Appendix 27

Terrestrial and Freshwater Ecological Effects Assessment

Eastern Busway

EB3 Commercial and EB4 Link Road

Terrestrial and Freshwater Ecological Effects Assessment

Document Number: EB-RP-3C4L-PL-000017

Eastern Busway

Quality Information

Document Number: EB-RP-3C4L-PL-000017

Document History and Status			
Rev	**Date**	**Author (s)**	**Status**
A	August 2023	Morgan Witton Caitlin Smith	Final

Document Approval					
Rev	**Action**	**Name**	**Position**	**Date**	**Signature**
A	Reviewed by	Fiona Davies	Associate Director - Environment	14.08.2023	On file
B	Reviewed by	Roger McDonald	Alliance Principal Planner	18.08.2023	On file
1	Approved by	Jarrod Snowsill	Alliance RMA Planning Lead	31.08.2023	On file

Table of Contents

Figures

Tables

List of Abbreviations and Definitions

Abbreviation and Definitions	Description
AEE	Assessment of Effects on the Environment
AC	Auckland Council
AT	Auckland Transport
AUP(OP)	Auckland Unitary Plan (Operative in Part) (Updated 20 July 2023)
BPO	Best Practicable option
CEMP	Construction Environmental Management Plan
CMA	Coastal Marine Area
Construction footprint	Temporary occupation areas, laydown areas, compounds, access tracks and around stormwater outfalls to allow for construction. The construction footprint is referred to as the 'construction land requirement' and is based conservatively on the land take requirement around properties boundaries (refer to EB3C and EB4L land Requirement Plans [EB3C_Land_Requirements_20230508 and EB4L_Land_Requirements_20230508]).
EB1	Eastern Busway 1 (Panmure to Pakuranga)
EB2	Eastern Busway 2 (Pakuranga Town Centre)
EB3C	Eastern Busway 3 Commercial (Tī Rākau Drive Bridge to Botany)
EB3R	Eastern Busway 3 Residential (SEART to Tī Rākau Drive Bridge)
EB4L	Eastern Busway 4 Link Road (link between Tī Rākau Drive and Te Irirangi Drive, Botany Town Centre)
EBA	Eastern Busway Alliance
EcIA	Ecological Impact Assessment
EIANZ	Environmental Institute of Australia and New Zealand
HNZPT	Heritage New Zealand Pouhere Taonga
HNZPTA	Heritage New Zealand Pouhere Taonga Act 2014
km	Kilometre(s)
m	Metre(s)
m^2	Square Metre(s)
m^3	Cubic Metre(s)
MCA	Multi Criteria Analysis
NES-CS	Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011
NES-ETA	Resource Management (National Environmental Standard for Electricity Transmission Activities) Regulations 2009
NES-FW	Resource Management (National Environmental Standards for

	Freshwater) Regulations 2020 (as amended by the Resource Management (National Environmental Standards for Freshwater) Amendment Regulations (No 2) 2022)
NPS-ET	National Policy Statement on Electricity Transmission 2008
NPS-FM	National Policy Statement for Freshwater Management 2020 (as amended February 2023)
NPS-IB	National Policy Statement for Indigenous Biodiversity 2023
NPS-UD	National Policy Statement for Urban Development 2020
NZCPS	New Zealand Coastal Policy Statement 2010
NoR	Notice of Requirement
PWA	Public Works Act 1981
Project alignment	Permanent footprint of the busway once operational
RTN	Rapid Transit Network
RRF	Reeves Road Flyover
RLTP	Regional Land Transport Plan 2018-2028
RPTP	Regional Public Transport Plan 2018-2028
RMA	Resource Management Act 1991
ZOI	Zone of Influence - defined in the EIANZ Guidelines as “the areas/resources that may be affected by the biophysical changes caused by the proposed Project and associated activities”

Executive Summary

The purpose of this Ecological Impact Assessment is to assess the terrestrial and freshwater ecological effects of the proposed construction and operation of Eastern Busway 3 Commercial (EB3C) and Eastern Busway 4 Link Road (EB4L) of the Eastern Busway Project.

The Eastern Busway 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 will be delivered in several stages.

This Assessment addresses EB3C – Gossamer Drive to Botany, including Bridge A, Bridge B, the Burswood Bus Station and EB4L, connecting EB3C to Te Irirangi Drive and Town Centre Drive.

Key elements of the EB3C works include the construction of two bridges, a noise wall and retaining walls, stormwater drainage, and a cycleway. The EB3C bridge structures, new and upgraded stormwater outfalls and two areas of reclamation required in the coastal marine area (CMA).

EB4L traverses Guys Reserve and Whaka Maumahara Reserve and includes road widening at the intersection of Te Irirangi and Town Centre Drive. The works include a bridge (Bridge C), retaining walls, stormwater drainage, and a new walking and cycling path.

The assessment of EB3C and EB4L effects on terrestrial, freshwater and wetland ecological features has been undertaken in accordance with the Environmental Institute of Australia and New Zealand (EIANZ) Guidelines (2018) (EIANZ Guidelines) and best practice methodology. It utilises the Ecological Impact Assessment (EcIA) approach to assign ecology values (**Negligible, Low, Moderate, High** and **Very high**) to classify ecological features (i.e., freshwater, wetland and terrestrial habitats and their fauna) to develop an ecological impact assessment for the Project. The criteria provide protocols to identify required mitigation to minimise Project effects. This assessment addresses the effects on terrestrial, freshwater and wetland ecosystems, with the effects on marine ecosystems addressed in the Marine Ecology and Coastal Avifauna Effects Assessment.

The EB3C and EB4L Project areas are located within an urban landscape and the surrounding present-day ecological habitats are heavily modified. EB3C and EB4L are not situated within any terrestrial Significant Ecological Areas (SEAs). Terrestrial habitat consists mainly of a mixture of native planted vegetation, regenerating mixed native and exotic vegetation and exotic scrub of **Low** to **Moderate** ecological value.

Based on desktop records and habitat types, the presence of “At Risk - Declining” Copper and Ornate skink has been assumed in some habitats (including unmaintained rank grass edges) across the Project areas. As such the ecological value of lizards and their associated habitat for EB3C and EB4L is **High**.

Considering the highly modified urban nature of the habitat available, the conservation status (largely Not-Threatened) and mobility of urban-adapted bird species considered common to the area, the ecological value of forest bird community potentially impacted by EB3C and EB4L is considered to be **Low**. Bats are not considered to be active (based on desktop records and an Automated Bat Monitor survey undertaken in April 2022) within the Zone of Influence (ZOI)[1] of EB3C and EB4L. As such, they were not considered further in the effects assessment.

[1] The ZOI of EB3C relates to an area occupied by habitats and species that are adjacent to and may fall beyond the boundary of the proposed works. It is defined in the EIANZ Guidelines as “the areas/resources that may be affected by the biophysical changes caused by the proposed Project and associated activities.”

Wetland habitat is contiguous and isolated to the riparian margins of tributaries of the Pakuranga Creek within Burswood Reserve, Bard Park Reserve and Guys Reserve. Wetlands within the ZOI of EB3C (Burswood Reserve, Bard Park Reserve and Guys Reserve) and five wetlands within the ZOI EB4L meet the definition of a "natural inland wetland" under the NPS-FM. These wetlands are considered to be of **Low** to **High** ecological value and are within 100 m of the EB3C and EB4L alignments.

Earthworks required to construct EB3C and EB4L are not likely to result in the complete or partial drainage of natural inland wetlands and do not trigger the need for resource consent under Regulation 45 (3) of the NES-FW. The EB3C and EB4L stormwater outfalls will discharge within 100 m of natural inland wetlands. However, the proposed stormwater discharges are not likely to change the water level range or hydrological function of wetlands present within Burswood Reserve, Bard Park Reserve or Guys Reserve and do not trigger the need for resource consent under Regulation 45 (5) of the NES-FW.

Earthworks and temporary vegetation clearance will occur within 10 m of three wetlands situated within Burswood Reserve and Guys Reserve to facilitate the construction of the EB3C cycleway (Wetland BR-W3) and the EB3C and EB4L stormwater outfalls (Wetlands BR-W4 and GR-W2). Earthworks and vegetation clearance for the purpose of constructing specified infrastructure within 10 m of a natural inland wetland is a Discretionary Activity under Regulations 45 (1) and 45 (2) of the NES-FW and the effects of these activities are considered in this assessment.

Three permanent streams (tributaries of Pakuranga Creek) were identified within the ZOI of EB3C and EB4L and are located within Burswood Reserve, Bard Park Reserve and Guys Reserve. The streams are of **Moderate** ecological value, owing to the Stream Ecological Valuation (SEV) and presence of the 'At-Risk Declining' Longfin eel.

The effects assessment considered direct, indirect and cumulative effects associated with the construction and operation of EB3C and EB4L. The Project by design, has avoided unnecessary habitat loss.

The Burswood Reserve, Bard Park Reserve and Guys Reserve wetlands are not subject to any direct effects from EB3C and EB4L. Indirect effects on wetland habitat have been considered. If not mitigated, construction of the EB3C cycleway within Burswood Reserve may be subject to temporarily elevated sediment discharge following riparian vegetation removal. However as described in the Erosion and Sediment Control Assessment (ESC Assessment), implementation of the proposed erosion and sediment control measures will minimise the risk of sediment-related effects from streamworks/vegetation removal. In addition, the wetland is situated within a high sediment laden zone and is already subject to natural sediment and hydrology fluctuations from the Pakuranga Creek tributary. The proposed upgrades to the current stormwater system and use of green infrastructure (refer to Stormwater Effects Assessment) are expected to improve discharges to the wider freshwater and marine environment. As above, the construction and operation of stormwater outfalls are not expected to result in a change to water level range or hydrological function of any NPS-FM natural inland wetlands. The construction of the stormwater outfalls and EB3C cycleway will not result in any wetland vegetation loss and all surrounding temporary vegetation clearance is proposed to be replaced with native vegetation. In this regard, the underlying character, composition and attributes of wetland habitat values will be maintained and the overall level of effect for these indirect effects on the Burswood and Guys Reserve wetlands is assessed to be **Very Low** to **Low**.

Indirect stream effects from stormwater upgrades have been assessed, with the level of effect assessed as **Low** to **Very Low**. There is no proposed extension/encasement of the outfall pipe or concrete structures into the stream bed (albeit riprap will be added to the stream bed). No works are expected to result in the permanent loss or reclamation of stream bed or prevent the passage of fish upstream or downstream. Instream works required for the installation of permeable erosion protection (riprap) around outfalls may impact native fish within stream reaches of Burswood Reserve, Bard Park Reserve and Guys Reserve. This activity may result in fish injury or mortalities. To mitigate this potential effect, fish salvage will be undertaken by an appropriately qualified and experienced ecologist to temporarily

exclude fish from the construction footprint. Fish salvage and exclusion methodology should be detailed in a **Native Fish Capture and Relocation Plan.**

There is a risk that during vegetation clearance that mortality or injury to certain native species may occur and this is an effect that requires mitigation. Lizard salvage should be undertaken by an appropriately qualified herpetologist prior to vegetation clearance and only when lizards are active (October to April). These and other controls should be detailed in a **Lizard Management Plan**. Further, if vegetation clearance is to occur within the bird nesting season (September to February), pre-construction nesting bird surveys are recommended.

The assessment of habitat loss associated with EB3C and EB4L considered the loss of native planted vegetation, mixed native and exotic, exotic vegetation, and unmaintained rank grasses and accounted for the value these habitats provide for 'At Risk – declining' Lizard species (Copper or Ornate skink). The anticipated loss of vegetation associated with lizard habitat includes:

- There is an anticipated permanent loss of approximately **0.327 ha** of potential lizard habitat under the EB3C alignment, including stormwater infrastructure.
- There is an anticipated permanent loss of approximately **0.251 ha** of potential lizard habitat under the EB4L alignment including stormwater infrastructure.

Overall, the permanent loss of terrestrial habitat for lizards results in a **High** level of effect that cannot be mitigated at the point of impact, as such it remains a residual effect and requires offset or compensation. The Biodiversity Compensation Model (BCM; Baber et al., 2021) was considered appropriate and was used to estimate the compensation required for the lizard habitat loss at EB3C and EB4L. All habitat extents that could accommodate lizards were included in the BCM.

- The total minimum planting required to manage the adverse effects of lizard habitat loss for EB3C and EB4L is **1.75 ha.**

Site specific details of lizard habitat restoration planting and the identified sites for this to occur will be detailed within a **Habitat Restoration Plan**.

Temporary loss of vegetation (EB3C - 0.421 ha, EB4L – 0.355 ha) associated with the construction of stormwater outfalls (both existing and new) and temporarily occupied areas for construction will be addressed through landscape planting and is considered to be an embedded control. Landscape planting includes the replanting of suitable native planting mixes for the Auckland Region at a 1:1 ratio (including provision of lizard refugia where possible). Planting specifications are detailed in the Landscape, Ecological and Arboricultural Mitigation plans (Appendix 9 of Landscape Report).

All other effects are considered below the threshold of requiring mitigation as detailed in the EIANZ Guidelines criteria.

Provided that the recommended mitigation, enhancement and best-practice construction measures are followed, the level of effects on terrestrial, wetland and freshwater ecological features associated with EB3C and EB4L are considered to be **Very low**. Details of lizard habitat replacement, vegetation enhancement and species management recommendations will be incorporated within the Project **Habitat Restoration Plan, Native Fish Capture and Relocation Plan** and **Lizard Management Plan** which are required by the conditions.

1.0 Introduction

1.1 Overview of the Programme

The Eastern Busway Project (the EB 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 EB Project includes:

- 5 km of two-lane busway
- Two new bridges (Bridges A & B) for buses across Pakuranga Creek
- A new bridge for buses crossing Guys Reserve and Whaka Maumahara Reserve (Bridge C)
- 3.2 km of two-way off-road cycleway and 6 km of one way on-road separated cycle lanes
- 12 km of footpath
- 3 intermediate bus stations
- 2 major interchange bus stations.

The EB Project forms part of the previous Auckland Manukau Eastern Transport Initiative (AMETI) programme (the AMETI 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 EB Project also includes new walking and cycling facilities, as well as modifications and improvements to the road network.

The AMETI programme includes the following works which do not form part of the EB Project:

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

The EB Project consists of the following packages:

- Early Works Consents – e.g., William Roberts Road extension from Reeves Road to Tī Rākau Drive
- Eastern Busway 2 (EB2) – Pakuranga Town Centre, including the Reeves Road Flyover (RRF) and Pakuranga Bus Station
- Eastern Busway 3 – Residential (EB3R) – Pakuranga Highway to Gossamer Drive, including Edgewater Bus Station
- Eastern Busway 3 - Commercial (EB3C) – which commences from Riverhills Park along Tī Rākau Drive to Botany, including two new bridges (Bridges A & B), and an offline bus route through Burswood **(this Assessment)**
- Eastern Busway 4 Link Road (EB4L) - Guys Reserve to the Botany Town Centre, including a link road and bridge (Bridge C) through Guys Reserve and Whaka Maumahara Reserve to Te Irirangi Drive/Town Centre Drive intersection (**this Assessment)**.

The overall Project is shown in Figure 1-1 below.

Figure 1-1 Project alignment

1.2 Project Objectives

The EB Project objectives are:

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

2.0 Proposal Description

The following sections provide a brief description of both EB3C and EB4L. These descriptions consist of the construction and operation of both EB3C and EB4L packages, with further details provided in the AEE and Notices of Requirement. A full set of proposed plans is attached to the AEE.

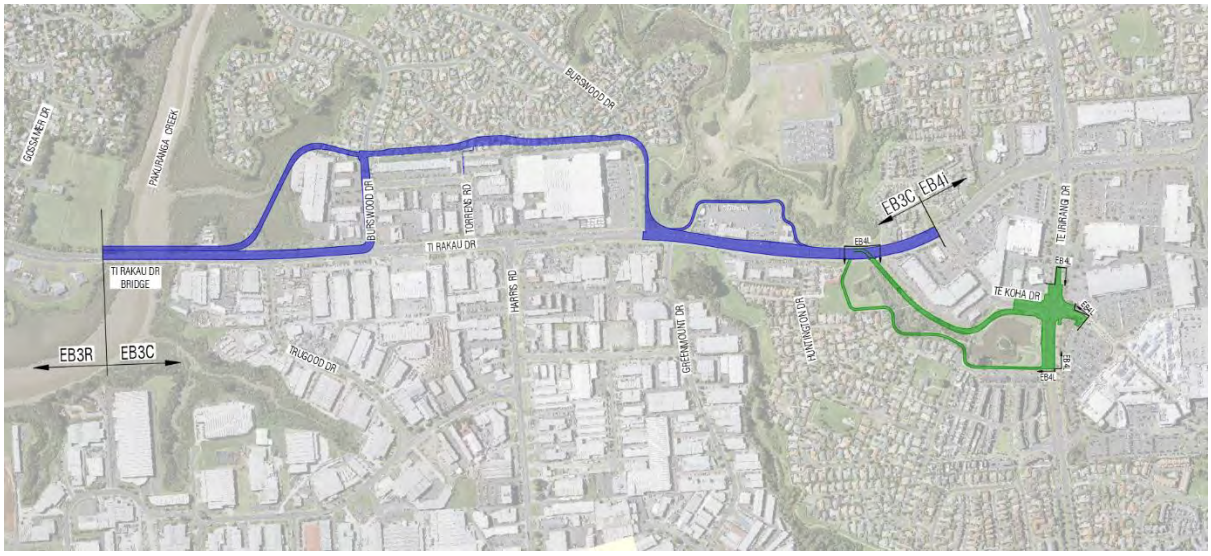


Figure 2-1 Eastern Busway 3 Commercial and 4 Link Road Project Extent

2.1 Eastern Busway 3 Commercial

The proposed EB3C works involve the establishment of an 'off-line' busway, cycleway, and stormwater upgrades. The proposed works will take place within existing road reserves, Council reserves[2] and privately held land within the proposed construction footprint (refer Figure 2-1). The extent of works for EB3C runs between Riverhills Park (i.e., adjacent to the terminus of the earlier EB3R package) in the west to Guys Reserve in the east, through the suburbs of Burswood and East Tāmaki.

The busway will be largely off-line (i.e., outside the current Tī Rākau Drive corridor), first crossing Pakuranga Creek by way of a new two-lane bridge (Bridge A) including abutments[3] and scour protection. It will then cross a coastal headland at 242 Tī Rākau Drive (a Mobil branded service station), and then an embayment within which a retaining wall, and a 4m^2 coastal reclamation will be constructed. The busway will cross a second headland at 254 Tī Rākau Drive (currently occupied by a pet store), before crossing a mangrove filled bay to the west of 262 Tī Rākau Drive (the 'Chinatown' retail business) via a second bridge (Bridge B). Bridge B will include two abutments with scour protection. Bridge B will require construction of a reinforced embankment at its northern end which includes imported fill, rip rap and permanent wick drains, and a 549m^2 coastal reclamation. In parallel, a retaining wall will be constructed to the eastern side of the embankment. The potential impacts of Bridge B (and other proposed works) on the marine environment are assessed in the Marine Ecology and Coastal Avifauna Effects Assessment.

Following this, the busway runs between the commercial area and residential area north of Tī Rākau Drive, crossing several residential sites. The busway also crosses Burswood Drive twice, with raised signalised crossings established to control both the busway and road traffic.

A new 'intermediate' style bus station will be established at Burswood, before the busway then crosses over Burswood Esplanade Reserve and onto a widened Tī Rākau Drive (by the Howick and Eastern bus

[2] Including Burswood Esplanade Reserve and Bard Place Reserve

[3] The western abutment and associated scour protection was included in the EB3R consenting package

depot). The busway will then run beside the eastbound lanes of Tī Rākau Drive, before crossing over Tī Rākau Drive to connect with EB4L at Guys Reserve.

The busway will include a new cycleway, which will largely run parallel to the busway for most of this section of the Project. The exceptions to this include Bridge B, between 254 Tī Rākau Drive and Burswood Esplanade (west) – for this section the cycleway will continue along Tī Rākau Drive before turning into Burswood Drive West, as well as where the cycleway runs behind the Howick and Eastern bus depot.

Other works included in EB3C are the relocation of existing utility services, the provision of new or upgraded stormwater infrastructure and open space upgrades. Stormwater works will involve new outfalls discharging to Pakuranga Creek (and its tributaries) and rain gardens.

Lastly, EB3C involves the establishment of two laydown areas, one at 242 Tī Rākau Drive and the other within the boundaries of Burswood Esplanade Reserve. Both laydown areas are located on land that will be occupied by the Project upon its completion.

Figure 2-2 Eastern Busway 3 Commercial Project Area

2.2 Eastern Busway 4 Link Road

The EB4L works will involve the establishment of an 'off-line' dedicated two-way busway, shared pathway and stormwater upgrades. These works will take place in Guys Reserve, Whaka Maumahara Reserve, existing road reserve and Botany Town Centre land for the intersection improvements on Town Centre Drive.

EB4L commences south of Tī Rākau Drive, crossing through Guys Reserve, Whaka Maumahara Reserve and ending at the intersection of Te Irirangi Drive/Town Centre Drive.

The works will primarily involve the construction of a new two-way busway corridor which will run along the eastern side of Guys Reserve and Whaka Maumahara Reserve to provide access for bus services between Pakuranga and Botany. The two-way busway is designed to integrate with EB3C and be a continuation of the EB3C busway.

This section of the busway will feature a bridge (Bridge C) approximately 350m long. This bridge is needed due to the sloping topography of the Reserves.

The busway will then connect to Te Irirangi Drive, following alterations to the existing Te Irirangi Drive/Town Centre Drive intersection.

A shared pathway and minor retaining walls will also be constructed along the southern and western boundaries of Guys Reserve and Whaka Maumahara Reserve. The shared pathway will connect to existing walkways and will terminate at Te Irirangi Drive.

A new shared pathway and retaining wall will also be constructed along the western boundary of Te Irirangi Drive and is partially located within the Whaka Maumahara Reserve.

A new stormwater outfall (including riprap) will be constructed within Guys Reserve. The outfall will discharge stormwater over scour protection prior to its entry into a tributary of Pakuranga Creek. Additionally, a new stormwater connection will be constructed in Whaka Maumahara Reserve, adjacent to Te Irirangi Drive. This new connection will discharge via an existing outfall into the existing stormwater pond within the Reserve.

A construction laydown area will also be established within Guys Reserve, adjacent to Tī Rākau Drive and 47C Huntington Drive. A second laydown area will be established in Whaka Maumahara Reserve, between the existing stormwater pond and Te Irirangi Drive. Construction access will also be gained from Te Koha Road beside VTNZ's vehicle inspection premise located at 451 Tī Rākau Drive.

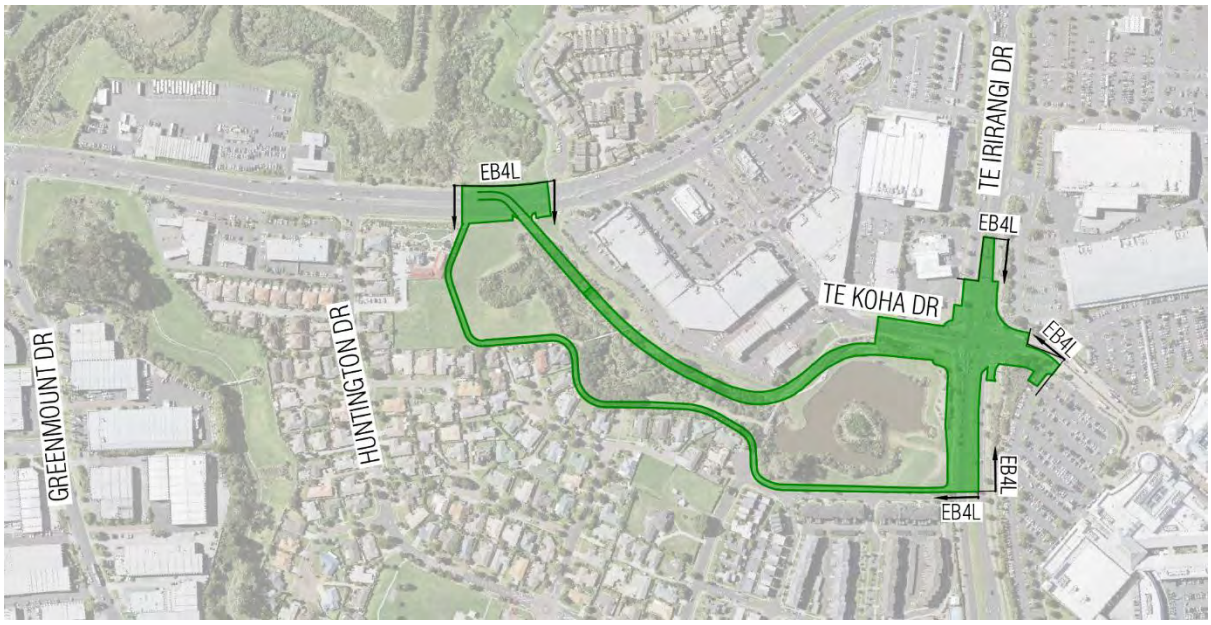


Figure 2-3 Eastern Busway 4 Link Road Project Area

3.0 Specialist Assessment

Chapter Summary
This chapter describes the context of the ecological assessment and the statutory framework. It also outlines the specific project elements that are relevant to this ecological assessment including vegetation clearance, earthworks and stormwater drainage.

3.1 Assessment Content

This assessment describes the assessment of ecological effects associated with the operation and construction of EB3C and EB4L. This assessment pertains to the terrestrial, wetland and freshwater environment and considers both the potential beneficial and adverse effects on features of ecological value that may be impacted by the EB3C and EB4L Project works.

Its purpose is to inform the AEE relating to the Notices of Requirement and required regional resource consents and consents required under National Environment Standards for EB3C and EB4L; and identify the ways in which any adverse effects will be avoided, remedied or mitigated.

An assessment of the marine environment (including coastal avifauna, benthic invertebrates and wetland mangrove habitat within the Coastal Marine Area (CMA) and potential impacts associated with the EB3C and EB4L sections of the Project was undertaken separately within the Marine Ecology and Coastal Avifauna Effects Assessment and should be considered in conjunction with this assessment. This report assesses all terrestrial, wetland and freshwater environments landward of the CMA, which is defined as the area of land above the Mean High Water Spring (MHWS). A MHWS survey was undertaken and then mapped by a qualified surveyor.

The ecological impact assessment methodology relating to the terrestrial, wetland and freshwater environments is detailed in Section 4.1.

3.2 Specific Project Elements

The specific Project elements associated with the construction and operation of EB3C and EB4L that ecological effects are derived from include vegetation clearance, earthworks, construction/replacement of stormwater outfalls (including riprap and streamworks) and new/altered stormwater discharges.

When describing these elements, we have used specific terminology for 'project alignment' and the 'construction footprint'. For context, these definitions are provided below.

Project alignment - permanent footprint of the busway once operational (excluding stormwater infrastructure)

Construction footprint – temporary occupation areas, laydown areas, compounds, access tracks and around stormwater outfalls to allow for construction. The construction footprint is referred to as the 'construction land requirement' and is based conservatively on the land take requirement around properties boundaries (refer to EB3C and EB4L land Requirement Plans [EB3C_Land_Requirements_20230508 and EB4L_Land_Requirements_20230508]).

An overview of works included in this Ecological Effects Assessment for EB3C and EB4L is detailed below.

3.2.1 Vegetation Clearance

Vegetation clearance (permanent and temporary) is required to facilitate the construction of the Project alignment as well as the new and upgraded stormwater outfalls and pipes.

The EB3C works will result in approximately **3,718 m^2/0.37 ha** of permanent vegetation loss under the EB3C alignment and stormwater outfalls and **4,210 m^2/0.42 ha** of temporary vegetation clearance

within the EB3C construction footprint. Table 3-1 below details the anticipated loss of vegetation associated with the EB3C Project works.

The EB4L works will result in approximately **5,516 m^2/0.55 ha** of permanent vegetation loss under the EB4L alignment and stormwater outfalls and **3,553 m^2/0.36 ha** of temporary vegetation clearance within the EB4L construction footprint. Table 3-2 below details the anticipated loss of vegetation associated with the EB4L Project works. Refer to Section 6.4 for detailed information regarding temporary and permanent vegetation loss.

Table 3-1 Direct permanent and temporary vegetation clearance in EB3C

Location	Area of Permanent Vegetation Loss (m^2)	Area of Temporary Vegetation Clearance (m^2)
EB3C		
EB3C Alignment (including Bridge A and Bridge B works and cycleway within Burswood Reserve)	3,643	3,910
Stormwater Infrastructure		
Upgrade to existing outfall MCC_108482 (SAP ID 2000380606)	25	75
Removal of existing outfall MCC_496129 (SAP ID 2000507038) and construct new outfall 53-1	25	75
Upgrade to existing outfall MCC_988531 (SAP ID 2000295186)	25	75
New network (pipeline 36) to connect to the existing upstream manhole (MCC_71866)	0	75
Total vegetation clearance (m^2)	**3,718**	**4,210**

*Includes areas of rank grass within the understory of vegetation and along edges

Table 3-2 Direct permanent and temporary vegetation clearance in EB4L

Location	Area of Permanent Vegetation Loss (m^2)	Area of Temporary Vegetation Clearance (m^2)
EB4L		
EB4L Alignment (including Bridge C and Botany Town Centre/Te Irirangi Drive Intersection)	5,491	3478
Stormwater Infrastructure		
New outfall (1-1), riprap (including rip rap and pipeline)	25	75
New Pipeline (37-3) proposed connection to the existing manhole	0	0
Total vegetation clearance (m^2)	**5,516**	**3,553**

*Includes areas of rank grass within the understory of vegetation and along edges

3.2.2 Earthworks

Construction of EB3C and EB4L will involve bulk earthworks resulting in the clearance of obstructions within the footprint. The expected duration of earthworks and vegetation clearance is staged throughout the construction programme from 2024 to 2027. Earthworks are expected to result in temporary disturbance (sediment discharge, noise, vibration, artificial light) and dust. Further details of the area and volume of earthworks that informed this assessment are provided in the Construction Methodology.

Streamworks associated with stormwater outfalls are addressed separately below.

3.2.3 Stormwater

New impervious areas will be created by the EB3C and EB4L Project works. To address potential stormwater effects, the proposal includes several new and upgraded stormwater outfalls (including pipes and outlets). Please refer to the stormwater effects assessment for specific design criteria including the proposed stormwater drainage and treatment systems (EB3C and EB4L Stormwater Assessment).

The majority of new or modified outfalls will occur within the CMA (refer Marine Ecology and Coastal Avifauna Effects Assessment) or stream /wetland habitats within Burswood Reserve. The stormwater outfalls and associated infrastructure that have been considered as part of this report in regard to stream/wetland effects are detailed in Section 6.1 and Section 6.2.

Four existing outfalls will be upgraded/modified and/or new stormwater pipelines installed within the vicinity of wetland habitats within EB3C (Table 3-3) and one new outfall and a stormwater pipeline upgrade are proposed within the vicinity of stream habitat of EB4L (Table 3-4). These works will involve vegetation clearance and earthworks. Specific effects from construction of outfalls on wetlands and streams are discussed further in Section 6.1 for EB3C and Section 6.2 for EB4L.

Table 3-3 Proposed EB3C outfalls modification/upgrades and associated new stormwater pipelines located within freshwater habitat

Outfall/Pipeline Referencing	Location	Proposed upgrades/modification	Streamworks (as per AUP:OP)
Existing Outfall MCC_108481 (SAP ID - 2000533442) New network (pipeline 36) proposed to connect to the existing manhole (MCC_71866).	Burswood Reserve Latitude: -36.926044 Longitude: 174.902982 Refer to Section 6.1.1 for mapped outfall location.	No works are proposed to this existing outfall (MCC_108481) and existing manhole (MCC_71866). No works are proposed between the existing outfall (MCC_108481) and manhole (MCC_71866). A new proposed network (pipeline 36) will be constructed and connected to the existing manhole (MCC_71866). The new network (pipeline 36) is proposed to be constructed within 10/12/12A Midvale Place.	No
Existing Outfall MCC_108482 (SAP ID - 2000380606)	Burswood Reserve Latitude: -36.92684 Longitude: 174.902648 Refer to Section 6.1.1 for mapped outfall location.	This existing outfall will be upgraded. A new pipeline will be constructed to the upgraded outfall to accommodate the existing and new networks (pipeline 43).	Yes
Removal of Existing Outfall MCC_496129 (SAP ID 2000507038) and new outfall 53-1	Bard Park Reserve Latitude: -36.928382 Longitude: 174.905142 Refer to Section 6.1.1	This existing outfall will be removed. A new outfall (53-1) will be constructed nearby (pipeline 53) to accommodate the cycleway.	Yes

	for mapped outfall location.		
Existing Outfall MCC_988531 (SAP ID 2000295186)	Bard Park Reserve Latitude: -36.928946 Longitude: 174.905531 Refer to Section 6.1.1 for mapped outfall location.	The existing outfall will be upgraded. A new pipeline will be constructed and connected to the upgraded outfall to accommodate the new network (pipeline 47).	Yes

Table 3-4 Proposed EB4L outfalls modification/upgrades and associated new stormwater pipelines within freshwater habitat

Outfall/Pipeline	Location	Proposed upgrades/modification	Streamworks (as per AUP:OP)
New Outfall 1-1 and New Pipeline 1	Guys Reserve near Tī Rākau Drive Latitude: -36.929888 Longitude: 174.906824 Refer to Section 6.1.2 for mapped outfall location.	A new outfall (including scour protection) will be constructed. A new pipeline will be constructed and connected to the new stormwater outfall.	Yes
New Pipeline 37-3	Whaka Maumahara Reserve near Te Irirangi Drive. Latitude: -36.931838 Longitude: 174.910601 Refer to Section 6.1.2 for mapped outfall location.	A new pipeline (37-3) will be constructed and connected to the existing manhole (SAP 200061181). No changes are proposed to the existing outfall (MCC_695723), existing outfall (MCC_480841) and existing manhole (SAP 200061181)	No

3.3 Reasons for Consent

Reasons for consent relating to the ecological aspects of EB3C and EB4L are specified below.

3.3.1 Eastern Busway 3C

Activity	Rule	Status
Trees/Vegetation		
Vegetation alteration or removal in coastal and riparian areas that does not comply with Standards E26.3.5.1 to E26.3.5.4	AUP(OP) - E26.3.3.1 (A77)	Restricted Discretionary
Stormwater/Construction		
Vegetation clearance within, or within a 10 m setback from a natural inland wetland (BR-W3, BR-W4)	NES-FW Reg 45 (1)	Discretionary
Earthworks or land disturbance within, or within a 10 m setback from, a natural wetland (BR-W3, BR-W4)	NES-FW Reg 45 (2)	Discretionary
Two stormwater outfalls do not comply with the permitted standards in E3.6.1.14 (MCC_108482 and MCC_988531)	AUP(OP) - E4.3.1 (A39)	Discretionary

3.3.2 Eastern Busway 4L

Activity	Rule	Status
Trees/Vegetation		
Vegetation alteration or removal in coastal and riparian areas that does not comply with Standards E26.3.5.1 to E26.3.5.4	AUP(OP) - E26.3.3.1 (A77)	Restricted Discretionary
Stormwater/Construction		
Vegetation clearance within, or within a 10 m setback from a natural inland wetland (GR-W1, GR-W2)	NES-FW Reg 45 (1)	Discretionary
Earthworks or land disturbance within, or within a 10 m setback from, a natural wetland (GR-W1, GR-W2)	NES-FW Reg 45 (2)	Discretionary

3.4 Statutory and Planning Framework

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

1. Resource Management Act 1991
2. Wildlife Act 1953
3. Conservation Act 1987
4. NPS-Freshwater Management (NPS-FM)
5. NES-Freshwater (NES-F) (as amended in 2022)
6. NPS-Indigenous Biodiversity (NPS-IB)
7. Auckland Unitary Plan (Operative in part) – Chapters B7, E3, E4, E8, E26, E30
8. Auckland Conservation Management Strategy 2014 to 2024
9. Auckland Council's Indigenous Biodiversity Strategy 2012.

