

Appendix 24

Groundwater Effects Assessment

Eastern Busway EB3 Commercial and EB4 Link Road

Groundwater Effects Assessment

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List of Abbreviations and Definitions

Abbreviation and Definitions	Description
AEE	Assessment of Effects on the Environment
AMETI	Auckland Manukau Eastern Transport Initiative programme
AUP(OP)	Auckland Unitary Plan (Operative in Part) (Updated 20 July 2023)
Bgl	Below ground level
BPO	Best Practicable Option
EB1	Eastern Busway 1 (Panmure to Pakuranga)
EB2	Eastern Busway 2 (Pakuranga Town Centre)
EB3C	Eastern Busway 3 Commercial (Gossamer Drive to Botany)
EB3R	Eastern Busway 3 Residential (SEART to Pakuranga Creek)
EB4L	Eastern Busway 4 Link Road (link between Tī Rākau Drive and Te Irirangi Drive, Botany Town Centre)
EBA	Eastern Busway Alliance
km	Kilometre(s)
m	Metre(s)
MSE Walls	Mechanically Stabilized Earth Walls
R&R	Removal and Replacement Method
DSM	Deep Soil Mixing Method
PVD	Perforated Vertical Drains, Wick Drains
NoR	Notice of Requirement
NIWA	National Institute of Water and Atmospheric Research
NZCPS	New Zealand Coastal Policy Statement 2010
RL	Reduced level
RTN	Rapid Transit Network
RMA	Resource Management Act 1991

Executive Summary

The purpose of this Groundwater Effects Assessment (this Assessment) is to provide an assessment of the groundwater effects of the Eastern Busway 3 Commercial (EB3C) and Eastern Busway 4 Link Road (EB4L) sections of the Eastern Busway Project (the Project).

This Assessment summarises the groundwater-related planning requirements for EB3C and EB4L. This assessment splits out the requirements for each proposed works footprint (EB3C and EB4L) and assesses groundwater effects of proposed works within each footprint against the standards outlined in Chapter E7 of the Auckland Unitary Plan (Operative in Part) (AUP (OP)).

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

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

Having regard to the relevant rules in the AUP (OP), EB3C complies with AUP (OP) Standard E7.6.1.6, however based on Standard E7.6.1.10 (1), the construction and operation of EB3C is not exempt from an assessment against Standard E7.6.1.10 (2-6) as there are piles with an external diameter of greater than 1.5 m proposed for Bridge B. This bridge contains a pile that is within 10m of a scheduled Historic Heritage Overlay (HHO). This HHO includes Historic Heritage site R11_1263, of which, a stockpile from the former McCallum's Quarry is most relevant to this assessment. For a greater overview of Archaeological Site R11_1263 please refer to the Archaeological Effects Assessment. In addition, the diversion of groundwater associated with excavation and installation of wick drains within 10m of a HHO amounts to a technical infringement of permitted Standard E7.6.1.10(6b).

As the piling construction methodology does not require dewatering and piles will be cased and socketed into rock, groundwater and settlement implications are expected to be negligible. Therefore, no effects from construction related groundwater diversions at Bridge B (Pier 3) are anticipated on the scheduled Historic Heritage site R11_1263. The abutment piles have been designed to avoid the heritage artefacts and a post and panel wall will protect the heritage items from any groundwater related effects. Minor settlement is expected to occur at the bridge abutments, however this is not expected to have any adverse effects on the heritage artefacts. No additional mitigation measures or conditions are required.

The proposed works for EB4L have been assessed as a permitted activity because they comply with AUP (OP) Standards E7.6.1.6 and E7.6.1.10 (1) and are therefore exempt from an assessment against Standard E7.6.1.10 (2-6). As a result, a groundwater consent is not required for EB4L.

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
- Two new bridges for buses across Pakuranga Creek (Bridge A and B)
- A new bridge for buses crossing Guys Reserve and Whaka Maumahara Reserve (Bridge C)
- Improved active mode infrastructure (walking and cycling) along the length of the busway
- Three intermediate bus stations
- Two major interchange bus stations.

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

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

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

The Project consists of the following packages:

- Early Works Consents – William Roberts Road (WRR) extension from Reeves Road to Tī Rākau 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.
- Eastern Busway 3 Residential (EB3R) – Tī Rākau Drive from the South-Eastern Arterial (SEART) to Pakuranga Creek, including Edgewater and Gossamer Intermediate Bus Stations.
- Eastern Busway 3 Commercial (EB3C) – which commences from Riverhills Park along Tī Rākau Drive to Botany, including two new bridges, 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 through Guys and Whaka Maumahara Reserves to Te Irirangi Drive/Town Centre Drive intersection (**this Assessment**).

The overall Project is shown in Figure 1 below.

