Eastern Busway
EB2 and EB3 Residential

Stormwater Effects Assessment

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Eastern Busway

Quality Information

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List of Abbreviations and Definitions

Abbreviation and Definitions	Description
AC	Auckland Council
AEE	Assessment of Effects on the Environment
AEP	Annual Exceedance Probability
AMETI	Auckland Manukau Eastern Transport Initiative
ARI	Average Recurrence Interval
AUP(OP)	Auckland Unitary Plan (Operative in part) 2016
BPO	Best practicable option
CEMP	Construction Environmental Management Plan
CLM	Contaminant Load Model
CMA	Coastal Marine Area
EB1	Eastern Busway 1 (Panmure to Pakuranga)
EB2	Eastern Busway 2 (Pakuranga Town Centre)
EB3C	Eastern Busway 3 Commercial (Pakuranga Creek to Botany)
EB3R	Eastern Busway 3 Residential (SEART to Pakuranga Creek)
EB4	Eastern Busway 4 (link between Ti Rakau Drive and Te Irirangi Drive, and Botany town centre station)
EBA	Eastern Busway Alliance
GD01	Auckland Council 'Guidance Document 2017/001 Stormwater Management Devices in the Auckland Region'
Healthy Waters	Auckland Council Healthy Waters
ISC	Infrastructure Sustainability Council
km	Kilometre(s)
m	Metre(s)
m^2	Square Metre(s)
m^3	Cubic Metre(s)
MHWS	Mean High Water Springs
NDC	Auckland Council Network Discharge Consent
NES - CS	Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011
NZCPS	New Zealand Coastal Policy Statement 2010
NoR	Notice of Requirement
RL	Reduced Level
RMA	Resource Management Act 1991
RRF	Reeves Road Flyover
RTN	Rapid Transit Network
SEART	The Ti Rakau Drive/Reeves Road, south eastern arterial intersection
TPH	Total Petroleum Hydrocarbons
TSS	Total Suspended Solids
VMS	Variable message signs
WRR	William Roberts Road

Executive Summary

General

The philosophy for the design of the drainage and treatment system for the Eastern Busway Project (the Project) is a 'maintenance-led' approach, seeking to reduce the maintenance and operational costs to Auckland Transport and ultimately, to the ratepayers of Auckland. The design philosophy has been developed to incorporate the aspirations of mana whenua and Auckland Council (AC) Healthy Waters (Healthy Waters) for the Project area. As a key partner, discussions with mana whenua are ongoing and these discussions will influence the development of the detailed design.

The proposed design avoids flood impacts to private properties by designing independent stormwater networks that only connect to the existing network near their outfalls. The downstream sections of the networks from the connection point to the outfall will be upgraded where necessary (including the outfalls themselves).

The philosophy adopts a best practicable option (BPO) approach for water quality treatment and does not follow Guidance Document 2017/001 (GD01) Stormwater Management Devices in the Auckland Region as the default position. This is a risk-based approach, providing treatment efficiencies and options that are proportional to the contaminant generating risk. The use of a BPO approach is balanced by the target of achieving an overall reduction in the existing contaminant contributions from roads following completion of the Project.

The proposed stormwater networks, their connections and discharge of stormwater to existing and new outfalls are proposed to be authorised under the Healthy Waters Network Discharge Consent (NDC). Under the NDC, a Stormwater Management Plan (SMP) is required to be developed as a result of adopting a BPO approach and the SMP is required to be submitted during the NDC connection approval process which is part of the Engineering Plan Approval (EPA) process. The SMP is therefore developed based on the final detailed design and connection and SMP approval are obtained following completion of detailed design rather than during the resource consent application process. The construction of new outfalls and upgrading existing outfalls in the CMA are not covered by the NDC and are to be authorised by resource consent(s) as outlined in the Assessment of Effects on the Environment (AEE).

EB2

Eastern Busway 2 (EB2) has several overland flow paths running through its extents, which crosses roads in the 10 and 100-year Average Recurrence Interval (ARI) events. Ti Rakau Drive is particularly subject to these flow paths. The existing stormwater networks were historically designed for a 5-year ARI event which is equivalent to a capacity of a 2-year ARI event when allowing for climate change (increased rainfall and sea level rise).

There is extensive existing flooding during the 10 and 100-year ARI events due to the under sized networks. Existing flood depths within the EB2 Project area ranges from shallow (10-40 mm) to deep (100-600 mm) in the 10-year ARI event, with the 100-year ARI event featuring deeper flooding and an increase in the extent of the flooding.

Large parts of the existing outfall catchments, including stormwater from roads, have no stormwater treatment. The exception is Outfall MCC_108633, which has Tetra Traps within some catchpits and an Ecosol unit (GPT 41350) within Bus Stop Reserve (96R Pakuranga Road). Existing roads are not required to be treated under the AUP(OP) until they are improved or redeveloped.

The proposed stormwater treatment in the design reduces the existing total contaminant load from all roads discharging to EB2 outfalls. The predicted reductions are 39% for Total Suspended Solids (TSS), 14% for zinc (based on total zinc), 18% for copper (based on total copper) and 23% for total petroleum hydrocarbons (TPH). All individual outfalls have their existing contaminant loads from roads reduced, except for Outfall MCC_108633 as it will be connected to more carriageway catchment as a result of the Project (due to the resolution of flooding risks). Whilst Outfall MCC_108633 is predicted to receive a reduced TSS contaminant load of 17%, it is predicted to receive very small increases for zinc, copper and TPH. The increase is very small relative to the contaminant load model (CLM) uncertainty (refer to Section 4.2.1) and in comparison, to the larger overall decreases. No mitigation is proposed for water quality as overall the Project improves water quality (i.e., reduces the total combined existing contaminant loads discharged from all roads within outfall catchments).

The EB2 stormwater design and Project works will have no flood impacts on private property during the 10 and 100-year events. Instead, EB2 will result in reduced flooding over large areas of the wider catchment within which EB2 is located.

There are some reduced overland flow path capacities as a result of the EB2 works because the EB2 stormwater network design has not provided enough additional pipe capacity to replace the reduced overland flow path capacity and therefore mitigation is required. This is based on a secondary flow assessment where pipe blockages are applied to pipes, in accordance with the Auckland Council Stormwater Code of Practice (Version 3 January 2022). These reduced overland flow path capacities result in predicted small to modest flood impacts on private property during the 10 and 100-year events where pipe blockages have been applied. Mitigation is proposed for these properties. The mitigation involves relatively minor pipe size upgrades at several locations and some minor localised geometric design changes to the ground surface levels. There were also some areas identified as model noise rather than an actual impact. All potential impacts have been confirmed by updated flood modelling results to have been mitigated with no residual impacts.

In summary, the Project has a positive impact on flooding and contaminants discharge. The EB2 design treats all the stormwater from the Project's roads and busway and a large amount of the existing roads outside of the Project area that are not currently treated. This achieves an overall decrease in contaminants discharged to the receiving environment across EB2 from that currently discharged from roads. The EB2 design also avoids flood impacts on private property and reduces flooding over large areas of the wider catchment within which EB2 is located.

EB3R

Eastern Busway 3 Residential (EB3R) crosses or follows several overland flow paths that cross Ti Rakau Drive in several locations during the 10 and 100-year ARI events. The existing stormwater networks were designed for a 5-year event which is equivalent to a capacity of a 2-year event when allowing for climate change (increased rainfall and sea level rise).

