area. A negligible magnitude of effect on low to high value species, results in a very low overall level of effect.

6.1.1.6 Cumulative Effects

The cumulative effects of temporary and permanent occupation of the CMA, vegetation removal, disturbance of sediment causing remobilisation of contaminants, habitat disturbance during construction have been considered in this assessment and determined to be a negligible magnitude of effects on marine and coastal avifauna values based on the small areas involved and the large areas of available habitat within the Tāmaki Estuary that area unaffected by the Proposal.

6.1.2 Summary of Ecological Effects of Construction

Overall, the marine ecological values are Low at most outfalls within EB2 and EB3R, whereas coastal avifauna ecological values potentially range between Low and High (the latter due to the potential but unconfirmed presence of banded rail) at some outfalls. The magnitude of effect of construction (including temporary occupation of the CMA, vegetation loss in the CMA, and coastal avifauna foraging habitat disturbance / displacement) is assessed as Negligible to Low (Table 9 – *Negligible – Having negligible effect on the known population or range of the element / feature. Low – Minor shift away*

from baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances/patterns; AND/OR Having a minor effect on the known population or range of the element / feature).

Pursuant to a recent High Court decision, the NES-FW covers wetlands in the CMA which has been interpreted by Auckland Council as including mangroves, saltmarsh, sea meadow and seagrass.

EB2 and EB3R's construction will require limited works within the CMA associated with the Project's stormwater infrastructure. These works in the CMA will involve both vegetation clearance and sediment disturbance. The works are necessary to address the stormwater effects of the Project, which meets the definition of specified infrastructure, and have a functional need to occur within the CMA.

The total area of CMA that is predicted to be adversely affected by temporary and permanent occupation is 3,556.5m^2, which is a small proportion of the abundant wetland habitat within the Tāmaki Estuary. A construction methodology has been proposed that will actively limit the potential for sediment discharge, while also minimising the Project's footprint. This methodology will also be captured by the Project's ESCP and ssESCPs.

The level of effect on marine ecological values and coastal avifauna is assessed as very low to low, and mitigation is not required for these low-level effects (refer to Table 17). Considering these points and the functional need of the works to occur within the CMA, the proposal is consistent with the NZCPS, NPS-FW and AUP(OP).

Table 17: Summary of construction effects of the Project for EB2 and EB3R

Construction Effect	Ecological Values	Magnitude of Effect	Level of Effect	Mitigation Required
Marine Ecology				
Occupation of CMA by stormwater structures (EB2 and EB3R)	Low to Negligible	Low	Low	Not required
Vegetation Removal in CMA (EB2 and EB3R)	Low	Low	Low	Not required
Remobilisation of contaminants currently bound in sediment during earthworks or vegetation removal.	Low	Negligible to Low	Very Low	Not required
Coastal Avifauna Ecology				
Disturbance to coastal avifauna foraging habitat (EB2 and EB3R)	Low to High value species	Negligible	Very Low	Not required
Disturbance to coastal avifauna foraging habitat (EB2 and EB3R)	Low to High value species	Negligible	Very Low	Not required

6.2 Effects of Operation

The primary operational potential effects for EB2 and EB3R on marine ecology and coastal avifauna is the discharge of treated stormwater directly or indirectly (via freshwater habitats first) before discharge to the Coastal Marine Area (CMA).

6.2.1 Stormwater Quality Discharges (EB2 and EB3R)

Figure 10 indicates the location of proposed stormwater discharges, with the Tāmaki River/Estuary being the ultimate receiving environment.

Stormwater treatment for the Project is provided by way of gross pollutant traps and raingardens. Many of the existing stormwater outfalls currently receive no treatment prior to discharge. At many of the stormwater discharge points, existing outfalls have been combined and include catchment areas that are not part of the Project. A summary of contaminant load for each catchment in the existing environment, with proposed treatment, where possible to provide, results in an overall improvement in the percentage of total suspended solids (TSS), zinc, copper and total petroleum hydrocarbons (TPH) discharged to the Tāmaki River (Table 3 for EB2 and Table 4 for EB3R).