In regard to the objectives and policies of Chapter B7 (Natural Resources) of the AUP(OP), this assessment and associated management of effects is consistent because biodiversity values have been protected and also maintained where degraded or impacted. Terrestrial, wetland and freshwater values (vegetation/habitats and fauna) have also been identified and valued as part of the assessment to inform impact management.

The NPS-IB came into effect on 4 August 2023. The overarching objective of the NPS-IB is to maintain indigenous biodiversity across New Zealand so that there is at least no overall loss in indigenous biodiversity. The NPS-IB includes a number of policies that enable this and are relevant to this project, including:

- Policy 2 (Tangata Whenua as partners)
- Policy 3 (Pre-cautionary approaches)
- Policy 8 (Indigenous biodiversity outside of SNAs)
- Policy 13 (Restoration)
- Policy 14 (increasing indigenous biodiversity cover)
- Policy 15 (Highly mobile fauna)

Overall, the Project will result in the permanent loss of approximately 0.924 ha of vegetation which a large proportion is exotic vegetation/habitat and temporary vegetation loss during construction of approximately 0.776 ha of which a large proportion is of exotic vegetation/habitat. The provision of replacement vegetation for native fauna has been assessed. A conservative and precautionary approach has been taken to the assessment and mitigation provided for native fauna species and their habitat, in particular lizards.

A large amount of indigenous planting will be undertaken as part of the project that will mitigate and enhance indigenous biodiversity. It is anticipated that the planting undertaken as part of the Project will bring wider ecological benefit such as enhancing connectivity, buffer zones, habitat availability and resources for native fauna (avifauna, lizards and invertebrates).

Planting includes:

- Landscape planting – detailed within Landscape, Ecological and Arboricultural Mitigation plans (Appendix 9 of Landscape Report).
- Replacement planting of all temporary vegetation loss at a 1:1 ratio (0.776 ha) - Landscape, Ecological and Arboricultural Mitigation plans (Appendix 9 of Landscape Report).
- Lizard habitat restoration planting as compensation for loss of lizard habitat (1.75 ha). This will result in a net gain of ecological value of approximately 10%. Detailed within the Habitat Restoration Plan.
- Coastal vegetation planting – pest plant control and revegetation with native coastal edge habitat (0.57 ha).

Excluding banded rail there are no highly mobile fauna/areas (as listed within the NPS-IB) that are relevant to this assessment. The Marine and Coastal Ecology Assessment assesses the relevance of banded rail and their habitat in relation to policies within the NPS-IB.

4.0 Methodology and Analysis

Chapter Summary

This chapter summarises methodologies used to assess ecological features potentially impacted by EB3C and EB4L and provides rationale for determining the level of expected ecological effects.

Desktop reviews and site investigations were undertaken to assess terrestrial, wetland and freshwater habitats and species within the EB3C and EB4L ZOI. The value of ecological features and associated effects were assessed according to the Environment Institute of Australia and New Zealand (EIANZ) guidelines (2018).

4.1 Ecological Impact Assessment Approach

The approach followed in this assessment is consistent with the approach outlined in the Ecological Impact Assessment Guidelines 2018 (EIANZ Guidelines).

The initial step (step one) in the Ecological Impact Assessment (EcIA) approach is to assess the value of ecological features within the ZOI of the Project with respect to Representativeness, Rarity, Diversity and Pattern, and Ecological context. Section 4.7 outlines the specific methodology applied to inform the ecological value assessment for terrestrial, wetland and freshwater features.

The second step of the EcIA approach requires a systematic assessment of the magnitude of ecological effects related to specific Project features and activities. The magnitude of effects is then combined with the outcome of the value assessment (step one) and magnitude assessment (step two) to determine an inherent level of effect prior to impact management (prior to consideration of controls and existing avoidance measures).

The third step relates to identifying reasonable and practical mitigation, generally where the level of effect is determined to be **Moderate** or higher. Mitigation should be developed that is consistent with the mitigation hierarchy, the management of uncertainty and should also consider cumulative effects.

The fourth step relates to the management of any residual effects where mitigation of ecological values cannot be achieved. This may entail offset (to achieve No Net Loss or preferably Net Gain) or compensation measures.

4.2 Project Area and Zone of Influence

The ZOI of EB3C relates to an area occupied by habitats and species that are adjacent to and may fall beyond the boundary of the proposed works. It is defined in the EIANZ Guidelines as “the areas/resources that may be affected by the biophysical changes caused by the proposed Project and associated activities.” The term ZOI is used throughout this assessment to describe the impacts of the Project (construction and operation) on adjacent or connected terrestrial, freshwater and wetland habitats and associated native species.

The ZOI of the Project varies for different species depending on how they use their environment e.g., mobile species such as long-tailed bats have a larger home range and more diverse habitat requirements compared to lizards and threatened plant species which may be restricted to a small area or specific habitat type. This affects how a species could be impacted by the Project and this was taken into consideration during the desktop review and site investigations. To reflect the likelihood of a species occurring or dispersal ability within each of the Project areas, varying search distances were used depending on the species context. The size of this search area is stated alongside any species or habitat records identified within the relevant sections of this assessment. It should be noted that presence within the ZOI of EB3C and EB4L does not necessarily mean the ecological feature will be impacted by the proposed works.

4.3 Desktop Review

To characterise and gain an understanding of the value of the terrestrial and freshwater species and habitats present onsite and within EB3C's and EB4L's ZOI, the following resources were reviewed:

- AUP(OP) – Overlays
- Auckland Council Geomaps[4]
- Ecological Regions and Districts of New Zealand (McEwen 1987)
- Department of Conservation (DOC) Threat Classification Series[5]
- DOC Bioweb records
- iNaturalist records within a radius of approximately 5 km
- Indigenous terrestrial and wetland ecosystems of Auckland (Singers et al, 2017)
- New Zealand Bird Atlas eBird database; recorded within 10 km^2 grid squares
- National Institute of Water and Atmospheric Research (NIWA) freshwater fish database.

4.4 Terrestrial Ecology – Site Investigations

Visual inspections of terrestrial habitat present within and adjacent to the area of works were undertaken on 15 March 2018, 28 and 29 April 2021 and 5 July 2022. This consisted of a walkover of the entire EB3C and EB4L alignment to identify key terrestrial features possessing ecological value. Habitats were classified into ecosystem type based on those described in Singers et al. (2017) and assessed in relation to their potential to support indigenous fauna including birds, bats and lizards.

Habitat assessments focused on areas that may uphold significant ecological value, such as stream corridors and areas of vegetation (trees, scrub, rank grasses). Aerial imagery, species records from relevant literature and biodiversity databases were utilised to refine search efforts to certain areas within the Project areas.

Vegetation assessments focused on maintained and unmanaged areas in open spaces and along the road reserve. The vegetation assessment included recording the dominant or characteristic species present and the general habitat quality including structure, maturity, presence of weeds and evidence of disturbance. Assessments of private gardens were undertaken via desktop to identify key areas of native vegetation and potential habitat for native fauna.

For information regarding roadside amenity trees and garden vegetation refer to EB3C's and EB4L's Arboricultural Effects Assessment.

4.4.1 Fauna

Incidental observations of any native species seen during site walkovers were recorded. For lizard species, this included incidental searches of natural/artificial refugia, such as turning over logs/wood/corrugated iron on the ground. For birds, incidental observations were made. All vegetation with understory was considered potential lizard habitat and is discussed further in Section 5.1.

4.4.1.1 Bat surveys

There are two extant species of native bat in New Zealand, the long-tailed bat (*Chalinolobus tuberculatus*) and the lesser short-tailed bat (*Mystacina tuberculata*). There are no known lesser short-tailed bat populations in mainland Auckland. To confirm the presence (or likely absence) of long-tailed

[4] https://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html
[5] All Department of Conservation Threat Classification Documents are listed in the below webpage. When individual reports are referenced hereafter, they are referenced in-text. https://www.doc.govt.nz/about-us/science-publications/conservation-publications/nz-threat-classification-system

bats in the EB3C and EB4L Project areas, five automatic bat monitors (ABM's; Song Meter SM4BAT bioacoustics recorder) were installed in potentially favourable bat habitat on the 24 March 2022 (Figure 4-1). The ABMs were deployed by an experienced ecologist and were left in situ to ensure at least 14 days of suitable weather for bat activity. The data was reviewed by an experienced ecologist to evaluate bat calls at each site.

Figure 4-1 Locations of automatic bat monitors (ABM's) across the wider Project area (EB2, EB3R, EB3C and EB4L) in habitat deemed potentially favourable for bat species.

4.5 Wetland Ecology – Site Investigations

4.5.1 Wetland delineation

Potential wetlands (excluding coastal/CMA wetlands which are covered in the Marine Ecology and Coastal Avifauna Effects Assessment) associated with EB3C and EB4L were delineated on desktop using available aerial images including Auckland Council Geomaps, Google Earth© and Retrolens. A site visit was undertaken on 29 April 2021 to ground truth the desktop delineation using the wetland delineation protocol (Clarkson, 2018; Ministry for the Environment [MfE], 2020). Where all dominant species across all strata are rated obligate wetland species (OBL) and/or facultative wetland species (FACW) a rapid test was undertaken (MfE, 2020).

Wetlands were divided into units identified based on geomorphology and hydrology (hydrogeomorphic units or HGMs) (adapted from Brinson, 1993) to assist with value interpretation. Wetlands were assessed against the NPS-FM definition (as amended in 2023) to determine the presence of a Natural Inland Wetland (Section 4.1.5.3). A detailed delineation of wetland extent was undertaken at BR-W4 in October 2022 owing to the proximity of stormwater works to the identified wetland. All other wetlands were rapidly assessed following the wetland delineation protocols (MfE, 2022).

4.5.2 Wetland condition assessment

The ecological health or condition of each wetland unit was assessed using the wetland condition assessment developed by Clarkson et al. (2004). The condition assessment evaluates the health of the wetland based on five impact indicators and includes hydrology, water quality, ecosystem intactness, change in browsing, predation and harvesting regimes and change in dominance of native plants. Each impact indicator consists of several indicator components. Impact indicator components were scored on

a scale from one to five, where very high modification is scored one and very low modification is scored five.

The condition assessment also includes a separate assessment of the catchment for each wetland unit. Catchment condition is based on pressures including, modification to catchment hydrology, water quality within the catchment, animal access, key undesirable species and percentage catchment introduced vegetation. Each catchment pressure was scored on a scale from one to five, where very low pressure was scored one and very high pressure was scored five.

To assist with the interpretation of wetland condition score, the overall impact indicator scores and the catchment pressures scores have been combined and expressed as a percentage. The overall percentage was then interpreted based on the wetland condition classes proposed by Rountree et al., (2007) and defined in Table 4-1 .

Table 4-1 Wetland condition categories and associated descriptions used within this assessment

Category Wetland Condition	Description	Condition Category (%)
Unmodified	Unmodified/natural	100%
Largely natural	Largely natural with a few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota have taken place	80-100%
Moderately modified	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	60-80%
Largely modified	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred	40-60%
Seriously modified	Seriously modified. The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable	20-40%
Critically modified	Critically modified. Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota	<20%

4.5.3 NPS-FM Natural Inland Wetland Status Criteria

Wetlands present were assessed against the NPS-FM which defines a 'natural inland wetland' to mean a 'wetland' (as defined in the RMA) that is not:

(a) in the coastal marine area; or

(b) a deliberately constructed wetland, other than a wetland constructed to offset impacts on, or to restore, an existing or former natural inland wetland; or

(c) a wetland that has developed in or around a deliberately constructed water body, since the construction of the water body; or

(d) a geothermal wetland; or

(e) a wetland that:

(i) is within an area of pasture used for grazing; and

(ii) has vegetation cover comprising more than 50% exotic pasture species (as identified in the National List of Exotic Pasture Species using the Pasture Exclusion Assessment Methodology (see clause 1.8)); unless

(iii) the wetland is a location of a habitat of a threatened species identified under clause 3.8 of this National Policy Statement, in which case the exclusion in (e) does not apply

4.6 Freshwater Ecology – Site Investigations

Detailed stream surveys of tributaries of the Pakuranga Creek were undertaken at Burswood Reserve, Bard Park Reserve (BR-S), and Guys Reserve (GR-S) to provide context to the ecological value of the system. This included the following:

- General notes on the stream and river including name, catchment, hydrological regime, channel morphology, cross-sectional features, and REC classification based on the River Environment Classification (REC) (Snelder et al., 2004)
- Stream classification as per Storey and Wadhwa (2009) into ephemeral, intermittent and permanent hydroperiods.
- Stream ecological valuation (SEV) following (Storey et al., 2011) – refer detailed methodology below.

The SEV methodology (Storey et al., 2011) was undertaken on the stream reaches within the ZOI of EB3C and EB4L. The application of this method was suitable to inform ecological conditions by assigning a SEV score based on 14 key ecological functions. The ecological functions are represented by four broad stream function categories (hydraulic, biochemical, habitat provision and biodiversity provisions). Inputs from each function are used to calculate an overall SEV score by means of averages and algorithms. The resulting score ranges between 0 (Poor) and 1 (Excellent) and is used to indicate the ecological function of the stream or watercourse (refer to Table 4-2).

Table 4-2 Interpretation of SEV scores (Storey et al. 2011)

Score	Ecological Value
0 – 0.4	Poor
0.41 – 0.60	Moderate
0.61 – 0.80	Good
0.81 +	Excellent

The SEV assessment of physical attributes, fish and macroinvertebrate surveys and methods are summarised below:

- Measurements of physical stream attributes including stream width, depth, velocity, in-stream habitat and riparian characteristics were assessed. The data was used to inform the hydrological function, biogeochemical function and habitat provisions of the stream
- Instream macroinvertebrate communities were sampled at SEV locations following protocols developed for the sampling of macroinvertebrates in wadeable, soft-bottomed streams in New Zealand (Stark *et al.,* 2001). Standard community-based invertebrate indices were used to interpret invertebrate data, including %EPT, QMCI-sb and MCI-sb (Appendix A2-3). An assessment of invertebrate habitat diversity and abundance with specific reference to stream dimension and

substrate composition and hydraulic diversity was completed for all sites. The invertebrate habitat availability assessment was adopted from McMillan (1998)

- The availability and quality of *Galaxiidae* spawning habitat was assessed as part of the SEV (Storey *et al.*, 2011). The fish assessment also considered any structures likely to impede fish passage within the Project Area, following NIWA fish passage guidelines (Franklin *et al.*, 2018)
- The fish assessment was undertaken with Environmental DNA (eDNA) sampling and augmented with available data from the Freshwater Fish Database (Stoffels, 2022). eDNA testing was used to address the limitations of conventional sampling (i.e. diurnal and seasonal differences in fish activity, electronarcosis bias, under representation of species occurring at low abundances and improved taxonomic confidence). During the 2021 Stream surveys, a 50-mL filtered water sample was taken using Wilderlab eDNA sample kits and sent to a laboratory (Wilderlab) for analysis. Laboratory analysis included eDNA sequence counts using multi-species DNA metabarcoding targeting fish, macroinvertebrates, mammals, and birds.

For a detailed methodology of the stream survey assessment refer to Appendix 2.

4.7 Ecological Value Assessment

The ecological value of each ecological feature (terrestrial, aquatic and wetland) was assessed using a spreadsheet template by assigning a score of *0 (None), 1 (Low), 2 (Moderate), 3 (High), or 4 (Very High)* based on professional judgement (with justification) to attributes associated with each of the four ecological matters recommended within the EIANZ Guidelines : *1) Representativeness; 2) Rarity/distinctiveness; 3) Diversity and pattern; and 4) Ecological context.*

Considerations in relation to the four matters and corresponding aspects for terrestrial, wetland and freshwater features are detailed below:

Terrestrial Ecology

1. **Representativeness:** Typical structure, species composition, and indigenous representation
2. **Rarity/distinctiveness:** Species of conservation significance, and distinctive ecological values
3. **Diversity and pattern:** Habitat diversity, species diversity, and patterns in habitat use
4. **Ecological context:** Size, shape and buffering function, sensitivity to change, and ecological networks (i.e., linkages, pathways, migration).

Wetland Ecology

1. **Representativeness:** Hydrological modification based on observations of drains, ponds, and catchment land use. Native vegetation informed by site visits and the review of landcover information
2. **Rarity/distinctiveness:** Wetland type (rare or distinctive), and distinctive ecological values (ecosystem services) in a larger catchment context
3. **Diversity and pattern:** Representation of different hydroperiods (permanent, seasonal, or temporary) and the structural complexity of vegetation cover
4. **Ecological context:** Flood attenuation, streamflow regulation, sediment trapping, water purification, and connectivity and migration

Freshwater Ecology

1. **Representativeness:** SEV score for sites and riparian habitat modification based on desktop stream and catchment assessments
2. **Rarity/distinctiveness:** Species of conservation significance informed by the potential occurrence of Threatened and At-Risk (TAR) fish species
3. **Diversity and pattern:** Level of natural diversity. Stream order, slope, and hydroperiod were applied as desktop proxies to judge the likely habitat diversity for streams where access was constraint
4. **Ecological context:** Stream order and hydroperiod.

The score for each matter was constrained to the highest score for each aspect (e.g., a High score allocated to a wetland for flood attenuation will result in a High score for the Ecological context matter). The combined ecological value score (ranging from Very High to Negligible), for the four matters, was determined in accordance with the EIANZ Guidelines.

Notwithstanding the ecological value associated with vegetation/habitat units, specific consideration still needs to be given to individual species and their conservation significance for the following reasons:

- The habitat value may dilute the conservation value associated with specific species. For example, the combined value for exotic grassland is **Low**, while the value for copper skink (At Risk - Declining) is **High**. The combined value of **Low** therefore understates the conservation value of the species
- Species may not be restricted to a single vegetation unit
- Potential effects on species are unrelated to habitat units. For example, impact on highly mobile species (such as bats) by noise and light may be independent of the habitat loss associated with the Project
- Consideration and adjustment of ecological value may occur dependent on regional threat status and local knowledge (if available). The more conservative of the ecological values should be used.

For the reasons outlined above, the ecological value assessments for individual species are defined by their conservation significance as outlined in the table below (Table 5 of EIANZ, 2018).

Table 5 **Factors to consider in assigning value to terrestrial species for EcIA**

Determining factors	
Nationally Threatened species, found in the ZOI either permanently or seasonally	Very High
Species listed as At Risk – Declining, found in the ZOI, either permanently or seasonally	High
Species listed as any other category of At Risk, found in the ZOI either permanently or seasonally	Moderate
Locally (ED) uncommon or distinctive species	Moderate
Nationally and locally common indigenous species	Low
Exotic species, including pests, species having recreational value	Negligible

4.8 Compensation Criteria

For effects on terrestrial habitat features, where impact management (avoid, remedy, mitigate) has been implemented and residual effects remain, the Biodiversity Compensation Model (BCM) for New Zealand has been applied (Baber et al., 2021). The BCMs can be used instead of biodiversity offset models when quantitative data is difficult to obtain or lacks adequate precision to determine if adverse effects can be demonstrably offset[6] (Baber et al., 2021 a,b,c). The BCM approach provides transparency and rigour to the development of measures to address residual adverse effects and is considered to be as close to an offset as possible.

To date the BCM has been utilised on the Amberfield subdivision for Hamilton City Council; the proposed Dome Valley Landfill for Waste Management New Zealand; Te Ahu a Turanga: Manawatū Tararua Highway for Waka Kotahi NZ Transport Agency, and Drury Central and Paerata stations for KiwiRail.

The BCM considers Impact Risk, Impact Uncertainty and Extent of Impact and provides modelled compensation area extents for the Project's effects. Model inputs are conservative to minimise risks of 'False Positives' and Net Gain target outcomes are also conservative, equating to a target of 10% exceedance of No Net Loss. Appendix 4 provides further information and justification behind the use of the BCM.

[6] A biodiversity offset is a 'measurable conservation outcome' that meets certain principles and balances adverse residual effects that cannot reasonably be avoided, remedied or mitigated, to a No Net Loss/ Net Gain standard. While offsetting requires a measurable outcome that has been quantified through a robust and transparent process, biodiversity compensation does not necessarily need to be quantified and measurable.

5.0 Baseline Environment – EB3C and EB4L

Chapter Summary

This chapter provides a summary of the ecological features and their value present in areas potentially impacted by EB3C and EB4L. Due to the similarities in ecological features present within EB3C and EB4L, these have been presented collectively, with differences noted as required.

Terrestrial, wetland and freshwater features are described based on information obtained during the desktop review and subsequent site investigations. Ecological value is assigned to terrestrial and wetland features based on EIANZ criteria.

5.1 Terrestrial ecology (flora and fauna)

5.1.1 Wider ecological context

The Project is situated in the Tāmaki Ecological District. The geology of the district is characterised by sandstone, siltstone and minor limestone with basaltic scoria cones, tuff rings, lava flows and areas of alluvium within stream corridors. The topography of the Project area generally slopes southeast to northwest with drainage eventually entering the Tāmaki River estuary. Soils in the district are mainly composed of volcanic ash soils and are generally silty, friable, and free draining (McEwen 1987). It also experiences warm, humid summers and relatively mild winters. Rainfall is typically plentiful throughout the year, with sporadic heavy storm events. Rainfall is approximately 1100 to 1450 mm per annum (Chappell, 2012).

Prior to forest clearance and land modification, historical forest cover would have been representative of characteristic North Island lowland forest with abundant taraire (*Beilschmiedia tarairi*) and puriri (*Vitex lucens*) (McEwen 1987). The dominant historical terrestrial ecosystem types (Singers & Rogers 2014) in the area have been classified as:

- Puriri, taraire forest (WF7.2) - which occurs on volcanic fields with underlying basalt geology and skeletal soils
- Kahikatea, puriri forest (WF7.3) – which occurs on alluvial terraces on recent fluvial soils
- Mangrove forest and scrub (SA1.6) – which is in coastal areas and the upper tidal areas of estuaries. Species would include salt-marsh ribbonwood, harakeke, coastal tree daisy, ngaio, and kōwhai, manuka, and cabbage trees on the estuarine margins.

The ‘puriri forest’ is described as a broadleaved forest with abundant puriri (*Vitex lucens*) and occasional podocarps; (Singers & Rogers 2014). Within the Project area WF7.2 would have dominated on the higher ground and WF7.3 within the riparian margins of the stream corridors. Where saline influence was present, (within Burswood Reserve) coastal forest and scrub would have dominated.

Historically, the area would have supported a diverse range of invertebrates, amphibians, reptiles, birds, and bats (Singers et al., 2017). However, the ecological district has been heavily modified, with the drainage of freshwater systems and clearance of terrestrial indigenous vegetation in support of urban development. Currently, the wider Project area comprises a mix of residential, business, and open space zones.

5.1.1.1 AUP(OP) Zoning and Overlays

Most of the land within the EB3C and EB4L areas is zoned for residential and business purposes under the AUP(OP); however, there are some green areas within EB3C and EB4L that are zoned ‘Open Space’ under the AUP(OP). These include:

- ‘Open Space – Conservation Zone’ along Burswood Reserve and Guys Reserve

- ‘Open Space – Informal Recreation Zone’ along Greenmount Reserve, Burswood Reserve and Guys Reserve.

AUP(OP) overlays indicate that two marine Significant Ecological Areas (SEAs) are located adjacent to EB3C, specifically Mangroves (SEA-M1-45a and SEA-M2-45b), which comprises tidal mudflats and mangrove habitat around Tī Rākau Drive and Burswood Esplanade Reserve (refer Figure 5-1). An assessment of the marine environment (including coastal avifauna) and potential impacts associated with the EB3C and EB4L sections of the Project has been undertaken (Document Number EB-RP-3C4L-PL-000011[).

There are no terrestrial SEA’s located within the EB3C and EB4L Project area.

No notable trees were identified within the ZOI. However, effects on Natural Heritage are assessed in the Arboricultural Assessment.

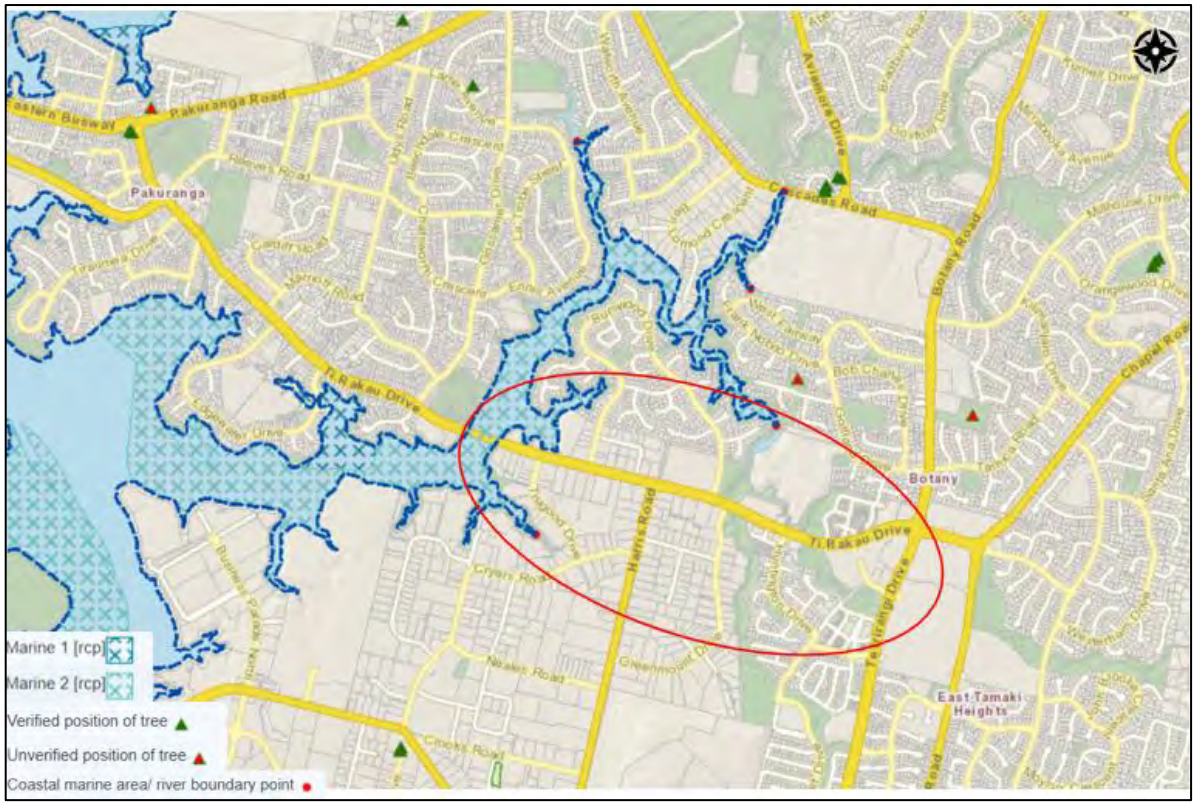


Figure 5-1 Significant Ecological Areas located in the vicinity of the EB3C and EB4L project area (red circle) (Extracted from Auckland Council Geomaps). Marine 1 = SEA-M1-45a, Marine 2= SEA-M2-45b.

5.1.2 Site Description

The present-day terrestrial habitats within the vicinity of EB3C and EB4L are predominantly heavily modified and consist mainly of a mixture of native and exotic planted vegetation. A proportion of the EB3C footprint is located within Burswood Esplanade Reserve and Bard Park Reserve. The majority of the EB4L footprint is located within Guys Reserve and Whaka Maumahara Reserve. These reserves contain stream and wetland habitat with native riparian plantings buffering the freshwater environment.

5.1.3 Terrestrial Vegetation Habitat Types

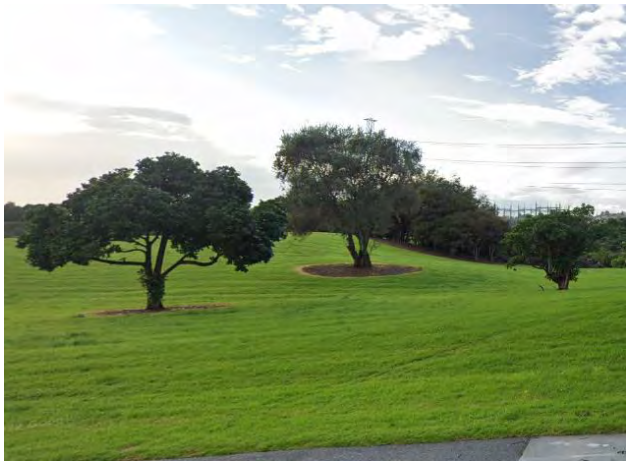
The terrestrial habitats within and adjacent to EB3C and EB4L are comprised of roadside planting, maintained amenity areas, exotic scrub and native plantings within the riparian zones of reserves. The habitats are generally consistent across both EB3C and EB4L. Excluding the coastal marine areas, the majority of the EB3C site is grassland (both rank grass and mown lawns) and native planted scrubland

growing along the existing road corridor and Burswood and Bard Park Reserves. The majority of the EB4L sites is open space consisting of maintained grassland and planted native vegetation along Guys and Whaka Maumahara Reserve. The riparian corridors within Burswood Reserve, Bard Park reserve, Guys Reserve and Whaka Maumahara Reserve have developed areas of naturally regenerating exotic trees and scrubland. Shelterbelts and boundary treelines have also been classified as exotic treeland. There are several exotic trees and areas of amenity planting associated with commercial properties along Tī Rākau Drive and residential properties along Burswood Drive of EB3C and Te Koha Road and Te Irirangi Drive of EB4L.

An overview of the dominant terrestrial vegetation types in and within the proximity of EB3C and EB4L are detailed below in Table 5-1. The mapped extent of vegetation present in and in the vicinity of EB3C and EB4L is detailed in Figure 5-2 and Figure 5-3.

There are no records or onsite observations of Threatened and At Risk (TAR) plant species occurring within the ZOI of EB3C and EB4L.

Table 5-1 The main vegetation types potentially impacted by EB3C and EB4L

Vegetation Classification (Singers et al., 2017)	Description and species	Photograph
TL.1 – Native dominated treeland	Tree canopy is discontinuous (20-80%). Native dominant (>75%). • EB3C - approximately 0.024 ha removed • EB4L – not present Includes planted native trees in amenity areas and parks within the ZOI. Areas of native treeland largely consist of planted semi mature pōhutukawa (*Metrosideros excelsa*), karaka *(Corynocarpus laevigatus*), and tītoki (*Alectryon excelsus* subsp. *excelsus*). Understorey is generally absent as these areas are managed, with mown exotic grassland areas.	

Vegetation Classification (Singers et al., 2017)	Description and species	Photograph
TL.2 - Mixed native and exotic vegetation	Tree canopy is discontinuous (20-80%). Mixed native/exotic: with 25-75% native tree cover. • EB3C – none present • EB4L – approximately 0.031 ha removed Includes mixed native and exotic trees in reserves within the ZOI. Stands of mixed vegetation where native trees include; pōhutukawa (*Metrosideros excelsa*), kānuka (*Kunzea amathicola*), and *Pittosporum* spp. Exotic trees present include cypress and poplars (*Populus sp.*). Understory vegetation is generally dominated by exotic weeds such as harakeke/flax (*Phormium tenax*), lemonwood (*Pittosporum eugenioides*), and *Pittosporum* spp. Unmaintained areas result in rank grasses in understory and edges.	
TL3 – Exotic-dominated treeland	Where tree canopy is discontinuous (20-80%) and exotic species dominate, with <25% native. • EB3C – approximately 0.010 ha removed • EB4L – none present Includes planted amenity areas and parks/reserves within the ZOI. Majority of trees include olive (*Olea* spp.), birch (*Betula pendula*), and fan palm (*Washingtonia sp.*).	

Vegetation Classification (Singers et al., 2017)	Description and species	Photograph
PL.1- Planted native vegetation	Native restoration plantings with <50% exotic biomass. Recently planted <20 years old. • EB3C – approximately 0.124 ha removed • EB4L – approximately 0.521 ha removed Includes restoration planting within parks/reserves and riparian areas within the ZOI. Species include mānuka (*Leptospermum scoparium*) tī kōuka/cabbage tree (*Cordyline australis*), karamu (*Coprosma* spp.), harakeke/flax, taupata (*Coprosma repens*), and pōhutukawa (*Metrosideros excelsa*).	
PL.3 – Planted amenity vegetation	Exotic and/or native amenity planting. • EB3C – approximately 0.021 ha removed • EB4L – none present Species include ivy (*Herdera sp.),* harakeke/flax, and exotic shrubs. Includes landscape planting within roadside properties and roadside berms.	
ES - Exotic Scrub	Exotic secondary scrub or shrubland with >50% cover/biomass of exotic species. • EB3C – approximately 0.193 ha removed • EB4L – none present Largely occurs within unmanaged riparian corridors. Species include pests like pampas (*Cortaderia selloana*), gorse (*Ulex europaeus*), tree privet (*Ligustrum lucidum*), and woolly nightshade (*Solanum*	

Vegetation Classification (Singers et al., 2017)	Description and species	Photograph
	mauritianum). Occasional native species also occur within these areas.	
EG – Exotic Grassland (mown)	Grassland dominated by exotic species, includes lawns within parks/reserves, grass berms and gardens within private property that is maintained. Dominant species include kikuyu grass (*Pennisetum clandestinum*) and paspalum grass (*Paspalum* spp.).	
EG – Exotic Grassland (rank)	Non-maintained grassland occurring in edge habitat, commonly fringing riparian stream margins or developing in the understory of tree canopies. Defined by tall, dense, and coarse grasses. Dominant species include kikuyu grass and paspalum grass.	