There is extensive existing flooding during the 10 and 100-year ARI events due to the undersized networks. Existing flood depths within the EB3R area of the Project ranges from shallow (10-40 mm) to deep (100-600 mm) in the 10-year ARI event, with the 100-year ARI event featuring deeper flooding and an increase in the extents of flooding.

There is no existing treatment of stormwater from carriageway within EB3R. The proposed stormwater treatment in the design reduces the existing total contaminant load from all roads discharging to EB3R outfalls. The predicted reductions are 59% for TSS, 43% for zinc (based on total zinc), 48% for copper

(based on total copper) and 53% for TPH. All individual outfalls have their existing contaminant loads from roads reduced except for Outfall MCC_108707 which receives more road catchment as a result of the Project works designed to reduce flooding impacts. Whilst Outfall MCC_108707 is predicted to receive a reduced TSS contaminant load of 1%, it is predicted to receive increases of 74% for zinc, 62% for copper and 49% for TPH. This increase is the result of a section of Ti Rakau Drive being diverted from Outfall MCC_108713 for flood mitigation reasons since it could not easily be upgraded (it runs under several houses and immediately adjacent to several others). No mitigation is proposed for water quality as overall the EB3R and Project works improves water quality (i.e., reduces the total combined existing contaminant loads discharged from all roads within outfall catchments).

There are no flood impacts on private property during the 10 and 100-year events as a result of the EB3R stormwater design and Project works. There are large areas of reduced flooding throughout the wider catchment EB3R is located within.

There are some reduced overland flow path capacities as a result of the EB3R works that the EB3R stormwater network design has not sufficiently replaced, based on the secondary flow assessment where pipe blockages are applied to pipes in accordance with the Stormwater Code of Practice. These reduced overland flow path capacities result in predicted small to modest flood impacts on private property during the 10 and 100-year events. Mitigation is proposed for these properties. The mitigation involves incorporating relatively minor pipe upgrades at several locations and some geometric design changes to the ground surface levels into the final detailed design. There were also areas identified as model noise. All potential impacts have been confirmed by updated flood model results to have been mitigated with no residual impacts.

In summary, the Project has a positive impact on flooding and contaminants discharged. The EB3R design treats all the stormwater from the Project's roads and busway and a large amount of the existing roads outside of the Project area that are not currently treated. This achieves an overall decrease in contaminants discharged to the receiving environment across EB3R from that currently discharged from roads. The EB3R design also avoids flood impacts on private property and reduces flooding over large areas of the wider catchment within which EB3R is located.

1 Introduction

1.1 Overview of the Eastern Busway Project

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

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

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

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

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

The Project consists of the following packages:

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

A visual overview of the Project is shown in Figure 1.

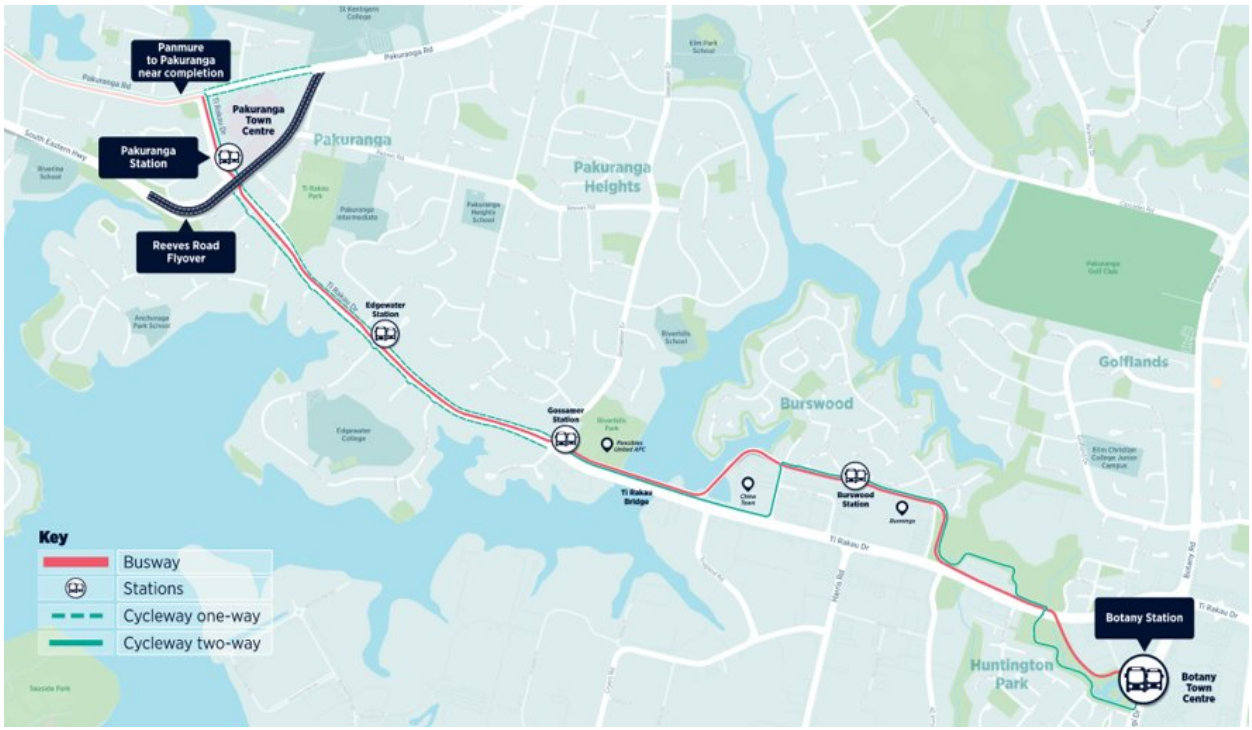

Figure 1. Project alignment

1.2 Project Objectives

The Project objectives are:

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

The Project objectives have been considered in relation to this assessment, with those particularly relevant to the assessment being objectives 1, 2, 3, and 5.

1.3 Consent Strategy and Design and Construction Zones

The Consent Strategy divides the Project into five consent packages for the purpose of developing and lodgement of resource consent and Notice of Requirement (NoR) applications. However, the stormwater design follows the Project zones that are being used for design and construction which more closely matches hydrological catchments than the Consent Strategy. The Consent Strategy is shown in Figure 2 with the differences to the design and construction zones identified.