An assessment of the current concentration of zinc in receiving environment sediment, combined with CLM zinc predictions are included in Table 15. We have identified the likely effects of the zinc in outfall receiving environments and determined which are likely to increase due to the increased zinc load (Table 15). Outfalls 1B (in EB3R) is likely to be affected by increased zinc load above DGV or GV values in the future. As noted above, all other outfalls will have reduced contaminant loads compared to the existing situation. The magnitude of effect of the discharge of stormwater to each outlet is considered to be negligible-low (Table 9) for most stormwater outlets, whereas the magnitude of effect of the contaminant load discharged to outfall 1B is assessed as low (Table 9).

All outfall locations have low-moderate or low ecological values, and a low-negligible magnitude of effect (Table 9) with the overall level of effect on marine ecological values assessed as very low. Where the magnitude of effect is assessed as moderate, in combination with low-moderate ecological values, results in a low to moderate overall level of effect[13].

[13] EIANZ guidelines (2018) state that Very Low and Low levels of effect are not significant effects and do not require mitigation. High and Very High levels of effect are significant and require mitigation. Moderate level of effect shall be mitigated or not, depending on the site characteristics.

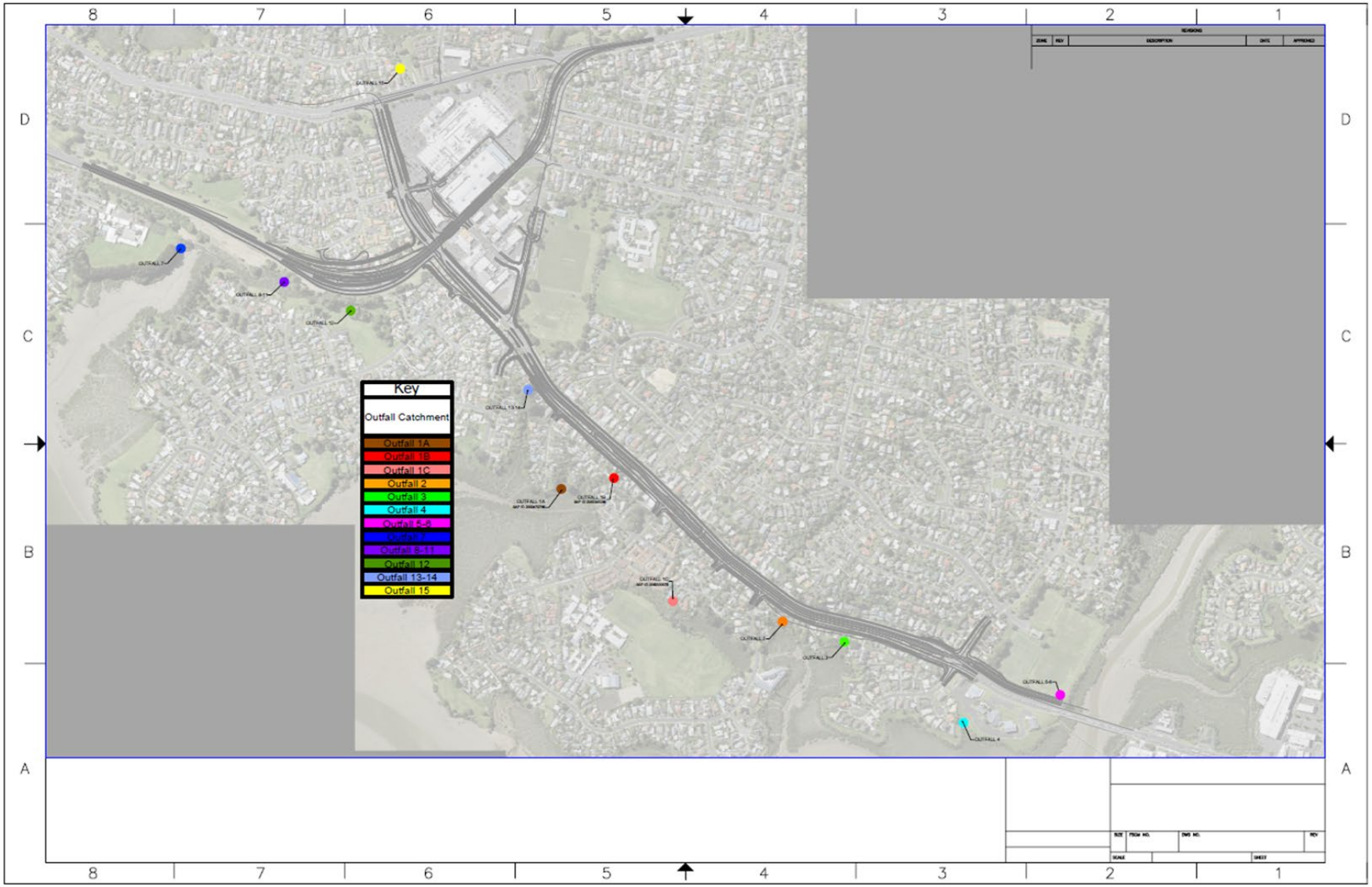


Figure 10: Location of stormwater discharge points for EB2 and EB3R

With respect to coastal avifauna, despite treatment of stormwater, there will still be an accumulation of contaminants in sediments in CMA foraging habitat at the outfalls and within the ZOI. This may reduce prey items available to coastal avifauna. However, given the small area of foraging habitat that will be impacted relative to the large quantity of alternative foraging habitat available in the wider foraging area / network, it is considered that potential reduced prey item availability and potential prey contaminant body burden as a result of stormwater contaminants will have a negligible magnitude of effect on coastal avifauna. A negligible magnitude of effect on low to high value species, results in a very low overall level of ecological effect.

6.2.2 Cumulative Effects of Discharge of Stormwater Contaminants