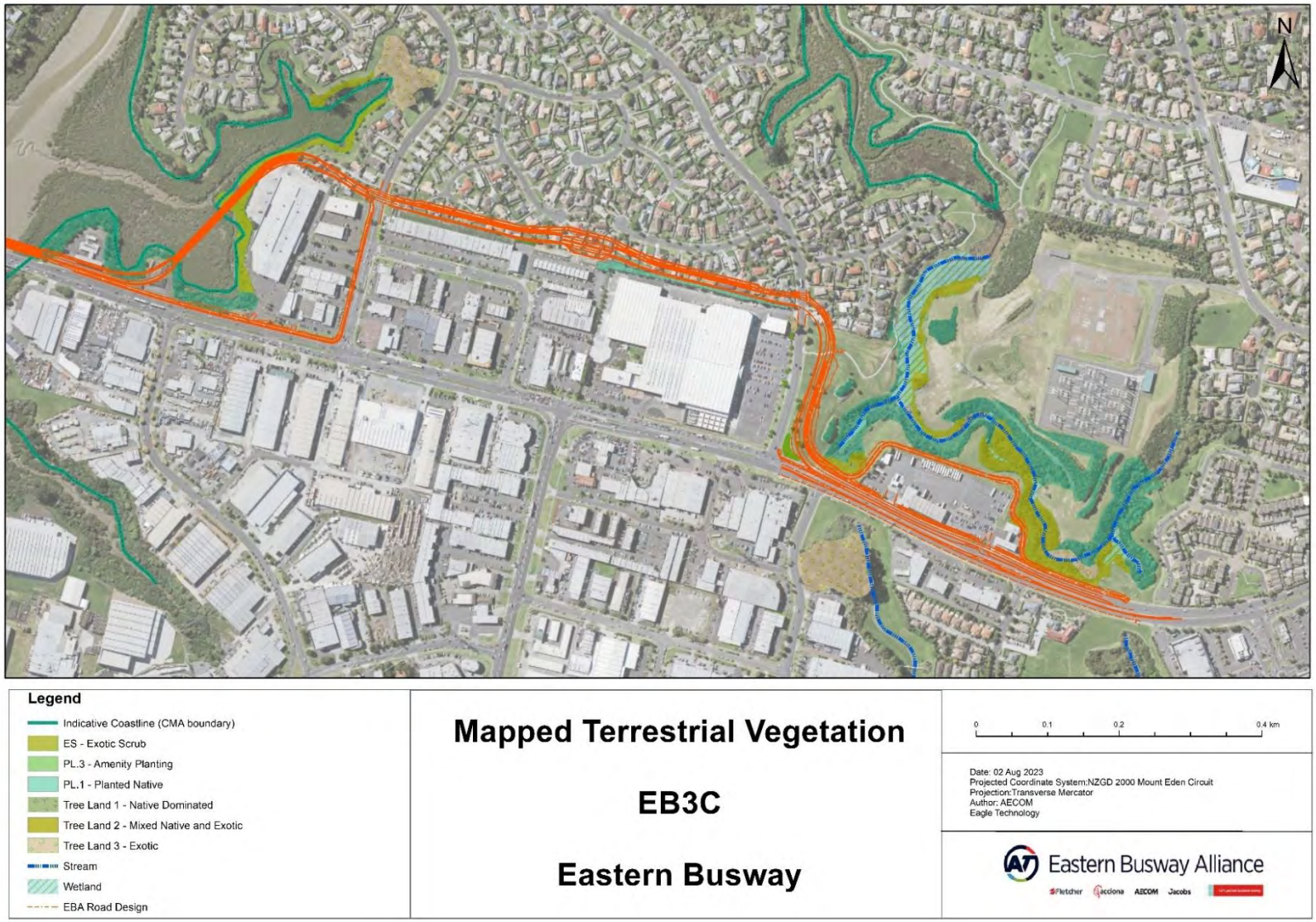


Figure 5-2 Mapped overview of terrestrial vegetation and freshwater features at EB3C

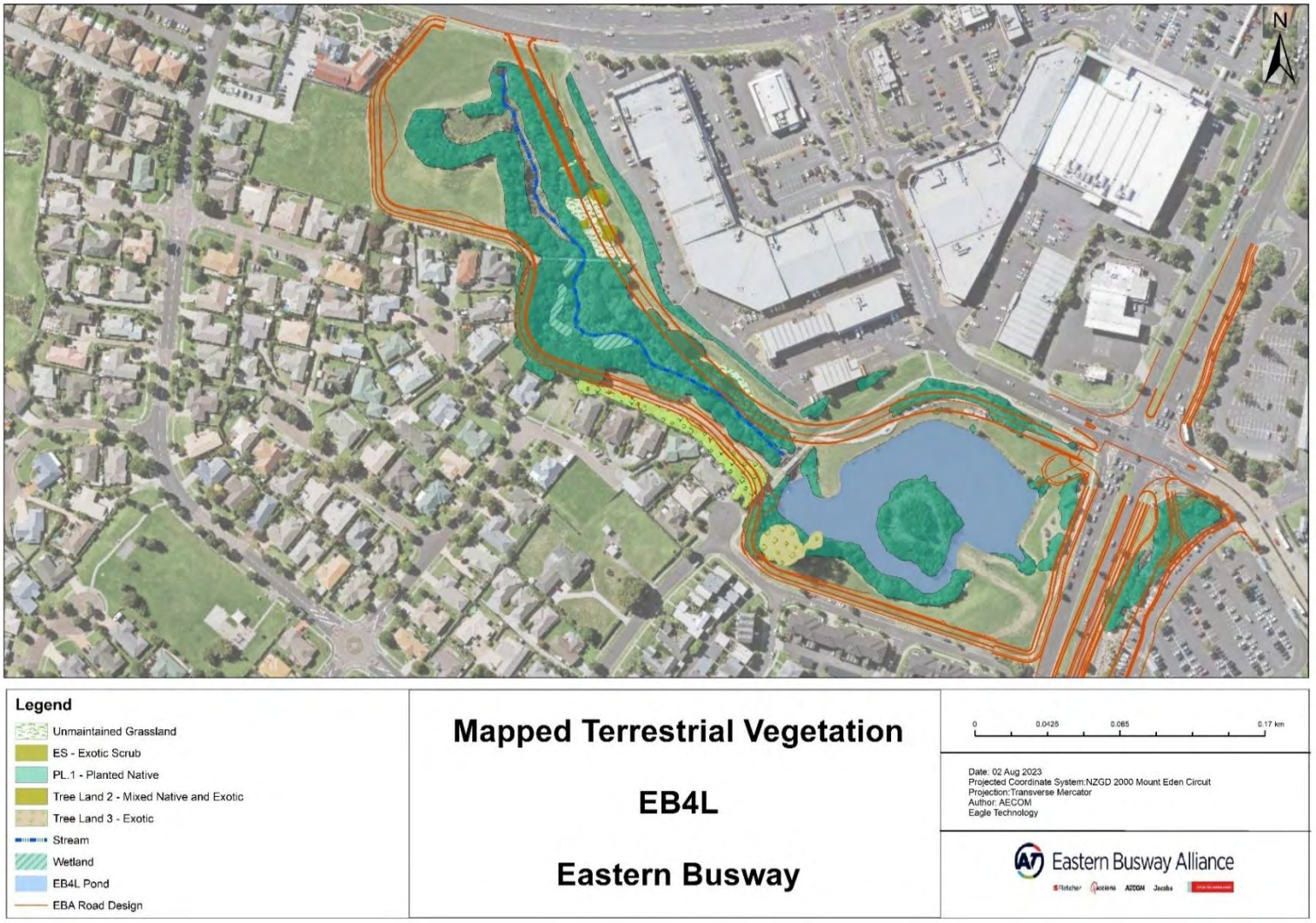


Figure 5-3 Mapped overview of terrestrial vegetation and freshwater features at EB4L.

5.1.4 Ecological Value of Terrestrial Vegetation

The value of terrestrial vegetation has been scored in accordance with the EIANZ Guidelines and is summarised in Table 5-2. Full details of the terrestrial value assessment is presented in Appendix 5. The vegetation impacted by EB3C and EB4L is considered to be of **Low** to **Moderate** ecological value. The ecological value of coastal mangrove vegetation is detailed in the Marine Ecology and Coastal Avifauna Effects Assessment (EB-RP-3C4L-PL-000011).

Table 5-2 Ecological value overview associated with terrestrial habitat present at EB3C and EB4L

Vegetation Type	Ecological value
TL.1 – Native dominated tree-land	Moderate
TL.2 – Mixed native and exotic vegetation	Moderate
TL. 3 – Exotic-dominated tree-land	Low
PL.1 – Planted native	Moderate
PL.3 – Amenity planting	Low
ES – Exotic scrub	Low
EG – Exotic grassland, includes mown and rank grasses	Low

5.1.5 Avifauna

All desktop records of bird species identified within 5 km of the Project areas are collated in Appendix 5; Section A5.4. This data is comprised of a series of five-minute bird counts undertaken at Pakuranga Golf Course (Chaffe, 2016), iNaturalist and NZ Bird Atlas records.

Formal wetland and terrestrial bird surveys were not undertaken during the April 2021 site walkover, but incidental observations were made. These have been included in Appendix 5; Section A5.4 and only include exotic and not threatened avifauna species. Coastal bird surveys (including banded rail) were undertaken as part of the Marine Ecology and Coastal Avifauna Effects Assessment.

The majority of the birds recorded within the vicinity of the Project area are exotic and 'Not Threatened' native species, except for the New Zealand dotterel (*Charadrius obscurus*), pied shag (*Phalacrocorax varius),* New Zealand dabchick *(Poliocephalus rufopectus)* which are 'At Risk-Recovering' and the little black shag *(Phalacrocorax sulcirostris)* which is 'At Risk – Naturally Uncommon'. Besides the New Zealand dabchick, all of these bird species are those that predominantly reside in the coastal environment and have been assessed in more detail within the Marine Ecology and Coastal Avifauna Effects Assessment. Dabchick habitat requirements include shallow waters with dense vegetation on small freshwater lakes and pools. There is no such habitat within the ZOI of the Project.

Wetland habitat within Burswood Reserve has the potential to support some TAR wetland bird species, including the 'At-Risk Declining' banded rail (*Gallirallus philippensis*) within the saltmarsh habitat. banded rail were not detected from surveys undertaken for the Marine Ecology and Coastal Avifauna Effects Assessment, but because they are cryptic, their presence could not be excluded completely from coastal areas. Effects to banded rail are addressed in the Marine Ecology and Coastal Avifauna Effects Assessment and are not considered further in this assessment due to their unlikely presence further inland from coastal areas.

Viable habitat for forest birds within the vicinity of EB3C and EB4L is sparse and highly fragmented. The only vegetation included in this assessment that is considered to provide any meaningful habitat is located within the exotic shelterbelts and amenity plantings located within Burswood and Guys Reserve. This vegetation is comprised entirely of edge habitat and considered only to provide basic resources for urban adapted species which are tolerant of high levels of disturbance. Though the habitat potential is

limited, the vegetation has the capacity to provide some resources and dispersal pathways for local bird populations, particularly around the riparian margins of Burswood and Guys Reserve.

Considering the highly modified urban nature of the habitat available, the conservation status (largely Not-Threatened) and mobility of urban-adapted bird species considered common to the area, the ecological value of forest bird community potentially impacted by EB3C and EB4L is considered to be **Low**.

5.1.6 Bats

There are two extant species of native bat in New Zealand, the long-tailed bat (*Chalinolobus tuberculatus*) and the lesser short-tailed bat (*Mystacina tuberculata*). There are no known lesser short-tailed bat populations in mainland Auckland. However, long-tailed bat populations do persist in some parts of the wider Auckland Region.

According to DOC records the closest known long-tailed bat population is located at 353 Redoubt Road, 9.5 km south of the Project footprint and in the Clevedon Scenic Reserve, 15 km south of the Project footprint (Figure 5-4). There are anecdotal reports of a bat sighting in Burswood Reserve and a further report of a sighting provided by Auckland Council in Point View Reserve, East Tamaki (Ben Paris, pers comms).

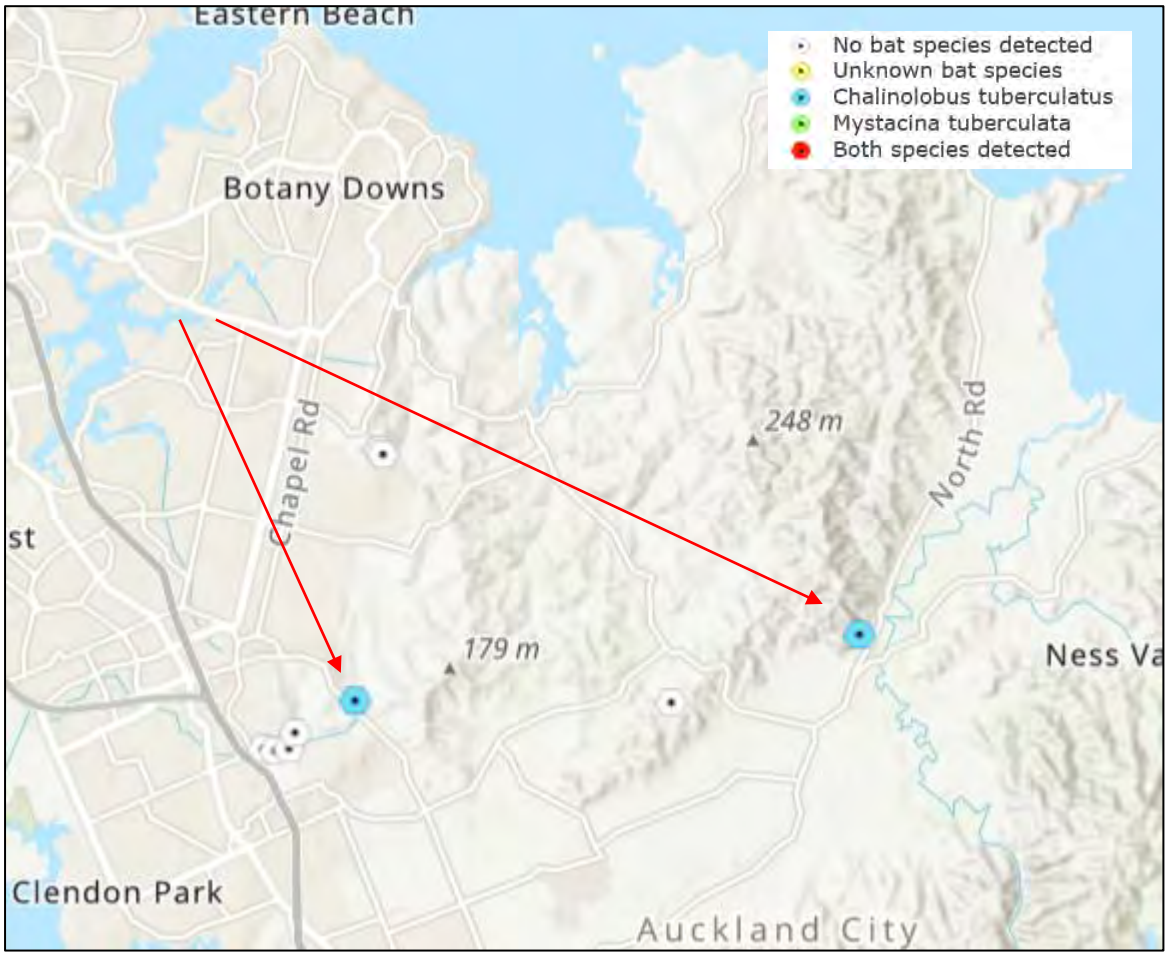


Figure 5-4 Bat records for the Project area

5.1.6.1 ABM Survey Results

Automated Bat Monitors (ABM's) were deployed to confirm the presence or likely absence of long-tailed bats within the ZOI of the EB3C and EB4L. The ABM's were retrieved on 20 April 2022 following 19 days of suitable weather for bat activity. During the analysis, several calls were heard but were not considered to be bat species. These results, in addition to the lack of suitable habitat, would discount

bat species from being present within the ZOI of the Project areas. As a result, effects associated with bats are not considered further as part of this assessment.

5.1.7 Herpetofauna

Ten species of native lizards (Mokomoko) have been recorded in the wider Auckland region, nine of which are classified as 'At Risk' or 'Threatened' (Bioresearches 2018; Hitchmough et al., 2021). Copper skink (*Oligosoma aeneum*), ornate skink (*Oligosoma ornatum)*, forest gecko and elegant gecko have been recorded within 10 km of the Project (Bioresearches 2018; Bioweb, 2022) (Table 5-3). Records from the EB1 lizard salvage (Bioresearches, 2020) found that Copper Skink (*n* = 23) were caught at:

- Lagoon Drive approximately 3.6 km from EB3C and 5.3 km from EB4L
- Kerswill Corner approximately 3.1 km from EB3C and 4.7 km from EB4L.

Forest gecko and elegant gecko are arboreal (tree dwelling) species and are associated with larger areas of established native vegetation and their habitat requirements are not represented within the Project area.

Although no formal lizard surveys were undertaken as part of the baseline surveys for EB3C and EB4L, previous assessments within the wider Project area have confirmed the presence of Copper Skink. Vegetation that is impacted by the Project is considered to have the potential to support Copper and Ornate Skink (refer Table 5-4 and Table 5-5 for estimated lizard habitat loss). High risk areas include planted native vegetation (PL.1), mixed/ exotic treeland (TL.2 and TL.3), exotic scrub (ES), unmanaged rank grassland (EG) and along stream corridors located within and outside reserves. These areas of vegetation have sufficient ground cover (such as tradescantia (*Tradescantia fluminensis*), unmaintained grasses, leaflitter and woody debris) to support native skink. Specifically, these areas include the riparian margins of Pakuranga Creek along Burswood Reserve, Bard Park Reserve and Guys Reserve.

Table 5-3 Native lizard (Mokomoko) species recorded within 10 km of EB3C and EB4L (= potential to occur within Project Area)*

Species	Threat Status (Hitchmough et al., 2021)	Habitat Preferences
Elegant gecko (*Naultinus elegans)*	At risk - Declining	Forest and scrub, especially kanuka/manuka shrubland
Forest gecko (*Mokopirirakau granulatus)*	At risk - Declining	Older forest. May persist in remnant stands, scrub, broadleaf and mixed forest and scrub, especially small leaved species with dense growth
Copper skink* *(Oligosoma aeneum)*	At risk - Declining	Open and shaded areas where sufficient cover is available (e.g., rock piles, logs, dense vegetation)
Ornate skink* *(Oligosoma ornatum)*	At risk - Declining	Forest or open areas with deep leaf litter, or stable cover (e.g., deep rock piles, thick vegetation), usually connected to higher value contiguous forest.

Figure 5-5 Planted vegetation (PL.2) at Burswood Reserve, unmaintained rank grasses and understory around riparian zone provides suitable potential habitat for native skink species. Photo credits: C Smith, 29.04.2021.

Table 5-4 Lizard habitat loss EB3C

Vegetation Loss	Approximate vegetation loss (ha)	Approximate lizard habitat loss (ha)
Permanent ES. Exotic scrub	0.193	0.193
Permanent PL.1 Planted vegetation	0.124	0.124
Permanent PL.3	0.021	-
Permanent TL.1	0.024	-
Permanent TL.3	0.010	0.010
Total permanent vegetation loss	**0.372 ha**	**0.327 ha**

Table 5-5 Lizard habitat loss EB4L

Cumulative Vegetation Loss	Approximate vegetation loss (ha)	Approximate lizard habitat loss (ha)
Permanent PL.1 Planted vegetation	0.521 ha	0.220 ha
Permanent TL.2 Mixed native and exotic treeland	0.031 ha	0.031 ha
Total permanent vegetation loss	**0.552 ha**	**0.251 ha**

Copper and Ornate skinks have a threat status of 'At Risk-declining' (Hitchmough et al., 2021). Copper Skink have been recorded within 5 km of the EB3C and EB4L project areas and Ornate Skink within 10 km of the EB3C and EB4L project areas (Bioweb, 2022). Although these species have not been observed within EB3C and EB4L, based on habitat potential and nearby desktop records, this assessment has taken a precautionary approach and assumed the presence of these species. In accordance with EIANZ

(2018) the value assessment for these species has been based on the threat status of Copper and Ornate skinks. As such, the ecological value of lizard species potentially present in areas potentially impacted by EB3C and EB4L is considered **High** (Table 5-6).

Table 5-6 Ecological value for terrestrial fauna (TAR species only) – EB3C and EB4L

Fauna type	Species within habitat	Habitat description	Threat status (NZ Classification system)	Ecological Value
Herpetofauna – lizards	Ornate skink (*Oligosoma ornatum*)	Planted native vegetation (PL.1), mixed/ exotic treeland (TL.2), exotic scrub (ES) with understorey, including unmanaged rank exotic grassland (EG) habitat edges and along stream corridors and esplanade reserves.	At risk - declining	High
Herpetofauna – lizards	Copper skink (*Oligosoma aeneum*)		At risk - declining	High

5.2 Wetland Ecology

5.2.1 Ecological Context

A desktop assessment was undertaken to assess potential wetlands within and beyond the ZOI for EB3C and EB4L. The ZOI for the wetland assessment was based on 100 m distance from the construction footprint in-line with restrictions on activities such as earthworks, vegetation clearance and discharge associated with the NES-FW.

Wetlands within the broader area are typically associated with the Tāmaki Estuary and its drowned river valley caused by Holocene marine transgression. Wetlands have formed in the low-lying valley bottoms systems and around stream reserves. The reference condition for wetlands within the Project Area is swamp forest.

A series of wetlands (outside of the CMA) adjacent to EB3C and EB4L have been identified from desktop and site investigations. These wetlands are close to the EB3C and EB4L corridors and are associated with a Pakuranga Creek tributary flowing through Burswood Reserve, Bard Park Reserve and Guys Reserve. The direct wetland catchment is urbanised, with these wetlands influenced by the riparian zone and existing stormwater discharges. Thirteen wetlands within the ZOI of EB3C were delineated in Burswood Reserve, Bard Park Reserve and Guys Reserve (Figure 5-6). Five wetlands within the ZOI of EB4L were delineated within Guys Reserve (Figure 5-7).

Figure 5-6 Wetlands located within Burswood Reserve and Guys Reserve associated with EB3C.

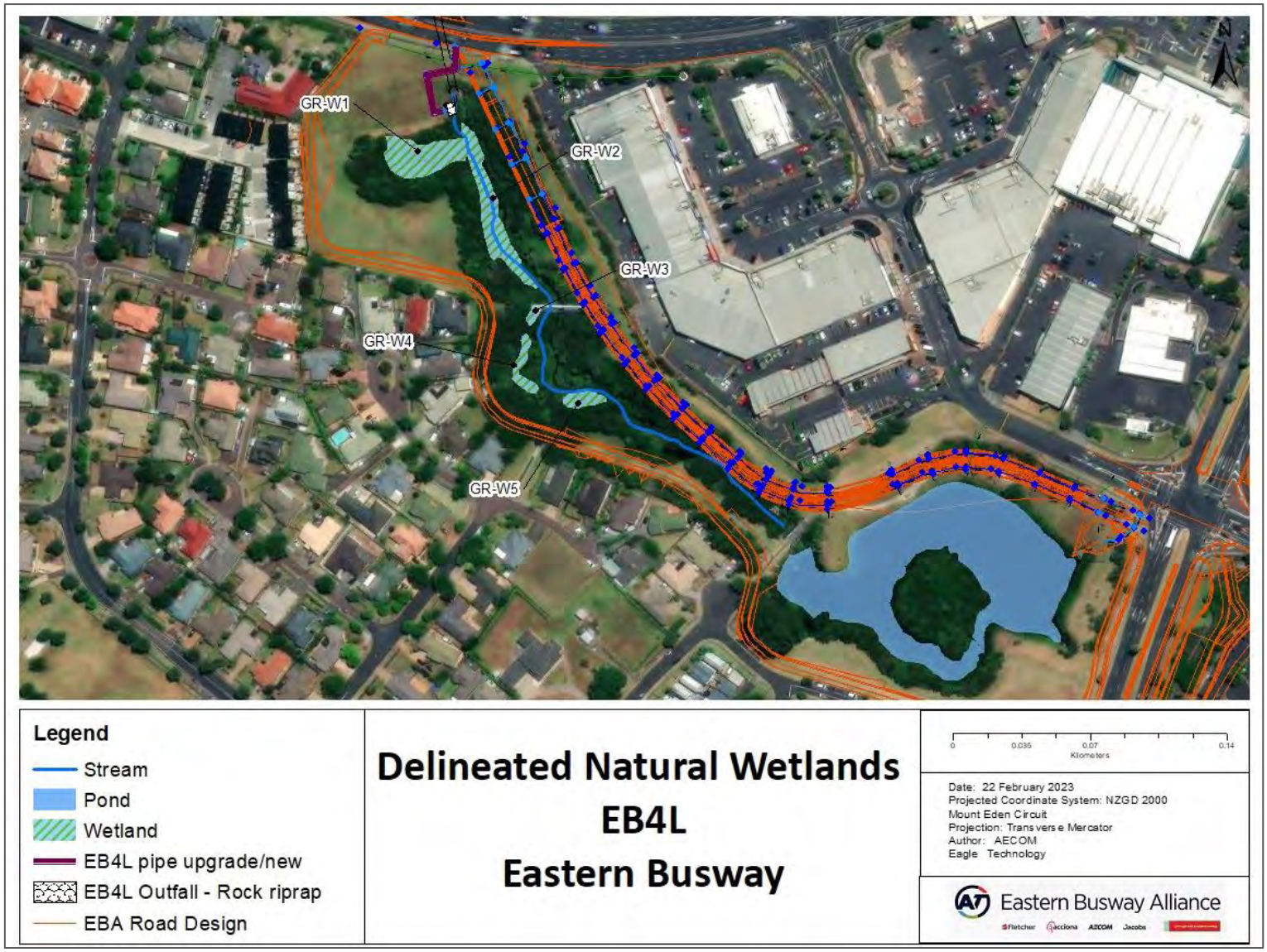


Figure 5-7 Wetlands located within Burswood Reserve and Guys Reserve associated with EB4L.

5.2.2 Wetland Delineation

5.2.2.1 Burswood Reserve and Bard Park Wetlands

Wetlands within Burswood Reserve and Bard Park wetlands are classed as riverine wetlands and are associated with the riparian margins of the Pakuranga Creek tributaries. According to the Singers et al., 2017 classification, four wetlands are classed as Exotic Wetland (EW), three are classed Oioi restiad rushland/reedland (WL10), three are classed Machaerina sedgeland (WL 11) and one is classed as a planted wetland (PL.1).

All of these wetlands are considered to meet the definition of a 'natural inland wetland' under the NPS-FM (as amended in 2023).

A description of the wetlands and their regional threat status is provided in Table 5-7 below. A detailed delineation of wetland extent was undertaken at BR-W4 owing to its proximity to proposed stormwater works (Appendix 1). All other wetlands were rapidly assessed following the vegetation profile and topographical confinement to margins of the Burswood reserve stream channel. Appendix 1 provides further information regarding the wetland delineation results.

Table 5-7 Description and regional IUCN threat status of wetlands present within Burswood Reserve and Bard Park.

Wetland	Singers et al. 2017 classification	Regional IUCN threat status	Description	NPS-FM Natural Inland Wetland	Location
BR-W1	EW Exotic wetland	NA	Wetland ecosystems with >50% exotic plant biomass. Exotic species include nettle (*Urtica urens*), buttercup (Ranunculus repens), and willow weed (*Persicaria lapathifolia*). Pest plants such as pampas (*Cortaderia selloana*) and crack willow (*Salix fragilis*), also occur.	Yes	EB3C
BR-W2	WL 11 Machaerina sedgeland	Critically endangered	This area forms a sedge dominated variant of this wetland type and is dominated by cutty grass (*Carex geminata),* a facultative wetland species. This habitat grades up-slope into bracken *(Pteridium esculentum)* scrub and planted native vegetation. Exotic species such as buttercup, water celery (*Apium nodiflorum*), bindweed (*Convolvulus arvensis*) and blackberry (*Rubus fruticosus aggregate*) are also present but do not dominate. The exotic weed, crack willow is also present.	Yes	EB3C
BR-W3	PL.1 Planted vegetation	NA	Native restoration plantings with >50% native species. Wetland <10 years old. Species include harakeke / flax (*Phormium tenax*) and tī kōuka / cabbage tree (*Cordyline australis*).	Yes	EB3C

Wetland	Singers et al. 2017 classification	Regional IUCN threat status	Description	NPS-FM Natural Inland Wetland	Location
BR-W4	WL10 Oioi restiad rushland/reedland	Endangered	This area forms a *Bolboschoenus sp.* variant of this wetland type with purua grass *(Bolboschoenus fluviatilis)* common throughout. As a transitional wetland, dominant species vary along the length of the wetland, with freshwater species more common upstream and increasingly saline tolerant species downstream. Typical estuarine species such as oioi (*Apodasmia similis*), sea rush. (*Juncus kraussii)* and saltmarsh ribbonwood *(Plagianthus divaricatus),* are present and become increasingly abundant downstream as tidal influence increases. Invasive exotic species such as mercer grass *(Paspalum distichum)* and alligator weed *(Alternanthera philoxeroides)* were also common.	Yes	EB3C
BR-W5	WL10 Oioi restiad rushland/reedland	Endangered	This area forms a *Bolboschoenus sp.* variant of this wetland type with purua grass *(Bolboschoenus fluviatilis)* common throughout. Exotic blackberry was also abundant, competing with the native purua grass.	Yes	EB3C
BR-W6	WL10 Oioi restiad rushland/reedland	Endangered	This area forms a *Bolboschoenus sp.* variant of this wetland type with purua grass *(Bolboschoenus fluviatilis)* dominant. The only other species identified within this habitat was exotic bindweed (*Calystegia sylvatica).*	Yes	EB3C
BR-W7	EW Exotic wetland	NA	Classified as a wetland habitat with >50% exotic plant biomass. Exotic species, such as buttercup and willow weed, dominate.	Yes	EB3C
BR-W8	WL 11 Machaerina sedgeland	Critically endangered	This area forms a sedge dominated variant of this wetland type and is dominated by cutty grass (*Carex geminata),* a facultative	Yes	EB3C

Wetland	Singers et al. 2017 classification	Regional IUCN threat status	Description	NPS-FM Natural Inland Wetland	Location
			wetland species. This habitat grades up-slope into harakeke / flax and planted native vegetation. Exotic species such as buttercup and willow weed, are also present but do not dominate. The exotic pest plant, crack willow *(Salix fragilis*), is also present and has the potential to invade and dominate this habitat if unmanaged.		
BR-W9	EW Exotic wetland	NA	Classified as a wetland habitat with >50% exotic plant biomass. Exotic species such as buttercup and onion weed dominate.	Yes	EB3C
BR-W10	WL 11 Machaerina sedgeland	Critically endangered	This area forms a sedge dominated variant of this wetland type and is dominated by cutty grass (*Carex geminata),* a facultative wetland species.	Yes	EB3C
BR-W11	EW Exotic wetland (left bank) Planted vegetation (right bank)	N/A	Exotic: Classified as a wetland habitat with >50% exotic plant biomass. Exotic species such as buttercup Planted vegetation: Native restoration plantings with >50% native species. Species include harakeke / flax (*Phormium tenax*).	Yes	EB3C

5.2.2.2 Guys Reserve wetlands – EB3C

Wetlands were assessed within Guys Reserve where EB3C aligns with Tī Rākau Drive. Two riverine wetland areas (GW-W1 and GR-W2) were associated with the riparian zone of the Pakuranga Creek tributary that flows through Guys Reserve. Both wetlands delineated are classed as Exotic Wetland (EW) (Singers et al., 2017). A description of the wetlands and their regional threat status is provided in Table 5-8 below. Appendix 1 provides further information regarding the wetland delineation results.

5.2.2.3 Guys Reserve wetlands – EB4L

Wetlands within the ZOI of EB4L were assessed along the entirety of Guys Reserve, i.e., within the riparian zone of the Pakuranga Creek tributary. Four wetlands were classed as Exotic Wetland (EW) and one as Machaerina sedgeland (WL11), consisting primarily of *Carex geminata* (Singers et al., 2017).

All wetlands within Guys Reserve are considered to meet the definition of a 'natural inland wetland' under the NPS-FM (MfE, 2023).

Table 5-8 Description and regional IUCN threat status of wetlands present within Guys Reserve.

Wetland	Singers et al. 2017 classification	Regional IUCN threat status	Description	NPS-FM Natural Inland Wetland	Location
GR-W1	EW Exotic wetland	NA	Wetland ecosystems with >50% exotic plant biomass. Exotic species include Willow weed (*Allium triquetrum*). Around the wetland margin, species include harakeke / flax (*Phormium tenax*) and tī kōuka / cabbage tree (*Cordyline australis*) have been planted.	Yes	EB3C/EB4L
GR-W2	EW Exotic wetland	NA	Wetland ecosystems with >50% exotic plant biomass. This area is dominantly associated with Exotic species such as buttercup (*Ranunculus repens*) and willow weed (*Allium triquetrum*).	Yes	EB3C/EB4L
GR-W3	EW Exotic wetland	NA	Wetland ecosystems with >50% exotic plant biomass. This area is dominantly associated with Exotic species such as buttercup (*Ranunculus repens*), willow weed (*Allium triquetrum*) and fire weed (*Haloragis erecta*).	Yes	EB4L
GR-W4	WL 11 Machaerina sedgeland	NA	This area forms a sedge dominated variant of this wetland type and is dominated by cutty grass (*Carex geminata*), a facultative wetland species.	Yes	EB4L
GR-W5	EW Exotic wetland	N/A	Wetland ecosystems with >50% exotic plant biomass. This area is dominantly associated with Exotic species such as buttercup (*Ranunculus repens*), onion weed (*Allium triquetrum*) and wandering hew (*Tradescanthia fluminensis*).	Yes	EB4L

5.2.3 Wetland Vegetation and Soil Profile

Appendix 1 provides a summary of the wetland vegetation, a description of wetland soils and hydroperiod indicated recorded for wetlands. This included a combination of rapid assessment and plots to determine wetland extents. Dominant vegetation included facultative wetland and facultative species to evaluate the dominance test and prevalence index (MfE, 2022).

5.2.4 Ecological Value of Wetland Habitat

Information obtained for the ecological baseline was used to score the matters that inform the ecological value. A summary table detailing ecological value of wetlands associated with EB3C and EB4L is summarised below (Table 5-9). Further detail informing wetland condition assessment and the full EcIA value assessment table for wetlands is provided in Appendix 1 (Section A3.6).

*Table 5-9 Ecological value of wetlands present in the Project area and score justification. The value categories applied ranged from **Negligible** (1) to **Very High** (5).*

Ecological Matters	**Exotic Wetlands (EW) BR-W1, BR-W7, BR-W9, BR-W10, GR-W1, GR-W2, GR-W3, GR-W5**	
	Score	Justification
Representativeness	2	Hydrologically, physico-chemically and geomorphically modified. Contains only exotic species and high condition index.
Rarity/ distinctiveness	2	No species of conservation significance, not considered rare or distinctive wetland type, however, provides ecosystem services at a larger context.
Diversity and pattern	1	Low range of habitat and species diversity.
Ecological context	3	Provides important ecosystem services.
Ecological Value	**Low**	
The value assigned is **Low** value, accounting for their ecological context, modification status and the dominance of exotic species over indigenous.		
Ecological Matters	**Oioi restiad rushland/reedland (WL 10) BR-W4, BR-W5, BR-W6**	
	Score	Justification
Representativeness	2	Hydrologically, physico-chemically and geomorphically modified.
Rarity/ distinctiveness	3	Contains species of conservation significance in addition to the presence of endemic species. Wetland considered rare or distinctive wetland type.
Diversity and pattern	2	Low range of diversity in species and habitat.
Ecological context	4	Provides important ecosystem services and saltmarsh wetland ecosystems have a Regional IUCN threat status of Endangered.
Ecological Value	**Moderate**	
The value that has been assigned is considered **Moderate** accounting for the modification status, the dominance of indigenous over exotic species, including vegetation threat status.		
Ecological Matters	**Machaerina sedgeland (WL 11) BR-W2, BR-W8, BR-W10, GR-W4**	
	Score	Justification
Representativeness	2	Hydrologically, physico-chemically and geomorphically modified.
Rarity/ distinctiveness	4	Contains species of conservation significance in addition to the presence of endemic species. Wetland considered rare or distinctive wetland type.
Diversity and pattern	3	Moderate range of diversity in species and habitat.
Ecological context	4	Provides important ecosystem services and saltmarsh wetland ecosystems have a Regional IUCN threat status of Critically Endangered.
Ecological Value	**High**	
The value that has been assigned is considered **High** accounting for the modification status, the dominance of indigenous over exotic species including vegetation threat status.		
Ecological Matters	**Planted wetland (PL.1) BR-W3**	
	Score	Justification
Representativeness	2	Hydrologically, physico-chemically and geomorphically modified.

Rarity/ distinctiveness	3	Contains native restoration plantings. Wetland considered distinctive wetland type.
Diversity and pattern	2	Some range of diversity in species and habitat.
Ecological context	4	Provides important ecosystem services.
Ecological Value	**Moderate**	
The value that has been assigned is **Moderate** accounting for the modification status.		

5.3 Freshwater Ecology

5.3.1 Ecological Context

A desktop assessment was initially undertaken to determine potential stream habitat within the ZOI of EB3C and EB4L. The ZOI for the streams assessment was based on 100m distance from the Project alignment. There are a number of watercourses within the receiving environment of the Project areas and these are located within the Burswood Esplanade Reserve, Bard Park Reserve (BR) and Guys Reserve (GR). The watercourses are all classed as 'permanent' streams under the AUP(OP) and RMA definitions.