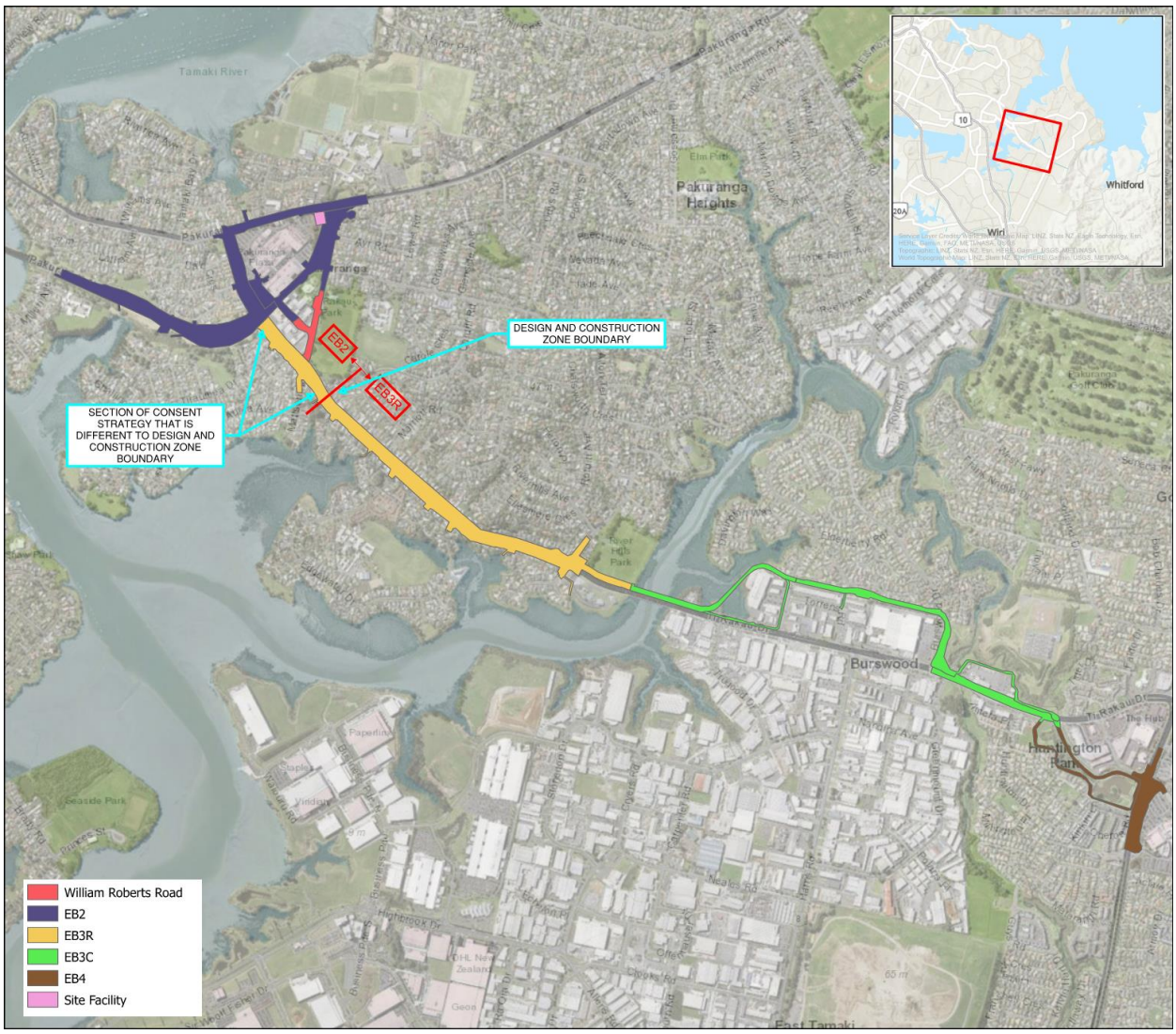

Figure 2: Consent Strategy and Design and Construction Zones

The following key elements discussed in this Stormwater Effects Assessment under Sections for EB2 are included in the EB3R consent package in accordance with the Consent Strategy:

- Outfall MCC_108699 (see Section 2.3, Table 1, Table 2 and Table 3)
- Potential flooding impacts on 7G and 9A Mattson Road identified for the overland flow path capacity assessment (with pipe blockages) as discussed in Section 6.1.4 Required Mitigation (see location 7 on Figure 57) for 7G and 9A Mattson Road as discussed in Section 7.1.3.

2 Proposal Description

2.1 Authorisation of Stormwater Network Connections and Discharges

Based on discussions with Healthy Waters, the Project proposes to use the NDC connection approval via the Engineering Plan Approval (EPA) process. This approach will authorise stormwater discharges to new and existing outfalls. Schedule 4 of the NDC outlines the requirements for connection approval and this report is structured to demonstrate the Project meets these requirements. The connection approval process is part of the EPA process that approves the final detail design rather than up front during the resource consent application process. As the Project has adopted a BPO approach a Stormwater Management Plan (SMP) is required to be prepared and submitted for approval as part of the connection approval process.

2.2 Stormwater Design Philosophy

The philosophy for the design of drainage and treatment system for the entire Project is a 'maintenance-led' approach, seeking to reduce the maintenance and operational costs to AT and ultimately, to the ratepayers of Auckland. The design philosophy has been developed to incorporate the aspirations of mana whenua and Healthy Waters for the Project area. There are ongoing discussions between AT, the EBA and Healthy Waters on their aspirations for Project-wide renewals and upgrades of their assets as part of the Project. These discussions provide an opportunity for best-for-Auckland solutions to overland flows, flooding and stormwater treatment. In parallel, EBA and Healthy Waters are meeting with the Project's key partners, mana whenua, to discuss their aspirations at ongoing hui.

The philosophy adopts a BPO approach for water quality treatment and does not follow Guidance Document 2017/001 (GD01) Stormwater Management Devices in the Auckland Region as the default position. This is a risk-based approach, providing treatment efficiencies and options that are proportional to the contaminant generating risk. The use of a BPO approach is balanced by the target of achieving a reduction in the existing contaminant contributions from roads, following completion of the Project. The target is assessed using the AC CLM which estimates loads for TSS, zinc, copper, and TPH and success is based on the total (sum of all outfalls) contaminant load (for each contaminant assessed in the CLM) for all outfalls that interact with the Project. Providing discretionary treatment that focusses on high contaminant generating roads and parking areas outside of the Project works is a key element of achieving this target.

The proposed stormwater networks and their connections and discharge of stormwater to existing outfalls are proposed to be authorised under the Healthy Waters NDC.

See the full Design Philosophy Statement provided in Appendix 1.

2.3 EB2 Design Statement

2.3.1 Design Overview

The main influences on the EB2 stormwater design are major utilities, trapped low points on EB2 and several overland flow paths crossing the Project area. The design does not currently fully address existing overland flows that cross the existing roads and therefore these overland flow paths are likely to continue to cross the general traffic lanes at a maximum depth of 100 mm in a 100-year ARI event for the busway subject to ongoing discussions with AT (asset owner of the busway and roads), mana

whenua and Healthy Waters (the asset owner of the existing stormwater networks and outfalls). The EB2 stormwater design drawings are provided in Appendix 2.

The increased flows as a result of the Project in EB2 will overload the existing stormwater network. To manage the increased flows and minimise the number of new outfalls required, the longitudinal drainage design provides new, independent stormwater networks that, where feasible, connect to the existing networks near their outfalls. This approach will only require upgrades to the outfall and last section of pipe – or a new outfall where connection to existing outfalls is unfeasible.

The design is in accordance with AT Transport Design Manual's (TDM) Engineering Design Code for Road Drainage (Engineering Design Code) and AC's Stormwater Code of Practice (Stormwater Code of Practice).