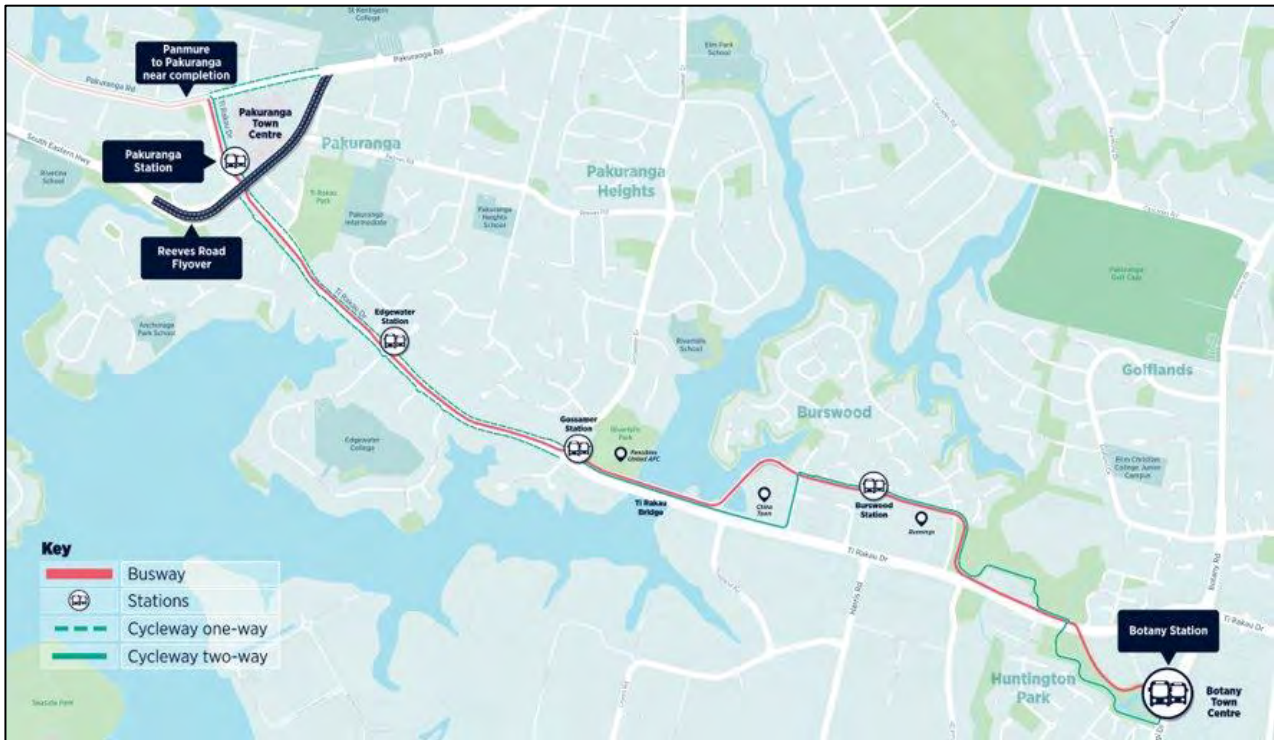


Figure 1: Project alignment

1.2 Project Objectives

The 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 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.