The permanent stream within Burswood Reserve is a tributary of Pakuranga Creek, which flows west into the Tāmaki Estuary. The stream has an approximate catchment area of 3.74 km^2 and is dominated by extensive urban development. Two permanent tributaries located at Greenmount Reserve and Guys Reserve join the Burswood Reserve stream before discharging out into Pakuranga Creek. The nearest Land, Air, Water Aotearoa (LAWA) monitoring site is located at Greenmount Reserve, which describes the streams water quality in the worst 25% when compared to stream sites across New Zealand (LAWA, 2022). Attribute band E has been assigned for *Escherichia coli* levels, while attribute band D has been assigned for dissolved reactive phosphorus (NPS-FW, 2023).

The streams are hard bottomed with fine-silted sediment deposition. All streams show active erosion and moderate degree of instream hydrologic heterogeneity. Surrounding riparian vegetation consists mainly of native plantings through restorative efforts. The physical stream attributes are presented in Table 5-10 below.

Table 5-10 Physical stream attributes for Burswood Reserve and Guys Reserve streams

Physical stream attributes	Burswood Reserve Stream	Bard Park Reserve Stream	Guys Reserve Stream
Average wetted width (m)	3	3	3.5
Average bankfull channel width (m)*	7.5	7.5	7.5
Average velocity (m^2 S^{-1})	0.23	0.23	0.28
Average depth (m)	1.05	0.23	0.29

5.3.2 Stream Ecological Valuations

Four SEV's were undertaken within the streams at Burswood Reserve, Bard Park Reserve and Guys Reserve and the scores are summarised in

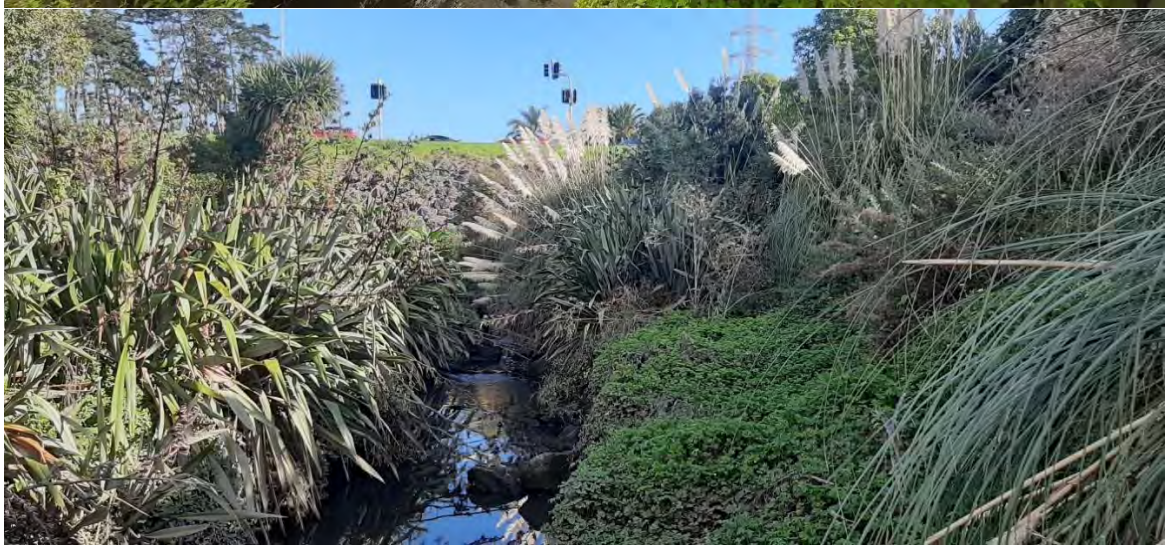


Figure 5-9 A) BR-S1 discharging into main stem of Pakuranga Creek at EB3C B) Downstream of BR-S2, discharging into main stem of Pakuranga Creek at EB3C; C) Downstream of BR-S3, discharging into main stem of Pakuranga Creek at EB3C D) Downstream of GR-S1, discharging into main stem of Pakuranga Creek at EB4L.

Table 5-11 (Refer to Figure 5-8 below for site locations). The full assessment is provided in Appendix 3. The hydraulic, biogeochemical, biodiversity and habitat provisioning functions of the streams assessed have been modified by existing land use and catchment development. SEV scores ranges between 0 and 1 and are used to indicate the ecological function of the sampled stream: Poor (0 - 0.40), Fair (0.41 - 0.60), Good (0.61 - 0.80) and Excellent (>0.8).

The stream at Guys Reserve (GR-S1) has an ecological value of **Moderate** (SEV score; 0.54). This stream section then drains into Bard Park Reserve at site BR-S2, which has also been assigned an ecological value of **Moderate** (SEV score; 0.41). Upstream of BR-S2, site BR-S3 has the highest SEV score of 0.55, however, remains classed as **Moderate**. Site BR-1 at Burswood Reserve (that drains from Greenmount reserve), has the lowest SEV score reflecting **Poor** ecological value (SEV score; 0.35). Figure 5-9 shows a photo of each stream location.

Figure 5-8 Stream Ecological Valuation (SEV) sites within Burswood Reserve, Bark Park Reserve and Guys Reserve

A)

B)

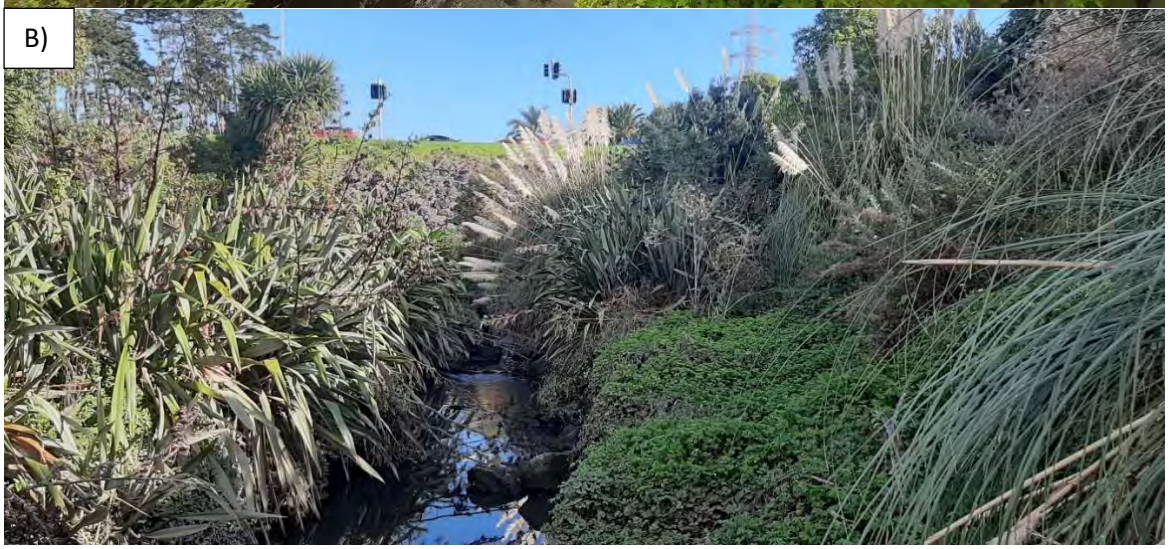


Figure 5-9 A) BR-S1 discharging into main stem of Pakuranga Creek at EB3C B) Downstream of BR-S2, discharging into main stem of Pakuranga Creek at EB3C; C) Downstream of BR-S3, discharging into main stem of Pakuranga Creek at EB3C D) Downstream of GR-S1, discharging into main stem of Pakuranga Creek at EB4L.

Table 5-11 Summary of mean scores for each component included within the SEV assessment, including the overall SEV score for the stream reaches that were surveyed.

Stream function	Stream BR-S1 Burswood Reserve	Stream BR-S2 Bard Park Reserve	Stream BR-S3 Bard Park Reserve	Stream GR-S1 Guys Reserve
Hydraulic	0.59	0.33	0.79	0.48
Biogeochemical	0.30	0.53	0.62	0.69
Habitat provision	0.12	0.49	0.25	0.60
Biodiversity	0.27	0.26	0.32	0.33
SEV Score	**0.353**	**0.410**	**0.552**	**0.538**
Ecological value	**Poor**	**Moderate**	**Moderate**	**Moderate**

5.3.3 Fish species

Fish species records from the New Zealand Freshwater Fish Database (NZFFD) within the connecting Pakuranga Creek and the neighbouring Botany Creek are dominated by 'Not-threatened' native and exotic species of **Low** ecological value. eDNA surveys at each SEV site collected on 30 April 2021 confirmed the presence of 'Not Threatened' native species including banded kokopu (*Galaxias fasciatus),* shortfin eel *(Anguilla dieffenbachia)* and exotic species including mosquitofish (*Gambusia affinis)* and Goldfish (*Carassius auratus)* (Table 5-12). However, there were two 'At Risk declining' species -Īnanga (*Galaxias maculatus*) and longfin eel (*Anguilla dieffenbachia*) detected in the desktop survey within the wider Pakuranga Creek/Stream that have the potential to occur within the tributaries within Burswood Reserve, Bard Park and Guys Reserve. Therefore, for the purposes of this assessment, the permanent tributaries are considered of **Moderate** ecological value for native fish.

Table 5-12 Freshwater fish species (Stoffels, 2022) recorded in local waterbodies

Common name	Scientific name	Threat Status (Dunn et al. 2018)	Stream recorded	Year recorded
Kōkopu/Banded kōkopu#	*Galaxias fasciatus*	Not threatened	Botany Creek	2007
Tīpokopoko/ Common bully	*Gobiomorphus cotidianus*	Not threatened	Pakuranga Creek	1996
Grass carp	*Ctenopharyngodon idella*	Introduced and naturalized	Pakuranga Creek	2008
Īnanga	*Galaxias maculatus*	At Risk - Declining	Pakuranga Creek Pakuranga Stream	2001 2015
Koi carp	*Cyprinus carpio*	Introduced and naturalized	Pakuranga Creek	2007
Goldfish*	*Carassius auratus*	Introduced and naturalized	Burswood Reserve Guys Reserve	2021
Tuna kuwharuwharu /Longfin eel	*Anguilla dieffenbachia*	At Risk - Declining	Pakuranga Creek	2001, 2007
Tuna hinahina /Shortfin eel*	*Anguilla australis*	Not threatened	Pakuranga Creek Botany Creek	1996, 2001, 2007, 2008 2001, 2007
Mosquitofish *	*Gambusia affinis*	Introduced and naturalized	Pakuranga Creek Pakuranga Stream	1996, 2001, 2002, 2007 2015
Unknown eel species	*Anguilla spp.*	-	Pakuranga Creek Pakuranga Stream Botany Creek	1996, 1997, 2001 2015 2001

*eDNA confirmed presence in Pakuranga tributaries within Burswood Reserve, Bard Park Reserve and Guys Reserve

5.3.4 Ecological value of streams

Owing to the presence of two 'At-Risk declining' species and EcIA criteria, the streams within Burswood Reserve, Bard Park and Guys Reserve have been classed as **Moderate** ecological value (Table 5-13).

*Table 5-13 Ecological value of streams present in the Project area and score justification. The value categories applied ranged from **Negligible** (1) to **Very High** (5).*

Ecological Matters	Stream tributary within Burswood Reserve and Bard Park (BR-S1/S2/S3)	
	Score	Justification
Representativeness	2	Instream habitat, riparian features and species have been affected by human activities. Fish assemblage not similar to potential assemblage. Low biodiversity function score with moderate overall SEV score.
Rarity/ distinctiveness	3	Potential for species with At-Risk declining status, SEV score and biogeochemical score between 0.6 and 0.7.
Diversity and pattern	3	Moderate diversity of riparian vegetation and geomorphic structure with habitat provision score between 0.2 and 0.6. Aquatic Community is uniform with generalist species and single guild present.
Ecological context	4	Perennial stream system. Habitat considered locally important habitat in terms of connectivity for species.
Ecological Value	**Moderate**	
The value assigned is **Moderate** value, accounting for their ecological context, modification status and the potential presence of At-risk declining species.		
Ecological Matters	**Stream tributary within Guys Reserve (GR-S1)**	
	Score	Justification
Representativeness	2	Instream habitat, riparian features and species have been affected by human activities. Fish assemblage not similar to potential assemblage. Low biodiversity function score with moderate overall SEV score.
Rarity/ distinctiveness	3	Potential for species with At-Risk declining status, SEV score and biogeochemical score between 0.6 and 0.7.
Diversity and pattern	3	Moderate diversity of riparian vegetation and geomorphic structure with habitat provision score is 0.6. Aquatic Community is uniform with generalist species and single guild present.
Ecological context	4	Perennial stream system. Habitat considered locally important habitat in terms of connectivity for species.
Ecological Value	**Moderate**	
The value assigned is **Moderate** value, accounting for their ecological context, modification status and the potential presence of At-risk declining species.		

5.4 Summary of Ecological Value

The ecological value of ecological features present within EB3C and EB4L is summarised below in Table 5-14.

Table 5-14 Summary of the ecological value of features present within EB3C and EB4L.

Ecological Feature	Ecological Value
Terrestrial habitat	
TL.1 – Native dominated treeland	Moderate
TL.2 – Mixed native and exotic vegetation	Moderate
TL. 3 – Exotic-dominated treeland	Low
PL.1 – Planted vegetation	Moderate
ES – Exotic Scrub	Low
EG – Exotic grassland includes mown and rank grasses	Low
Fauna	
Native forest birds	Low
Native herpetofauna	High
Wetland habitat	
BR-W1	Low
BR-W2	High
BR-W3	Moderate
BR-W4	Moderate
BR-W5	Moderate
BR-W6	Moderate
BR-W7	Low
BR-W8	High
BR-W9	Low
BR-W10	High
BR-W11	Low
GR-W1	Low
GR-W2	Low
Freshwater	
Permanent stream at Burswood Reserve (BR-S1)	Moderate
Permanent stream at Bard Park Reserve (BR-S2/S3)	Moderate
Permanent stream at Guys Reserve (GR-S1)	Moderate

6.0 Assessment of Ecological Effects

Chapter Summary

This chapter summarises the potential effects of the construction and operational phases of EB3C and EB4L prior to mitigation.

*Construction of EB3C and EB4L has impacts on fish, lizards (and their habitat) and birds where the level of effect is **Moderate** or higher, as such measures to mitigate these effects and offset any residual effects is required. Other construction effects on ecological features are considered to be **Very low** to **Low**.*

*Operational effects of EB3C and EB4L on terrestrial, stream and wetland ecological values are considered to be **Very low** to **Low** based on embedded controls.*

6.1 EB3C Stormwater Effects – Streams and Wetlands

The following sections provide further detail on wetland and stream effects from the construction and operation of the stormwater outfalls related to EB3C.

6.1.1 EB3C Wetlands and Stormwater Outfalls

Four outfalls located within Burswood Reserve and Bard Park Reserve require connecting pipe upgrades or upgrade/modification to the outfall structure that are within 100 m of wetland habitat.

6.1.1.1 Stormwater outfall MCC_108481 and Wetland BR-W4

The connecting pipe to stormwater outfall MCC_108481 will require upgrading to ensure stormwater infrastructure maintains new flow capacities modelled for the Project. Construction works to connect the pipe (laying parallel to the Burswood reserve board walk) to the existing manhole (manhole MCC_71866) will be required. However, the section of pipe that discharges into the wetland will remain in place and operational. Construction works (earthworks and vegetation clearance) will occur within 10 m of a natural inland wetland (BR-W4) (Figure 6-1). This will require resource consent under Regulation 45 (1), (2) of the NES-FW as a Discretionary Activity. No wetland vegetation or wetland habitat will be removed as part of the proposed MCC_108481 pipe upgrade.

The wetland is currently hydrologically maintained by both natural fluctuations of the Pakuranga tributary within Burswood Reserve and the existing discharges occurring from the current stormwater network.

The existing pipe to the outfall does not change size and remains a 1050 mm diameter pipe. The stormwater network will have an increase in impervious surface area as a result of the busway. Stormwater will be collected and conveyed to the stream and wetland more efficiently (i.e. higher discharge flows from the outfall). However, the catchment area upstream of the stream and wetland is in the over 100 ha category on GEOMAPs GIS and the increased flow from the busway is unlikely to be measurable when compared to the stream flows from GEOMAPS of 24 m^3/s during a 2-year rainfall event, 52 m^3/s during a 10-year event and 91 m^3/s during a 100-year event. The hydrological regime would therefore not be changed. The catchment of the stream and wetland is very large (greater than 100 ha) and the project will not have measurable increase flood flows. Existing base flows will not be impacted by the project given the small amount of busway compared to the catchment size. Therefore, the discharge of stormwater within 100 m of this wetland does not trigger consent under regulation 45 (5) of the NES-FW.

The construction and operational ecological effects associated with the upgrade of the pipe to the existing manhole (manhole MCC_108481) and wetland BR-W4 are detailed in Section 6.5.1 and 6.6.1.

6.1.1.2 Stormwater outfall MCC_108482 and Wetlands BR-W1, BR-W2 and BR-W3

The existing stormwater outfall (MCC_108482) will require upgrading to accommodate the existing and new networks (pipeline 43). The outfall is located within steep terrain within rock substrate of the riparian zone of the Pakuranga tributary within Burswood Reserve. The outfall will continue to discharge within 100 m of wetlands BR-W1, BR-W2 and BR-W3 (Figure 6-2).

These wetlands are hydrologically maintained by natural fluctuations of the Pakuranga tributary within Burswood Reserve and existing discharges from stormwater infrastructure.

The existing network pipe size is upgraded from 300 mm to 525 mm. The stormwater network will have an increase in impervious surface area as a result of the busway. Stormwater will be collected and conveyed to the stream and wetland more efficiently (i.e. higher discharge flows from the outfall). However, there is a very large outlet culvert immediately adjacent to the outfall and the catchment area upstream of the stream and wetland is in the over 100 ha category on GEPMAPs GIS. Increased flow from the busway is unlikely to be measurable when compared to the stream flows from GEOMAPS of 11 m^3/s during a 2-year rainfall event, 26 m^3/s during a 10-year event and 45 m^3/s during a 100-year event. The hydrological regime would therefore not be changed. The catchment of the stream and wetland is very large (greater than 100 ha) and the project will not measurably increase flows. Existing base flows will not be impacted by the project given the small amount of busway compared to the catchment size. Therefore, the discharge of stormwater within 100 m of this wetland is not subject to regulation 45 (5) of the NES-FW. No earthworks or vegetation clearance will occur within 10 m of these wetlands.
The construction and operational ecological effects associated with the upgrade of the existing outfall (MCC_108482) and wetlands BR-W1, BR-W2 and BR-W3 are detailed in Section 6.5.1 and 6.6.1.

6.1.1.3 Stormwater outfall MCC_496129 and Wetland BR-W7 and BR-W9

The existing stormwater outfall (MCC_496129) will require relocation due to the EB3C cycle path alignment resulting in the construction of a new outfall (refer to the Stormwater Report for further information). The proposed outfall is located within the riparian zone of the Pakuranga Tributary within Bard Park Reserve and will discharge within 100 m of wetland BR-W7 and BR-W9 (Figure 6-3).

These wetlands are hydrologically maintained by natural fluctuations of the Pakuranga tributary within Bard Park Reserve and the existing discharges from stormwater infrastructure.

The existing network pipe size remains a 300 mm pipe and will have a decreased flow as the road carriageway is diverted to outfall MCC_988531. The wetland is downstream of the outfall discharge, and it has an upstream catchment area in the over 100 ha category on GEPMAPs GIS. Decreased flow from the outfall, as a result of, the road catchment diversion is unlikely to be measurable when compared to the stream flows from GEOMAPS of 15 m^3/s during a 2-year rainfall event, 32 m^3/s during a 10-year event and 54 m^3/s during a 100-year event. The hydrological regime would therefore not be changed. The catchment of the stream and wetland is very large (greater than 100 ha) and the project will not measurably decrease flows. Existing base flows will not be impacted by the project given the small amount of busway compared to the catchment size. Therefore, the discharge of stormwater within 100 m of this wetland does not trigger consents under regulation 45 (5) of the NES-FW.

The construction and operational ecological effects associated with the outfall relocation (MCC_496129) and wetland BR-W7 and BR-W9 are detailed in Section 6.5.1 and 6.6.1.

6.1.1.4 Stormwater outfall MCC_988531 and Wetland BR-W7

The existing stormwater outfall (MCC_988531) will require upgrading. A new pipeline will be constructed to the upgraded outfall to accommodate the new network (pipeline 47). The proposed outfall is located within the riparian zone of the Pakuranga Tributary within Bard Park Reserve and will discharge downstream within 100 m of wetland BR-W8 and within 100 m upstream of BR-W7 (Figure 6-3).

The wetlands are hydrologically maintained by natural fluctuations of the Pakuranga Tributary within Bard Park Reserve and the existing discharges from stormwater infrastructure.

The existing network pipe size is upgraded from 525 mm to 600 mm. The stormwater network will have an increase in impervious surface area, as a result of the busway. Stormwater will be collected and conveyed to the stream and wetland more efficiently (i.e. higher discharge flows from the outfall). However, the catchment area upstream of the stream and wetland is in the over 100 ha category on GEPMAPs GIS. Increased flow from the busway is unlikely to be measurable when compared to the stream flows from GEOMAPS of 15 m^3/s during a 2-year rainfall event, 32 m^3/s during a 10-year event and 54 m^3/s during a 100-year event. The hydrological regime would therefore not be changed. The catchment of the stream and wetland is very large (greater than 100 ha) and the project will not measurably decrease flows. Existing base flows will not be impacted by the project given the small amount of busway compared to the catchment size. Therefore, the discharge of stormwater within 100 m of these wetlands is not subject to regulation 45 (5) of the NES-FW.

The construction and operational ecological effects associated with the upgrade of the pipe for MCC_988531 and wetland BR-W7 and BR-W8 are detailed in Section 6.5.1 and 6.6.1.

6.1.2 EB3C Streams and Stormwater Outfalls

Three of the proposed outfalls (MCC_108482, MCC_496129 and MCC_988531) require works located on the stream bank and/or stream bed. There is no proposed extension of the outfall pipes or concrete structures (or impermeable surfaces) into the stream bed[7]. However, erosion protection consisting of permeable rock riprap will extend marginally into the 'stream bed' at MCC_108482 and MCC_988531 (Riprap lengths are provided in Table 6-1). Note 1 of the AUP(OP) states that "Reclamation consents are not required when installing erosion protection structure." The construction effects from the installation of the rock rip rap on the stream are provided in Section 6.5.

The works required for MCC_108481 to upgrade the pipe will be located outside of the stream bed (applying the definitions of "river" and "bed" under s2 of the RMA) but within the wider riparian zone. The construction effects from the installation of the rock riprap on the stream are provided in Section 6.5.

The upgrade/modification of the pipe associated with outfall MCC_108481 and outfall MCC_496129 within Burswood Reserve and Bard Park Reserve are considered as a Permitted Activity under Rule E3.4.1 (A39) of the AUP because the works will comply with Standard E3.6.1.14. Outfalls MCC_108482 and MCC_988531 are considered Discretionary Activities as the length of scour protection exceeds 5m (Standard E3.6.1.14 1(b)).

The approximate area of riparian extent temporarily removed for construction are provided below in Table 6-1. Estimates of temporary riparian loss are based on the construction footprint derived from the EB3C construction Methodology Report.

[7] The RMA defines the bed of a river/stream as "the space of land which the water of the river cover at it's fullest flow without overtopping it's banks." We have estimated this as the bankful width of the stream.

Table 6-1 Length of permanent scour protection within the stream bed and riparian extent temporarily removed for stormwater construction.

Outfall Feature	Approximate permanent loss of riparian extent (m^2)*	Approximate temporary loss of riparian extent (m^2)**	Length of permanent permeable scour protection within the stream bed[8]	Bed disturbance upstream or downstream of the structure exceeds 10m either side	Complies with standard E.3.6.1.14
MCC_108481	N/A	75 m^2	N/A	N/A	Yes - Permitted
MCC_108482	25 m^2	75 m^2	7.5 m	Approximately 3 m	No – Discretionary +
MCC_496129	25 m^2	75 m^2	Not located within stream bed.	Approximately 2 m	Yes - Permitted
MCC_988531	25 m^2	75m^2	8.5 m	Approximately 1 m	No – Discretionary +
Cumulative total	**75 m^2**	**300 m^2**	**16 m**	**6 m**	

**Calculated from proposed construction footprint.

+Standards E3.6.1.14 1(b) any required erosion or scour management works must not exceed 5 m in length either side of extended structure.

6.1.2.1 Stream Ecological Value – Impact (SEVi)

A Stream Ecological Valuation at impact (SEVi) was modelled to assess any anticipated loss of value and function of the stream associated with permanent permeable scour protection, as per the requirements of the NES-FW and AUP(OP) Chapter E3 policies.

The anticipated Stream Ecological Valuation at Current (SEVc) and Impact (SEVi) are summarised below (the full stream ecological valuation at impact is provided in Appendix 3). Using conservative estimates, the SEVi at stream BR-S1 at Burswood Reserve (Outfall MCC_ 108482) will result in an anticipated -0.01 change in hydraulic and biodiversity functional attributes, leading to no change in the overall value of the stream. The SEVi at BR-S2 at Bard Park Reserve (MCC_988531) will result in an anticipated -0.01 change in biodiversity function, leading to no change to the overall value of the stream (Table 6-2). No works are expected to result In the loss or reclamation of stream or prevent the passage of fish upstream or downstream. Section 6.5.1 details the effects assessment.

[8] Stream bed is defined to be any habitat within the bankfull width of the stream (as per the RMA definition). See Table 5-8 for average physical stream attributes.

Table 6-2 Summary of mean scores for each component included within the SEVc and SEVi assessment, including the overall SEV score for the stream reach. Conservative estimates have been applied to SEVi.

	SEVc	**SEVi** **Scour protection associated with Outfall MCC_ 108482**	**SEVc**	**SEVi** **Scour protection associated with Outfall MCC_988531**
Stream function	Stream BR-S1 Burswood Reserve	Stream BR-S1 Burswood Reserve	Stream BR-S2 Bard Park Reserve	Stream BR-S2 Bard Park Reserve
Hydraulic	0.59	0.58	0.33	0.33
Biogeochemical	0.30	0.30	0.53	0.53
Habitat provision	0.12	0.12	0.49	0.49
Biodiversity	0.27	0.26	0.26	0.25
SEV Score	**0.353**	**0.348**	**0.410**	**0.408**
Ecological value	**Poor**	**Poor**	**Moderate**	**Moderate**

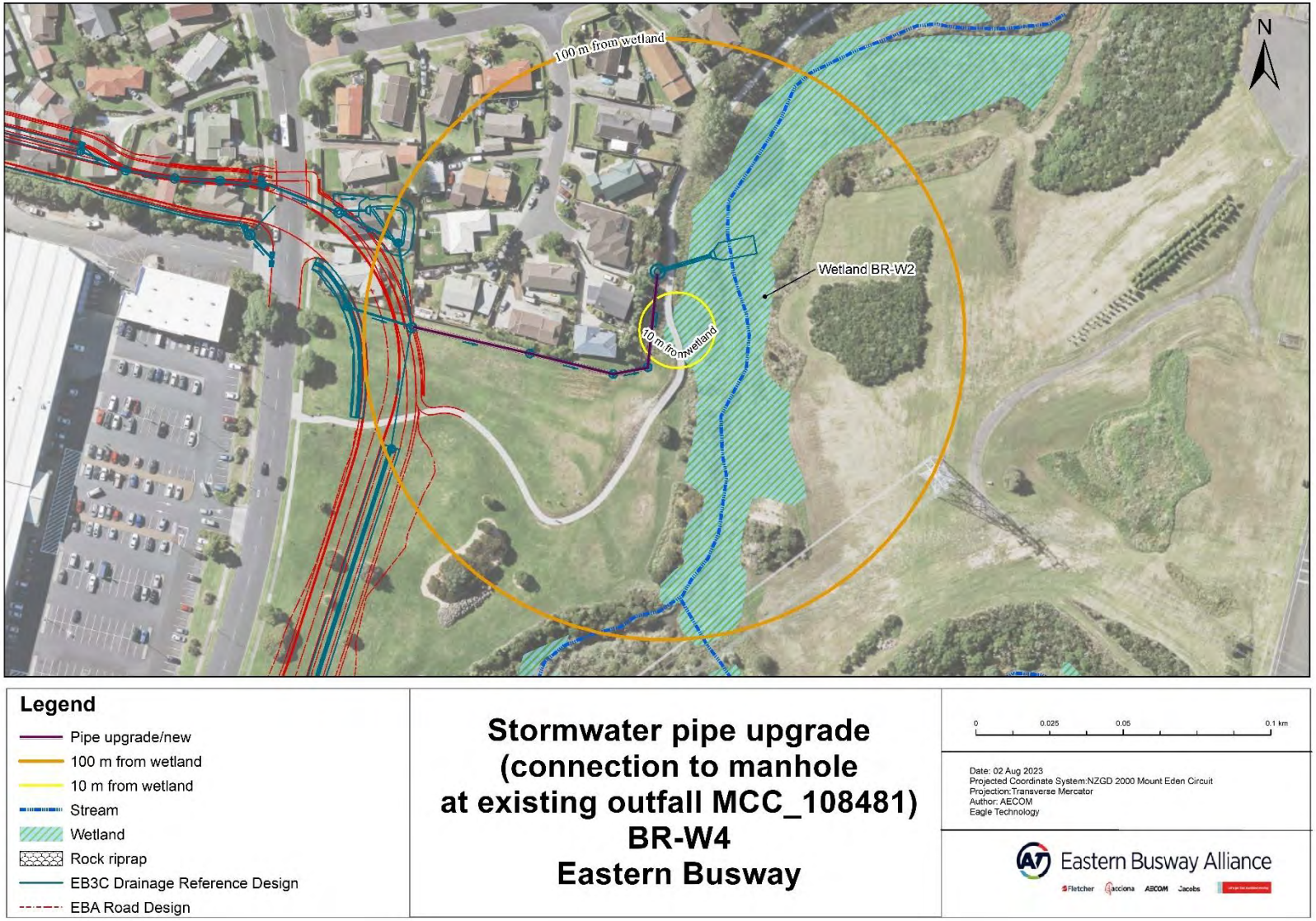


Figure 6-1 Stormwater outfall upgrade MCC_108481 and 10m and 100m locality to wetland habitat within Burswood Reserve. The MCC_108481 pipe upgrade is shown in purple.

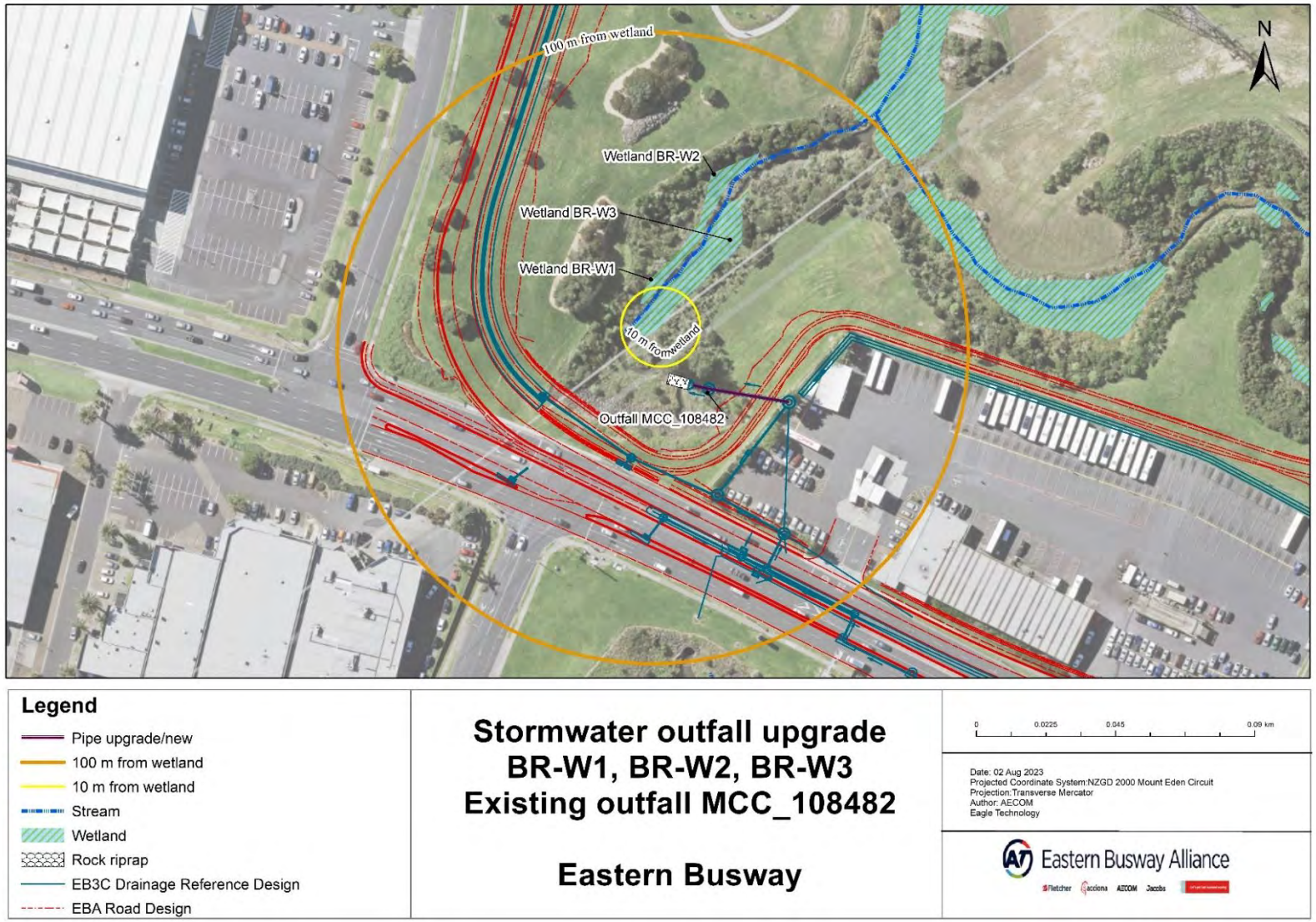


Figure 6-2 Stormwater outfall upgrade MCC_108482 and 10m and 100m locality to wetland habitat within Burswood Reserve

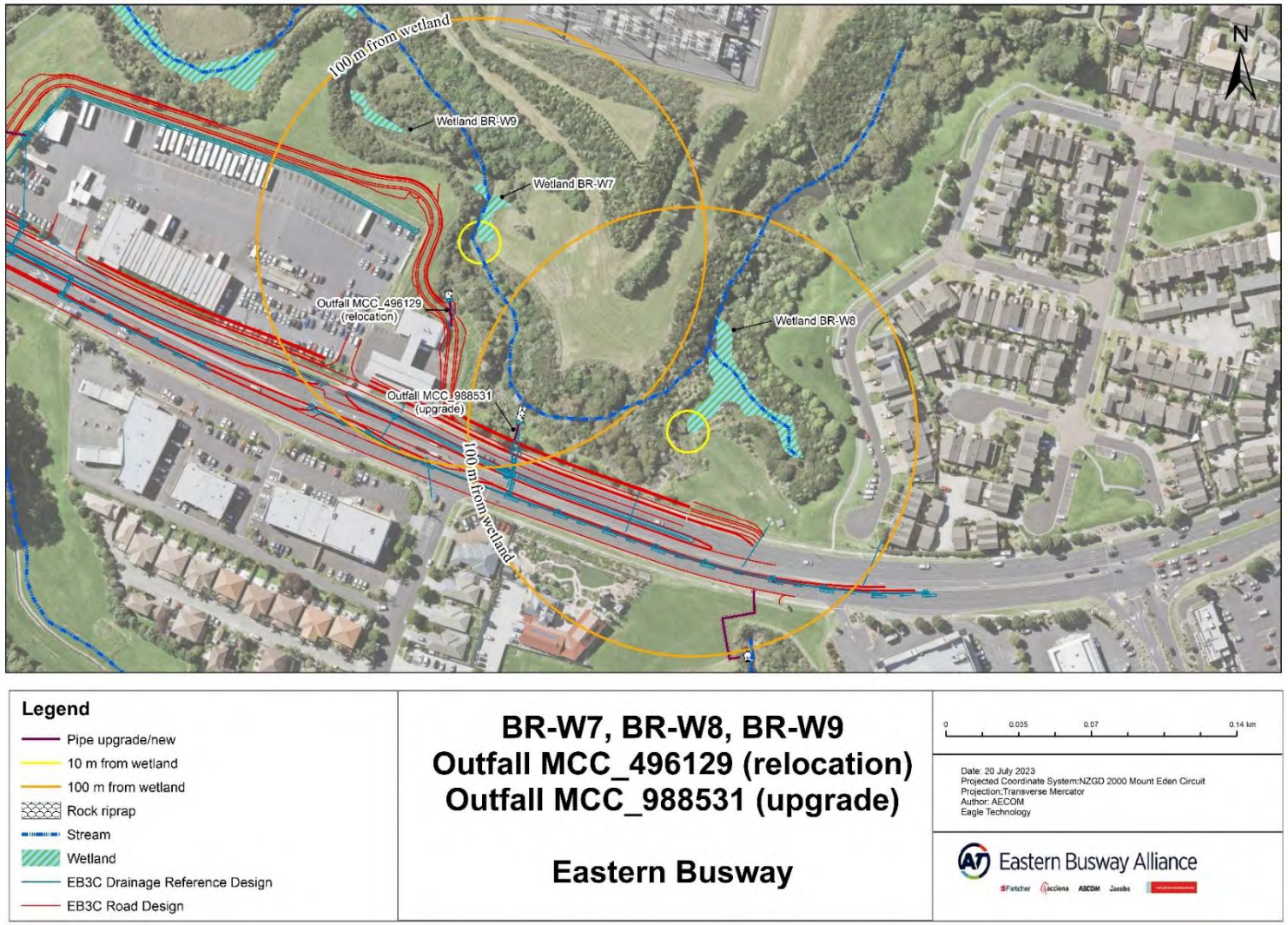


Figure 6-3 Stormwater outfall relocation (MCC_496129) and upgrade (MCC_988531) and 10m and 100m locality to wetland habitat within Burswood Reserve

6.2 EB4L Stormwater Effects – Streams and Wetlands

6.2.1 EB4L Wetlands and Stormwater Outfalls

A single outfall located within Guys Reserve is proposed and is within 10 m of wetland habitat.