2.3.2 Scope of networks

The proposed independent networks for EB2 serve the following areas, which are shown on Figure 3 below:

- Existing outfall MCC_108633 - new stormwater network connects to the existing network within Bus Stop Reserve. This new network services a catchment covering the Pakuranga area including:
    - Ti Rakau Drive from Pakuranga Road to and including realigned Aylesbury Street to adjacent Countdown and half of the kiss and ride area
    - The intersection of Reeves Road and Pakuranga Road including the Reeves Road Flyover (RRF) eastern abutment
    - The northern section of William Roberts Road (WRR) North.
- Existing Outfall MCC_108673 - some existing drainage upstream of the SEART crossing (900 mm pipe) is modified to retain existing connections from the upstream residential catchment. The 900 mm pipe is not proposed to be upgraded as it has been confirmed that a Transpower high voltage cable joint bay has been built over the pipe. A separate pipe crossing further to the east is now proposed (refer to outfall 06-05)
- New outfall (Outfall 06-05) east of MCC_108673 - a new network and outfall servicing the following areas:
    - Approximately 90 m section of SEART near the RRF abutment
    - SEART off ramp
    - Approximately 80 m section of SEART on ramp
    - The westbound lanes of SEART, from the Millen Avenue overbridge to the location of the new pipe crossing, serviced by a swale which terminates at the new outfall (06-05)
    - The eastbound lanes of SEART from the Millen Avenue overbridge to the location of the new pipe crossing.
- New outfall (Outfall 89-18) further east of outfall 06-05. This new stormwater network services the following areas:
    - The southern section of WRR North
    - RRF western abutment
    - RRF itself
    - Reeves Road

    - Most of the SEART on ramp (approximately 320 m)
    - Part of Ti Rakau Drive from immediately after the realigned Aylesbury Street and Palm Avenue intersection to immediately before Mattson Road

- Existing outfall MCC_108680 is an existing outfall that discharges to a wetland. Healthy Waters has indicated aspirations to upgrade Sections of this network within Ti Rakau Drive. This creates an opportunity to divert part of the southern side of Ti Rakau Road (westbound lane and the busway) into this network (Outfall MCC_108680) and divert part of its existing commercial land catchment to the main pipeline of proposed new Outfall 89-18, which is significantly constrained by required clearances to the Transpower high voltage cable. This network currently services:

    - Residential land south of the SEART
    - Commercial land between Reeves Road, WRR and Cortina Place
    - Parts of Ti Rakau Drive, Reeves Road (residential Section), a small section of WRR and Cortina Place (the design removed Reeves Road (commercial section)), WRR, part of Cortina Place and part of Ti Rakau Drive from this existing network).

- Existing outfall MCC_108699, an existing outfall and network that services a large residential catchment south and north of Ti Rakau Drive including part of the residential area north of Reeves Road between Lewis Road and Udys Road. EB2 works include completing the WRR network (covered by the WRR early works consent package for the temporary solution) by installing a new pipeline across Ti Rakau Drive and connecting to manhole MCC_74649. The existing 900 mm pipe is proposed to be upgraded from manhole MCC_74649 to its outfall and the outfall structure is also proposed to be upgraded. Healthy Waters have indicated an aspiration to upgrade the existing 900 mm pipe across Ti Rakau Drive. In accordance with the WRR early works resource consent (condition 4.1), once these works are completed the flood mitigation bund along the northern and eastern boundaries of 6 Mattson Road, Pakuranga on land controlled by the consent holder can be removed. Condition 4.2 of the WRR early works consent application requiring these works to be completed within 30 months of the WRR consent being granted will also have been satisfied. AT and Healthy Waters are in the process of agreeing on carrying out Healthy Waters renewals and upgrades as part of the Project works. The design proposes an independent network that services:

    - WRR from Ti Rakau Drive up to the Pakuranga Rugby League Club driveway entrance
    - A section of Ti Rakau Road from Williams Roberts Road to approximately adjacent to 94 Ti Rakau Drive.

The drainage network on Reeves Road will be upgraded and diverted to Outfall 89-18 to suit the new alignment. The network will consist of:

- Raingardens located within the median that separates the northbound and the southbound lanes between the RRF piers. They will form the green infrastructure treatment facilities for the runoff directly falling on Reeves Road and a partial area of the RRF's traffic lanes. The raingardens will form urban design features (design development during detailed design) that simulate rainfall onto the raingarden. Mana whenua have been involved in discussions around this design detail. The raingardens are bordered by split kerbs (i.e., short sections of kerb removed to allow runoff to flow through the gaps into the raingardens) to allow the runoff capture and will include grated manholes as outlet structures to collect treated stormwater via the subsoil drains and overflows during larger rainfall events via direct entry into the large grate

- A collector pipe located behind the footpath on the southbound carriageway which discharges into the Coastal Marine Area (CMA) at outfall 89-18
- The drainage design for Ti Rakau Drive which provides a new system between Pakuranga Road and WRR for the entire cross-sectional area of the alignment and consists of:
    - Inlets spaced and sized to capture runoff at low points on Ti Rakau Drive and Reeves Road (Megapits, catchpits, grated trench drains and combined kerb drainage systems which are hollow kerbs that convey runoff)
    - A piped gravity system to convey the 10-year runoff and avoids clashes with major utilities.

2.3.3 Constraints and limitations

EB2 has many constraints and limitations which make the stormwater design proposed complex and challenging. The constraints and limitations are:

- Existing major utilities (Hunua 2 Watermain, 220 kV high voltage cables and the Howick Interceptor)
- Topography, particularly the low points along Ti Rakau Drive and Reeves Road
- Tie in with existing roads - limited opportunities for adjustment of the proposed vertical alignment
- Existing drainage was historically designed to a 5-year standard and when climate change is added the current capacity is approximately equal to a 2-year ARI event
- The network capacity of outfall MCC_108633 is upgraded by a proposed pipeline along Pakuranga Road which otherwise has no works proposed. This is because stormwater from new pavements and modified pavements at two Pakuranga Road intersections (WRR/RRF) and Ti Rakau Drive are part of a stormwater sub-catchment that drains to Bus Stop Reserve. The alignment is therefore constrained to minimise impacting pavements that would otherwise not be modified by the Project.

Although the proposed drainage system is following the topography such that the pipe depths are minimised, utilities crossings are a major factor in driving the system very deep (i.e., 4 to 7 m in places). Outfalls 06-05 and 89-18 have outfall invert levels at coastal bed levels.

The SEART off ramp conflicts with an overland flow path for catchments north of the alignment as well as displacing flood water. This has required upgrades to the existing drainage crossing SEART to be incorporated into the design. Both on and off ramps are proposed to drain to swales to provide treatment and to improve sustainability outcomes (i.e., providing green infrastructure wherever feasible).

The RRF drainage design was undertaken for a crowned cross section, with 0.6 m shoulders. Catchpits spaced at approximately 15 m apart have been provided against the outside barriers. Downpipes into the Reeves Road drainage system (i.e., raingardens or piped system) are provided at each pier.

For the Reeves Road drainage network, several utilities which are retained, including the Hunua 2 watermain (part of which is to be realigned), are located within the median between the busway and the westbound carriageway. This creates a constraint for the proposed drainage system. A one-way crossfall on the busway has been provided to limit the number of drainage structures required which helps reduce potential clashes with other utilities.

2.3.4 Stormwater Treatment and Discharge

EB2 will connect to existing networks, except for two new networks, and discharge to or adjacent to the CMA at the locations summarised in Table 1.