Stormwater discharges in the Project catchments (from numerous sources) are currently discharged to the freshwater and estuarine environments untreated, resulting in elevated zinc in sediments at most existing outfalls and receiving environments. The treatment of stormwater overall for EB2 and EB3R results in an overall decreased contaminant load from the Project. However, the discharge of contaminants from urban and road stormwater throughout Tāmaki River occurs largely untreated. The elevated contaminant load at outfall 1B (MCC_108707) (located in EB3R) contributes to a small degree to the cumulative effect at the Tāmaki River scale.

In terms of marine ecology, the contribution of the Project to the cumulative effects of contaminant discharge and deposition, has a low magnitude of effect for all outfalls (excluding 1B within EB3R where contaminants are predicted to increase). Based on low ecological values, the level of effect on marine ecology is assessed as low and mitigation is not required for contribution to cumulative effects.

For coastal avifauna, the contribution of the Project to the cumulative effects of contaminant discharge and deposition on prey availability and contaminant body burden of prey has a negligible magnitude of effect for all outfalls given that only a small proportion of prey items could be contaminated relative to food availability in the wider Tāmaki River foraging network. Based on low to high coastal avifauna species ecological values, the level of effect on coastal avifauna is assessed as very low and mitigation is not required for contribution to cumulative effects.

6.2.3 Summary of Ecological Effects of Operation

Operation of the Project involves the discharge of stormwater contaminants (treated via gross pollutant traps and raingardens) to aquatic receiving environments (freshwater to CMA or direct to CMA).

The treatment of stormwater, whilst reducing the existing contaminant concentrations discharged to the receiving environments significantly, still contributes to the accumulation of contaminants in sediments and may reduce the number of prey items and type available to coastal avifauna (Table 18).

Mitigation is not required for these low-level effects.

Table 18: Summary of ecological effects of operation of Project

Operational Effect	Ecological Values	Magnitude of Effect	Level of Effect	Mitigation Required
Marine Ecology				
Discharge of stormwater contaminants at outfalls within EB2 and EB3R (excluding outfall 1B)	Low to Negligible	Low	Low	Not required
Discharge of stormwater contaminants at outfall 1B (within EB3R)	Low	Low	Low	Not required