6.2.1.1 Stormwater outfall 1-1 and Wetlands GR-W1 and GR-W2

A new stormwater outfall 1-1 is proposed within EB4L to ensure stormwater infrastructure maintains new flow capacities modelled for the Project. The proposed outfall is located within the riparian zone of the Pakuranga Tributary within Guys Reserve and will discharge downstream of wetlands GR-W1 and GR-W2. However, construction works (earthworks and vegetation clearance) will occur within 10 m of a natural inland wetland (GR-W2) (Figure 6-4). This will require resource consent under Regulation 45 (1), (2) of the NES-FW as a Discretionary Activity. No wetland vegetation or wetland habitat will be removed for the proposed outfall.

The wetland is hydrologically maintained by both natural fluctuations of the Pakuranga tributary within Guys Reserve and the existing discharges occurring from the current stormwater network. The outfall is located downstream of the wetland and the construction and operation of the outfall will not change the water level range or hydrological function of this wetland. Therefore, the discharge of stormwater within 100 m of this wetland is not subject to regulation 45 (5) of the NES-FW.

The construction and operational ecological effects associated with outfall 1-1 and wetland GR-W1 are detailed in Section 6.3 and Section 6.5.

6.2.2 EB4L Streams and Stormwater Outfalls

6.2.2.1 Outfall 1-1

The proposed outfall 1-1 and connecting pipeline nearby Tī Rākau Drive will require works located on the stream bank and/or stream bed and require streamworks consent. There is no proposed extension of the outfall pipe or concrete structure (or impermeable surfaces) into the stream bed[9]. However, erosion protection consisting of permeable rock riprap will extend into the 'stream bed' by approximately 4.1 m (Riprap length is provided in Table 6-3). Note 1 of the AUP(OP) states that "Reclamation consents are not required when installing erosion protection structure." The construction effects from the installation of the rock rip rap on the stream are provided in Section 6.5. The proposed outfall within Guys Reserve is considered a Permitted Activity under Rule E3.4.1 (A39) of the AUP because the works will comply with Standard E3.6.1.14.

6.2.2.2 New pipeline 37-3

The proposed new pipeline 37-3 will not involve any works within the pond or the riparian margin within Whaka Maumahara Reserve. Figure 6-5 below shows the location of the new pipeline 37-3 in relation to the Whaka Maumahara Reserve pond. The setback distance is approximately 18.6 m from Whaka Maumahara Reserve Pond and the construction of the new pipeline will not result in any additional vegetation loss beyond what has already been accounted for in the calculations of permanent vegetation loss associated with the alignment for EB4L[10] (Figure 6-5; Table 6-3).

[9] The RMA defines the bed of a river/stream as "the space of land which the water of the river cover at it's fullest flow without overtopping it's banks." We have estimated this as the bankful width of the stream.

[10] Vegetation loss already accounted for as permanent loss to construct EB4L main alignment

Table 6-3 Length of permanent scour protection within stream bed and riparian extent temporarily removed for construction of EB4L outfall 1-1 and the appropriate temporary loss of vegetation for the construction of the new pipeline 37-3.

Outfall Feature	Approximate permanent loss of vegetation (m^2)*	Approximate temporary loss of vegetation (m^2)**	Length of permanent permeable scour protection within the stream bed[11]	Bed disturbance upstream or downstream of the structure exceeds 10m either side	Complies with standard E.3.6.1.14
Outfall 1-1	25 m^2	75 m^2	4.1 m	Approximately 2 m	Yes–- Permitted
New Pipeline 37-3	n/a	n/a	n/a	n/a	n/a
Cumulative total	**25 m^2**	**75 m^2**	**4.1 m**	**2 m**	

**Calculated from proposed construction footprint.

[11] Stream bed is defined to be any habitat within the bankfull width of the stream (as per the RMA definition). See Table 5-8 for average physical stream attributes.

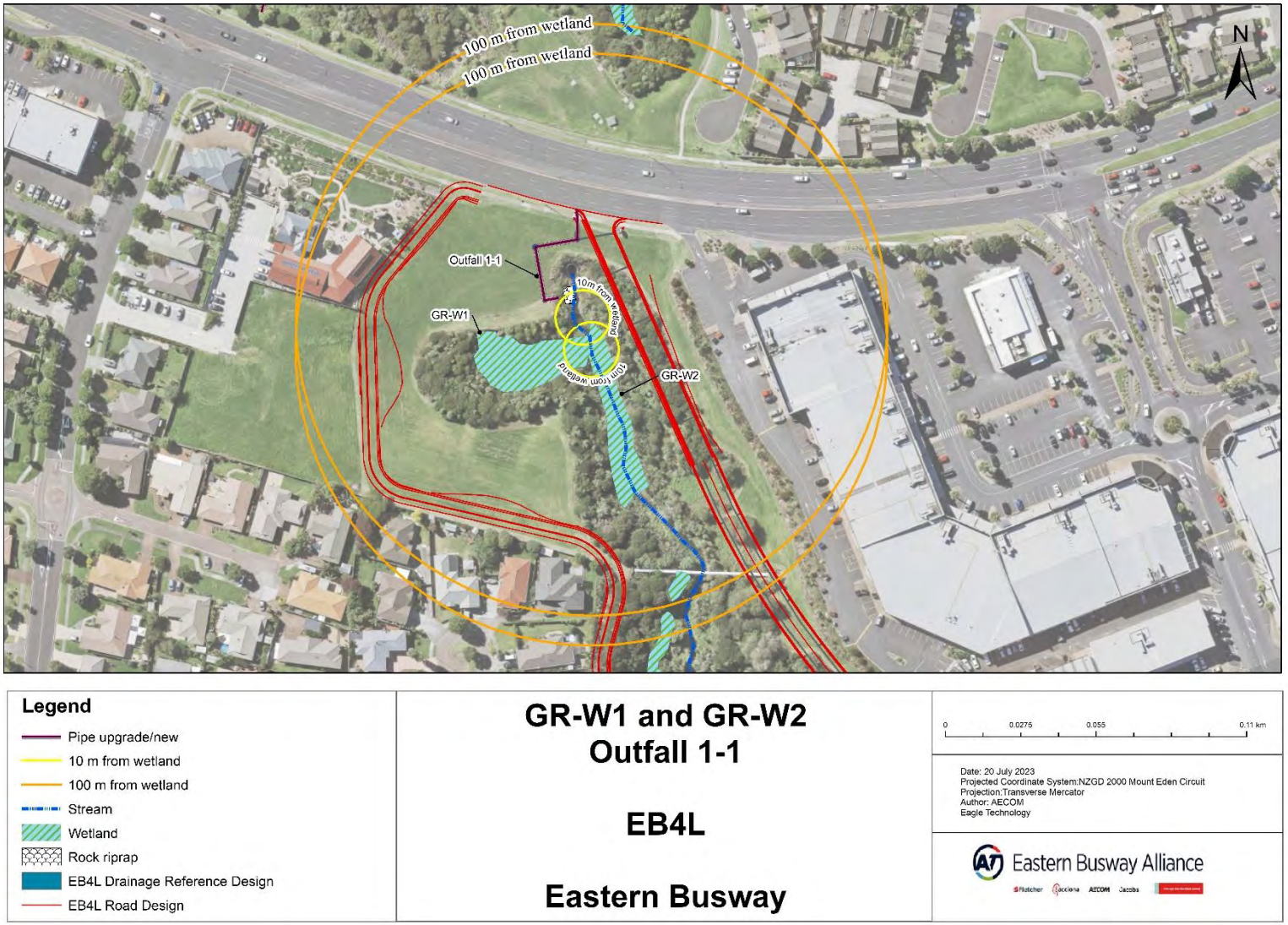


Figure 6-4 Proposed stormwater outfall 1-1 and 10m and 100m locality to wetland habitat (GR-W1 and GR-W2) within Guys Reserve

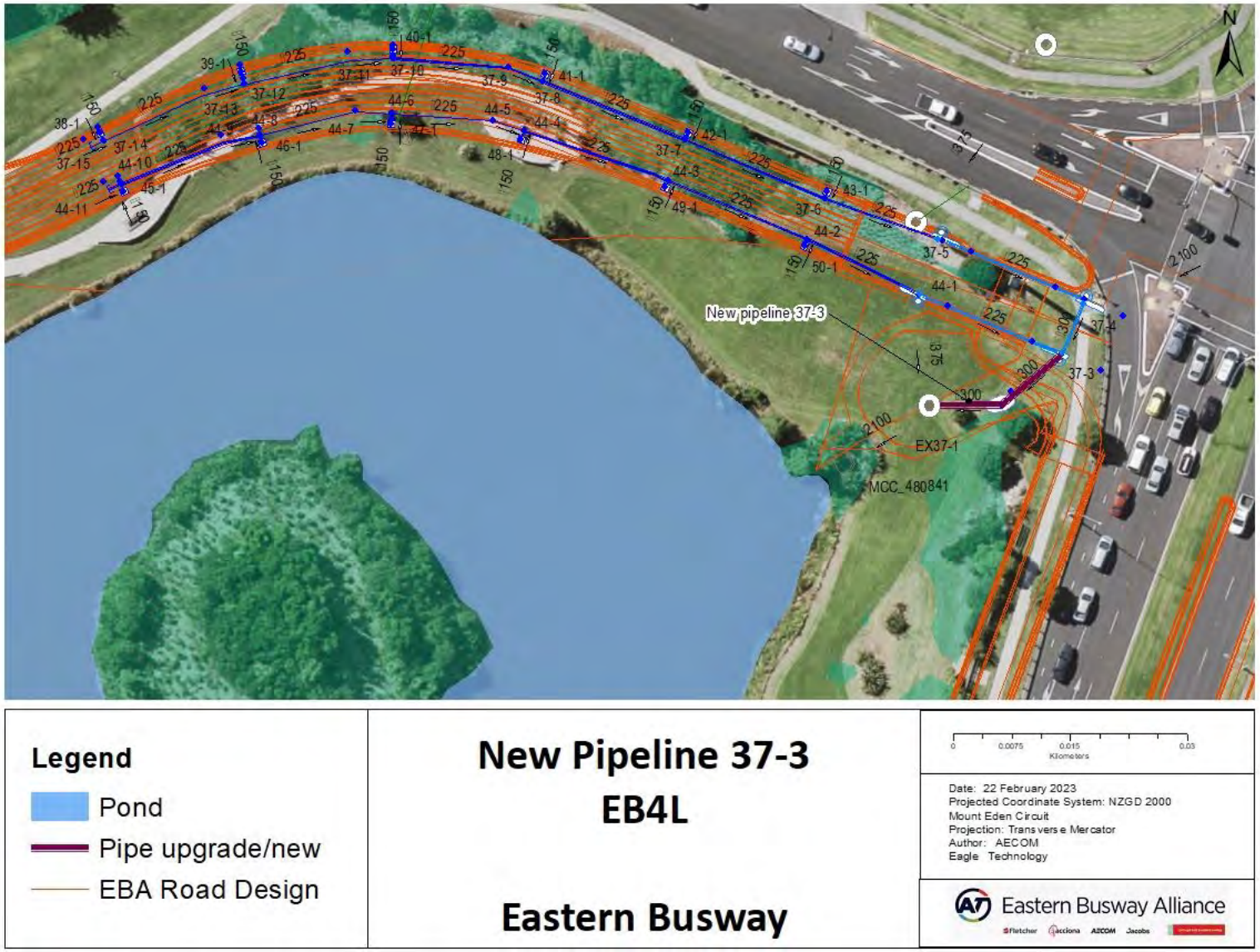


Figure 6-5 Proposed new pipeline 37-3 situated in locality to Whaka Maumahara Reserve Pond.

6.3 EB3C and EB4L Construction footprint – Temporarily Occupied Areas

For the purpose of this ecological effects assessment, it has been assumed that all vegetation that is located within the wider construction footprint but outside of the EB3C and EB4L alignment will be temporarily lost. This includes temporary vegetation loss from occupation areas, laydown areas, compounds, access tracks and around outfalls to allow for construction (Refer to Section 6.1.2 and 6.2.2 for vegetation loss around outfalls). The construction footprint is referred to as the 'construction land requirement' and is based conservatively on the land take requirement around properties boundaries (refer to EB3C and EB4L Designation Plans).

The purpose of this section is to detail any temporary vegetation loss relating to the construction footprint from temporary occupational areas for construction. Refer to Section 2.1 and 2.2 for laydown areas and the EB3C and EB4L Construction Methodology report for details on temporarily occupied areas. Vegetation within these areas consists mainly of exotic, mixed native exotic and planted vegetation. All temporary vegetation will be replaced with native vegetation at a ratio of 1:1, which will be detailed in the Landscape, Ecological and Arboricultural Mitigation plans (Appendix 9 of Landscape Report).

6.3.1 Temporary vegetation loss – EB3C construction footprint

The temporary vegetation loss, including bridgeworks and the cycleway within Burswood Reserve, within the construction footprint of EB3C is detailed below in Table 6-4. This excludes stormwater outfalls which is detailed in Table 3-1.

Table 6-4 Total temporary vegetation loss within the construction footprint including the bridgeworks and cycleway

Location	Approximate temporary vegetation loss (m^2)
EB3C Alignment (includes bridge works and cycleway within Burswood Reserve)	3,910 m^2

6.3.1.1 Wetland BR-W3 and cumulative vegetation loss

Although efforts to avoid and reduce the impact area have been made, construction of the EB3C cycleway will require the clearance of vegetation and earthworks within the riparian margin of Burswood Reserve that is within 10 m of a natural inland wetland (wetland BR-W3) (Refer to Figure 6-6 below). For the purposes of this effects assessment, the cumulative effects of the vegetation loss within 10m of a natural wetland has been considered and includes the temporary vegetation loss from the construction of the cycleway and the vegetation loss (permanent and temporary) from construction of outfall MCC_10848.

Approximately 595 m^2 of mixed native and exotic vegetation within the riparian margin of Burswood Reserve will be either temporarily or permanently lost within 10 m of natural inland wetland BR-W3. Table 6-5 sets out the permanent vegetation loss and temporary vegetation loss. This will require resource consent under Regulation 45 (1), (2) of the NES-FW as a Discretionary Activity. No vegetation will be removed from within the natural inland wetland BR-W3 feature.

Table 6-5 Approximate extent of temporary and permanent vegetation loss for the construction of the cycleway and outfall MCC_108482 at BR-W3

Location	Approximate vegetation loss (m^2)
Burswood Reserve temporary vegetation loss associated with wetland BR-W3 – construction of the cycleway	495 m^2
MCC_108482 - Permanent vegetation loss	25 m^2
MCC_108482 – Temporary vegetation loss	75 m^2
Cumulative total within 10 m of natural wetland BR-W3	**595 m^2**

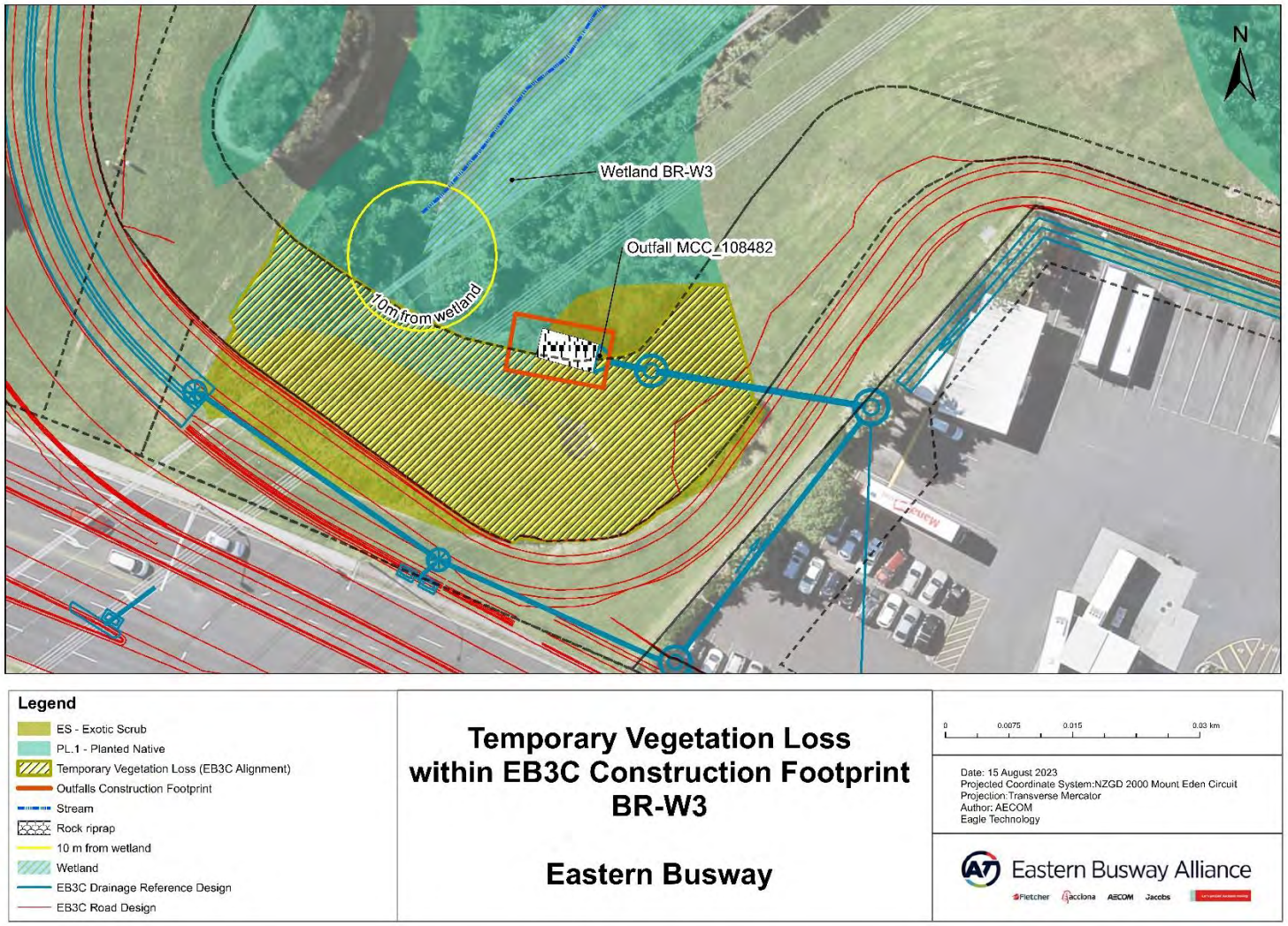


Figure 6-6 Area of temporary vegetation loss required for the cycleway and outfall MCC_108482 (orange box). Cumulative total includes the temporary vegetation loss arising from the construction of the cycleway and the temporary and permanent vegetation loss to construct outfall MCC_108482.

6.3.2 Temporary vegetation loss – EB4L construction footprint

The temporary vegetation loss within the construction footprint of EB4L is detailed below in Table 6-6. This includes the bridgeworks within Guys Reserve and the Te Irirangi Drive/ Town Centre Drive Intersection. This excludes stormwater outfalls which is detailed in Table 3-2.

Table 6-6 Approximate extent of temporary vegetation loss within the construction footprint from temporarily occupied areas

Location	Approximate temporary vegetation clearance (m^2)
EB4L Alignment (includes bridgeworks within Guys Reserve and Te Irirangi Drive/Town Centre Drive Intersection)	3,478 m^2

No temporary vegetation clearance associated with the construction of EB4L alignment and Te Irirangi/ Town Centre Drive Intersection is proposed within 10 m of a natural inland wetland.

6.4 Summary of Vegetation Loss

6.4.1 EB3C Total Vegetation Loss

The total extent of permanent and temporary vegetation loss from EB3C is provided in Table 6-7 below. Permanent loss includes all exotic, mixed native and exotic, and planted vegetation loss under the EB3C alignment and around stormwater outfalls. Temporary loss includes exotic, mixed native and exotic, and planted vegetation within the EB3C construction footprint (including stormwater outfalls).

Table 6-7 Cumulative permanent and temporary vegetation loss EB3C

Cumulative Vegetation Loss	Approximate vegetation loss (ha)
Permanent ES. Exotic scrub	0.193
Permanent PL.1 Planted vegetation	0.124
Permanent PL.3	0.021
Permanent TL.1	0.024
Permanent TL.3	0.010
Total permanent vegetation loss	**0.372 ha**
Total temporary vegetation loss*	**0.421 ha**

*Includes all temporary vegetation loss from EB3C laydown areas, bridge structures and stormwater infrastructure (Refer to Section 3.2.1).

6.4.2 EB4L Total Vegetation Loss

The total extent of permanent and temporary vegetation loss from EB4L is provided in Table 6-8 below. Permanent loss includes all mixed native and exotic tree land and planted vegetation loss under the EB4L alignment and the stormwater outfall. Temporary loss includes all mixed native and exotic, and planted vegetation within the EB4L construction land requirement and around stormwater outfalls.

Table 6-8 Cumulative permanent and temporary vegetation loss EB4L

Cumulative Vegetation Loss	Approximate vegetation loss (ha)
Permanent PL.1 Planted vegetation	0.521 ha
Permanent TL.2 Mixed native and exotic tree land	0.031 ha
Total permanent vegetation loss	**0.552 ha**
Total temporary vegetation loss*	**0.355 ha**

*Includes all temporary vegetation loss from EB4L laydown areas, bridge structures and stormwater infrastructure (Refer to Section 3.2.1).

6.5 Construction Effects

6.5.1 Eastern Busway 3C

The proposed construction activities associated with EB3C have the potential to impact on ecological features within and adjacent to the Project area, unless appropriate mitigation is implemented. A project description is provided in Section 2.0, with specific project elements that are relevant to the assessment of ecological effects provided in Section 3.2, 6.1, 6.3.1 and 6.4.1.

6.5.1.1 Assessment of ecological effects EB3C – Terrestrial, wetland and freshwater features

The following tables presents the assessment of effects on **terrestrial, wetland** and **freshwater** features from the construction of EB3C (Table 6-9).

Table 6-9 Magnitude of effects and subsequent level of effects (without mitigation) from the Project construction activities upon ecological features present within the EB3C Project area.

Effect No.	Ecological Feature	Ecological value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of effect Without Mitigation
Terrestrial Vegetation						
1a. Direct	Loss of vegetation including: PL.1 Planted vegetation (0.152 ha) TL.2 Mixed native and exotic treeland (0.022 ha) ES. Exotic scrub (0.053 ha) Temporary vegetation loss (0.421 ha)	Moderate – Low	Permanent and temporary loss of habitat/ecosystem fragmentation and edge effects due to vegetation removal.	Low	Although permanent loss of vegetation (0.227 ha in total) will occur, remaining ecosystems will be similar to pre-development circumstances given the vegetation types being removed and the quantity of those remaining vegetation types within the wider landscape. Temporary loss of vegetation around stormwater outfalls and within temporarily occupied areas for construction will be replaced at a ratio of 1:1*.	Low – Very low
Terrestrial - Avifauna and Lizards						
2a. Direct	Native birds utilising habitat provided by: PL.1 Planted vegetation (0.152 ha) TL.2 Mixed native and exotic treeland (0.022 ha) ES. Exotic scrub (0.053 ha) Temporary vegetation loss (0.421 ha)	Low	Permanent and temporary loss of bird habitat (foraging and breeding) through vegetation removal.	Low	The majority of the birds recorded within the vicinity of EB3C are Exotic and 'Not Threatened' native species. Species are urban adapted. Loss of terrestrial vegetation may result in temporary disruption only to foraging and dispersal behaviour of resident bird populations during construction. Due to the available habitat in the areas adjacent to the Project footprint and the small area of canopy vegetation to be removed, it is likely that the underlying character, composition and attributes of the terrestrial habitat will be maintained. Temporary loss of vegetation will be replaced at a ratio of 1:1*.	Very low

Effect No.	Ecological Feature	Ecological value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of effect Without Mitigation
3a. Direct	Native birds utilising habitat provided by: PL.1 Planted vegetation (0.152 ha) TL.2 Mixed native and exotic treeland (0.022 ha) ES. Exotic scrub (0.053 ha) Temporary vegetation loss (0.421 ha)	Low	Fragmentation of bird habitat and loss of connectivity.	Low	Due to the available habitat in the areas adjacent to the Project footprint and the small area of canopy vegetation to be removed, it is likely that the underlying character, composition and attributes of terrestrial habitat will be maintained. Temporary loss of vegetation will be replaced at a ratio of 1:1*.	Very low
4a. Direct	Native lizards assumed to be utilising habitat provided by: PL.1 Planted vegetation (0.152 ha) TL.2 Mixed native and exotic treeland (0.022 ha) ES. Exotic scrub (0.053 ha)	High	Permanent loss of lizard foraging and breeding habitat through vegetation removal.	Moderate	Construction will result in the permanent loss of favourable lizard habitat (0.327 ha). Removal of habitat will permanently reduce foraging and breeding habitat for “At Risk-Declining” lizards that are assumed to be present in the Project area. The permanent loss of habitat is likely to reduce overall resources available to the local population. There will be temporary loss of lizard habitat that will be replaced at a ratio of 1:1*.	High

Effect No.	Ecological Feature	Ecological value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of effect Without Mitigation
5a. Direct	Native Lizards assumed to be utilising habitat provided by: PL.1 Planted vegetation (0.152 ha) TL.2 Mixed native and exotic treeland (0.022 ha) ES. Exotic scrub (0.053 ha) Temporary vegetation loss (0.421 ha)	High	Fragmentation of lizard habitat and loss of connectivity.	Low	Habitat fragmentation effects are unlikely to deviate from baseline conditions and habitat will remain along the southern riparian zones along the Tī Rākau Drive and adjacent reserves. All temporary loss of vegetation will be replaced at a ratio of 1:1*.	Low
6a. Direct	Native birds utilising habitat	Low	Kill or injure individual during vegetation removal.	Very high	Killing or injuring native species is considered an unacceptable effect.	Moderate
7a. Direct	Native lizards assumed to be utilising habitat	High	Kill or injure individual during vegetation removal/earthworks.	Very high	Killing or injuring native species is considered an unacceptable effect.	Very high
8a. Indirect	Native birds utilising habitat	Low	Construction disturbance resulting from elevated noise, light and dust may result in disruption to dispersal and nest abandonment.	Negligible	The level of disturbance (noise, light and vibration) is expected to temporarily increase during construction. For example, earthworks and any pile driving, or night work may result in the temporary loss of habitat quality, disruption or dispersal. Terrestrial avifauna present are urban-adapted and exposed to pre-existing road user effects. It is expected there will be only a slight and temporary shift from baseline conditions during construction.	Very Low

Effect No.	Ecological Feature	Ecological value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of effect Without Mitigation
9a. Indirect	Native lizards assumed to be utilising habitat	High	Construction disturbance resulting from elevated noise, light and dust may result in disruption to normal behaviours.	Negligible	The level of disturbance (noise, light and vibration) is expected to temporarily increase during construction. For example, earthworks and any pile driving, or night work may result in the temporary loss of habitat quality, disruption or dispersal. However, disturbance to these species is considered temporary, both at a local and population level. Any herpetofauna that may be present will be urban-adapted and exposed to pre-existing road user effects.	Very Low
Wetlands						

Effect No.	Ecological Feature	Ecological value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of effect Without Mitigation
10a. Indirect	BR-W1 (setback from natural inland wetland is 45.6 m). BR-W2 (setback from natural inland wetland is 58.2 m). BR-W4 (setback from natural inland wetland is 82 m). BR-W5 (setback from natural inland wetland is 15.5 m). BR-W6 (setback from natural inland wetland is 12.6m). BR-W7 (setback from natural inland wetland is 30.4 m). BR-W8 (setback from natural inland wetland is 30.4 m). BR-W9 (setback from natural inland wetland is 17.2). BR-W10 (setback from natural inland wetland is 39.6). BR-W11 (setback from natural inland wetland is 70.9 m). GR-W1 (setback from natural inland wetland is 22.5 m). GR-W2 (setback from natural inland wetland is 22.5 m).	Low to High	Construction of main alignment/cycleway is within 100 m of natural inland wetlands and could lead to sediment and uncontrolled discharges into wetlands. NES-FW regulations are not triggered.	Negligible	The effects assessment assumes the successful implementation of embedded controls such as erosion and sediment controls** and bunded chemical storage. Effective implementation of best practice management will reduce the frequency, duration and probability of this effect occurring. Temporarily elevated sediment discharge may still occur during construction of the alignment. However, wetlands are situated within high sediment laden zones and subject to natural sediment fluctuations from Burswood stream. Temporarily elevated sediment discharge is unlikely to affect the current ecological value or extent of the wetland systems. Earthworks within 100m are unlikely to result in the complete or partial drainage of these wetlands. There are no earthworks or vegetation clearance associated with the construction of the project busway alignment occurring within 10 m of natural inland wetlands.	Very Low

Effect No.	Ecological Feature	Ecological value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of effect Without Mitigation
11a. Direct	BR-W3 (Earthworks and vegetation clearance (totalling 595 m^2) within 10 m of a natural inland wetland).	Moderate	Land requirement for construction of the cycleway is within Burswood Reserve and requires earthworks and vegetation removal within 10 m of natural wetland (BR-W3). This has the potential for stream bank instability leading to increased sediment loading within proximity to the wetland. Regulation 45 (1), (2) of the NES-FW triggered.	Low	A large portion of the proposed vegetation clearance is temporary removal (570 m^2). The permanent removal (25 m^2) relates to the outfall (MCC_10848) and is outside of the 10 m setback from BR-W3 (Refer to effect 12a below). All temporary vegetation clearance is proposed to be replaced with native vegetation as an embedded control. No wetland vegetation will be removed as part of construction works. Temporarily elevated sediment discharge may occur following removal of riparian vegetation. However, the wetland is situated within a high sediment laden zone and subject to natural sediment and hydrology fluctuations from the Pakuranga Creek tributary. Temporarily elevated sediment discharge is unlikely to affect the current ecological value or extent of the wetland systems. Earthworks and vegetation clearance within 10 m are unlikely to result in changes to the water level range or hydrological function of this wetland, nor result in partial or complete drainage of the wetland feature. The effects assessment assumes the successful implementation of embedded controls such as erosion and sediment controls during construction** and bunded chemical storage. Effective implementation of best practice management will reduce the frequency, duration and probability of this effect occurring.	Low

Effect No.	Ecological Feature	Ecological value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of effect Without Mitigation
12a. indirect	BR-W1 (setback from natural inland wetland is 30 m). BR-W2 (setback from natural inland wetland is 61 m). BR-W3 (setback from natural inland wetland is 14 m). **BR-W4 (within 10 m of a natural inland wetland).** BR-W7 (setback from natural inland wetland is 24 m) BR-W8 (setback from natural inland wetland is 90 m) All other natural inland wetlands are located >100 m from proposed stormwater outfall.	Low to High	Construction or land disturbance (including vegetation clearance) associated with the construction of stormwater outfalls within 100 m to a natural wetland leading to increased sediment discharge. The proposed works for outfall BR-W4 are within 10 m of a natural inland wetland and trigger requirements under Regulation 45 of the NES-FW.	Low	Temporarily elevated sediment discharge may occur during construction. However, wetlands are situated within high sediment laden zones and subject to natural sediment fluctuations from the Pakuranga Tributaries within Burswood and Bard Park Reserves. Temporarily elevated sediment discharge is unlikely to affect the current ecological value or extent of the wetland system. Earthworks within 100 m are unlikely to result in the complete or partial drainage of these wetlands. Construction works and temporary vegetation clearance required to upgrade the pipe, parallel to the boardwalk is within 10 m of BR-W4. There is an existing outfall discharging to this location. No wetland vegetation will be removed as part of construction works. The upgrade of the connecting pipe is not expected to result in changes to the water level range or hydrological function of this wetland, nor result in partial or complete drainage of the wetland feature. The effects assessment assumes the successful implementation of embedded controls such as erosion and sediment controls** and bunded chemical storage. Effective implementation of best practice management will reduce the frequency, duration and probability of this effect occurring.	Low
Freshwater – Streams						

Effect No.	Ecological Feature	Ecological value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of effect Without Mitigation
13a. Indirect	Permanent stream tributaries at Burswood Reserve and Bard Park Reserves	Moderate	Permanent installation of permeable erosion protection (rock riprap) within the stream bed leading to a permanent change in stream bed character and temporary sediment disturbance during construction. Outfall MCC_108482: 7.5 m of permeable scour protection within the stream bed. Outfall MCC_988531: 8.5 m of permeable scour protection within the stream bed.	Low	The stream habitat and their catchments are highly urbanised and subject to existing stormwater drainage. The stormwater outfall upgrades will require erosion protection which will result in permanent permeable rock riprap within the bed. This will lead to disturbance of a small portion of stream bed. The anticipated SEVi suggests that there will be no change in the function or value of the stream from the change in stream bed. No works are expected to result in the loss or reclamation of stream or prevent the passage of fish upstream or downstream. Temporarily elevated sediment discharge may occur during construction. However, the streams are well buffered by riparian vegetation and situated within an urbanised catchment. Temporarily elevated sediment discharge is unlikely to affect the current ecological value of the streams. The effects assessment assumes the successful implementation of embedded controls such as erosion and sediment controls** and bunded chemical storage. Effective implementation of best practice management will reduce the frequency, duration and probability of this effect occurring.	Low
14a. Direct	Native fish within Burswood and Bard Park Reserves	Low	Kill or injure fish due to construction of outfall structures.	Very High	The killing of native fish is considered an unacceptable effect.	**Moderate**

Effect No.	Ecological Feature	Ecological value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of effect Without Mitigation
15a. Indirect	Permanent stream tributaries at Burswood Reserve and Bard Park Reserves	Moderate	Permanent and temporary vegetation loss of riparian habitat (approximately 75 m^2 of permanent loss 300 m^2 of temporary loss for stormwater outfalls/pipelines) leading to potential bank instability and increased sediment loading. May result in negative effects to water quality and stream biota.	Low	The effects assessment assumes the successful implementation of embedded controls such as erosion and sediment controls** and replanting. Effective implementation of best practice management will reduce the frequency, duration and probability of this effect occurring. Temporarily elevated sediment discharge may occur following removal of riparian vegetation. However, the streams are well buffered by riparian vegetation and situated within an urbanised catchment. Effects from temporary sediment are unlikely to deviate from existing baseline condition. All temporary vegetation loss will be replaced at point of impact at a 1:1 ratio.	Low
16a. Indirect	Permanent stream tributaries at Burswood Reserve and Bard Park Reserves	Moderate	Increased sediment loading due to construction of the EB3C alignment. May result in negative effects to water quality and stream biota.	Low	The effects assessment assumes the successful implementation of embedded controls such as erosion and sediment controls** and bunded chemical storage. Effective implementation of best practice management will reduce the frequency, duration and probability of this effect occurring. Temporarily elevated sediment discharge may occur during construction. However, the streams are well buffered by riparian vegetation and situated within an urbanised catchment. Effects from temporary sediment are unlikely to deviate from existing baseline condition.	Low

* Embedded controls for the temporary loss of vegetation (0.421 ha) associated with the construction of stormwater outfalls (both existing and new) and temporarily occupied areas for construction within EB3C include the replanting of suitable native planting mixes for the Auckland Region at a 1:1 ratio (including provision of lizard refugia where possible). Planting specifications are detailed in the Landscape, Ecological and Arboricultural Mitigation plans (Appendix 9 of Landscape Report).