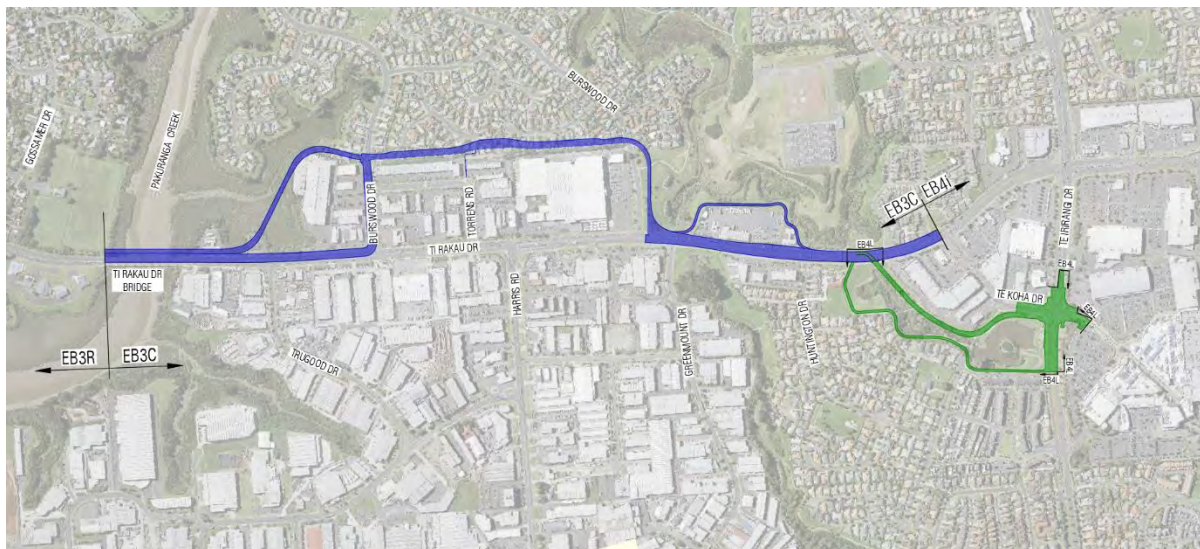


Figure 2: Eastern Busway 3 Commercial and 4 Link Road Project Extent

2.1 Eastern Busway 3 Commercial

The proposed EB3C works involve the establishment of an ‘off-line’ busway, cycleway, and associated stormwater upgrades. The proposed works will take place within existing road reserves, Council reserves¹ and privately held land within the proposed works footprint (refer Figure 3). 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 abutments² 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 4m² 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 549m² coastal reclamation. In parallel, a retaining wall will be constructed to the eastern side of the embankment. 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.

¹ Including Burswood Esplanade Reserve and Bard Place Reserve

² The western abutment and associated scour protection was included in the EB3R consenting package

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 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 3: 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/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.

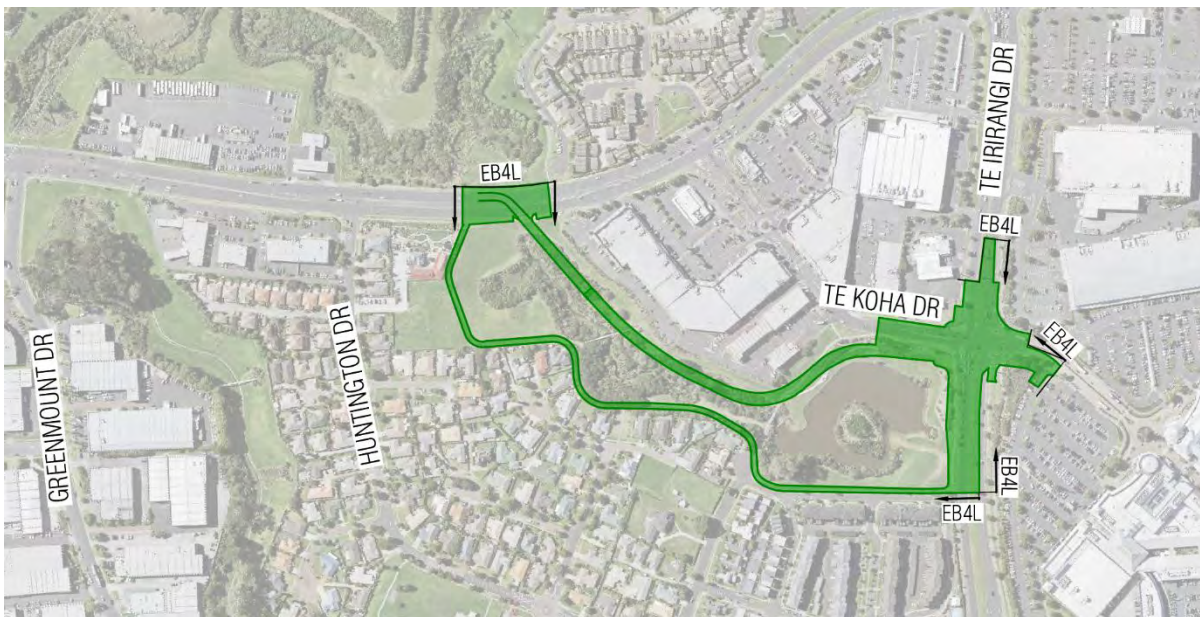


Figure 4: Eastern Busway 4 Link Road Project Area

3 Specialist Assessment

Chapter Summary

This chapter provides an overview of the specialist assessment, there are no groundwater operational effects anticipated after construction. This chapter also outlines the project elements that this assessment relates to as well as an overview of the relevant construction methodologies.

3.1 Assessment Content

This report provides the assessment of groundwater effects associated with the construction of the EB3C and EB4L sections of the Project. There are no groundwater-related operational effects anticipated after construction. This report is solely focused on the potential impacts to groundwater and does not consider surface water. The retaining walls proposed across EB3C and EB4L sections of the Project do not require any dewatering or groundwater diversions.

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

This groundwater effects assessment:

- Identifies and describes the existing groundwater environment for the EB3C and EB4L footprints
- Assesses the compliance of construction activities (and associated structures) with AUP(OP) Standards E7.6.1.6 and E7.6.1.10 based on an initial screening and identification of construction activities requiring assessment against these standards
- Where construction activities do not comply with the above standards an assessment against E7.8.2 has been completed.

3.2 Specific Project Elements

The specific Project elements related to this groundwater assessment include the following:

- Underground utilities (e.g. stormwater, water, power etc.)
- Retaining walls
- Piling
- Temporary piling for bridge construction
- Earthworks
- Ground Improvement

This assessment considers the relevant activities described in the Construction Methodology and associated structures against the relevant AUP(OP) standards.