Due to the complexity of avoiding major utility clashes (i.e., the Transpower high voltage cable, Hunua 2 watermain, and the Howick Interceptor), as well as the need to achieve an outfall invert above the CMA bed level, the stormwater network draining to Outfall MCC_108680 which discharges to a wetland may also need to be modified. However, the modification to its network will be limited to diverting some of the peak flows to adjacent networks (via a flow splitting manhole that allows low to moderate flows to continue to discharge to the wetland) and including some of the Projects carriageway catchment to the outfall.

Table 1: Summary of Outfalls proposed to receive discharges from EB2 stormwater networks

Outfall	Existing Outfall	Discharges to CMA	Outfall in CMA	Comment
Outfall MCC_108633	✓	✓	✗	Connection point is in Bus Stop Reserve, approximately 60 m upstream of outfall (see Figure 3). The existing outfall is approximately 1 m from the AUP(OP) indicative CMA boundary (see Figure 3). The Project works are not within the CMA.
Outfall 06-05	✗	✓	✓	New outfall and pipe to be constructed approximately 24 m southeast of MCC_108673. The proposed outfall invert level is RL0.73 m which is very close to CMA bed level. The proposed outfall is either on or within the AUP(OP) indicative CMA boundary (see Figure 3). The outfall requires CMA bed channel lowering works and erosion and scour protection. The Project works are within the CMA.
Outfall 89-18	✗	✓	✓	New outfall and pipe to be constructed approximately 53 m southeast of MCC_108673. The proposed outfall invert level is RL0.58 m which is very close to CMA bed level. The proposed outfall is either on or within the AUP(OP) indicative CMA boundary (see Figure 3). The outfall requires erosion and scour protection within the CMA and potentially CMA bed channel lowering. The Project works are within the CMA.
Outfall MCC_108699	✓	✓	✗	The connection point is the last manhole before the outfall. The outfall and the downstream section of pipe is to be upgraded. The outfall is approximately 133 m clear of the AUP(OP) indicative CMA boundary (see Figure 3). The Project outfall works are not considered to be within the CMA.
Outfall MCC_108680	✓	✓	✗	The final detailed design is proposed to include modifications to reduce the number of complex and high-risk crossings of the Transpower high voltage cable (critical infrastructure) by stormwater pipes. This will require some project stormwater from westbound lanes of Ti Rakau Drive and the busway to be discharged to this network and some of the network's catchment on the eastern side of Ti Rakau Drive being diverted to another network during larger rainfall events (i.e., part of the peak during larger events will be diverted away from the wetland).

The CMA landward boundary delineates a jurisdictional limit for rules under New Zealand's Resource Management Act (RMA) policy and planning framework and is defined by the line of mean high water

springs (MHWS). The MHWS is defined as "the long-term average of the highest high tide ('spring tide') that occurs after every new and full moon" by NIWA 2012 (Development of an updated Coastal Marine Area boundary for the Auckland Region) and can be retrieved from recorded measurements or NIWAs MHWS model. From a coastal management perspective, the CMA boundary is of significance because Section 12 of the RMA provides that various identified activities within the CMA can only be carried out if they are authorised by a national environmental standard, a regional coastal plan or resource consent. Conversely, from a landward perspective, the CMA boundary is of significance as it defines the boundary along the coast for land-based planning frameworks (i.e., Sections 9(2) and 9(3) of the RMA). Based on the AUP(OP) indicative CMA boundary (see Figure 3) and the proposed outfall upgrades, works within the CMA are proposed at Outfalls 06-05 and 89-18.

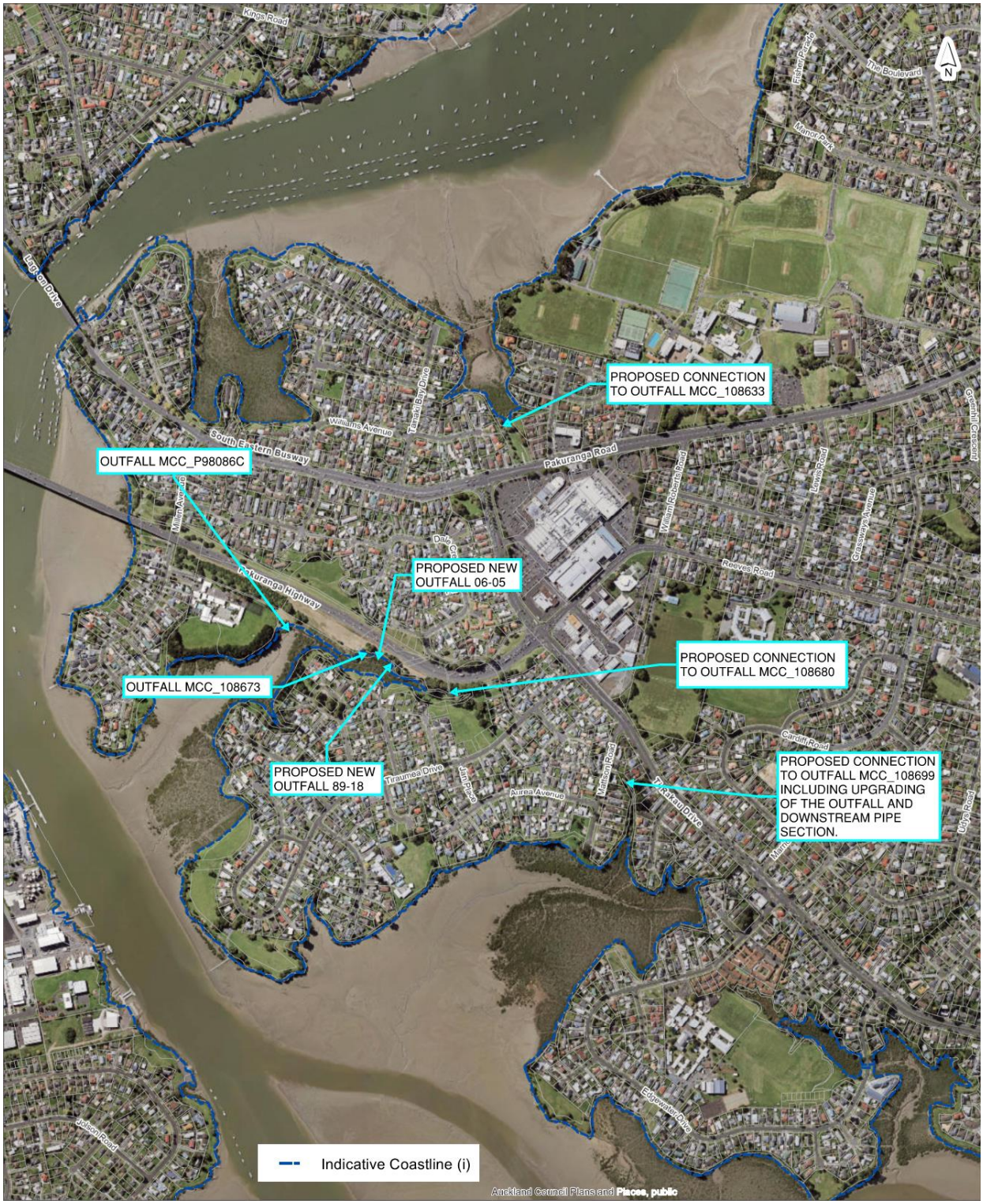

Figure 3: EB2 outfall locations and AUP(OP) indicative CMA boundary

The stormwater treatment BPO includes a combination of:

- Green infrastructure (i.e., swales (Figure 4) and bio-retention raingardens (Figure 5)) where feasible (i.e., adjacent to ramps, within residual land and some in the busway medians where the width permits)
- Gross pollutant traps (GPT) designed to include a 5 mm screen and to remove litter, debris, and at least 50% of TSS, are proposed at the downstream end of each network at each outlet within the road reserve or other locations convenient for maintenance access

- Discretionary targeted treatment of high use roads and carparks, outside of areas where the Project is modifying or creating new impervious areas, has been used where necessary to achieve the desired reductions to existing contaminant loads as stated in the design philosophy (subject to ongoing discussions between mana whenua, Healthy Waters and EBA).