** Embedded controls for surface water will be managed in general accordance with Auckland Council Erosion and Sediment Control Guidelines (GD05) as recommended by the Erosion and Sediment Assessment Report. The proposed sediment control measures are detailed within the Erosion and Sediment control assessment and include:

- Appropriate staging of works
- Silt fences
- Clean and dirty water diversion bunds
- Decanting earth bund systems
- Flocculant chemicals
- Stabilisation measures, mulching, grass seeding
- Filter protection around stormwater catch pits.

Where possible, existing surface water runoff from the roadways will be diverted away from the construction site and into the existing network drainage system or existing surface overflow paths. Silt fences will manage the sediment run-off within the construction zones. Adherence to best practice erosion and sediment control plans during construction, in accordance with the recommendations of the Erosion and Sediment Control Assessment and conditions, will reduce any unwarranted additional

6.5.1.2 Indirect Effects

Further potential **indirect effects** associated with EB3C include:

- Creation of dispersal corridors for invasive plant species and increased weed incursion
- Potential alteration to soil physiochemical properties (pH, salinity, moisture content and nutrient contents) leading to shifts to exotic plant communities (Lee & Power, 2013)
- Earthworks may also result in elevated airborne dust. There is a risk that this may have an adverse effect on native vegetation adjacent to the Project footprint by affecting their ability to photosynthesise.

These effects are considered **Negligible** and will be appropriately minimised and managed through construction best practice, including implementation of the proposed Erosion Sediment Control measures and Landscape Plans for the Project. As such, they were not considered further in accordance with the EIANZ Guidelines.

Positive indirect effects on terrestrial vegetation may include:

- Native replanting proposed as part of landscaping will enhance habitat connectivity and habitat availability (refer to the EB3C Landscape Visual Assessment).

6.5.2 Eastern Busway 4L

The proposed construction activities associated with EB4L have the potential to impact on ecological features within and adjacent to the Project area, unless appropriate mitigation is implemented. A project description is provided in Section 2.0, with specific project elements that are relevant to the assessment of ecological effects provided in Section 3.2, 6.3.2 and 6.4.2.

6.5.2.1 Assessment of ecological effects EB4L – Terrestrial, wetland and freshwater features

The following tables presents the assessment of effects on **terrestrial, wetland** and **freshwater** features from the construction of EB4L (Table 6-10).

Table 6-10 Magnitude of effects and subsequent level of effects (without mitigation) from the Project construction activities upon ecological features present within the EB4L Project area.

Effect No.	Ecological Feature	Ecological value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of effect Without Mitigation
Terrestrial Vegetation						
1b. Direct	Permanent loss of vegetation including: PL.1 Planted vegetation (0.256 ha) TL.2 Mixed native and exotic treeland (0.040 ha) Unmaintained rank grasses (0.009 ha) Temporary vegetation loss (0.355 ha)	Moderate - Low	Permanent and temporary loss of habitat/ecosystem fragmentation and edge effects due to vegetation removal.	Low	Although permanent loss of vegetation (0.305 ha in total) will occur, remaining ecosystems will be similar to pre-development circumstances in the wider landscape given the vegetation types being removed and the quantity of those remaining vegetation types within the wider area. Temporary loss of vegetation around stormwater outfalls and within temporarily occupied areas for construction will be replaced at a ratio of 1:1*.	Low – Very low
Terrestrial - Avifauna and Lizards						
2b. Direct	Native birds utilising habitat provided by: PL.1 Planted vegetation (0.256 ha) TL.2 Mixed native and exotic treeland (0.040 ha) Temporary vegetation loss (0.355 ha)	Low	Permanent and temporary loss of bird habitat (foraging and breeding) through vegetation removal.	Low	The majority of the birds recorded within the vicinity of EB4L are Exotic and 'Not Threatened' native species. Species are urban adapted. Loss of terrestrial vegetation may result in temporary disruption only to foraging and dispersal behaviour of resident bird populations during construction. Due to the available habitat in the areas adjacent to the Project footprint and the small area of canopy vegetation to be removed, it is likely that the underlying character, composition and attributes of the terrestrial habitat pre-EB4L development will be similar to post-EB4L development circumstances. Temporary loss of vegetation will be replaced at a ratio of 1:1*.	Very low

Effect No.	Ecological Feature	Ecological value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of effect Without Mitigation
3b. Direct	Native birds utilising habitat provided by: PL.1 Planted vegetation (0.256 ha) TL.2 Mixed native and exotic treeland (0.040 ha) Temporary vegetation loss (0.355 ha)	Low	Fragmentation of bird habitat and loss of connectivity.	Low	Due to the available habitat in the areas adjacent to the Project footprint and the portion of riparian vegetation to be removed, however, it is likely that the underlying character, composition and attributes of the terrestrial habitat pre-EB4L development will be similar to post-EB4L development circumstances. Temporary loss of vegetation will be replaced at a ratio of 1:1*.	Very low
4b. Direct	Native lizards assumed to be utilising habitat provided by: PL.1 Planted vegetation (0.256 ha) TL.2 Mixed native and exotic treeland (0.040 ha) Unmaintained rank grasses (0.009 ha) Temporary vegetation loss (0.355 ha)	High	Permanent loss of lizard foraging and breeding habitat through vegetation removal.	Moderate	Construction will result in the permanent loss of favourable lizard habitat (0.251 ha). Removal of habitat will permanently reduce foraging and breeding habitat for “At Risk-Declining” lizards that are assumed to be present in the Project area. The permanent loss of habitat is likely to reduce overall resources available to the population. There will be temporary loss of lizard habitat that will be replaced at a ratio of 1:1*.	High

Effect No.	Ecological Feature	Ecological value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of effect Without Mitigation
5b. Direct	Native Lizards assumed to be utilising habitat provided by: PL.1 Planted vegetation (0.256 ha) TL.2 Mixed native and exotic treeland (0.040 ha) Unmaintained rank grasses (0.009 ha) Temporary vegetation loss (0.355 ha)	High	Fragmentation of lizard habitat and loss of connectivity.	Low	Habitat fragmentation effects are unlikely to deviate from baseline conditions. Habitat will remain along the adjacent reserves (Burswood Reserve, Bard Park Reserve and Greenmount Reserve). The Pakuranga Stream tributary within Guys Reserve will be partially bridged and all temporary vegetation loss will be replaced at a ratio of 1:1*.	Low
6b. Direct	Native birds utilising habitat	Low	Kill or injure individual during vegetation removal.	Very high	Killing or injuring native species is considered an unacceptable effect.	Moderate
7b. Direct	Native lizards assumed to be utilising habitat	High	Kill or injure individual during vegetation removal/earthworks.	Very high	Killing or injuring native species is considered an unacceptable effect.	Very high
8b. Indirect	Native birds utilising habitat	Low	Construction disturbance resulting from elevated noise, light and dust may result in disruption to dispersal and nest abandonment.	Negligible	Terrestrial avifauna present are urban-adapted and exposed to predisposing road user effects. It is expected there will be only a slight and temporary shift from baseline conditions.	Very Low

Effect No.	Ecological Feature	Ecological value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of effect Without Mitigation
9b. Indirect	Native lizards assumed to be utilising habitat	High	Construction disturbance resulting from elevated noise, light and dust may result in disruption to normal behaviours.	Negligible	The level of disturbance (noise, light and vibration) is expected to temporarily increase during construction. For example, earthworks and any pile driving, or night work may result in the temporary loss of habitat quality, disruption or dispersal. However, disturbance to these species is considered temporary, both at a local and population level. Any herpetofauna that may be present will be urban-adapted and exposed to predisposing road user effects. It is expected there will be only a slight and temporary shift from baseline conditions.	Very Low
Wetlands						

Effect No.	Ecological Feature	Ecological value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of effect Without Mitigation
10b. Indirect	GR-W1 (setback from natural inland wetland is 27.5 m). GR-W2 (setback from natural inland wetland is 10.3 m). GR-W3 (setback from natural inland wetland is 15.0 m). GR-W4 (setback from natural inland wetland is 14.2 m). GR-W5 (setback from natural inland wetland is 10.7 m).	Low to High	Construction of main EB4L alignment and bridge is within 100 m of natural inland wetlands and could lead to sediment and uncontrolled discharges into wetlands. NES-FW regulations are not triggered.	Negligible	The effects assessment assumes the successful implementation of embedded controls such as erosion and sediment controls** and bunded chemical storage. Effective implementation of best practice management will reduce the frequency, duration and probability of this effect occurring. Temporarily elevated sediment discharge may still occur during construction of the alignment. However, wetlands are situated within high sediment laden zones and subject to natural sediment fluctuations from the Pakuranga Tributary within Guys Reserve. Temporarily elevated sediment discharge is unlikely to affect the current ecological value or extent of the wetland systems. Earthworks within 100 m are unlikely to result in the complete or partial drainage of these wetlands. There are no earthworks or vegetation clearance associated with construction of the main (busway) project alignment occurring within 10 m of natural inland wetlands.	Very Low - Low

Effect No.	Ecological Feature	Ecological value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of effect Without Mitigation
11b. indirect	GR-W1 (setback from natural inland wetland is 12.7 m). **GR-W2 (setback from natural inland wetland is 5.1 m).** All other natural inland wetlands are located >100 m from proposed stormwater outfall.	Low to High	Construction or land disturbance associated with the construction of stormwater outfalls within 100 m to a natural wetland leading to increased sediment discharge. The proposed works for outfall GR-W2 are within 10 m of a natural inland wetland and trigger requirements under Regulation 45 of the NES-FW (see section 5.2	Low	Temporarily elevated sediment discharge may occur during construction. However, wetlands are situated within high sediment laden zones and subject to natural sediment fluctuations from the Pakuranga stream tributary within Guys Reserve. Temporarily elevated sediment discharge is unlikely to affect the current ecological value or extent of the wetland system. Earthworks within 100 m are unlikely to result in the complete or partial drainage of these wetlands. Construction works and temporary vegetation clearance is within 10 m of GR-W2. No wetland vegetation will be removed as part of construction works. The wetland is situated upstream of the proposed works and the installation of the outfall is not expected to result in changes to the water level range or hydrological function of this wetland, nor result in partial or complete drainage of the wetland feature. The effects assessment assumes the successful implementation of embedded controls such as erosion and sediment controls** and bunded chemical storage. Effective implementation of best practice management will reduce the frequency, duration and probability of this effect occurring.	Low
Freshwater – Streams						

Effect No.	Ecological Feature	Ecological value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of effect Without Mitigation
12b. Indirect	Permanent stream at Guys Reserve.	Moderate	Permanent installation of permeable erosion protection (rock riprap) within the stream bed leading to a permanent change in stream bed character and temporary sediment disturbance during construction. Outfall 1-1: 2.9 m of permeable scour protection within the stream bed. Outfall structure meets the permitted status under the AUP(OP).	Low	The stream habitat and catchment are highly disturbed through urbanisation and subject to existing stormwater discharges. The stormwater outfall upgrades will require erosion protection which will result in permanent permeable rock riprap within the bed (4.1 m). This will lead to disturbance of a small portion of stream bed that will not change the overall value of stream. No works are expected to result in the loss or reclamation of stream or prevent the passage of fish upstream or downstream. Temporarily elevated sediment discharge may occur during construction. However, the streams are well buffered by riparian vegetation and situated within an urbanised catchment. Temporarily elevated sediment discharge is unlikely to affect the current ecological value of the streams. The effects assessment assumes the successful implementation of embedded controls such as erosion and sediment controls** and bunded chemical storage. Effective implementation of best practice management will reduce the frequency, duration and probability of this effect occurring.	Low
13b. Direct	Native fish within Guys Reserve	Low	Kill or injure fish due to construction of outfall structures	Very High	The killing of native fish is considered an unacceptable effect.	**Moderate**

Effect No.	Ecological Feature	Ecological value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of effect Without Mitigation
14b. Indirect	Permanent stream at Guys Reserve	Moderate	Permanent and temporary loss of riparian habitat. Vegetation removal leading to potential bank instability and increased sediment loading. May result in negative effects to water quality and stream biota.	Low	The effects assessment assumes the successful implementation of embedded controls such as erosion and sediment controls** and replanting. Effective implementation of best practice management will reduce the frequency, duration and probability of this effect occurring. Temporarily elevated sediment discharge may occur following removal of riparian vegetation. However, the streams are well buffered by riparian vegetation and situated within an urbanised catchment. Effects from temporary sediment are unlikely to deviate from existing baseline condition. All temporary vegetation loss will be replaced at point of impact at a 1:1 ratio*.	Low
15b. Indirect	Permanent stream at Guys Reserve	Moderate	Increased sediment loading due to construction of the EB4L alignment. May result in negative effects to water quality and stream biota.	Low	The effects assessment assumes the successful implementation of embedded controls such as erosion and sediment controls** and bunded chemical storage. Effective implementation of best practice management will reduce the frequency, duration and probability of this effect occurring. Temporarily elevated sediment discharge may occur during construction. However, the streams are well buffered by riparian vegetation and situated within an urbanised catchment. Effects from temporary sediment are unlikely to deviate from existing baseline condition.	Low

* Embedded controls for the temporary loss of vegetation (0.355 ha) associated with the construction of stormwater outfalls (both existing and new), the EB4L bridge alignment and temporarily occupied areas for construction include the replanting of suitable native planting mixes for the Auckland region at a 1:1 ratio (including provision of lizard refugia where possible). Planting specifications are detailed in the Landscape, Ecological and Arboricultural Mitigation plans (Appendix 9 of Landscape Report).

** Embedded controls for surface water will be managed in general accordance with Auckland Council Erosion and Sediment Control Guidelines (GD05) as recommended by the Erosion and Sediment Assessment Report. The proposed sediment control measures are detailed within the Erosion and Sediment control assessment and include:

- Appropriate staging of works
- Silt fences
- Clean and dirty water diversion bunds
- Decanting earth bund systems
- Flocculant chemicals
- Stabilisation measures, mulching, grass seeding
- Filter protection around stormwater catch pits.

Where possible, existing surface water runoff from the roadways will be diverted away from the construction site and into the existing network drainage system or existing surface overflow paths. Silt fences will manage the sediment run-off within the construction zones. Adherence to best practice erosion and sediment control plans during construction, in accordance with the recommendations of the Erosion and Sediment Control Assessment and conditions, will reduce any unwarranted additional effects.

6.5.2.2 Indirect Effects

Further potential **indirect effects** associated with EB4L include:

- Creation of dispersal corridors for invasive plant species and increased weed incursion
- Potential alteration to soil physiochemical properties (pH, salinity, moisture content and nutrient contents) leading to shifts to exotic plant communities (Lee & Power, 2013)
- Earthworks may also result in elevated airborne dust. There is a risk that this may have an adverse effect on native vegetation adjacent to the Project footprint by affecting their ability to photosynthesise.

These effects are considered **Negligible** and will be dealt with through construction best practice, including the Erosion Sediment Control measures set out in the conditions and Landscape Plans for the Project. As such, they were not considered further in accordance with the EIANZ Guidelines.

Positive indirect effects on terrestrial vegetation may include:

- Native replanting proposed as part of landscaping will enhance habitat connectivity and habitat availability (refer to the EB4L Landscape Visual Assessment).

6.6 Operational Effects

6.6.1 Eastern Busway 3C

The operation of EB3C has the potential to impact on ecological features within and adjacent to the EB3C area, without mitigation. A project description is provided in Section 2.0, with specific project elements that are relevant to this assessment of ecological effects provided in Section 3.2, 6.1, 6.3.1 and 6.4.1. Operational effects on ecological features are discussed below (Table 6-11).

Table 6-11 Magnitude of effects and subsequent level of effects (without mitigation) from the Project operational activities upon ecological features present within the EB3C Project area.

Effect No.	Ecological Feature	Ecological value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of effect Without Mitigation
Avifauna						
1c. Indirect	Disturbance or displacement to native fauna (birds, lizards) from operational activities.	Low	Disturbance or displacement to avifauna from increased traffic flows and artificial light.	Low	The EB3C Project and adjacent land uses are located within an environment that has been highly modified from residential/commercial development and is subject to existing disturbance effects (i.e., noise, vibration and lighting) from the road/urban area. Current faunal assemblages are expected to be well accustomed to high levels of operational disturbances associated with roading (i.e., noise, vibration and lighting). Given the existing disturbance effects from the road and the minimal loss of connecting habitat, the EB3C Project is unlikely to result in disturbance that deviates from existing conditions.	Very Low
Wetlands						

Effect No.	Ecological Feature	Ecological value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of effect Without Mitigation
2c. direct	All wetlands	Low to high	Hydrological modification to wetlands from stormwater discharges resulting in degradation or loss of wetland habitat. Stormwater discharges within 100 m setback of natural wetlands.	Low	Wetlands are already subject to existing stormwater effects and fluctuating hydrological circumstances (e.g., stream flow dynamics, high rainfalls and drought). The underlying character, composition and attributes of the existing wetland habitat will be similar to pre-EB3C development circumstances. This is based on the design in which the stormwater discharge will remain relatively unchanged. The hydrological effects arising from stormwater discharges are covered under the existing Network Discharge Consent. However, discharges are unlikely to change the water level range or hydrological function of the wetlands.	Low

Effect No.	Ecological Feature	Ecological value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of effect Without Mitigation
3c. Indirect	All wetlands	Low to high	Changes to stormwater discharge leading to additional contaminants and sediment discharges and ultimately degradation or loss of wetland habitat. Stormwater discharges within, and within 100 m setback of natural wetlands.	Negligible	The existing stormwater network is currently discharging runoff into the wetland locations. The discharges associated with stormwater outfalls are covered under the existing Network Discharge Consent. However, the proposed stormwater system is expected to improve the overall quality of the stormwater discharged from the roadway via stormwater management and treatment. The Project aims to minimise the effects of stormwater discharges on the freshwater receiving environment through use of Water Sensitive Design systems, as well as preventing further erosion issues associated with stormwater discharge. In this regard, the underlying character, composition and attributes of the wetland habitat will be maintained.	Very Low Potential **positive** effect may include: Treatment of stormwater runoff in areas where current treatment is ineffective.
Streams						

Effect No.	Ecological Feature	Ecological value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of effect Without Mitigation
4c. direct	Permanent stream at Burswood Reserve and Bard Park	Moderate	Stormwater discharging directly into stream leading to contamination and elevated sediments. May result in negative effects to water quality and stream biota.	Negligible	Four stormwater outfalls will discharge directly into the stream at Burswood Reserve and Bard Park. The stream is situated within an urbanised catchment and currently receives water from the existing stormwater network. The discharges associated with stormwater outfalls are covered under the existing Network Discharge Consent. The proposed stormwater system is expected to improve the overall quality of the stormwater discharged from the roadway via stormwater management and treatment. The Project aims to minimise the effects of stormwater discharges on the freshwater receiving environment through use of Water Sensitive Design systems, as well as preventing further erosion issues associated with stormwater discharge. In this regard, the underlying character, composition and attributes of the existing stream habitat will be maintained.	Low

6.6.2 Eastern Busway 4L

The operation of EB4L has the potential to impact on ecological features within and adjacent to the EB4L area, without mitigation. A project description is provided in Section 2.0, with specific project elements that are relevant to this assessment of ecological effects provided in Section 3.2, 6.3.2 and 6.4.2. Operational effects on ecological features are discussed below (Table 6-12).

Table 6-12 Magnitude of effects and subsequent level of effects (without mitigation) from the Project operational activities upon ecological features present within the EB4L Project area.

Effect No.	Ecological Feature	Ecological value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of effect Without Mitigation
Avifauna						
1d. Indirect	Disturbance or displacement to native fauna (birds, lizards) from operational activities.	Low	Disturbance or displacement to avifauna from increased traffic flows and artificial light.	Low	The EB4L Project and adjacent land uses are located within an environment that has been highly modified from residential/commercial development and is subject to existing disturbance effects (i.e., noise, vibration and lighting) from the road/urban area. Current faunal assemblages are expected to be well accustomed to high levels of operational disturbances associated with roading (i.e., noise, vibration and lighting). Given the existing disturbance effects from the road and the small loss of connecting habitat, the EB4L Project is unlikely to result in disturbance that deviates from existing conditions.	Very Low
Wetlands						

Effect No.	Ecological Feature	Ecological value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of effect Without Mitigation
2d. direct	All wetlands	Low to high	Hydrological modification to wetlands from stormwater discharges resulting in degradation or loss of wetland habitat. Stormwater discharges within 100 m setback of natural wetlands.	Low	Wetlands are already subject to existing stormwater effects and fluctuating hydrological circumstances (e.g., stream flow dynamics, high rainfalls and drought). The underlying character, composition and attributes of the wetland habitat will be maintained. This is based on the design in which the stormwater discharge will remain relatively unchanged. The hydrological effects arising from stormwater discharges are covered under the existing Network Discharge Consent. However, discharges are unlikely to change the water level range or hydrological function of the wetlands.	Low

Effect No.	Ecological Feature	Ecological value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of effect Without Mitigation
3d. Indirect	All wetlands	Low to high	Changes to stormwater discharge leading to additional contaminants and sediment discharges and ultimately degradation or loss of wetland habitat. Stormwater discharges within, and within 100 m setback of natural wetlands.	Negligible	The existing stormwater network is currently discharging runoff into the wetland locations. The discharges associated with stormwater outfalls are covered under the existing Network Discharge Consent. However, discharges are unlikely to change the water level range or hydrological function of the wetlands. The Project aims to minimise the effects of stormwater discharges on the freshwater receiving environment through use of Water Sensitive Design systems, as well as preventing further erosion issues associated with stormwater discharge. In this regard, the underlying character, composition and attributes of the wetland habitat will be maintained. The proposed stormwater system is expected to maintain the overall quality of the stormwater discharged from the roadway via stormwater management and treatment.	Very Low Potential **positive** effect may include: Treatment of stormwater runoff in areas where current treatment is ineffective.
Streams						

Effect No.	Ecological Feature	Ecological value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of effect Without Mitigation
4d. direct	Permanent stream at Guys Reserve	Moderate	Stormwater discharging directly into stream leading to contamination and elevated sediments. May result in negative effects to water quality and stream biota.	Negligible	One stormwater outfall will discharge directly into the stream at Guys Reserve. The stream is situated within an urbanised catchment and currently receives water from the existing stormwater network. As such, the effects arising from stormwater discharges are not likely to result in a change from existing baseline conditions. The discharges associated with the stormwater outfall are covered under the existing Network Discharge Consent. The proposed stormwater system is expected to improve the overall quality of the stormwater discharged from the roadway via stormwater management and treatment. The Project aims to minimise the effects of stormwater discharges on the freshwater receiving environment through use of Water Sensitive Design systems, as well as preventing further erosion issues associated with stormwater discharge. In this regard, the underlying character, composition and attributes of the existing stream habitat will be maintained.	Low

6.7 Cumulative Effects

The Eastern Busway ZOI is located within an area that is subject to considerable urban development and pre-existing anthropogenic effects. Cumulative effects from the construction and operation of the entire Eastern Busway Project and further development of the surrounding area are likely to result in only small shifts away from baseline conditions. The overall cumulative level of effect is considered **Very Low**.

7.0 Impact Management and Residual Effects Assessment

Chapter Summary

The Project has integrated design features to avoid and minimise adverse effects where practicable; however, there will be some impacts on terrestrial ecology that cannot be avoided and will require mitigation (in accordance with EIANZ, 2018).

In summary, the following mitigation is recommended (along with best practice construction methods and embedded controls) and should be required as conditions:

- *Preparation and implementation of a Lizard Management Plan which details lizard salvage and relocation requirements by a suitably qualified herpetologist.*
- *Programming of work to avoid the bird nesting season (September to February) or if this is not possible, then pre-construction nesting bird surveys of vegetation for clearance must occur*
- *Preparation and implementation of a Native Fish Capture and Relocation Plan which details fish salvage and exclusion methodologies.*
- *Address residual effects by compensating for the loss of lizard habitat at EB3C and EB4L through 0.75 ha and 1.00 ha of habitat replacement/enhancement respectively. This will be detailed within a Habitat Restoration Plan.*

*Provided the mitigation and offset/compensation measures outlined in this assessment are implemented and best-practice construction measures (including proposed Erosion and Sediment Control measures) are followed the anticipated residual ecological effects are considered to be **Very low**.*

7.1 Eastern Busway 3C – Mitigation

This section outlines the recommended mitigation requirements for the actual and potential effects from EB3C outlined in Table 6-3. In accordance with the EIANZ Guidelines, measures to avoid, remedy or mitigate effects are focused on ecological features where the level of effect was assessed to be **Moderate, High** or **Very high**.

An options assessment process was undertaken whereby the Project has aimed to avoid ecological features of value. The remaining ecological effects that have been identified to require mitigation are the permanent loss of herpetofauna habitat (Effect No. 4a), which resulted in a **High** level of effect, and the risk of killing or injuring native birds and lizards during vegetation removal (Effect No. 6a and 7a), which resulted in a **Moderate** and **Very high** level of effect. Mitigation with respect to birds and lizards is presented below and also ensures compliance with the Wildlife Act 1953.

7.1.1 Birds (Effect No 6a)

The EB3C Project area is likely to contain "Not Threatened" indigenous birds. Although of low value, vegetation clearance of TL.1 Native vegetation TL.2, Mixed native and exotic treeland, TL.2 Exotic treeland and PL.1 Planted vegetation should be avoided (where practicable) within the bird nesting season (September – February). A condition has been included in the proposed conditions set to require that a pre-construction nesting bird survey is undertaken if vegetation removal is to occur within the nesting season to avoid unintentional injury or mortality to native birds.

7.1.2 Lizards (Effect No 4a and 7a)

There is the potential for indigenous lizard species (Copper Skink and Ornate skink) to be present within the EB3C Project area, within the majority of the permanent and temporary vegetation. High risk areas include the understory of PL.1 Planted vegetation, TL.2/TL.3 Mixed native and exotic treeland and ES Exotic scrub (including unmaintained rank grasses). There is the potential that clearance required for construction may result in mortality or injury to indigenous lizard species. Lizard salvage and relocation will be required prior to any vegetation removal and must be undertaken between the months of September to April inclusive by an appropriately qualified herpetologist. A condition has been included

in the proposed conditions set requiring preparation of a Lizard Management Plan (LMP) which will detail this and other recommended management controls.

The loss of 0.327 ha of lizard habitat cannot be mitigated at the point of impact, as such it remains a residual effect and requires offset or compensation which is addressed in section 7.3 below.

7.1.3 Fish (Effect No. 14a)

Instream works during construction e.g., installation of permanent permeable erosion protection may impact native fish within stream reaches. This activity may result in fish injury or mortalities. To mitigate this potential effect the conditions require preparation of a Native Fish Capture and Relocation Plan. The conditions require that the Plan include:

1) Details on timing of plan implementation, taking into account native fish migration and potential inanga spawning (November to May);
2) Methodologies to capture native fish
3) Details of the qualified ecologist to undertake the capture and relocation.
4) Details of the relocation site
5) Any storage or transportation methods.

7.2 Eastern Busway 4L – Mitigation

This section outlines the recommended mitigation requirements for the actual and potential effects from EB4L outlined in Table 6-10. In accordance with the EIANZ Guidelines measures to avoid, remedy, or mitigate effects are focused on ecological features where the level of effect was assessed to be **Moderate, High** or **Very high**.

An options assessment process was undertaken whereby the Project has aimed to avoid ecological features of value. The remaining ecological effects that have been identified to require mitigation are the permanent loss of herpetofauna habitat (Effect No. 4b), which resulted in a **High** level of effect, and the risk of killing or injuring native birds and lizards during vegetation removal (Effect No. 6b and 7b), which resulted in a **Moderate** and **Very high** level of effect. Mitigation with respect to birds and lizards is presented below and also ensures compliance with the Wildlife Act 1953.

7.2.1 Birds (Effect No 6b)

The EB4L Project area is likely to contain “Not Threatened” indigenous birds. Although of low value, vegetation clearance of PL.1 Planted vegetation and TL.2 Mixed native should be avoided (where practicable) within the bird nesting season (September – February). A condition has been included in the proposed conditions set to require that a pre-construction nesting bird survey is undertaken if vegetation removal is to occur within the nesting season to avoid unintentional injury or mortality to native birds.

7.2.2 Lizards (Effect No 4b and 7b)

There is the potential for indigenous lizard species (Copper Skink and Ornate skink) to be present within the EB4L Project area, within the majority of the permanent and temporary vegetation. High risk areas include the understory of PL.1 Planted vegetation and TL.2 Mixed native and exotic treeland within unmaintained rank grasses along Guys Reserve. There is the potential that clearance required for construction may result in mortality or injury to indigenous lizard species. Lizard salvage and relocation will be required prior to any vegetation removal and must be undertaken between the months of September to April inclusive by an appropriately qualified herpetologist. A condition has been included in the proposed conditions set requiring preparation of a Lizard Management Plan (LMP) which will detail this and other recommended management controls.

The loss of 0.251 ha of lizard habitat cannot be mitigated at the point of impact, as such it remains a residual effect and requires offset or compensation. This is addressed in section 7.3 below.

7.2.3 Fish (Effect No. 13b)

Instream works during construction e.g.; installation of permanent permeable erosion protection may impact native fish within stream reaches of Guys Reserve. This activity may result in fish injury or mortalities. To mitigate this potential effect the conditions require preparation of a Native Fish Capture and Relocation Plan. The conditions require that the Plan include:

1) Details on timing of plan implementation, taking into account native fish migration and potential inanga spawning (November to May)
2) Methodologies to capture native fish
3) Details of the qualified ecologist to undertake the capture and relocation.
4) Details of the relocation site
5) Any storage or transportation methods.

7.3 Eastern Busway 3C and Eastern Busway 4L – Residual Effects Management

7.3.1 Biodiversity Compensation Model

The BCM has been applied to determine the compensation requirements for residual effects relating to the loss of lizard habitat within EB3C and EB4L. The loss of rank grass is included in the extent of lizard habitat loss owing to the habitat provided by tree-land understory and edges. Thus, the model input data includes the loss of planted vegetation, mixed native and exotic treeland, and exotic scrub (inclusive of unmaintained areas of grasses). Further information on the BCM criteria and detailed inputs in regard to the model are provided in Appendix 4.

Model outputs to compensate for the loss of lizard habitat for EB3C and EB4L are summarised below (see Appendix 4 for model inputs).

7.3.2 Lizard habitat replacement

Approximately **0.327 ha** of vegetation (native and exotic) and **0.251 ha** of vegetation (native and exotic) would be permanently lost under the footprint at EB3C and EB4L (respectively), that is assumed to provide lizard habitat.

- The total minimum planting required to compensate for lizard habitat loss associated within EB3C and EB4L is **1.75 ha**.

Compensation to address these residual effects on lizard habitat related to EB3C and EB4L will be undertaken through habitat restoration and enhancement measures, which will be detailed in the proposed Habitat Restoration Plan which is required to be prepared by the EB3C and EB4L Project conditions.

7.3.3 Habitat Restoration Plan

Preliminary locations for lizard habitat restoration have been identified and were selected based upon the proximity to the EB3C and EB4L Project area, future development effects and ability to enhance existing connections for lizards. These areas are shown on plans in Appendix 8 (full set is located in the Landscape, Ecological and Arboricultural Plans, Landscape Visual Assessment, Appendix 9). Lizard relocation areas are also shown. These sites will collectively cover lizard habitat area compensation requirements for EB3C and EB4L and include:

- Riparian margins of the Pakuranga Tributary by Tī Rākau Drive
- Burswood Reserve, Bard Park Reserve and Guys Reserve.

The conditions require the LMP to include guidance on the type of planting and supplementary refuges required to enhance habitats for lizards.

A Habitat Restoration Plan will be developed as a condition to detail the restoration required to compensate for the loss of lizard habitat. Restoration will be site specific depending on the location. The Plan requirements are detailed in the proposed project conditions and include:

- Identification of areas (1.75 ha) to be restored as lizard habitat
- Detail of the restoration required at each site to replace and enhance lizard habitat including the planting design (including vegetation to be retained), and supplementary refuges
- Details of fencing to protect and demarcate plantings (where appropriate)
- A programme of establishment and post establishment protection and maintenance of plants (fertilising, weed removal/spraying, replacement of dead/poorly performing plants, watering to maintain soil moisture, maintenance programme). All plantings shall be maintained for 10 years
- Details of the proposed plant species, plant sourcing (locally EcoSourced native pioneer species that are adapted to the Auckland environment are preferred in the first instance), plant sizes at time of planting, plan of the planted area within the planting area required, density of planting, and timing of planting.

8.0 Recommendations and Conclusions

By design, the EB3C and EB4L Project avoids major loss of vegetation, wetland and freshwater habitat. Effects will be further minimised by the implementation of best practice construction methods, embedded controls and conditions including:

- Minimising disruption and unnecessary removal of vegetation throughout the Project
- Replanting (at 1:1 ratio) where all temporary vegetation clearance has occurred within EB3C and EB4L Project areas. This will include replacing vegetation cleared within all temporarily occupied areas for construction, around bridges and stormwater outfalls. This is recommended as a condition of consent
- Best-practice site construction management practices for sediment, dust and erosion control as well as storage of hazardous materials
- Preparation and implementation of the EB3C and EB4L Project erosion sediment and control plan
- Minimise the effects of stormwater discharges on the freshwater receiving environment through use of Green infrastructure (wherever practicable).