3.3 EB3C Construction Methodology

3.3.1 Open trenching

Open trenching will be used for the installation and relocation of underground services and utilities (e.g. water infrastructure, communications networks, electrical lines etc.). Trenches for network utilities will be progressively opened, closed, and stabilised and are expected to be open for less than 10 days.

3.3.2 Retaining walls

Permanent retaining walls are anticipated to be predominately mechanically stabilised earth walls (MSE walls) or gravity walls with minimal embedment and no dewatering or water diversion will be required.

Two post and panel retaining walls are proposed for Bridge B:

- RW302 at Abutment A, will have an approximate 10 m span, with an approximate maximum retained height of 2.5 m
- New RW303a at Abutment B (Figure 5), will have an approximate 20 m span, height of approximately up to 4 m expected (as per typical details 'EB234—GT-SK-Z0-00001').

The piles for these post and panel walls have an anticipated external diameter of <0.6 m and are therefore a permitted activity under the AUP(OP) because they comply with Standard E7.6.1.10 (1)(d).

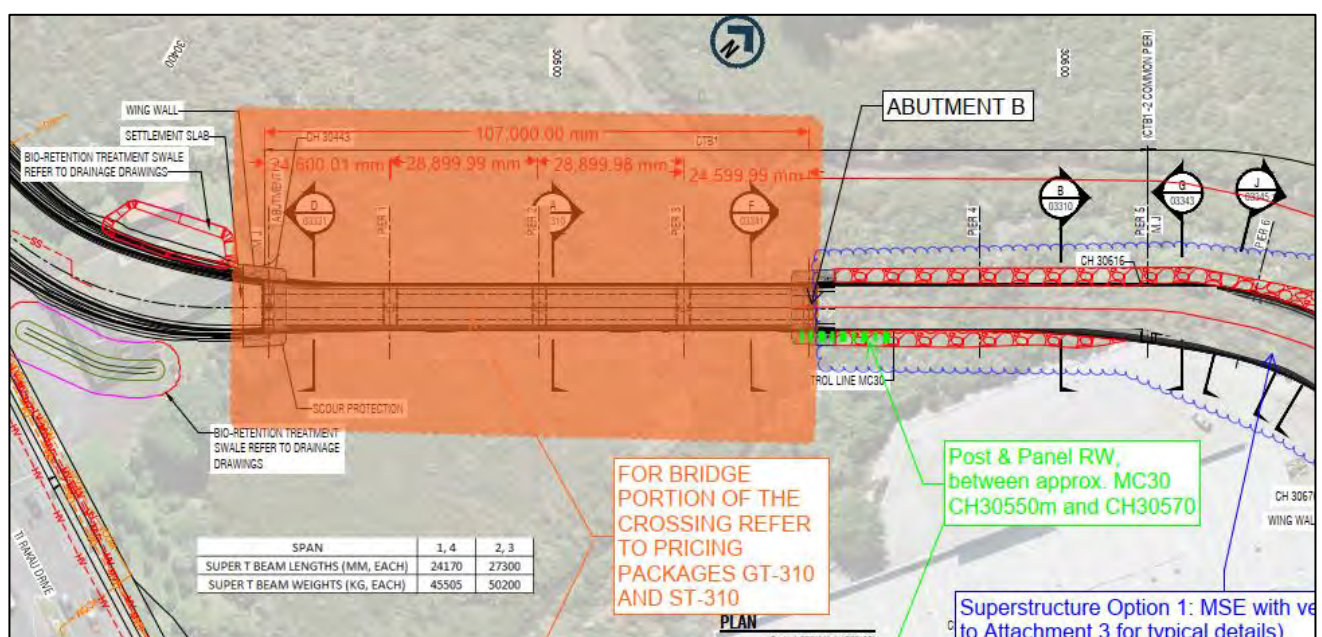


Figure 5: Currently unnamed post and panel retaining wall (in green) at Bridge B, Abutment B.

Bridge B has three pier piles with a diameter of up to 1.8m, and abutment piles of 1.5 m (see EB-1-D-5-ST-SK-203305).

For Bridge A, pile diameters of less than 1.5m are anticipated (see EB-2-D-3-ST-DG-000010).

The piling specification (EB-2-D-0-ST-SP-100003) details the methodology for concreting under water. The tremie method will be applied where a dry excavation cannot be achieved. No dewatering or diversion will be required under this method.

3.3.3 Earthworks

Except for the Bridge B ground improvements discussed in section 3.3.5, there are two main areas of cut in EB3C. The first is in the Burswood Reserve with slope reprofiling, to prevent over steepening when installing to the road design level. The existing groundwater level at this location is approximately 4 m below ground level (bgl), based on data retrieved from two piezometers in the immediate area of the proposed works (EB21_DH326_P and EB21_DH319_P).