Figure 4: Example of a Swale (sourced from AC Swales and Filter Strips Construction Guide)

Figure 5: Example of a Raingarden

A stormwater management options assessment based on integrated catchment management approaches was carried out to identify the BPO. The Stormwater Management Option and BPO Report will be finalised and included in the SMP. The BPO treatment devices provided within EB2 for each outfall that receives Project stormwater discharges are summarised in Table 2. The proposed treatment devices included in the BPO for the design, are subject to ongoing discussions with mana whenua and Healthy Waters.

Table 2: Summary of proposed EB2 stormwater devices

Outfall	Treatment Category	Treatment Devices	Comment
Outfall P98086C	Not Treated	None	Existing network which is not receiving any Project stormwater discharges.
Outfall MCC_108673	Not Treated	None	Existing network which is not receiving any Project stormwater discharges.
Outfall 06-05	EBA BPO	GPT	All Project stormwater will be treated by a GPT.
Outfall 89-18	EBA BPO	GPT and Raingardens	Raingardens will be provided for Reeves Road, RRF and some parts of Ti Rakau Drive (busway and west bound traffic). Swales will be provided for SEART ramps and a GPT will be provided for the entire catchment.
Outfalls MCC_108680	EBA BPO and discretionary for existing network	GPT	A GPT (designed to remove 50% TSS) will be provided for both the existing stormwater network and Project stormwater.
Outfall MCC_108699	EBA BPO and discretionary for existing network	GPT	A GPT (designed to remove 50% TSS) will be provided for both the existing stormwater network and Project stormwater.
Outfall MCC_108633	EBA BPO	GPT and raingarden	A Raingarden will be provided to treat a small part of catchment (short section of Ti Rakau Drive). A GPT (designed to removal 50% TSS) will be provided to treat Project stormwater and the existing stormwater network.

A CLM (see Section 4.2.1 for methodology and analysis) for EB2 has been developed to compare the BPO treatment option with existing contaminant load contributions from roads to each outfall that receives discharges or has had its catchment changed (i.e., road source areas reduced). The CLM estimates the percent change from the existing situation for TSS, zinc, copper, and TPH as summarised in Table 3.

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

existing contaminant load contributions from all roads to outfalls that interact with the Project on an overall basis.

The CLM currently predicts EB2 as achieving an overall improvement for TSS, copper and TPH (see

Table 3). Outfall P98086C currently has no change to its catchment and no discharge from Project stormwater (including from SEART) as reflected in Table 3.

Outfall MCC_108633 is predicted to receive an increase in contaminant loads for zinc, copper and TPP which is caused by an increase in road catchment area and constraints preventing the use of green infrastructure (i.e., treatment is only by a GPT designed for 50% removal of TSS).

Table 3: Summary of EB2 predicted change in contaminant loads

Outfall	TSS[1]	Zinc[1]	Copper[1]	TPH
Outfall P98086C	**0%**	**0%**	**0%**	**0%**
Outfalls MCC_108673, 06,05, & 89-18	**-41%**	**-5.3%**	**-14%**	**-23%**
Outfalls MCC_108680	**-73%**	**-81%**	**-81%**	**-81%**
Outfall MCC_108699	-54%	-43%	-46%	-50%
Outfall MCC_108633	-17%	0%	0%	0%
Total EB2 change	-39%	-14%	-18%	-23%

Note: [1] Refer to Section 4.2.1 for general level of uncertainty associated with the CLM outputs.

2.3.5 Flood Management

A comprehensive flood model for EB2 (includes EB3R for assessing cumulative effects) has been developed for the Project based on an existing AC flood model for the Tāmaki River – Pakuranga Catchment Boundary. The methodology of the modification of the model is discussed in Section 4.3. The results of the flood modelling for the existing situation (the 'base case') are discussed in Sections 5.1.5 (Overland Flow Paths and Flooding) and 5.1.6 (Overland Flow Path Capacity). The results for the design case are discussed in Sections 6.1.3 (Flooding Assessment) and 6.1.4 (Overland Flow Path Assessment).

2.4 EB3R Design Statement

2.4.1 Design Overview

The main characteristics influencing stormwater design for this section of the Project are major utilities and several overland flow paths crossing the alignment of EB3R. The design addresses current overland flow that crosses the existing general traffic lanes and the proposed busway and is discussed in more detail in the design philosophy statement at Appendix 1. The EB3R design drawings are provide in Appendix 3.

In accordance with the design philosophy for longitudinal drainage, EB3R provides new independent stormwater networks to avoid flooding impacts from increasing flows in existing stormwater networks. The new stormwater networks connect to the existing stormwater networks near their outfalls with the outfall and pipe between the connection point and outfall upgraded where necessary.

No stormwater works are proposed where existing kerb positions are retained and where only minor modification of existing pavements is proposed (i.e., pavement overlays and repairs) unless this is required for flood mitigation.

The design is in accordance with the Engineering Design Code and the Stormwater Code of Practice.

2.4.2 Scope of networks

The proposed independent networks for EB3R serve the following areas:

- Outfall MCC_108703 is an existing outfall and network that serves residential areas north and south of Ti Rakau Drive including part of Cardiff Road. The Project stormwater network upstream of the connection point services the following area:
    - Ti Rakau Drive westbound (From Roseburn Place to approximately 99 Ti Rakau Drive)
    - Ti Rakau Drive eastbound (between 96 and 118 Ti Rakau Drive)
    - Busway (same extents as the Ti Rakau Drive eastbound carriageway).
- Outfall MCC_108707 is an existing outfall and network that serves residential areas north and south of Ti Rakau Drive including part of Marriot Road and Opal Avenue. The Project stormwater network upstream of the connection point services the following area:
    - Ti Rakau Drive westbound (between 101 Ti Rakau Drive and Wheatley Avenue)
    - Ti Rakau Drive southbound (between 120 to 160 Ti Rakau Drive)
    - Busway (between 120 and 160 Ti Rakau Drive).
- Outfall MCC_108713 is an existing outfall and network that serves residential areas to the north and south of Ti Rakau Drive including parts of Ti Rakau Drive. The Project design diverts the Ti Rakau Drive stormwater to the EBA network that connects to MCC_108707
- Outfall MCC_108718 is an existing outfall and network that serves Ti Rakau Drive and residential areas to the north and south of Ti Rakau Drive including parts of Edgewater Drive, Te Anau Place and Ellemere Crescent. All of Ti Rakau Drive in this network is diverted by the new Project stormwater network into outfall MCC_108719
- Outfall MCC_108719 is a small outfall and network that serves a few residential properties south of Ti Rakau Drive that have been purchased for the Project. The Project stormwater network upstream of the connection point services the following area:
    - Ti Rakau Drive westbound (From Wheatley Avenue to approximately 157 Ti Rakau Drive)
    - Ti Rakau Drive eastbound (between 164 and 180 Ti Rakau Drive)
    - Busway (between 164 and 180 Ti Rakau Drive).
- Outfall MCC_108738 is an existing outfall and network that serves residential areas to the south of Ti Rakau Drive including parts of Ti Rakau Drive. The eastbound carriageway stormwater remains within the existing network with the proposed Project design. The Project stormwater network upstream of the connection point services the following area:
    - Ti Rakau Drive westbound (between 159 and 187 Ti Rakau Drive)
    - Busway (between 180 and 192 Ti Rakau Drive).
- Outfall MCC_108748 is an existing outfall and network that serves residential areas to the south of Ti Rakau Drive including parts of Ti Rakau Drive. The proposed connection point for the Project stormwater network is manhole SAP ID 2000639538. The Project stormwater network upstream of the connection point services the following area:
    - Ti Rakau Drive westbound (from between 189 Ti Rakau Drive to Fremantle Place)
    - Busway (from 194 Ti Rakau Drive to Fremantle Place).