EB3C and EB4L Project effects have been assessed and some require mitigation as well as some offsetting/compensation. In line with EIANZ (2018) this has been recommended where the level of effect is assessed to be **Moderate** or above. In summary, the following recommended mitigation measures have been included as conditions:

- Preparation and implementation of a **Lizard Management Plan** which details lizard salvage and relocation requirements by a suitably qualified herpetologist
- Programming of work to avoid the bird nesting season (September to February) or if this is not possible, then pre-construction nesting bird surveys of vegetation for clearance must occur
- Preparation and implementation of a **Native Fish Capture and Relocation Plan** which details fish salvage and exclusion methodologies.

It is proposed to address residual effects by compensating for the loss of lizard habitat at EB3C and EB4L through **1.75 ha** of habitat replacement/enhancement. This will be detailed within a **Habitat Restoration Plan** which is required by the conditions.

Provided the recommended mitigation and compensation measures outlined in this assessment are implemented and best-practice construction measures are followed in accordance with the proposed conditions the anticipated residual ecological effects are considered to be **Very low**.

9.0 References

Auckland Council. (2012). Environmental strategy and policy: Auckland Council's indigenous biodiversity strategy, July 2012.

Baber, M., Dickson, J., Quinn, J., Ussher, G., Heggie-Gracie, S., & Jacson, S. (2021). Biodiversity Compensation Model for New Zealand – A User Guide (Version 1). Prepared by Tonkin & Taylor Limited. Project number 1017287.0000P.

Baber, M., Christensen, M., Quinn, J., Markham, J., Ussher, G. & Signal-Ross, R. (2021b). The use of modelling for terrestrial biodiversity offsets and compensation: a suggested way forward. Resource Management Journal, Resource Management Law Association (April 2021).

Baber, M., Dickson, J., Quinn, J., Ussher, G., Heggie-Gracie, S., & Jacson, S. 2021. Biodiversity Compensation Model for New Zealand – Excel Calculator Tool (Version 1). Prepared by Tonkin & Taylor Limited. Project number 1017287.0000P.

Bioresearches Limited. (2018). Lizard Management Plan for AMETI 2 & 3. Report prepared by Bioresearches for AECOM.

Bioresearches Limited. (2020). Final Works Completion Report: Lizard Management: AMETIEB Stage 1.Panmure to Pakuranga.

Brinson, M. M. (1993). A hydrogeomorohic classification for wetlands [Wetlands Research Program Technical Report WRP-DE-4]. Vicksburg: US Army Engineer Waterways Experimental Station

Chaffe, A. E. (2016

). Do urban golf courses have the potential to contribute to the sustainability of urban biodiversity in Auckland, New Zealand? [Unpublished MSc thesis]. University of Auckland.

Chappell, P.R. (2012). The climate and weather of Auckland. 2nd edition. The National Institute of Water and Atmospheric Research.

Clarkson, B. R. (2018). Wetland delineation protocols [Contract Report: LC3354]. Prepared by Manaaki whenua – Landcare Research for Tasman District Council.

Clarkson, B. R., Sorrell, B. K., Reeves, P. N., Champion, P. D., Partridge, T. R., & Clarkson, B. D. (2004) Handbok for Monitoring Wetland Condition. Manaaki Whenua – Landcare Research. DOI: 10.7931/J2Z60KZ3

Dejean, T., Valentini, A., Duparc, A., Pellier-Cuit, S., Pompanon, F., Taberlet, P., & Miaud, C. (2011) Persistence of Environmental DNA in Freshwater Ecosystems. PLoS ONE, 6(8): e23398. DOI: 10.1371/journal.pone.0023398

de Lange, P. J., Rolfe, J. R., Barkla, J. W., Courtney, S. P., Champion, P. D., Perrie, L, R., Beadel, S. M., Ford, K. A, Breitwieser, I., Schonberger, I., Hindmarsh-Walls, R., Heenan, & P. B., Ladley, K. (2018). Conservation status of New Zealand indigenous vascular plants, 2017. New Zealand Threat Classification Series 22. Department of Conservation.

Department of Conservation, & Ministry for the Environment. (2000). The New Zealand biodiversity strategy 2000-2020.

Department of Conservation. (2014). Conservation Management Strategy: Auckland 2014-2024. Volume I - operative 17 November 2014.

Dunn, N. R., Allibone, R. M., Closs, G. P., Crow, S. K., David, B. O., Goodman, J. M., Griffiths, M., Jack, D. C., Ling, N., Waters, J. M., & Rolfe, J.R. (2018). Conservation status of New Zealand freshwater fishes, 2017. New Zealand Threat Classification Series 24. Department of Conservation.

Franklin, P., Gee, E., Baker, C., & Bowie, S. (2018). New Zealand Fish Passage Guidelines. The National Institute of Water and Atmospheric Research

Hitchmough, R. A., Barr, B., Knox, C., Lettink, M., Monks, J.M., Patterson, G.B., Reardon, J.T., van Winkel, D., Rolfe, J., & Michel, P. (2021). *New Zealand Threat Classification Series* 35. Conservation status of New Zealand reptiles, 2021. 23 p, 978–1–99–115292–3–0.

International Union for Conservation of Nature. (2012). Guidelines for application of IUCN Red List Criteria at regional and national levels: Version 4.0. Switzerland, International Union for Conservation of Nature.

Jowett, I. G., & Richardson, J. (1996). Distribution and abundance of freshwater fish in New Zealand rivers. New Zealand Journal of Marine and Freshwater Research, 30(2): 239-255.

Land, Air, Water Aotearoa. (2022). Pakuranga Creek at Greenmount Reserve. Auckland Council. https://www.lawa.org.nz/explore-data/auckland-region/river-quality/Pakuranga-creek/Pakuranga-creek/.

Lee, M. A., & Power, S. A. (2013). Direct and indirect effects of roads and road vehicles on the plant community composition of calcareous grasslands. Environmental Pollution, 176: 106-113. DOI: 10.1016/j.envpol.2013.01.018

Maseyk, F., Ussher, G.T.,Kessels, G., Christensen, M., & Brown, M. (2018). Biodiversity Offsetting under the Resource Management Act: A guidance document. Prepared for the Biodiversity Working Group on behalf of the BioManagers Group.

Maseyk, F., Maron, M., Seaton, R., & Dutson, G. (2015). A Biodiversity Offsets Accounting Model for New Zealand [Contract Report No: 2014-008]. Prepared for the Department of Conservation.

New Zealand Government. (2019). Draft National Policy Statement for Indigenous Biodiversity.

McEwen, W. M. (1987). Ecological regions and districts of New Zealand: districts in the northern Kermadec to Mayor. New Zealand Biological Resources Centre, Publication No. 5, Part 1. Department of Conservation.

Ministry for the Environment. (2023). National Policy Statement for Indigenous Biodiversity.

Ministry for the Environment. (2017). National Policy Statement for Freshwater Management 2014. Updated August 2017 to incorporate amendments from the National Policy Statement for Freshwater Amendment Order 2017.

Ministry for the Environment. (2021). Defining 'natural wetlands' and 'natural inland wetlands'.

Ministry for the Environment. (2022). Wetland delineation protocols. Delineating wetlands under the Resource Management Act (RMA) 1991 and the National Policy Statement for Freshwater Management 2020 (NPS-FM)

Ministry for the Environment. (2022). Resource Management (National Environmental Standards for Freshwater) Amendment Regulations (No 2).

Minister of Conservation v Mangawhai Harbour Restoration Society Incorporated (2021) NZHC 3113. CIV 2021-488-24. Retrieved from: https://www.nrc.govt.nz/media/c5tlyt5s/high-court-decision-on-jurisdiction-of-nes-f-in-cma-_2021_-nzhc-3113-18-november-2021.pdf.

Robertson, H. A., Baird, K., Dowding, J. E., Elliot, G.P., Hitchmough, R. A., Miskelly, C. M., McArthur, N., O'Donnell, C. F. J., Sagar, P. M., Scofield, R. P., & Taylor, G. A. (2017). Conservation status of New Zealand birds, 2016. New Zealand Threat Classification Series 19. Department of Conservation.

Roper-Lindsay, J., Fuller, S, A., Hooson, S., Sanders, M. D., & Ussher, G. T. (2018). Ecological impact assessment. EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd edition. Melbourne: Environment Institute of Australia and New Zealand.

Rountree, M., Todd, C. P., Kleynhands, C. J., Batchelor, A. L., Louw, M. D., Kotze, D., Walters, D., Schroeder, S., Illgner, P., Uys, M., & Marneweck, G. C. (2007). Manual for the assessment of a Wetland Index of Habitat Integrity for South African floodplain and channelled valley bottom wetland types

[Report no. N/0000/00/WEI/0407]. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria, South Africa.

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

Singers, N. J. D., & Rogers, G. M. (2014). A classification of New Zealand's terrestrial ecosystems. Science for Conservation 325. Department of Conservation.

Snelder, T., Leathwick, J., Weatherhead, M., & Wild, M. (2004). Pilot Marine Environment Classification of New Zealand's Exclusive Economic Zone and the Hauraki Gulf [Report CHC2004-003]. The National Institute of Water and Atmospheric Research

Stoffels, R. (2022). New Zealand Freshwater Fish Database (extended). The National Institute of Water and Atmospheric Research (NIWA). Sampling event dataset https://doi.org/10.15468/jbpw92 accessed via GBIF.org on 2022-03-21.

Stark, J. D., Boothroyd, I. K.G., Harding, J. S., Maxted, J. R., & Scarsbrook, M. R., (2001). Protocols for sampling macroinvertebrates in wadeable streams (New Zealand Macroinvertebrate Working Group Report No. 1). Prepared for the Ministry for the Environment: Sustainable Management Fund Project No. 5103.

Stark, J. D., & Maxted, J. R. (2007). A biotic index for New Zealand's soft-bottomed streams. New Zealand Journal of Marine and Freshwater Research, 41(1): 43-61.

Storey, R. G., Neale, M. W., Rowe, D. K., Collier, K. J., Hatton, C., Joy, M. K., Maxted, J. R, Moore, S., Parkyn, S. M., Phillips, N., & Quinn, J. M. (2011). Stream Ecological Valuation (SEV): a method for assessing the ecological function of Auckland streams [Technical Report 2011/009]. Auckland Council.

Storey, R. G., & Wadhwa, S. (2009). An Assessment of the Lengths of Permanent, Intermittent and Ephemeral Streams in the Auckland Region. [Technical Report 2009/028]. Prepared by the National Institute of Water and Atmospheric Research for Auckland Regional Council.

Townsend, A. J. de Lange, P. J., Duffy C, A, J., Miskelly, C. M., Molloy, J., Norton, D. A. 2008. New Zealand threat classification system manual. Department of Conservation.

Appendix 1 Wetland Assessment Methodology and Wetland Value Assessment

A1.1 Hydrogeomorphic Unit

Conceptual model for different HGM units as applied within this assessment (Figure A1-1).

Hydrogeomorphic types		Description	Source of water maintaining the wetland[1]	
			Surface	Sub-surface
Floodplain		Valley bottom areas with a well defined stream channel, gently sloped and characterized by floodplain features such as oxbow depressions and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*
Valley bottom with a channel		Valley bottom areas with a well defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and be characterized by the net loss of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*/***
Valley bottom without a channel		Valley bottom areas with no clearly defined stream channel, usually gently sloped and characterized by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.	***	*/***
Hillslope seepage linked to a stream channel		Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well defined stream channel connecting the area directly to a stream channel.	*	***
Isolated Hillslope seepage		Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs mainly from sub-surface flow and outflow either very limited or through diffuse sub-surface and/or surface flow but with no direct surface water connection to a stream channel.	*	***
Depression (includes Pans)		A basin shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. it is inward draining). It may also receive sub-surface water. An outlet is usually absent, and therefore this type is usually isolated from the stream channel network.	*/***	*/***

[1] Precipitation is an important water source and evapotranspiration an important output in all of the above settings

Water source: * Contribution usually small

*** Contribution usually large

*/*** Contribution may be small or important depending on the local circumstances

*/*** Contribution may be small or important depending on the local circumstances.

 Wetland

Figure A1-1 The HGM classification according to Brinson (1993) and adopted from Kotze et al. (2007)

A1.2 Wetland Functional Value

Matrix outlining the likely presence of specific wetland functions associated with different wetland types (Table A3-1)

Table A3-1 Likely presence of different functional wetland values associated with different HGM units (Wetland and Types)

Variable	Early wet season flood attenuation	Late wet season flood attenuation	Stream flow regulation	Erosion control	Sediment trapping	Phosphate removal	Nitrate removal	Toxicants
Depression	Likely	Likely	Unlikely	Unlikely	Unlikely	Unlikely	Likely	Likely
Hillslope seep (Isolated)	Likely	Unlikely	Unlikely	Very Likely	Unlikely	Unlikely	Very Likely	Likely
Hillslope seep (Connected)	Likely	Unlikely	Likely	Very Likely	Unlikely	Unlikely	Very Likely	Very Likely
Unchanneled valley bottom	Likely	Likely	Unlikely	Very Likely	Very Likely	Likely	Likely	Very Likely
Channelled valley bottom	Likely	Unlikely	Likely	Very Likely	Likely	Likely	Likely	Likely
Floodplain	Very Likely	Likely	Unlikely	Very Likely	Very Likely	Very Likely	Likely	Likely

A1.3 Wetland Condition Assessment

Based on *Clarkson et al.,* (2004) handbook for monitoring wetland condition, to assess a range of external pressures which can lead to a decline in the health or condition of the wetland. For example, changes in hydrology, water pollution, nutrient enrichment, and invasion by weeds and pests can lead to biodiversity loss and impaired wetland functioning (Table A3-2). The wetland condition score was interpreted through wetland condition categories proposed by Kleynhans (2007) (Table A3-8). These conditions where used to value the functional integrity of the wetland habitat and therefore provide a way to value the system with regards to the EIANZ Guidelines.

Table A3-2 Summary of aspects and components considered within the wetland condition assessment (Clarkson et al., 2004). The degree of modification was assessed using the following scoring 5 = very low/non, 4= low, 3 = medium, 2 = high, 1 = very high and 0 = extreme.

Impact indicator	Impact components
Hydrological integrity	Impact of manmade structure
	Water table depth
	Dryland plant invasion
Physico-chemical parameters	Fire damage
	Degree of sedimentation
	Nutrient levels
	Von Post index
Change in browsing, predation and harvesting regimes	Damage by domestic or feral animals
	Introduces predator impact on wildlife
	Harvesting levels
Change in dominance of native plants	Introduced plant canopy cover
	Introduced plant understory cover
Total wetland condition index/25	

Table A3-3 Key wetland pressures assessed within the catchment of the wetland (Clarkson et al. 2004). Pressure scores were assigned as follows: 5 = very high, 4 = high, 3 = medium, 2 = low, 1 = very low, 0 = none.

Pressure
Modification to catchment hydrology
Water quality within the catchment
Animal access
Key undesirable species
% catchment introduced vegetation
Other
Total catchment pressure index/30

Table A3-4 Wetland condition categories and associated descriptions used within this assessment.

Category Wetland Condition	Description	%
Unmodified	Unmodified/natural	100%
Largely natural	Largely natural with a few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota have taken place.	80 – 100%

Moderately	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	60 – 80%
Largely	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	40-60%
Seriously	Seriously modified. The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	20-40%
Critically	Critically modified. Modifications have rich a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	<20%

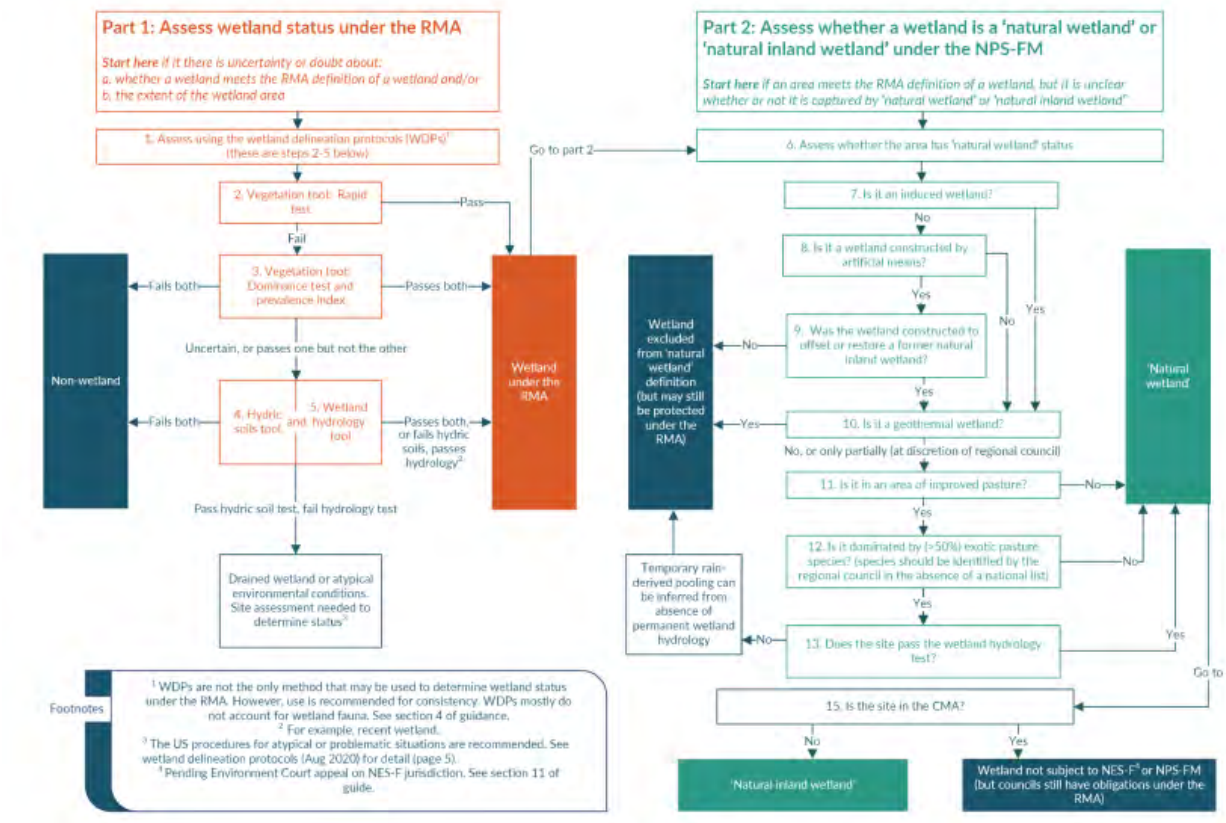


Figure A3-2 Criteria for defining natural wetland and natural inland wetland status under the NPS-FM taken from Mfe, 2021.

A1.4 Wetland photos

Table A1-5 Wetlands within the ZOI of EB3C

Wetland	Photos
BR-W1 (EW- Exotic Wetland)	
BR-W2 (WL 11 Machaerina Sedgeland)	
BR-W3 (PL.1 Planted vegetation)	

BR-W4 (WL10 Oioi restiad rushland/reedland)	
BR-W5 (WL10 Oioi restiad rushland/reedland)	
BR-W6 (WL10 Oioi restiad rushland/reedland)	
BR-W7 (EW- Exotic Wetland)	

BR-W8 (WL 11 Machaerina Sedgeland)	
BR-W9 (EW- Exotic Wetland)	
BR-W10 (WL 11 Machaerina Sedgeland)	
BR-W11 (EW- Exotic Wetland)	

GR-W1	
GR-W2	
GR-W3	 

GR-W4	
GR-W5	

A1.5 BR-W4 Wetland Vegetation and Soil Profile Description

Owing to the locality of the stormwater upgrade and wetland BR-W4 a targeted wetland delineation was undertaken. Nineteen plots were undertaken to delineate the wetland extents following the wetland delineation protocol (MfE, 2020). All other wetlands were rapidly assessed following the vegetation profile and confinement to Burswood stream channel margins.

Table A1-6 Wetland vegetation and soil profile description

BR-W4 Targeted wetland delineation											
Plot	**Common Name**	**Scientific Name**	**Cover (%)**	**Hydrophytic classification**	**Indigenous or Exotic species**	**Dominance Test (%)**	**Prevalence index (PI)**	**Hydric soils**	**Soil characteristics**	**Natural Wetland**	**Notes/photos**
BUR1	Tall Fescue	*Lolium arundinaceum*	30	FAC	Exotic	<50%	3.1	No	Organic soils, no distinct mottling and manganese, terrestrial soils.	No	
	Saltmarsh ribbonwood	*Plagianthus divaricatus*	20	FACW	Indigenous						
	Creeping buttercup	*Ranunculus repens*	15	FAC	Exotic						
	Field bindweed	*Calystegia sepium subsp. roseata x C. silvatica subsp. disjuncta*	10	FAC	Exotic						
	Onion weed	*Allium triquetrum*	10	FAC	Exotic						
	Cleavers	*Galium aparine*	15	FACU	Exotic						
BUR2	Alligator weed	*Alternanthera philoxeroides*	25	FACW	Exotic	>50%	2.7	Yes	Mottles present, black/dark brown staining, manganese	Yes	
	Water pepper	*Persicaria*	40	FACW	Exotic						

		hydropiper									
	Wandering Willie	*Tradescantia fluminensis*	30	FACU	Exotic						
	Broad-leaved dock	*Rumex obtusifolius*	5	FAC	Exotic						
BUR3	Common vevlet grass	*Holcus lanatus*	40	FAC	Exotic	<50%	3.1	No	Organic soils, no distinct mottling and manganese, terrestrial soils.	No	
	Creeping buttercup	*Ranunculus repens*	20	FAC	Exotic						
	Field bindweed	*Calystegia sepium subsp. roseata x C. silvatica subsp. disjuncta*	5	FAC	Exotic						
	Giant umbrella sedge, Upoko-tangata	*Cyperus ustulatus*	10	FACW	Endemic						
	Cleavers	*Galium aparine*	20	FACU	Exotic						
	Creeping cinquefoil, Eur opean cinquefoil, cre eping tormentil	*Potentilla reptans*	5	FAC	Exotic						
BUR4	Kikuyu grass	*Cenchrus clandestinus*	40	FACU	Exotic	<50%	3.6	No	Organic soils, no distinct mottling and manganese, terrestrial soils.	No	
	Creeping	*Ranunculus*	20	FAC	Exotic						

	buttercup	*repens*									
	Cleavers	*Galium aparine*	25	FACU	Exotic						
	Giant umbrella sedge, Upoko-tangata	*Cyperus ustulatus*	5	FACW	Endemic						
	Creeping cinquefoil, European cinquefoil, creeping tormentil	*Potentilla reptans*	10	FAC	Exotic						
BUR5	Kikuyu grass	*Cenchrus clandestinus*	30	FACU	Exotic	<50%	3.0	Yes	Mineral soils with mottles and manganese staining	Yes	
	Creeping buttercup	*Ranunculus repens*	20	FAC	Exotic						
	Cleavers	*Galium aparine*	25	FACU	Exotic						
	Giant umbrella sedge, Upoko-tangata	*Cyperus ustulatus*	15	FACW	Endemic						
	Creeping cinquefoil, European cinquefoil, creeping tormentil	*Potentilla reptans*	10	FAC	Exotic						

BUR6	Alligator weed	*Alternanthera philoxeroides*	100	FACW	Exotic	>50%	2.0	Yes	Mineral soils with mottles and manganese staining	Yes	
BUR7	Alligator weed	*Alternanthera philoxeroides*	100	FACW	Exotic	>50%	2.0	Yes	Mineral soils with mottles and manganese and iron staining.	Yes	
BRPED GE1	New Zealand Flax	*Phormium tenax*	60	FACW	Planted native	>50%	2.7,	No	No evidence of mottles, soils largely organic, no manages or iron oxides	No	Distinct transition between planted flax, topography and wetland features. 
	Cleavers	*Galium aparine*	25	FACU	Exotic						
	Creeping buttercup	*Ranunculus repens*	15	FAC	Exotic						
BRPED GE2	New Zealand Flax	*Phormium tenax*	70	FACW	Planted native	>50%	2.7	No	Terrestrial soils No evidence of mottles, soils largely organic, no manganese or iron oxides.	No	Distinct transition between planted flax, topography and wetland features.
	Creeping buttercup	*Ranunculus repens*	10	FAC	Exotic						
	Cleavers	*Galium aparine*	15	FACU	Exotic						
	Field bindweed	*Calystegia sepium subsp. roseata x C. silvatica*	5	FAC	Exotic						

		subsp. disjuncta									
BRPED GE3	New Zealand Flax	*Phormium tenax*	70	FACW	Planted native	>50%	2.7	No	Terrestrial soils. No evidence of saturation , mottles, soils largely organic, no manganese or iron oxides.	No	Distinct transition between planted flax, topography and wetland. 
	Cleavers	*Galium aparine*	30	FACU	Exotic						
BRPED GE4	New Zealand Flax	*Phormium tenax*	95	FACW	Planted native	>50%	2.7	No	Terrestrial soils No evidence of mottles, soils largely organic, no manganese or iron oxides.	No	Distinct transition between planted flax, topography and wetland. 
	Field bindweed	*Calystegia sepium subsp. roseata x C. silvatica subsp. disjuncta*	5	FAC	Exotic						
BRPED GE15	New Zealand Flax	*Phormium tenax*	60	FACW	Planted native	>50%	2.7	No	Terrestrial soils. No evidence of mottles, soils largely organic, no manganese or iron oxides.		Distinct transition between planted flax, topographical features and wetland,
	Cleavers	*Galium aparine*	20	FACU	Exotic						
	Creeping buttercup	*Ranunculus repens*	20	FAC	Exotic						
BRP8	Creeping buttercup	*Ranunculus repens*	10	FAC	Exotic	<50%	3.2	Yes	Evidence of grey mottled soils, saturation with	Yes, owing to soil	

	Onion weed	*Allium triquetrum*	30	FAC	Exotic				evidence of oxidised rhizospheres.	profile	 
	Cleavers	*Galium aparine*	20	FACU	Exotic						
	Tall Fescue	*Lolium arundinaceum*	30	FAC	Exotic						
	Field bindweed	*Calystegia sepium subsp. roseata x C. silvatica subsp. disjuncta*	5	FAC	Exotic						
	New Zealand Flax	*Phormium tenax*	5	FACW	Native planted						
BRP9	Creeping buttercup	*Ranunculus repens*	5	FAC	Exotic	<50%	3.4	No	Terrestrial soils. No evidence of mottles, soils largely organic, no manganese or iron oxides.	No	
	Onion weed	*Allium triquetrum*	30	FAC	Exotic						
	Cleavers	*Galium aparine*	15	FACU	Exotic						
	Tall Fescue	*Lolium arundinaceum*	25	FAC	Exotic						
	Ribwort plantain	*Plantago lanceolata*	35	FACU	Exotic						
BRP1	River bulrush	*Bolboschoenus fluviatilis*	20	OBL	Non-Endemic	>50%	1.7	Yes		Yes	
	Mercer grass	*Paspalum distichum*	60	FACW	Exotic						
	Fool's	*Apium*	15	OBL	Non-						

	watercress	*nodiflorum*			Endemic						
	Onion weed	*Allium triquetrum*	5	FAC	Exotic						
BRP2	Creeping bent	*Agrostis stolonifera*	60	FACW	Exotic	>50%	2.3	Yes		Yes	
	River bulrush	*Bolboschoenus fluviatilis*	10	OBL	Non-Endemic						
	Onion weed	*Allium triquetrum*	20	FAC	Exotic						
	Ribwort plantain	*Plantago lanceolata*	5	FACU	Exotic						
BRP3	Bachelor's buttom, Yellow buttom	*Cotula coronopifolia*	5	FACW	Non-Endemic	>50	2.3	Yes	Evidence of soil saturation with mottling and gley soil structure, some iron deposits present	Yes	
	Jointleaf rush	*Juncus articulatus*	10	FACW	Exotic						
	Creeping bent	*Agrostis stolonifera*	65	FACW	Exotic						
	Common plantain	*Plantago coronopus*	10	FAC	Exotic						
	Ribwort plantain	*Plantago lanceolata*	5	FACU	Exotic						

	Common plantain	*Plantago major*	5	FACU	Exotic						
BRP4	Alligator weed	*Alternanthera philoxeroides*	50	FACW	Exotic	>50%	2.2	Yes	Evidence of soil saturation and oxidised rhizospheres.	Yes	
	Creeping bent	*Agrostis stolonifera*	25	FACW	Exotic						
	Jointleaf rush	*Juncus articulatus*	5	FACW	Exotic						
	Common plantain	*Plantago major*	5	FACU	Exotic						
	Tall Fescue	*Lolium arundinaceum*	5	FAC	Exotic						
	Slender bird'sfoot trefoil	*Lotus pedunculatus*	5	FAC	Exotic						
BRP5	Creeping bent	*Agrostis stolonifera*	30	FACW	Exotic	<50%	3.2	No	Terrestrial soils, no evidence of mottles of soil saturation	No	
	Perrenial ryegrass	*Lolium perenne*	30	FACU	Exotic						
	Annual bluegrass	*Poa annua*	20	FACU	Exotic						
	Common plantain	*Plantago major*	5	FACU	Exotic						
	Ribwort plantain	*Plantago lanceolata*	5	FACU	Exotic						
	Bachelor's buttom, Yellow buttom	*Cotula coronopifolia*	5	FACW	Non-Endemic						
	Dallis grass	*Paspalum dilatatum*	10	FACU	Exotic						

	Alligator weed	*Alternanthera philoxeroides*	5	FACW	Exotic						
	Daisy	*Bellis perennis*	5	FACU	Exotic						

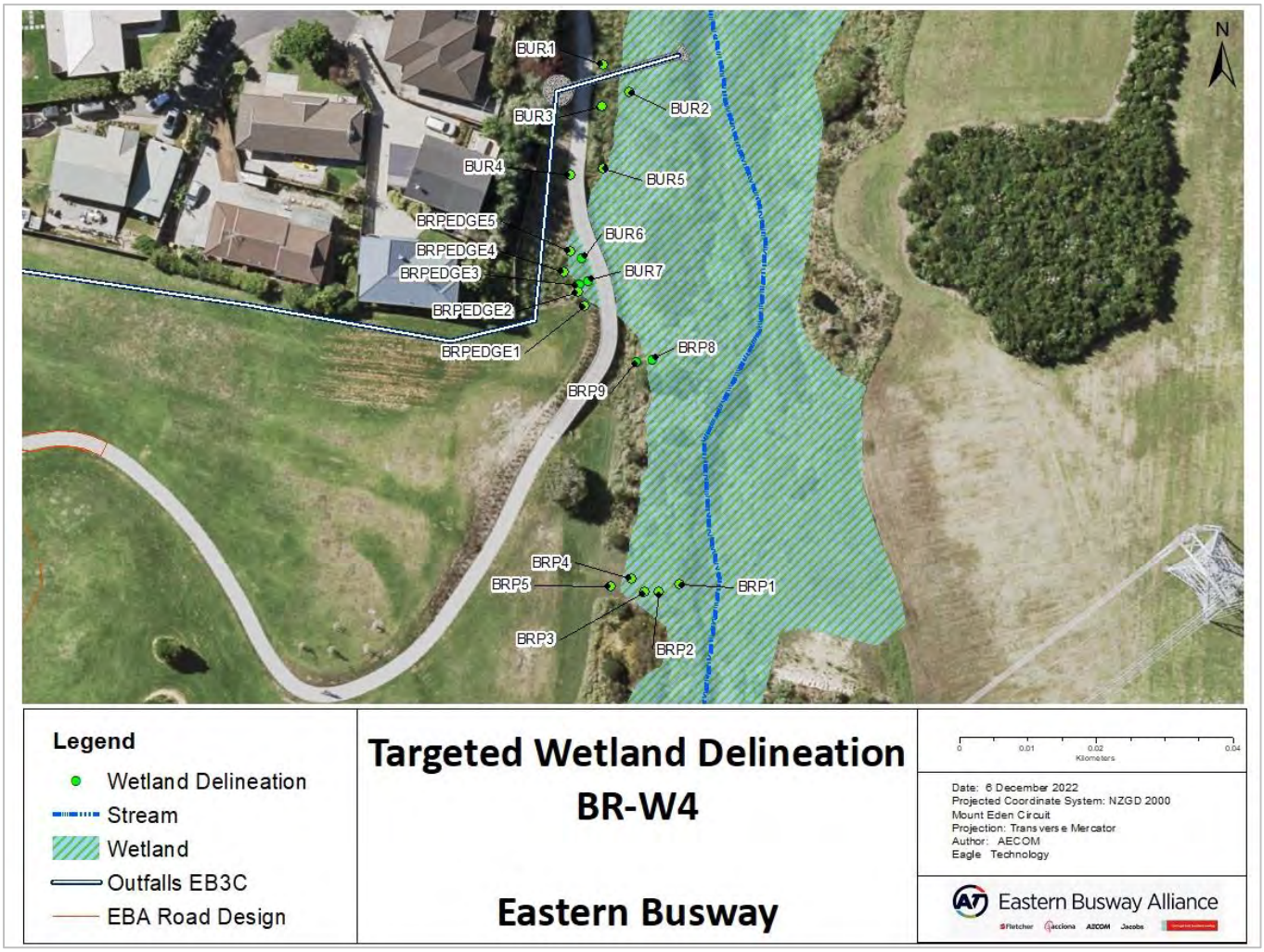


Figure A3-3 Targeted wetland delineation at BR-W4 in relation to proposed stormwater works. Twenty-one plots were taken following the wetland delineation protocols (MfE, 2020).

Figure A3-4 Historical extent of wetland prior to boardwalk construction in 2010/2011 (Auckland geomaps, 2022)

Figure A3-5 Historical extent of wetland following boardwalk construction in 2015/2016 (Auckland geomaps, 2022)

Figure A3-6 Wetland present to planted flax edge, distinct transition is soils and topography

A1.6 Wetland Ecological Value Assessment

Table A1-7 Summary of impact indicator scores for each component included within the wetland condition assessment, including the overall wetland condition category for HGM1 assessed during April 2021.