The second main area of cut is behind Bunnings, spanning the current private property land parcels 26, 30 and 32 Burswood Drive. At this location there are two cut retaining walls (RW305 and RW306) which have an approximate maximum retained height of 1.3 m. The existing groundwater level at these cut walls is approximately 1.8 m bgl and has been estimated from the adjacent piezometer EB21_DH318_P (location shown in Figure 13 below). The retaining walls allow slope steepening and do not represent areas of significant cutting. The walls are permeable to allow water to transmit through and avoid pore water pressure build up behind the walls.

Therefore, the proposed excavations associated with earthworks are not expected to extend to groundwater level and the requirement is not to be >1 m below natural groundwater level and will, as required, not reduce natural groundwater level by more than 2 m on any adjoining sites. If water take is required, it will only occur during earthwork related construction activities and be temporary in nature.

Any other areas of cutting across EB3C are negligible and will not exceed 1.0 mbgl and will not reduce natural groundwater level by more than 2 m on any adjoining sites.

3.3.4 Embankment Superstructure

Two options were considered for the east approach embankment for Bridge B, however the following approach is being progressed:

- Geotextile reinforced 1v:1h embankment, between approximately MC30 chainage 30550 m to chainage 30676 m (Figure 6)

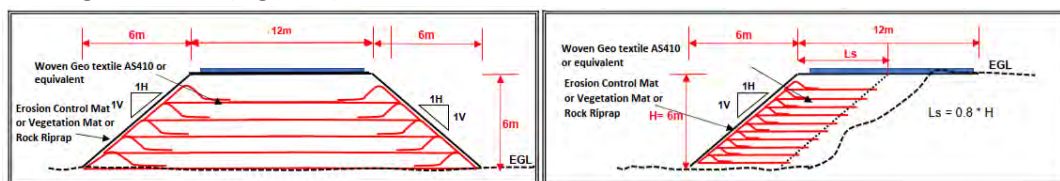


Figure 6: Geotextile reinforced embankment schematic

For this option, a maximum 24-months hold period is required following the completion of the embankments, and prior to pavement construction, to control post-construction settlement and minimise future maintenance.

This superstructure embankment option will be founded above ground improvement areas (as described below) to reduce the time of the consolidation settlement and to increase the degree of consolidation processes of very soft to soft subsoil layer below.

3.3.5 Ground Improvement

Ground improvement is planned below the proposed superstructure embankment at Bridge B, east approach embankment to Abutment B (Figure 7). The areas where the thickness of soft soil encountered is less than 2m, removal will occur to a maximum depth of 2 m with a suitable temporary shoring system in place and will be replaced with hardfill (termed as Removal and Replace) or Deep Soil Mixing (DSM) with additives such as cement or lime as an alternative to the removal and replacement method (R&R) for improvement of soft ground below. Replacement of native soils will be done progressively so that excavations are backfilled prior to advancement, and excavations will not be open for more than 10 days. The excavation area is less than 1 ha in total (see Figure 7, and Figure 8 extracted from EB234-1-GT-SK-Z3-00100). The areas where the depth of soft soil encountered is more than 4m, wick drains, known as Prefabricated Vertical Drains (PVD) are proposed to improve soft ground below to support the filled embankments along the alignment. The shallow depth PVD (Approximately 2m to 4m depth) will be replaced with GSM to increase the effectiveness

of the ground improvement of soft soil below the embankment. The proposed wick drains (PVD) for ground improved are discussed below.

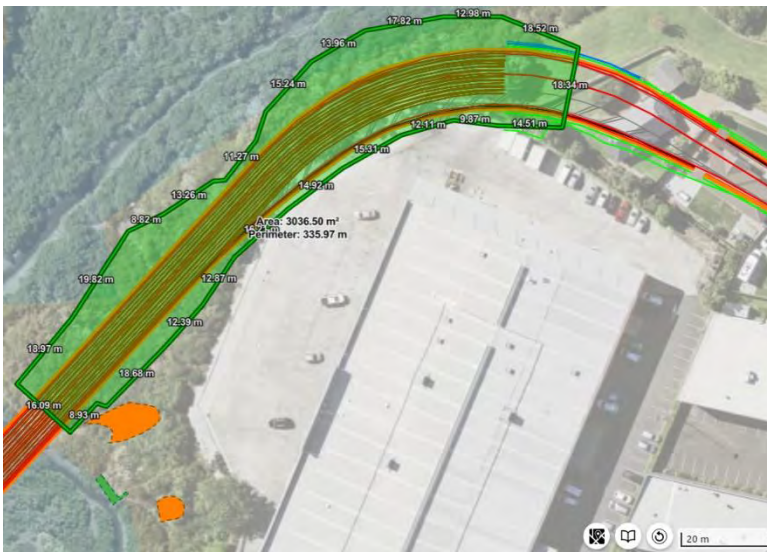


Figure 7: Approximate area of ground improvement (cut and replace) to 2 m, well below the AUP-OP permitted maximum area of 1 Ha.