Cumulative effects on contaminant deposition (for all outfalls excluding 1B)	Low to Negligible	Low	Low	Not required
Cumulative effects on contaminant deposition at outfall 1B	Low	Low	Low	Not required
Coastal Avifauna Ecology				
Discharge of stormwater contaminants at all outfalls within EB2 and EB3R affecting avifauna prey availability and prey contaminant body burden	Low to High	Negligible	Very Low	Not required
Cumulative effects on contaminant deposition for all outfalls affecting avifauna prey availability and prey contaminant body burden	Low to High	Negligible	Very Low	Not required

7 Mitigation

Chapter Summary
• *Avoid/Minimise occupation of CMA during construction* • *Avoid/Minimise removal of coastal/estuarine (wetlands) vegetation during construction* • *Avoid/Minimise coastal avifauna habitat disturbance during construction* • *No mitigation required or proposed for construction effects for marine ecology or avifauna ecology* • *Mitigation for operational effects of stormwater contaminant discharges at outfalls MCC_108707 could be included as an ISCA response*

There is an expectation that the permanent and temporary occupation of the CMA, disturbance of the CMA and vegetation removal are minimised.

The level of identified adverse effects do not require mitigation (Low and Very Low) according to the EIANZ Guidelines (2018).

Mitigation for the predicted increase in metals and TPH at outfall MCC_108707 could be provided as a voluntary ISCA response, though it is not required because there are no significant adverse effects to mitigate.

8 Recommendations and Conclusions

Chapter Summary
• *Minimise removal of coastal wetland habitat (mangroves and saltmarsh)* • *Investigate opportunities to gather and dispose of rubbish/debris in the CMA* • *Investigate opportunities to remove/treat exotic pest vegetation species and replace with native species*

No mitigation is required as no significant adverse effects (only low and very low levels of effect were identified) have been detected on marine ecology or coastal avifauna ecology.

Recommendations are to minimise removal of coastal wetland habitat during the construction and operational stage.

Additional voluntary ISCA works could include gathering and disposing of rubbish/debris in the CMA and removal of pest plant vegetation and replacement with native coastal species.

9 References

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Appendix 1: Stormwater Report Relevant Excerpts

EB2

As discussed in the design philosophy it is aligned with the Project sustainability target of achieving a 10 per cent reduction in contaminant load contributions from roads to outfalls on an overall basis. However, Eastern Busway is attempting to exceed the target while meeting affordability in terms of construction and long-term maintenance cost. In addition, the final outcomes will be influenced by ongoing joint Eastern Busway and Healthy Waters hui with mana whenua.

The CLM currently predicts EB2 is achieving an overall improvement for TSS, copper and TPH of 3% to 9% while there is an increase predicted for zinc (see Table 2). Outfall P98086C currently has no change to its catchment and sources as reflected in the Table 2. Outfall MCC_108633 is predicted to receive an increase in contaminant loads which is caused by an increase in catchment area and contaminant sources and constraints preventing the use of green infrastructure (i.e treatment is only by a VortCapture gross pollutant trap). Outfall MCC_108699 also has an increase in catchment and contaminant sources and limited opportunities for green infrastructure. The target of ten per cent reduction in existing contaminant loads could be achieved by installing a StormFilter™ by Stormwater360 with ZPG media (granular activated carbon, perlite and zeolite blend) after the existing and proposed GPTs in Bus Stop Reserve. This would result in a decrease in the existing contaminant loads from roads across all of EB2 by 17.5 per cent with TSS, copper and TPH reducing by 52, 34 and 43 per cent respectively. However, Healthy Waters and Auckland Transport have expressed a strong preference to not use StormFilters™ devices due to specialised maintenance requirements and confined space entry.

The proposed typical outfall detail which is a naturalised rip rap armoured basic without concrete headwalls provide outfall erosion and scour protection and the required energy dissipation to avoid downstream erosion of the CMA. The proposed outfall detail will be further developed for each location by a multidisciplinary design team incorporating landscape architects, ecologists, coastal scientists, and stormwater engineers to achieve appropriate form and outcomes for each receiving environment location.