Wetland impact indicator	BR-W1	BR-W2	BR-W3	BR-W4	BR-W5	BR-W6	BR-W7	BR-W8	BR-W9	BR-W10	BR-W11	GR-W1	GR-W2	GR-W3	GR-W4	GR-W5
Hydrological integrity	5	5	5	5	5	5	5	5	5	5	5	3	3	3	4	4
Physico-chemical	4	4	4	4	4	4	4	4	4	4	4	3	3	4	4	3
Change in ecosystem intactness	2	2	2	2	2	2	2	2	2	2	2	2	2	4	5	4
Change in browsing, predation and harvesting regimes	4	4	4	4	4	4	4	4	4	4	4	3	3	4	4	4
Change in dominance of native plants	4	4	4	4	4	4	4	4	4	4	4	3	3	2	3	3
Wetland condition index /25	**19.0**	**19.0**	**19.0**	**19.0**	**19.0**	**19.0**	**19.0**	**19.0**	**19.0**	**19.0**	**19.0**	**14.0**	**14.0**	**15.7**	**20.0**	**16.2**
Condition Index (%)	**63.33**	**63.33**	**63.33**	**63.33**	**63.33**	**63.33**	**63.33**	**63.33**	**63.33**	**63.33**	**63.33**	**44.00**	**44.00**	**62.67**	**80**	**64.67**
Catchment pressures																
Modification to catchment hydrology	5	5	5	5	5	5	5	5	5	5	5	3	3	3	3	1

Wetland impact indicator	BR-W1	BR-W2	BR-W3	BR-W4	BR-W5	BR-W6	BR-W7	BR-W8	BR-W9	BR-W10	BR-W11	GR-W1	GR-W2	GR-W3	GR-W4	GR-W5
Water quality within the catchment	4	4	4	4	4	4	4	4	4	4	4	3	3	3	3	3
Animal access	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	4
Key undesirable species	4	4	4	4	4	4	4	4	4	4	4	3	3	3	3	3
Catchment introduced vegetation	4	4	4	4	4	4	4	4	4	4	4	3	3	3	3	2
Catchment pressure index/25	**15.2**	**16.7**	**16.7**	**17.2**	**16.7**	**19.8**	**14.5**	**15.0**	**16.7**	**16.0**	**16.0**	16.5	16.5	14.0	14.0	13.0
Catchment condition (%)	**37**	**37**	**37**	**37**	**37**	**37**	**37**	37	37	37	37	44	44	44	44	48
Combined condition (%)	**49**	**52**	**52**	**53**	**52**	**58**	**47**	**48**	**52**	**50**	**50**	**55**	**55**	**53**	**62**	**56**
Overall wetland condition category	**Largely modified**	**Largely modified**	**Largely modified**	**Largely modified**	**Largely modified**	**Largely modified**	**Largely modified**	**Largely modified**	**Largely modified**	**Largely modified**	**Largely modified**	**Largely modified**	**Largely modified**	**Largely modified**	**Moderately modified**	**Largely modified**

Table A3-8 EcIA criteria assessment of ecological value of Wetlands within EB3C and EB4L

Attributes		Wetland feature			
		Exotic Wetlands (EW) BR-W1, BR-W7, BR-W9 , BR-W10, GR-W1, GR-W2, GR-W3, GR-W5	Machaerina sedgeland (WL 11) BR-W2, BR-W8, BR-W10, GR-W4	Oioi restiad rushland/reedland (WL 10) BR-W4, BR-W5, BR-W6	Planted wetland (PL.1) BR-W3
Representativeness	Hydrological modification	2	2	2	2
	Physico-chemical modification	2	2	2	2
	Sediment and geomorphological modification	1	1	1	1
	Biota	1	1	1	1
	Wetland Conditions Index Score	2	2	2	2
	Score	**2**	**2**	**2**	**2**
Rarity/distinctiveness	Species of conservation significance	1	4	3	3
	Range restricted or endemic species	1	4	3	1
	Wetland type (rare or distinctive)	1	4	3	1
	Distinctive ecological values (ecosystem services) Larger context	2	2	2	2
	Score	**1**	**4**	**3**	**3**
Diversity and pattern	Diversity of habitat types	1	3	2	2
	Species diversity	1	3	2	2
	Score	**3**	**3**	**2**	**3**
Ecological context (Ecosystem services, importance and sensitivity)	Sensitivity to change in floods	1	1	1	1
	Sensitivity to change in baseflows (low flows)	1	1	1	1
	Sensitivity to change in water quality	1	1	1	1
	Flood attenuation	2	2	2	2
	Streamflow regulation	2	2	2	2
	Sediment trapping	2	2	2	2
	Phosphate assimilation	2	2	2	2
	Nitrate assimilation	2	2	2	2
	Toxicant assimilation	2	2	2	2
	Erosion control	3	3	3	3
	Carbon storage	2	2	2	2
	Connectivity and migration	1	1	1	1
	Protected status of the wetland	3	4	3	3
	Score	**Low**	**High**	**Moderate**	**Moderate**

Appendix 2 Stream Assessment Methodology

A2. 1 Storey & Wadha (2009) Stream Classification Methodology

During the site walkovers detailed above, all streams within the Project Areas identified on Auckland Council Geomaps ('Overland Flow Paths') were ground truthed and classified as permanent, intermittent or ephemeral, according to the stream definitions described by Storey and Wadhwa (2009), which are presented in Table A2-1. Any additional streams observed during site walkovers were also classified and where appropriate artificial swales, ditches and piped flow paths were also recorded.

Table A2-1 Stream classification criteria (Storey and Wadhwa, 2009)

Criteria	Definition
Permanent stream	
1	Evidence of continuous flow
Intermittent or ephemeral stream*	
1	Evidence of natural pools
2	Well defined banks and bed
3	Retains surface water present more than 48 hours after a rain event
4	Rooted terrestrial vegetation not established across channel
5	Organic debris from flooding present on floodplain
6	Evidence of substrate sorting, including scour and deposition
*If three or more of the six assessment criteria can be met with confidence, the watercourse is considered intermittent. If at least three criteria cannot be met, the watercourse is considered ephemeral.	
Ephemeral	
Stream reach with a bed above the water table at all times. Concentrated flow for short periods of time during and/or after rainfall. Not confined within a defined channel.	

A2.2 Stream Ecological Valuation Methodology

The SEV methodology (Storey et al., 2011) was developed by Auckland Council to enable the quantification of the ecological value of wadable streams and watercourses in a consistent manner that would inform resource management decisions. The SEV method is commonly used to assess the ecological state of streams within the Auckland region and essentially measures a stream's ecological value based on 14 key ecological functions, representing four broad stream function categories (hydraulic, biochemical, habitat provision and biodiversity provisions).

Inputs from each function are used to calculate an overall SEV score by means of averages and algorithms. The resulting score ranges between 0 and 1 is used to indicate the ecological function of the sampled stream or watercourse (refer to Table A2-2). Instream macroinvertebrate and fish communities were sampled at each SEV location, in accordance with the methodologies described in the Sections below. The results of the macroinvertebrate and fish surveys were fed into the SEV calculations and this provided the biological data required for the assessment.

Table A2-2 Interpretation of the overall SEV score (Storey et al., 2011)

Score	Ecological Conditions
0 – 0.40	Poor
0.41 – 0.60	Fair
0.61 – 0.80	Good
0.81 +	Excellent

A2.3 Macroinvertebrate Sampling Methodology

Instream macroinvertebrate communities were sampled at SEV location following protocols developed for the sampling of macroinvertebrates in wadeable, soft-bottomed streams in New Zealand (Stark *et al.,* 2001). Using protocol C2 (soft-bottomed, semi-quantitative) (Stark *et al*., 2001) a substrate area of approximately 3 m2 was manually disturbed at various locations at each site. Dislodged organisms and materials were then swept up using a D-net (0.5 mm mesh). Sampled substrate types varied according to availability at each site, but included submerged wood and macrophytes, banks margins and overhanging vegetation.

Composite samples were preserved on site in ethanol and shipped to a qualified macroinvertebrate taxonomist where they were processed following protocol P3 (full count with subsampling option) (Stark *et al*., 2001).

The analyses of macroinvertebrate data included:

- Taxonomic richness – the number of macroinvertebrate taxa recorded at each site;
- Abundance – the total number of individual macroinvertebrates recorded at each site. This includes analysis of percentage composition based on abundance;
- Overall community composition – EPT % richness – percentage representation of the major macroinvertebrate community groups recorded at each site, based on taxa richness. Percentage (%) of *Ephemeroptera* (mayflies), *Plecoptera* (stoneflies) and *Trichoptera* (caddisflies) (EPT) taxa was also calculated dividing the total number of EPT taxa present in a sample by total taxa richness and multiplying by 100 and used to provide an indicator of stream health; and
- Macroinvertebrate Community index (MCI) (Stark & Maxted, 2007) is a standardised method used in New Zealand to assess water quality in streams. The index reflects changes in taxonomic composition and uses a scoring system between 1 (tolerance to organic enrichment) and 10 (sensitive to organic enrichment) to assign a value to each taxon. This study uses the soft-bottom variants including MCI-sb and QMCI-sb to evaluate stream health (refer to Table 7).

2.4 eDNA Collection Methodology – Fish survey

Traditional survey methodologies used to detect the presence of cryptic species are often ineffective and seasonally constrained (traditional fishing methods are often not possible during low flow or in intermittent streams). eDNA fish sample and processing will be undertaken to supplement / replace fish surveys where necessary. Environmental Deoxyribonucleic acid (eDNA) is an alternative method of identifying the presence of a species, through the collection analysis of water samples (Dejean et al. 2011). Water was sampled from the stream bank at SEV locations. Water samples were taken using eDNA mini kits from Wilderlab NZ Ltd. Water was pushed through a filter stack (for turbid water sampling) using a 60 mL syringe. The samples were preserved placed in a sterile Ziploc bag and sent to Wilderlab NZ Ltd. for DNA analysis. DNA metabarcoding analysis was undertaken at the lab and DNA sequences compared against reference database to assign species.

Appendix 3 Stream Ecological Valuation (SEV) – Detailed Results

The SEV's undertaken within Burswood Reserve, Bard Park and Guys Reserve are presented Below in Table A3-1.

Table A3-1 Stream Ecological Valuation at Current (SEVc) scores for each component included within the SEV assessment, including the overall SEV score for the stream reaches that were surveyed within Burswood Reserve, Bard Park and Guys Reserve.

Function category	Report section	Function	Variable	BR-S1	BR-S2	BR-S3	GR-S1
			Vchann	0.10	0.41	0.76	0.64
			Vlining	0.90	0.66	0.82	0.38
			Vpipe	1.00	0.30	1.00	1.00
Hydraulic	4.1	NFR	=	**0.37**	**0.15**	**0.78**	**0.55**
			Vbank	0.40	0.30	0.70	0.58
			Vrough	0.69	0.70	0.79	0.82
Hydraulic	4.2	FLE	=	**0.28**	**0.21**	**0.55**	**0.48**
			Vbarr	1.00	0.30	1.00	0.30
Hydraulic	4.3	CSM	=	**1.00**	**0.30**	**1.00**	**0.30**
			Vchanshape	0.41	0.69	0.87	0.96
			Vlining	0.90	0.66	0.82	0.38
Hydraulic	4.4	CGW	=	**0.74**	**0.67**	**0.84**	**0.57**
		Hydraulic function mean score		**0.59**	**0.33**	**0.79**	**0.48**
			Vshade	0.22	0.52	0.54	0.72
biogeochemical	4.5	WTC	=	**0.22**	**0.52**	**0.54**	**0.72**
			Vdod	0.50	0.60	0.68	0.68
biogeochemical	4.6	DOM	=	**0.50**	**0.60**	**0.68**	**0.68**
			Vripar	0.30	0.60	0.50	0.60
			Vdecid	1.00	0.31	0.84	0.74
biogeochemical	4.7	OMI	=	**0.30**	**0.39**	**0.46**	**0.52**
			Vmacro	0.95	0.83	0.77	0.93
			Vretain	0.20	0.36	0.86	0.68
biogeochemical	4.8	IPR	=	**0.20**	**0.36**	**0.77**	**0.68**
			Vsurf	0.19	1.00	0.62	1.00
			Vripfilt	0.40	0.56	0.70	0.68
biogeochemical	4.9	DOP	=	**0.29**	**0.78**	**0.66**	**0.84**
		Biogeochemical function mean score		**0.30**	**0.53**	**0.62**	**0.69**
			Vgalspwn	0.00	0.55	0.55	0.40
			Vgalqual	0.00	0.25	0.25	0.25
			Vgobspwn	0.20	1.00	0.10	1.00
habitat provision	4.10	FSH	=	**0.10**	**0.57**	**0.12**	**0.55**
			Vphyshab	0.24	0.59	0.67	0.79
			Vwatqual	0.06	0.31	0.18	0.31
			Vimperv	0.00	0.20	0.00	0.70
habitat provision	4.11	HAF	=	**0.13**	**0.42**	**0.38**	**0.65**
		Habitat provision function mean score		**0.12**	**0.49**	**0.25**	**0.60**
			Vfish	0.33	0.33	0.47	0.53
Biodiversity	4.12	FFI	=	**0.33**	**0.33**	**0.47**	**0.53**
			Vmci	0.23	0.05	0.28	0.28
			Vept	0.00	0.17	0.00	0.06
			Vinvert	0.12	0.12	0.12	0.11
Biodiversity	4.13	IFI	=	**0.11**	**0.11**	**0.13**	**0.15**
			Vripcond	0.36	0.56	0.58	0.53
			Vripconn	1.00	0.59	0.60	0.60
Biodiversity	4.14	RVI	=	**0.36**	**0.33**	**0.35**	**0.32**
		Biodiversity function mean score		**0.27**	**0.26**	**0.32**	**0.33**
Overall mean SEV score (maximum value 1)				**0.353**	**0.410**	**0.552**	**0.538**

The SEVi scores associated with the permanent rock riprap at Burswood Reserve (BR-S1) and Bard Park (BR-S2) are presented below in Table A3-2.

Table A3-2 Stream Ecological Valuation at Current (SEVc) and Stream Ecological Valuation at Impact (SEVi) scores associated with the effect of the proposed permanent permeable scour protection within the stream bed at BR-S2B and BR-S1A.

Function category	Report section	Function	Variable	BR-S1 SEVc	BR-S1 Impact	BR-S2 SEVc	BR-S2 Impact
			Vchann	0.10	0.10	0.41	0.41
			Vlining	0.90	0.88	0.66	0.65
			Vpipe	1.00	1.00	0.30	0.30
Hydraulic	**4.1**	**NFR**	**=**	**0.37**	**0.36**	**0.15**	**0.15**
			Vbank	0.40	0.40	0.30	0.30
			Vrough	0.69	0.64	0.70	0.65
Hydraulic	**4.2**	**FLE**	**=**	**0.28**	**0.26**	**0.21**	**0.20**
			Vbarr	1.00	1.00	0.30	0.30
Hydraulic	**4.3**	**CSM**	**=**	**1.00**	**1.00**	**0.30**	**0.30**
			Vchanshape	0.41	0.41	0.69	0.69
			Vlining	0.90	0.88	0.66	0.65
Hydraulic	**4.4**	**CGW**	**=**	**0.74**	**0.72**	**0.67**	**0.66**
		Hydraulic function mean score		**0.59**	**0.58**	**0.33**	**0.33**
			Vshade	0.22	0.22	0.52	0.52
biogeochemical	**4.5**	**WTC**	**=**	**0.22**	**0.22**	**0.52**	**0.52**
			Vdod	0.50	0.50	0.60	0.60
biogeochemical	**4.6**	**DOM**	**=**	**0.50**	**0.50**	**0.60**	**0.60**
			Vripar	0.30	0.30	0.60	0.60
			Vdecid	1.00	1.00	0.31	0.31
biogeochemical	**4.7**	**OMI**	**=**	**0.30**	**0.30**	**0.39**	**0.39**
			Vmacro	0.95	0.95	0.83	0.83
			Vretain	0.20	0.20	0.36	0.36
biogeochemical	**4.8**	**IPR**	**=**	**0.20**	**0.20**	**0.36**	**0.36**
			Vsurf	0.19	0.19	1.00	1.00
			Vripfilt	0.40	0.40	0.56	0.56
biogeochemical	**4.9**	**DOP**	**=**	**0.29**	**0.29**	**0.78**	**0.78**
		Biogeochemical function mean score		**0.30**	**0.30**	**0.53**	**0.53**
			Vgalspwn	0.00	0.00	0.55	0.55
			Vgalqual	0.00	0.00	0.25	0.25
			Vgobspwn	0.20	0.20	1.00	1.00
habitat provision	**4.10**	**FSH**	**=**	**0.10**	**0.10**	**0.57**	**0.57**
			Vphyshab	0.24	0.24	0.59	0.59
			Vwatqual	0.06	0.06	0.31	0.31
			Vimperv	0.00	0.00	0.20	0.20
habitat provision	**4.11**	**HAF**	**=**	**0.13**	**0.13**	**0.42**	**0.42**
		Habitat provision function mean score		**0.12**	**0.12**	**0.49**	**0.49**
			Vfish	0.33	0.33	0.33	0.33
Biodiversity	**4.12**	**FFI**	**=**	**0.33**	**0.33**	**0.33**	**0.33**
			Vmci	0.23	0.23	0.05	0.05
			Vept	0.00	0.00	0.17	0.17
			Vinvert	0.12	0.12	0.12	0.12
Biodiversity	**4.13**	**IFI**	**=**	**0.11**	**0.11**	**0.11**	**0.11**
			Vripcond	0.36	0.34	0.56	0.54
			Vripconn	1.00	1.00	0.59	0.59
Biodiversity	**4.14**	**RVI**	**=**	**0.36**	**0.34**	**0.33**	**0.32**
		Biodiversity function mean score		**0.27**	**0.26**	**0.26**	**0.25**
Overall mean SEV score (maximum value 1)				**0.353**	**0.348**	**0.410**	**0.408**

Table A3-3 below provides the associated SEVi score changes at impact and justification for predicted scores following the installation of permeable rock riprap into the stream bed at Burswood Reserve and Bard Park Reserve.

Table A3-3 Associated SEVi score changes at impact and justification for predicted scores from installing rock riprap into the stream bed.

SEV Function	Current (SEVc)		Impact (SEVi)		Justification for predicted scores following installation of permeable rock riprap
	BR-S1	BR-S2	BR-S1	BR-S2	
Natural flow regime (NFR)	0.37	0.15	0.36	0.15	**Vchann**: Armouring small portion of stream bed, hydraulic complexity within 100m reach main stem unlikely to change. **Vlining**: Large portion of Burswood stream already lined with gabion baskets. Change incorporates bank to be lined within impermeable artificial material (outfall structure) and bed lined with permeable rock rip rap (predicted change at BRS2B to reduce by 0.05 and BR-S1 to reduce by 0.02). **Vpipe**: No change to piped inflow to the impacted length of stream.
Floodplain effectiveness	0.28	0.21	0.26	0.20	**Vbank**: Connectivity to flood plain remains similar to SEVc. Bank already protected by rock riprap and gabion baskets. **Vrough**: Permeable rock rip rap will replace small portion natural stream bed, temporary minor riparian vegetation removed for stormwater works.
Connectivity for species migration	1.00	0.30	1.00	0.30	**Vbarr**: Assumes no change at impact.
Natural connectivity to groundwater	0.74	0.67	0.72	0.66	**Vlining:** Bed now partially lining with permeable rock riprap.
Water temperature control	0.22	0.52	0.22	0.52	**Vshade**: Construction will result in minor temporary vegetation removal, which is assumes no change to water temperature control.
Dissolved oxygen levels maintained	0.50	0.60	0.50	0.60	**Vdod**: Assumed no change in dissolved oxygen levels as permeable riprap lining.

Organic matter input	0.30	0.39	0.30	0.39	**Vripar**: Assumes no change in organic matter input. **Vdecid**: Assumes no change in deciduous vegetation from impact.
In-stream particle retention	0.20	0.36	0.20	0.36	**Vmacro**: Assumes no change at impact.
Decontamination of pollutants	0.29	0.78	0.29	0.78	**Vsurf**: Assumes no change at impact. **Vripfilt**: Assumes no change at impact.
Fish spawning habitat	0.10	0.57	0.10	0.57	**Vgalspwn, Vgalqual, Vgobspwn:** No change in spawning habitat, considered already low suitability at current.
Habitat for aquatic fauna	0.13	0.42	0.13	0.42	**Vphyshab**: Habitat heterogeneity, diversity, and abundance to remain similar to SEVc. **Vwatqual**: Catchment-wide water quality will remain the same. Note: conservative as potential for improvement. **Vimperv**: Catchment-wide proportion of impervious surfaces remain at >25%.
Fish fauna intact	0.33	0.33	0.33	0.33	**Vfish**: Assumes no change at impact.
Invertebrate fauna intact	0.11	0.11	0.11	0.11	**Vmci**: Assumes no change at impact.
Riparian vegetation intact	0.36	0.33	0.34	0.32	**Vripconn**: Minor reduction to connection between stream and riparian zone.
Overall score	**0.353**	**0.410**	**0348**	**0.408**	**Scores reduced by 0.01**

Appendix 4 Summary Biodiversity Compensation Model Methodology

A4.1 Overview

The BCMs are used instead of biodiversity offset models when quantitative data is not available or lacks adequate precision to determine if adverse effects can be demonstrably offset[12] (Baber et al., 2021a,b,c). This is almost always the case for plan change and resource consent applications that are based on future predictions rather than on real data that has been collected after compensation has been undertaken (Baber et al. 2021a,b).

The BCMs include the determination of a biodiversity value score (herein "value score") for habitats and/or species, both before and after impacts ("losses") and before and after implementation of proposed compensation action(s) ("gains"). These value scores are derived from the EcIA assessments of ecological effects. Specifically, the assessments of ecological value (before impacts) and magnitude of effect are as set out in the respective ecology reports. To this end, the value scores are based on a combination of site-specific field assessments, scientific literature and the professional judgement of project ecologists.

The BCM approach and methods are described in detail in the User Guide developed by Tonkin & Taylor Ltd (T+T) (Baber et al. 2021a).

A4.2 Advantages of BCMs

To date, determination of biodiversity compensation requirements for plan change or resource consent applications has been based solely on professional opinion and may include the use of compensation ratios or 'multipliers'. These approaches have increasingly been challenged due to a lack of transparency and rigour, and often ad-hoc application.

The general advantages of BCMs in comparison to these previous approaches are that BCMs provide greater transparency and rigour to the process of developing measures to address residual adverse effects on biodiversity through compensation actions at proposed compensation site(s). In doing so, the BCMs operate at the 'as close to offset as possible' end of the compensation continuum. This is termed 'biodiversity compensation' in the Draft National Policy Statement for Indigenous Biodiversity (NPSIB).

A4.3 Model limitations

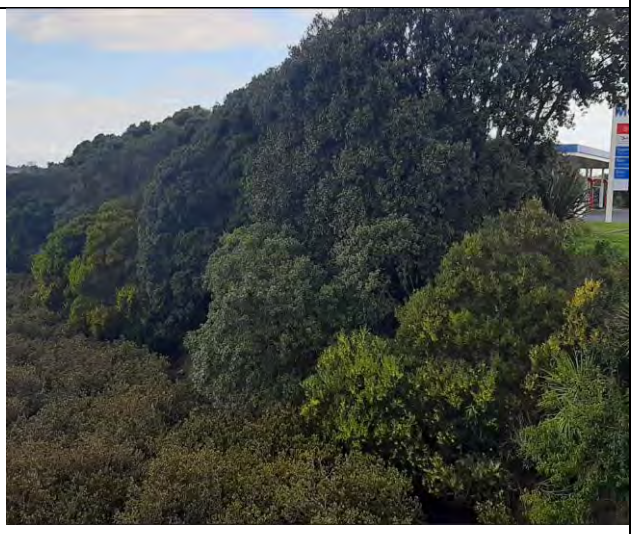
In applying any biodiversity offset or compensation model, it is important to acknowledge the limitations, constraints and uncertainties associated with such models (Maseyk et al, 2018). Notably for BCMs, these limitations, constraints and uncertainties have the potential to generate false positives, i.e. instances where the models generate Net Gain outcomes when the converse is true (Baber et al, 2021b). Model inputs are conservative to minimise this risk, and NG target outcomes are also conservative, equating to a target of 10% exceedance of No Net Loss.

It is also important to recognise that as described above in A4.2, this approach is robust, provides transparency and a validation process for determining compensation requirements to address residual adverse effects.

[12] A biodiversity offset is a 'measurable conservation outcome' that meets certain principles and balances adverse residual effects that cannot reasonably be avoided, remedied or mitigated, to a No Net Loss / Net Gain standard. While offsetting requires a measurable outcome that has been quantified through a robust and transparent process, biodiversity compensation does not necessarily need to be quantified and measurable.

Appendix 5 Terrestrial Ecological Observations and Value Assessment

A5.1 Eastern Busway EB3C and EB4L - Terrestrial Observations

	
Mixed native and exotic shelterbelt within the Project site, near China town.	Large exotic stand situated at Greenmount reserve.
	
Planted vegetation along riparian zone of Burswood reserve	Mixed native and exotic shelterbelt bordering mangrove habitat.
	
Planted vegetation along riparian zone of Burswood reserve	Understory scrub and deadwood may provide habitat for native lizards

A5.2 Terrestrial Habitat Value Assessment

Table A5-1 details the justification and scoring output for ecological value of terrestrial features.

Table A5-1 Justification of ecological value for terrestrial habitats related to the Project (Scores are weight 0 - 4)

Ecological Matters	**TL.1 – Native dominated treeland**	
	Score	Justification
Representativeness	3	Habitat has been significantly altered by human activities, however, contains 50-90% indigenous species within a stand.
Rarity/ distinctiveness	3	Nationally and locally common indigenous species where habitat may play an important role in provisional or regulatory ecosystem services at a local scale. Likely to contain 'At Risk-declining' lizard species in understory and along habitat edges.
Diversity and pattern	3	Moderate diversity of vegetation with habitat utilised by native birds and lizards at a local scale.
Ecological context	3	Habitat could provide locally important connectivity link for native avifauna. Habitat present is largely fragmented.
Ecological Value	**Moderate**	
Ecological Matters	**TL.2 - Mixed native and exotic vegetation**	
	Score	Justification
Representativeness	2	Habitat has been significantly altered by human activities and contains 10-50% indigenous species within a stand.
Rarity/ distinctiveness	3	Nationally and locally common indigenous species present where habitat may play an important role in provisional or regulatory ecosystem services at a local scale. Likely contains 'At Risk-declining' lizard species in understory and along habitat edges.
Diversity and pattern	2	Moderate diversity of vegetation largely exotic, with understorey dominated by exotic weeds. Habitat utilised by native species at a local scale.
Ecological context	3	Largely modified and fragmented habitat with exotic weeds. However, habitat could provide locally important connectivity link for native avifauna. While understory and habitat edges likely to provide for At Risk-declining' lizard species.
Ecological Value	**Moderate**	
Ecological Matters	**TL.2 – Exotic dominated treeland**	
	Score	Justification
Representativeness	1	Habitat has been significantly altered by human activities and contains <10% indigenous species within a stand.
Rarity/ distinctiveness	3	Exotic species present where habitat may play an important role in provisional or regulatory ecosystem services at a local scale. Likely to contain 'At Risk-declining' lizard Species in understory and along habitat edges.

Diversity and pattern	2	Exotic trees with understorey are largely absent and/or dominated by exotic weeds. Habitat utilised by native species at a local scale.
Ecological context	1	Largely modified and fragmented exotic habitat with exotic weeds. However, habitat could provide locally important connectivity link for native avifauna. Habitat understory likely providing habitat for "At risk declining" lizards at a local scale.
Ecological Value	**Low**	
Ecological Matters	**PL.1 – Planted vegetation**	
	Score	Justification
Representativeness	3	Habitat has been significantly altered by human activities, however, contains 50-90% indigenous species.
Rarity/ distinctiveness	3	Nationally and locally common indigenous species where habitat may play an important role in provisional or regulatory ecosystem services at a local scale. Likely to contain 'At Risk-declining' lizard species in understory and along habitat edges.
Diversity and pattern	2	Moderate diversity of vegetation with habitat utilised by native birds and lizards at a local scale.
Ecological context	3	Habitat could provide locally important connectivity link for native avifauna.
Ecological Value	**Moderate**	
Ecological Matters	**EG - Exotic scrub**	
	Score	Justification
Representativeness	1	Habitat and species have been significantly altered by human activities. <10% of the species are indigenous.
Rarity/ distinctiveness	3	Exotic species, including weed species and pests. Exotic understorey dominated by exotic weeds. Likely contain 'At Risk-declining' Lizard Species.
Diversity and pattern	2	Limited habitat diversity dominated by exotic species. Habitat potentially utilised by native species at a local scale.
Ecological context	1	Largely modified habitat. Habitat could provide some connectivity for the survival of species as any scale.
Ecological Value	**Low**	
Ecological Matters	**EG - Exotic grassland (Maintained)**	
	Score	Justification
Representativeness	0	Habitat and species have been significantly altered by human activities (mown areas).
Rarity/ distinctiveness	1	Exotic species, including weed species and pests. Maintained grass is unlikely contain 'At Risk-declining' Lizard Species but may provide corridor.
Diversity and pattern	1	Limited habitat diversity. Not significant at any scale.
Ecological context	1	Largely modified habitat. However, maintained grasses (non-maintained) areas are likely to provide lizard habitat.

Ecological Value	Very Low	
Ecological Matters	**EG - Exotic grassland (Rank grass)**	
	Score	Justification
Representativeness	1	Habitat and species have been significantly altered by human activities Subject to periodic mowing under vegetation stands along berms. <10% of the species are indigenous.
Rarity/ distinctiveness	3	Exotic species, including weed species and pests. Rank grass to likely contain 'At Risk-declining' Lizard Species.
Diversity and pattern	1	Limited habitat diversity. Habitat potentially utilised by native species at a local scale.
Ecological context	2	Largely modified habitat. However, Rank grasses (non-maintained) areas are likely to provide lizard habitat.
Ecological Value	**Low**	

A5.3 Bird records

Table A5-2 details all bird records undertaken from incidental bird assessments and available scientific sources.

Table A5-2 Desktop records and incidental observations of bird species within a 5km radius of the Project Area

Common Name	Scientific Name	Source	Conservation Status (Robertson et al. 2017)
Blackbird*	*Turdus merula*	Chaffe, 2016	Introduced and Naturalised
Chaffinch	*Fringilla coelebs*		Introduced and Naturalised
Eastern rosella*	*Platycercus eximius*		Introduced and Naturalised
Fantail*	*Rhipidura fuliginosa*		Native - Not Threatened
Goldfinch*	*Carduelis carduelis*		Introduced and Naturalised
Greenfinch	*C. chloris*		Introduced and Naturalised
Grey warbler*	*Gerygone igata*		Native - Not Threatened
Magpie*	*Gymnorhina tibicen*		Introduced and Naturalised
Mallard	*Anas platyrhynchos*		Introduced and Naturalised
Myna*	*Acridotheres tristis*		Introduced and Naturalised
Song thrush*	*T. philomelos*		Introduced and Naturalised
Sparrow*	*Passer domesticus*		Introduced and Naturalised
Spotted dove*	*Streptopelia chinensis*		Introduced and Naturalised

Common Name	Scientific Name	Source	Conservation Status (Robertson et al. 2017)
Starling	*Sturnus vulgaris*		Introduced and Naturalised
Tui*	*Prosthemadera novaeseelandiae*		Native - Not Threatened
Yellowhammer	*Emberiza citrinella*		Introduced and Naturalised
White faced heron*	*Egretta novaehollandiae*	iNaturalist	Not threatened
Pukeko*	*Porphyrio melanotus*	iNaturalist	Not threatened
New Zealand dotterel	*Charadrius obscurus*	iNaturalist	At-risk recovering
Pied shag	*Phalacrocorax varius*	NZ Bird Atlas	At risk-recovering
New Zealand dabchick	*Poliocephalus rufopectus*	NZ Bird Atlas	At risk-recovering
Little black shag	*Phalacrocorax sulcirostris*	NZ Bird Atlas	At risk- naturally uncommon
Kingfisher/Kotare*	*Todiramphus sanctus*	Incidental observation	Native – not threatened
Pheasant	*Phasianus colchicus*	Incidental observation	Introduced and Naturalised
Silvereye/tauhou*	*Zosterops lateralis*	Incidental observation	Native – not threatened

*Also, incidental observations in 2018 and 2021 site walkover.

Appendix 6 Biodiversity offset Model - Results

A6.1 Terrestrial BCMs EB3C and EB4L

A single preliminary BCM has been developed for the EB3C and EB4L application, to determine the type and magnitude of effort that is expected to achieve Net Gain outcomes for terrestrial biodiversity after 10 years.

Table A6-1 and Table A6-2 below describes the data inputs into the BCM. Table A6-3 below provides a data input and output summary. In conclusion, the BCM predicts that 10 % Net Gain outcomes for effects on the terrestrial habitats will be exceeded through the proposed compensation actions, i.e., the compensation score is 10% higher than the impact score. Given the nature of the Project location, a significant proportion of grasses are maintained, all perspective rank grasses are assumed to be present within the vegetation understory and fringing habitat and extents have been accounted for in the model. All habitat with understory has been valued as high (3) to account for potential lizard habitat lost as per the EcIA assessment.

Table A6-1 Biodiversity compensation model inputs ecological compensation ratios for vegetation clearance at EB3C and EB4L

ES Exotic scrubland		
Criteria	Data input	Justification
Impact risk multiplier	1.1 (+10%)	The impact risk assessed was deemed 'High' and is multiplied by 1.10 (+10%)
Impact uncertainty contingency	1.05 (+5%)	Effects associated explicitly with the loss of vegetation are of low uncertainty. Impact score is multiplied by 1.05 (+5%). Assumption that lizards are present in relatively low numbers given the results from the EB1 lizard salvage. No areas subject to predator control.
Areal extent	0.1934 ha	As determined by the extent of loss under the Project footprint
Value score prior to impact	3	Ecological value of habitat prior to impact relating to the representativeness, rarity, distinctiveness, diversity and ecological context and utilisation by lizards owning to the At Risk- Declining threat status of lizards. A score of '4' 'very high' habitat would include native vegetation with coarse woody debris subject to pest control, pest control is unlikely possible given the nature of the location. Score is of '3' is deemed conservative given the model justifies a score of 3 as "high value habitat that would typically provide for all species or species assemblage life-history requirements and/or provide a critical resource or resource(s) for life-history requirements. The habitat quality is high and the relative abundance within the habitat is, or is likely to be, high compared to other habitat types."
Value score after impact	0.001	Permanent loss of vegetation will occur (the model does not accept a score of 0).

PL.1 Planted native vegetation		
Criteria	Data input	Justification
Impact risk multiplier	1.1 (+10%)	The impact risk assessed was deemed 'High' and is multiplied by 1.10 (+10%)
Impact uncertainty contingency	1 (+5%)	Effects associated explicitly with the loss of vegetation are of low uncertainty. Impact score is multiplied by 1.05 (+5%)
Areal extent	0.345 ha	As determined by the extent of loss under the Project footprint
Value score prior to impact	3	Ecological value of habitat prior to impact relating to the representativeness, rarity, distinctiveness, diversity and ecological context and utilisation by lizards.
Value score after impact	0.001	Permanent loss of vegetation will occur (the model does not accept a score of 0).
TL.2 Mixed native and exotic		
Criteria	Data input	Justification
Impact risk multiplier	1.1 (+10%)	The impact risk assessed was deemed 'High' and is multiplied by 1.10 (+10%)
Impact uncertainty contingency	1 (+5%)	Effects associated explicitly with the loss of vegetation are of low uncertainty. Impact score is multiplied by 1.05 (+5%)
Areal extent	0.04 ha	As determined by the extent of loss under the Project footprint
Value score prior to impact	3	Ecological value of habitat prior to impact relating to the representativeness, rarity, distinctiveness, diversity and ecological context and utilisation by lizards.
Value score after impact	0.001	Permanent loss of vegetation will occur (the model does not accept a score of 0).

Table A6-2 Compensation actions model inputs for loss of vegetation at EB3C and EB4L

Compensation Actions	Action 1 (Revegetation)	Justification
Discount rate	3.0%	Temporal time lag between impact occurring and the biodiversity gains generated. Discount of 3% is recommended by the model (Maseyk et al., 2015; Baber et al., 2021).
Finite end point	10	The finite end point equates to the time between commencement of compensation and revegetation at 10 years. Defined by the duration of proposed monitoring and management programmes.
Impact uncertainty contingency	3	Moderate compensation confidence (50% to 75%) has been applied for the success of the proposed compensation measures.
Areal extent of offset (ha)	**0.75**	Adjusted to meet project net gain outcomes of 10%.
Value prior to compensation	0.5	Compensation proposed onsite to assist with corridor connectivity. Current value along the road corridor and within adjacent parks are mown grass with some biodiversity < 1. Marginal habitat criteria denotes this value as "may be used but is not important for any part of the species or species assemblage life cycle(s)."
Value score after compensation	3	Revegetation of habitat is considered of High ecological value. Consistent with replanted vegetation scores. The native revegetation is expected to improve terrestrial biodiversity value through the provision of terrestrial habitat in the form of native plants and coarse woody debris (felled logs) that in time will provide habitat for indigenous terrestrial species that colonise from surrounding habitats. This revegetation will also improve ecological connectivity by increasing ecological linkages between existing high value habitats and will provide a buffer within the development area.

Table A6-3 Mitigation requirements associated with vegetation loss for EB3C and EB4L

Model output	Total impact score
Exotic vegetation	-0.15312
Planted native vegetation	-0.27315
Mixed native and exotic	-0.45794
Compensation score	0.48831
Net-gain outcome	**6.6%**