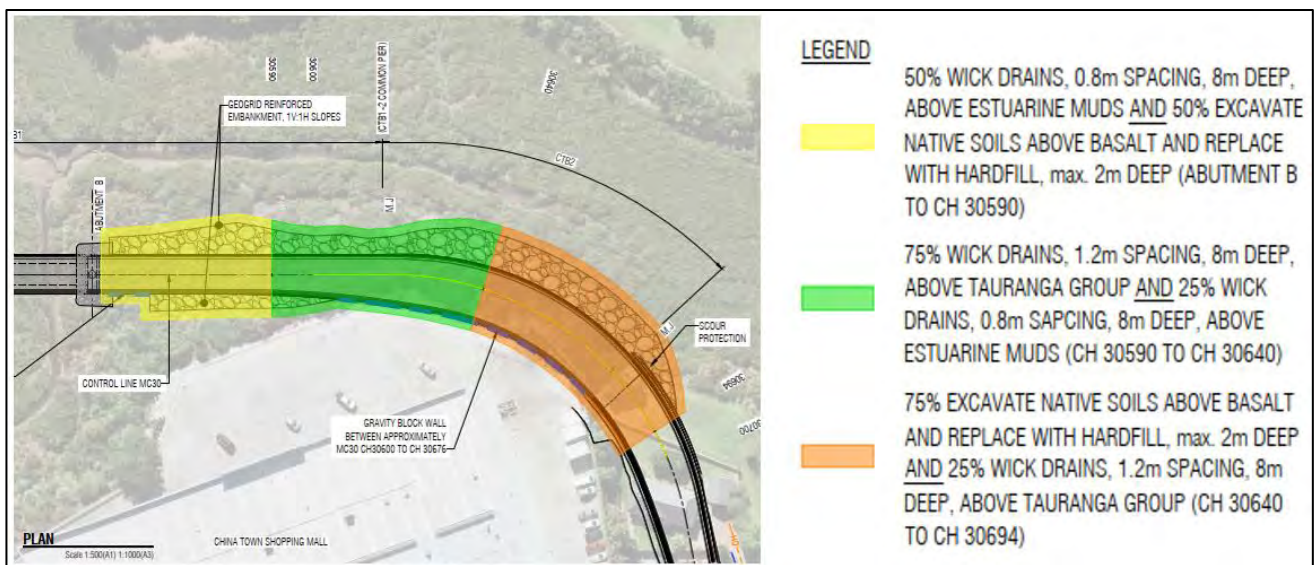


Figure 8: Approximate ground improvement area: cut and replace, and wick drain placement. See EB234-1-GT-SK-Z3-00100 for further details.

Wick drains (PVD) will be installed with a triangular spacing ranging from 0.8 m (when above estuarine muds) to 1.2 m (when above Tauranga Group soils) and with depths of up to 8 m using a wick drain rig (Figure 9).



Figure 9: Photo taken from Ara Tūhono- Puhoi to Warkworth: Wick Drain Rig.

Wick drains are prefabricated geotextile plastic strips which are driven down into the soil and provide a preferential pathway for groundwater to escape under the applied vertical stress from the embankment fill (Figure 10). When embankment fill is loaded onto the existing soils, consolidation occurs as the soil particles deform and are repacked into a smaller volume with the expulsion of water. In low permeability clayey soils, water cannot quickly expel from the soil causing an increase in porewater pressure and this consolidation process can take many years. The addition of wick drains only accelerates the natural process of consolidation which would occur regardless. The embankment stability is also improved by adding wick drains as they generate accelerated rates of settlement and increase the undrained shear strength at a faster rate. Wick drains do not permanently change the natural groundwater level, but rather alleviate excess pore water pressure generated from loading. Pre-loading of the embankment is expected to be completed within 24 months, and excess pore water will largely dissipate within the granular drainage layer constructed above the natural soil.