- A new outfall for the proposed overland flow stream in Riverhills Park with an outfall to Pakuranga Creek. The Project stormwater network upstream of the connection point services the following area:
    - Ti Rakau Drive eastbound (from 180 to Gossamer Drive)
    - Busway (from Gossamer to Ti Rakau Bridge)
    - Gossamer Drive (from Riverhills Avenue to Ti Rakau Drive).
- Outfall MCC_108746 is an existing outfall and network that serves approximately 85 m of Ti Rakau Drive west and eastbound lanes. The Project design does not change this existing network
- Outfall MCC_108749 is an existing outfall and network that serves approximately 165 m of Ti Rakau Drive west and eastbound lanes between Gossamer Drive/Fremantle Place intersection with Ti Rakau Drive and the start of the catchment for outfall MCC_108746. The EBA design does not change this existing network.

2.4.3 Constraints and limitations

EB3R has several constraints and limitations which drive the design towards the solutions adopted. The constraints and limitations are:

- Existing major utilities
    - Hunua 2 Watermain runs along the median between the busway and westbound lanes then crosses over near Edgewater Drive (West) into private properties to the north and finally runs along under part of the proposed busway after Gossamer Drive before crossing Ti Rakau Drive to its bridge across Pakuranga Creek
    - Transpower 220 kV high voltage cables run along the eastbound carriageway close to the proposed median between the eastbound lanes and the busway until it approaches Ti Rakau Bridge where it crosses over to the northern edge of Ti Rakau Bridge
    - Howick Interceptor crosses from within private property on the southern side of Ti Rakau Drive to the northern side of Ti Rakau Drive as it approaches Gossamer Intersection. This cross over section is the only interaction with EB3R.
- Topography, as there are areas that have very flat longitudinal grade along Ti Rakau Drive.
- Existing drainage was historically designed to a 5-year standard and when climate change is added the current capacity is approximately equal to a 2-year ARI event.

2.4.4 Stormwater Treatment and Discharge

EB3R will connect to existing networks, except for one proposed new network, and discharge at outfalls near or within the CMA based on the AUP(OP) indicative CMA boundary (see Figure 6) at the locations summarised in Table 4.

Table 4: Summary of EB3R outfalls proposed to receive discharges

Outfall	Existing Outfall	Discharges to CMA	Outfall in CMA	Comment
Outfall MCC_108703 (1a)	✓	✓	✗	The connection point is the last manhole before the outfall. The last section of pipe from the connection point to the outfall is to be upgraded. The outfall is to be upgraded and is well clear of the AUP(OP) indicative CMA boundary which is 50 m away (see Figure 6).

Outfall MCC_108707 (1b)	✓	✓	✗	The connection point is the second to last manhole before the outfall. The last two sections of pipe from the connection point to the outfall are to be upgraded. The outfall is to be upgraded and is well clear of the AUP(OP) indicative CMA boundary which is 23 m away (see Figure 6).
Outfall MCC_108719 (2)	✓	✓	✓	The connection point is the last manhole before the outfall. The last section of pipe from the connection point to the outfall is to be upgraded. The outfall is to be upgraded and the AUP(OP) indicative CMA boundary is 5 m away. The outfall works are within the AUP(OP) indicative CMA boundary. The outfall works are within the CMA (see Figure 6).
Outfall MCC_108738 (3)	✓	✓	✗	The connection point is the second to last manhole before the outfall. The last two sections of pipe from the connection point to the outfall are to be upgraded. The outfall is to be upgraded and the outfall and outfall works (scour protection) are outside of the AUP(OP) indicative CMA boundary (see Figure 6).
Outfall MCC_108748 (4)	✓	✓	✗	Connection is to the last manhole before the outfall and the outlet pipe is approximately 10 m away from the AUP(OP) indicative CMA boundary (see Figure 6). Therefore, proposed works are outside of the CMA.
New outfall adjacent MCC_108746	✗	✓	✗	A new outfall is required for a proposed overland flow path and discharge channel in the form of a naturalised stream channel along Riverhills Park (see Figure 7). The outfall to Pakuranga Creek will be in a similar form to the outlet detail in Figure 29 with modifications for a channel at the inlet. The permanent outfall will be located within Riverhills Park up to the AUP(OP) indicative CMA boundary (see Figure 6) subject to detailed survey and design.

The stormwater treatment BPO includes a combination of:

- Green infrastructure (i.e., swales (Figure 4) and bio-retention raingardens (Figure 5)) where feasible (i.e., adjacent to ramps, within residual land and some in the busway medians where the width permits)
- GPTs designed to remove litter via a 5 mm screen and at least 50% of TSS, are proposed at the downstream end of each network at each outlet within the road reserve or other locations convenient for maintenance access
- Discretionary targeted treatment of high use roads and carparks, outside of areas where the Project is modifying or creating new impervious areas, has been used where necessary to achieve the desired reductions to existing contaminant loads as stated in the design philosophy (subject to ongoing discussions between mana whenua, Healthy Waters and EBA).

A stormwater management options assessment following integrated catchment management approaches was carried out to identify the BPO. The Stormwater Management Option and BPO Report will be finalised and included in the SMP. The BPO treatment systems provided within EB3R for each outfall that receives EBA stormwater discharges are summarised in Table 5. The proposed treatment devices included in the BPO for the design, are subject to ongoing discussions with key Project partner mana whenua and Healthy Waters.