As discussed in the design philosophy, [the approach] is aligned with the Project sustainability target of achieving a 10 per cent reduction in contaminant load contributions from roads to outfalls on an overall basis. However, Eastern Busway is attempting to exceed the target while meeting affordability in terms of construction and long-term maintenance cost. In addition, the final outcomes will be influenced by ongoing joint Eastern Busway and Healthy Waters hui with mana whenua. The CLM (see Table 2) currently predicts EB2 is achieving this target for all TSS while TPH almost meets the target with a 9% reduction. Zinc is predicted to increase by 2.5% while copper is achieving a 3% decrease. On an individual outfall basis outfalls MCC_108680 (reduced catchment areas), MCC_108673 (including outfalls 06-05 and 89-18) and MCC_108699 all reduce existing contaminant loads by more than ten per cent except for zinc at MCC_108673 (including outfalls 06-05 and 89-18) which is reduced by 7.1 per cent. Outfall MCC-108633 is the outfall that has not been able to reduce existing contaminant loads from roads in part due to diversion of additional catchment to this outfall. There is an option to install a StormFilter™ by

Stormwater360 at this outfall which results in all of EB2 achieve at least a ten per cent reduction in existing contaminant loads but Auckland Transport and Healthy Waters have expressed strong preferences to not use StormFilter™ devices due to specialised maintenance requirements and confined space entry.

In addition to the outfalls in Table 5, it is possible that EB2 stormwater networks may also need to connect to the following outfalls as part of the solution to resolving complex utility clearance challenge for proposed new outfalls 06-05 and 89-18:

- *MCC_108680 with discharges to a natural wetland south of SEART entry ramp. Connection to this existing network would require upgrading of the pipeline from Ti Rakau Drive to the outfall. Healthy Waters has indicated they aspire to upgrade at least part of this network. Subject to negotiations between Healthy Waters and the Eastern Busway Alliance, it is possible a best for Auckland solution could be achieved by upgrading this network and reducing flows directed to the new outfall 89-12.*

- *P98086C could be used to reduce flows directed to new outfall 06-05 to help reduce the pipe size or number of barrels as part of the solution to utility clearance challenges.*

The overall outcomes for EB2 stormwater treatment are a positive effect on existing contaminant loads from roads except for a small increase in zinc (ie 2.5 per cent increase). This could be mitigated by providing a StormFilter™ in Bus Stop Reserve. A StormFilter™ with a ZPG media (zeolite, perlite and granular activated carbons media blend) installed between the outfall and existing and proposed GPTs would result in a reduction for zinc of 17% for all of EB2 with a reduction for TSS of 52%. Reductions in copper and TPH would achieve 34% and 43% respectively.

EB3

As discussed in the design philosophy is aligned with the Project sustainability target of achieving a 10 per cent reduction in contaminant load contributions from roads to outfalls on an overall basis. However, Eastern Busway is attempting to exceed the target while meeting affordability in terms of construction and long-term maintenance cost. In addition, the final outcomes will be influenced by ongoing joint Eastern Busway and Healthy Waters hui with mana whenua. The CLM currently predicted EB3 is achieving and overall improvement of 18% to 29% for each of the contaminant types (see Table 3). Outfall P98086C currently has no change to its catchment and sources as reflected in the Table 3. Outfall MCC_108633 is predicted to receive an increase in contaminant loads which is caused by an increase in catchment area and contaminant sources and constraints preventing the use of green infrastructure (i.e. treatment is only by a VortCapture gross pollutant trap). Outfall MCC_108699 also has an increase in catchment and contaminant sources and limited opportunities for green infrastructure.

All of the proposed existing and new outfalls of EB3 Residential stormwater networks are proposed to discharge to the CMA and therefore there are no flooding or capacity impacts from any increased discharge rates. The proposed typical outfall detail which is a naturalised rip rap armoured basic without concrete headwalls provide outfall erosion and scour protection and the required energy dissipation to avoid downstream erosion of the CMA. The proposed outfall detail will be further developed for each location by a multidisciplinary design team incorporating landscape architects, ecologists, coastal scientists, and stormwater engineers to achieve appropriate form and outcomes for each receiving environment location.