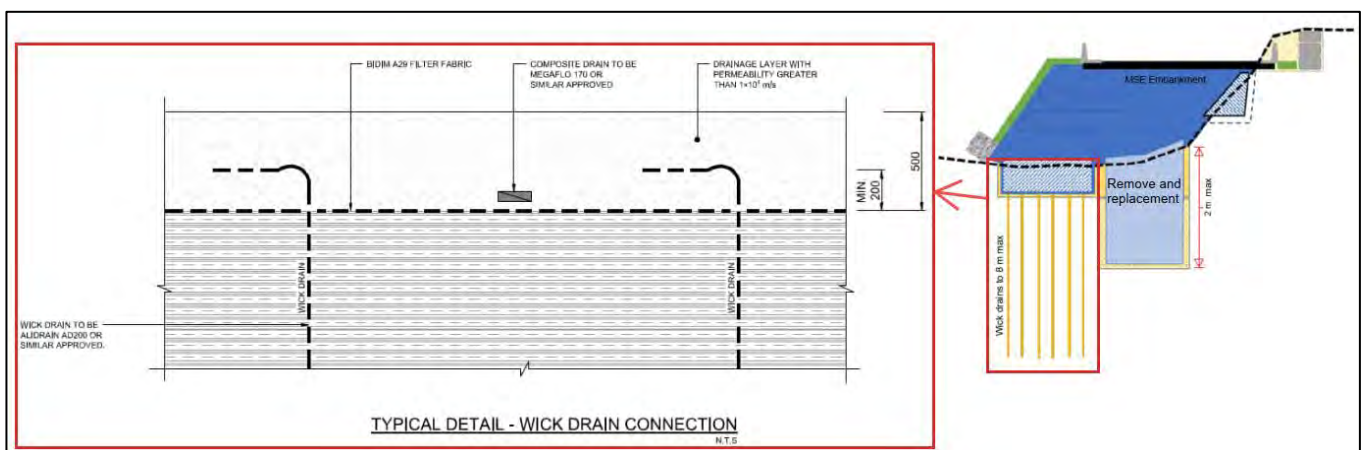


Figure 10: Schematic MSE Wall embankment with wick drains and remove and replacement ground improvement.

Wick drains will be active in the construction phase for a maximum 24-month construction period and more likely for less than 18 months and will not be removed after construction. After the consolidation process is complete the drains serve no function, although the drains will decrease time taken for the groundwater pressures to return to the natural state. The construction phase includes the 24-month (maximum) preload phase, after which the pavement will be placed.

The settlement and therefore wick drains are targeted in the soft ground. The soft ground is expected in the coastal marine area where the sediments are softest, and settlement reduces rapidly up the existing slopes. Settlement is not expected in the existing carpark of the Chinatown retail business as this lies on top of basalt which is underlain by stiff Tauranga Group. The embankment fill is greater than 20m away from the existing buildings at the nearest point and no settlement on the existing structure will occur due to the work.

3.4 EB4 Link Construction Methodology

3.4.1 Open trenching

Open trenching will be used for the installation and relocation of underground services and utilities (e.g. Transpower cables, stormwater networks). Trenches for network utilities will be progressively opened, closed and stabilised to ensure they are not open for longer than 10 days.

3.4.2 Retaining walls

Based on the design (EB234-1-DM-RP-Z0-0001), the anticipated permanent retaining walls will be a combination of gravity block walls and a post and panel wall. These walls are anticipated to reach a maximum retained height of approximately 3.5 m.

The post and panel wall are anticipated to have piles with an external diameter of less than 1.5 m and are therefore considered a permitted activity as per AUP (OP) Standard E7.6.1.10 (1)(c).

Gravity block walls rely solely on their own weight to retain the ground behind. These blocks may require some embedment (<0.5 m), however they are not anticipated to extend >2 m below the natural groundwater level. Therefore, gravity walls are expected to meet the AUP (OP) permitted activity criteria.

3.4.3 Piling

The proposed Guys Reserve bridge (Bridge C) is expected to have piers with an external diameter of 1.5 m. The piling specification (EB-2-D-0-ST-SP-100003) details the methodology for concreting under water. The tremie method will be applied where a dry excavation cannot be achieved. No dewatering or diversion will be required under this method.

3.4.4 Earthworks

Earthworks are only anticipated to involve areas of fill and no large areas of cut are anticipated.

4 Permitted Activity Standards

Chapter Summary

This chapter provides an overview of the sections of the AUP (OP) that are relevant to this assessment, that being Chapter E7. This chapter also provides a comparison of proposed works against the relevant permitted activity standards (E7.6.1.6 and E7.6.1.10). This chapter concludes that a restricted discretionary consent is required for the piling works at Bridge B.

Chapter E7 “Taking, using, damming and diversion of water and drilling” of the AUP (OP) sets out the criteria under which the diversion of groundwater is considered a Permitted Activity. Table 1 provides a comparison of the proposed works in EB3C and EB4L against the relevant permitted activity Standards E7.6.1.6 and E7.6.1.10 of the AUP(OP).

The utility trench excavations in EB3C are a road network linear trenching activity, where no section of a trench will be open for more than 10 days. This is considered a permitted activity as per AUP (OP) E7.6.1.10 (1)(d) and no assessment against Standards E7.6.10(2)-(6) is required.

The Bridge A piles (both abutment and pier piles) and the Bridge B abutments piles are up to 1.5 m in external diameter and are considered a permitted activity as per AUP (OP) standard E7.6.1.10 (1)(c). Therefore, they are exempt from the standards E7.6.1.10 (2)-(6).