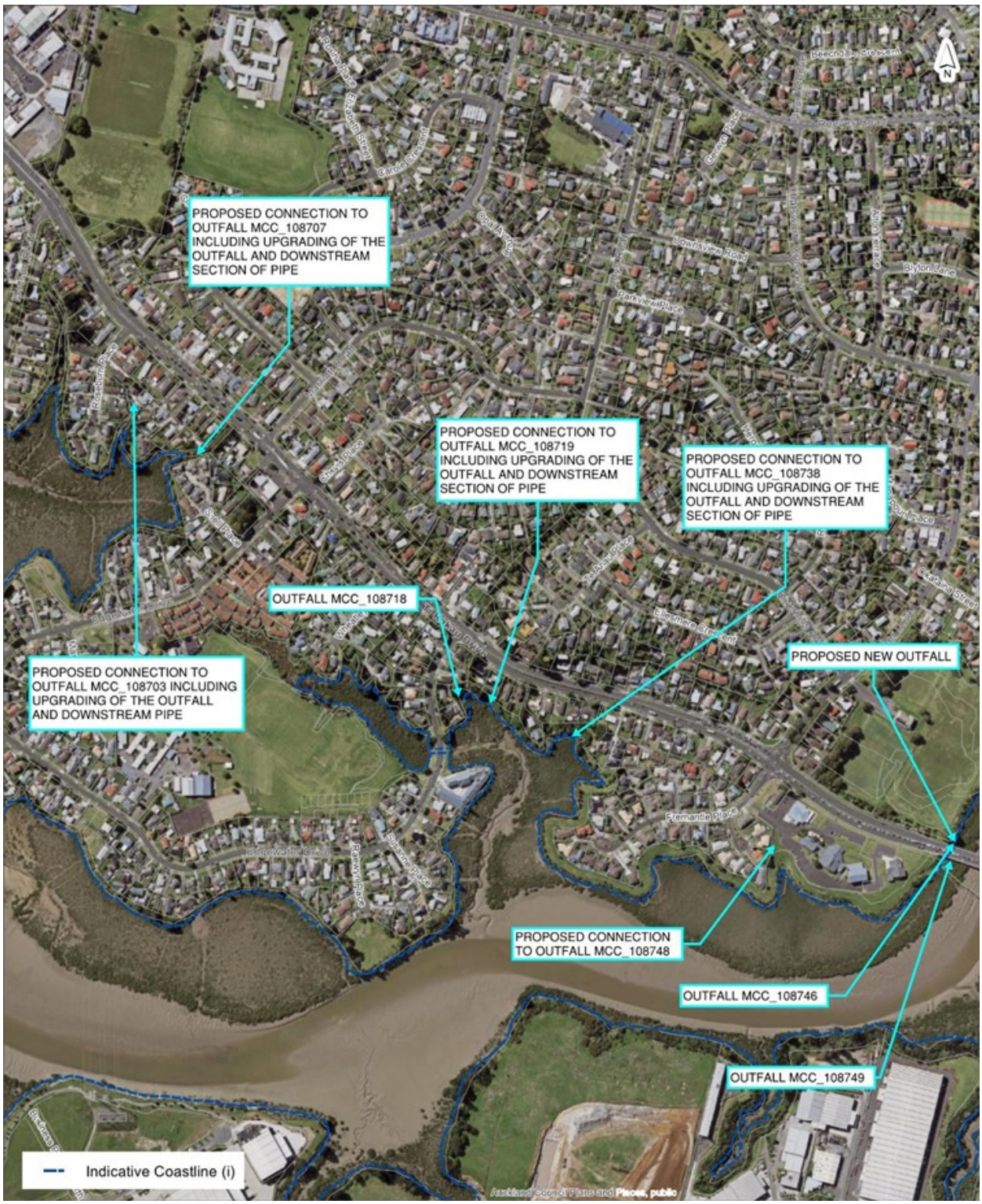

Figure 6: EB3R outfall locations and AUP(OP) indicative CMA boundary

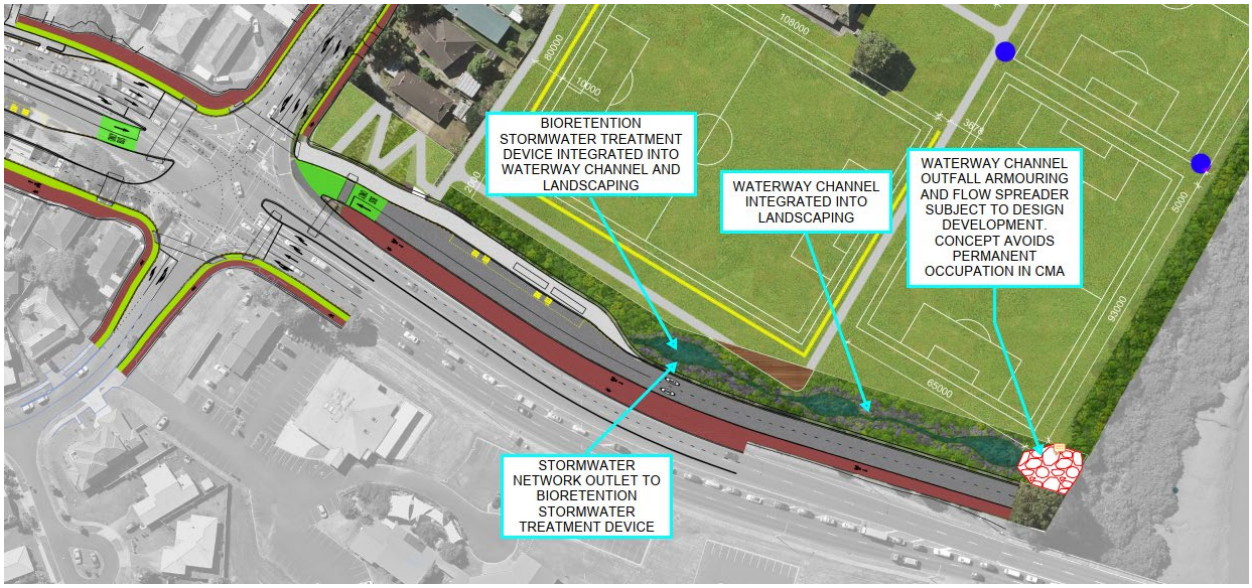

Figure 7: Riverhills Overland Flow Path Waterway Concept.

Table 5: Summary of proposed EB3R stormwater devices

Outfall	Treatment Category	Treatment Devices	Comment
Outfall MCC_108703	EBA BPO (Discretionary treatment of existing network)	GPT and Raingardens	Raingardens are proposed for parts of the busway and most of the westbound lanes of Ti Rakau Drive for this stormwater network. All Project stormwater for this outfall and the existing stormwater network (discretionary treatment) will be treated by a GPT.
Outfall MCC_108707	EBA BPO (Discretionary treatment of existing network)	GPT and Raingardens	Raingardens are proposed for most of the busway and the westbound lanes of Ti Rakau Drive for this stormwater network. All Project stormwater for this outfall and existing stormwater network (discretionary treatment) will be treated by a GPT.
Outfall MCC_108719	EBA BPO	GPT and Raingardens	Raingardens are proposed for all of the busway and slightly more than half the westbound lanes of Ti Rakau Drive for this stormwater network. All Project stormwater for this outfall will be treated by a GPT.
Outfall MCC_108738	EBA BPO	GPT and Raingardens	Raingardens are proposed for the busway and two thirds of the westbound lanes of Ti Rakau Drive for this stormwater network. All Project stormwater for this outfall will be treated by a GPT.
Outfall MCC_108748	EBA BPO	GPT and Raingardens	Raingardens are proposed for slightly more than half of the busway and two thirds of the westbound lanes of Ti Rakau Drive for this stormwater network. All Project stormwater for this outfall will be treated by a GPT.