As discussed in the design philosophy, [the approach] is aligned with the Project sustainability target of achieving a 10 per cent reduction in contaminant load contributions from roads to outfalls on an overall basis. However, Eastern Busway is attempting to exceed the target while meeting affordability in terms of construction and long-term maintenance cost. In addition, the final outcomes will be influenced by ongoing joint Eastern Busway and Healthy Waters hui with mana whenua. The CLM (see Table 3) currently predicts EB3 Residential is achieving this target for all contaminants modelled except zinc which is current achieving a 9% decrease from the existing EB2 road constructions. On an individual outfall basis outfalls MCC_108703, MCC_108713 (reduced catchment), MCC_108738, and the new outfall in Riverhills (including MCC_108746 and 108749) all reduce existing contaminant loads by more than ten per cent. Outfall MCC_10848 is predicted to meet the 10 per cent target but has increases for zinc, copper and TPH. Outfalls MCC_108707 and MCC_108719 (including MCC_108718) have large increases predicted as a result of increase road catchment.

Appendix 2: OSNZ Square List

Appendix 2: Avifauna Species

The following table lists species recorded during the site visits (3/10/18, 6/12/18 and 23/2/22) and within the OSNZ atlas for the 10 km x 10 km grid square (267, 647), which encompass the Ti Rakau Drive bridge and surrounding environment. The primary (dark green) and secondary (light green) habitats for each of the species recorded was obtained from Heather & Robertson (2005), along with each species' New Zealand threat status according to Robertson et al. (2021).

SPECIES		THREAT STATUS		Native forest	Exotic Forest	Scrub / shrubland	Farmland / open country	Freshwater / wetlands	Coastal / Estuary	Oceanic	Urban/Residential	OSNZ square (267, 647)	Site visits
Morepork	*Ninox n. novaeseelandiae*	Not Threatened	Not Threatened									✓	
North Island fantail	*Rhipidura fuliginosa placabilis*	Not Threatened	Not Threatened[EF]									✓	
Kingfisher	*Todiramphus sanctus vagans*	Not Threatened	Not Threatened									✓	✓
Kereru	*Hemiphaga novaeseelandiae*	Not Threatened	Not Threatened[CD Inc]									✓	
Shining cuckoo	*Chrysococcyx l. lucidus*	Not Threatened	Not Threatened[DP]									✓	
Tui	*Prosthemadera n. novaeseelandiae*	Not Threatened	Not Threatened[OL St]									✓	
Blackbird	*Turdus merula*	Introduced	Introduced & Naturalised[SO]									✓	
Eastern rosella	*Platycercus eximius*	Introduced	Introduced & Naturalised[SO]									✓	
Grey warbler	*Gerygone igata*	Not Threatened	Not Threatened									✓	
Silvereye	*Zosterops lateralis lateralis*	Not Threatened	Not Threatened[SO]									✓	
California quail	*Callipepla californica*	Introduced	Introduced & Naturalised[SO]									✓	
Pheasant	*Phasianus colchicus*	Introduced	Introduced & Naturalised[SO]									✓	
Chaffinch	*Fringilla coelebs*	Introduced	Introduced & Naturalised[SO]									✓	
Greenfinch	*Carduelis chloris*	Introduced	Introduced & Naturalised[SO]									✓	
Magpie	*Gymnorhina tibicen*	Introduced	Introduced & Naturalised[SO]									✓	
Song thrush	*Turdus philomelos*	Introduced	Introduced & Naturalised[SO]									✓	
Goldfinch	*Carduelis carduelis*	Introduced	Introduced & Naturalised[SO]									✓	
House sparrow	*Passer domesticus*	Introduced	Introduced & Naturalised[SO]									✓	
Myna	*Acridotheres tristis*	Introduced	Introduced & Naturalised[SO]									✓	
Rook	*Corvus frugilegus*	Introduced	Introduced & Naturalised[SO]									✓	
Skylark	*Alauda arvensis*	Introduced	Introduced & Naturalised[SO]									✓	
Spur-winged plover	*Vanellus miles novaehollandiae*	Not Threatened	Not Threatened[SO]									✓	
Starling	*Sturnus vulgaris*	Introduced	Introduced & Naturalised[SO]									✓	
Swamp harrier	*Circus approximans*	Not Threatened	Not Threatened[SO]									✓	
Welcome swallow	*Hirundo n. neoxena*	Not Threatened	Not Threatened[Inc SO]									✓	
Yellowhammer	*Emberiza citrinella*	Introduced	Introduced & Naturalised[SO]									✓	
Black shag	*Phalacrocorax carbo novaehollandiae*	At Risk	Naturally Uncommon[SO Sp]									✓	
Black swan	*Cygnus atratus*	Not Threatened	Not Threatened[SO]									✓	
Black-billed gull	*Larus bulleri*	Threatened	Nationally Critical[RF]									✓	
Grey duck	*Anas s. superciliosa*	Threatened	Nationally Critical[SO]									✓	
Little black shag	*Phalacrocorax sulcirostris*	At Risk	Naturally Uncommon[RR]									✓	
Little shag	*Phalacrocorax melanoleucos brevirostris*	Not Threatened	Not Threatened[Inc]									✓	
Mallard	*Anas platyrhynchos*	Introduced	Introduced & Naturalised[SO]									✓	

SPECIES		THREAT STATUS		Native forest	Exotic Forest	Scrub / shrubland	Farmland / open country	Freshwater / wetlands	Coastal / Estuary	Oceanic	Urban/Residential	OSNZ square (267, 647)	Site visits
NZ pied oystercatcher	*Haematopus finschi*	At Risk	Declining					■				✓	
Paradise shelduck	*Tadorna variegata*	Not Threatened	Not Threatened					■				✓	✓
Pied shag	*Phalacrocorax varius varius*	At Risk	Recovering					■				✓	
Pied stilt	*Himantopus h. leucocephalus*	Not Threatened	Not Threatened					■				✓	
Pukeko	*Porphyrio m. melanotus*	Not Threatened	Not Threatened[Inc SO]					■				✓	✓
Banded dotterel	*Charadrius bicinctus bicinctus*	Threatened	Nationally Vulnerable[DP]						■			✓	
Banded rail	*Gallirallus philippensis assimilis*	At Risk	Declining[DP RR]						■				
Black-backed gull	*Larus d. dominicanus*	Not Threatened	Not Threatened[SO]						■			✓	✓
Caspian tern	*Hydroprogne caspia*	Threatened	Nationally Vulnerable[SO Sp]						■			✓	
Eastern bar-tailed godwit	*Limosa lapponica baueri*	At Risk	Declining[TO]						■			✓	
Lesser knot	*Calidris canutus rogersi*	Threatened	Nationally Vulnerable[TO]						■			✓	
Northern NZ dotterel	*Charadrius obscurus aquilonius*	At Risk	Recovering[CD Inc]						■			✓	
Red-billed gull	*Larus novaehollandiae scopulinus*	At Risk	Declining						■			✓	
Red-necked stint	*Calidris ruficollis*	Non-resident Native	Migrant[SO]						■			✓	
Reef heron	*Egretta sacra sacra*	Threatened	Nationally Endangered[DP SO Sp St]						■			✓	
Royal spoonbill	*Platalea regia*	At Risk	Naturally Uncommon[Inc RR SO Sp]						■			✓	
Variable oystercatcher	*Haematopus unicolor*	At Risk	Recovering[Inc]						■			✓	
White-faced heron	*Egretta novaehollandiae*	Not Threatened	Not Threatened[SO]						■			✓	✓
White-fronted tern	*Sterna s. striata*	At Risk	Declining[DP]						■			✓	
Wrybill	*Anarhynchus frontalis*	Threatened	Nationally Vulnerable[RR]						■			✓	
Australasian gannet	*Morus serrator*	Not Threatened	Not Threatened[De Inc SO]							■		✓	
Northern blue penguin	*Eudyptula minor iredalei*	At Risk	Declining[DP EF]							■		✓	
Barbary dove	*Streptopelia risoria*	Introduced	Introduced & Naturalised[SO Sp]								■	✓	
Rock pigeon	*Columba livia*	Introduced	Introduced & Naturalised[SO]								■	✓	
Spotted dove	*Streptopelia chinensis tigrina*	Introduced	Introduced & Naturalised[SO]								■	✓	