The piling works in EB3C will involve pier piles with an external diameter of greater than 1.5 m at Bridge B. These pier piles are proposed to be 1.8 m in diameter and bored into rock head and cased above this. Therefore, these have been assessed against AUP (OP) Standards E7.6.1.10 (2) – (6). Except for the three pier piles, the remaining Bridge B Piers are considered permitted (diameter of 1.5 m or less), and no groundwater assessment is required. Bridge A piles are a permitted activity.

The ground improvement works of cut and replacement of native soil for the construction of the embankment associated with Bridge B require assessment against AUP (OP) Standards E7.6.1.10 (2) – (6). The proposed works trigger the following requirements for consent:

- A restricted discretionary resource consent is required under Rule E7.4.1(A28) as Bridge B does not comply with AUP (OP) standard E7.6.1.10 (6)(b) which requires a minimum separation distance of 10 m from a scheduled Historic Heritage Overlay (HHO).
- A restricted discretionary resource consent is required because the installation of wick drains does not comply with AUP(OP) standard E7.6.1.6 (2) as water take will occur for more than 10 days.

An assessment against E7.8.2 has been completed for the ground improvement works. The ground improvement works are not compliant with E.7.6.1.6 (2).

Additional earthworks in EB3C were compliant with AUP (OP) Standard E7.6.1.6 however were not exempt from Standards E7.6.10(2)-(6) under E7.6.1.10 (1) and therefore were assessed against these standards. The earthworks were found to be compliant with Standards E7.6.10(2)-(6).

Piling works in the EB4L project area will have a maximum external diameter of 1.5m and are considered a permitted activity as per standard E7.6.1.10 (1)(c). Therefore, they are exempt from the standards E7.6.1.10 (2)-(6).

Set out below is an assessment of the proposed works for EB3C and EB4L against the relevant AUP(OP) standards.

Table 1 Permitted activity criteria for groundwater diversion in EB3C and EB4L.

	EB3C		EB4L	
Rule	Complies	Notes	Complies	Notes
Rule E7.6.1.6 – water take for dewatering or groundwater level control associated with a groundwater diversion permitted under standard E7.6.1.10				
(1) Water take must not be geothermal water	✓	No geothermal water take is anticipated	✓	No geothermal water take is anticipated.
(2) Water take must not be for a period of more than 10 days where it occurs in peat soils, or 30 days in other types of soils or rock	X	No water take during piling works anticipated If required, dewatering during service trench installation will only occur during construction and will adhere to E7.6.1.10 (1)(d) Wick drains will not comply with E7.6.1.10 (2) as they will be operational for a period of up to 24 months.	✓	If required, water take during service trench installation will be progressively opened, closed and stabilised where the part of the trench that is open at any given time is no longer than 10 days.
(3) The water take must only occur during construction	✓	No water take during piling works anticipated If required, dewatering during service trench installation will only occur during construction and will adhere to E7.6.1.10 (1)(d) Wick drains will not be removed after construction however will no longer be operational after construction is complete.	✓	
Rule E7.6.1.10 – diversion of groundwater caused by any excavation, including trench or tunnel				
(1) All of the following activities are exempt from the standards E7.6.1.10 (2-6):				
<ul style="list-style-type: none"> Pipes, cables, or tunnels which are drilled or thrust and are up to 1.2 m in external diameter 	N/A	Cut and cover trenches – no drilling or thrusting anticipated	N/A	Cut and cover trenches – no drilling or thrusting anticipated.

	EB3C		EB4L	
Rule	Complies	Notes	Complies	Notes
<ul style="list-style-type: none"> Pipes including associated structures up to 1.5 m in external diameter where a closed faced or earth pressure balanced machine is used 	N/A	No closed face or earth pressure balance machines anticipated.	N/A	No closed face or earth pressure balance machines anticipated.
<ul style="list-style-type: none"> Piles up to 1.5 m in external diameter are exempt from this standard 	x	<p>Not exempt from this standard as three pier piles up to 1.8m diameter are anticipated at Bridge B. An assessment against standards E7.6.1.10 (2-6) is required for Bridge B Piers (refer to assessment against 2-6 below).</p> <p>Temporary piles required for the construction of Bridge B are up to 700mm in diameter and are therefore exempt.</p>	✓	No piles greater than 1.5m in diameter proposed for EB4L.
<ul style="list-style-type: none"> Diversion for no longer than 10 days, or diversion for network utilities and road network linear trenching activities that are progressively opened, closed and stabilised where the part of the trench that is open at any given time is no longer than 10 days. 	✓	Water take during service trench installation will be progressively opened, closed and stabilised where the part of the trench that is open at any given time is no longer than 10 days. If water take is required, the ground water shall be collected in a sump pit by gravity flow and will be pumped out from the collection sump rather than using deep well pumping.	✓	Water take during service trench installation will be progressively opened, closed and stabilised where the part of the trench that is open at any given time is no longer than 10 days. If water take is required, the ground water will be collected in a sump pit by gravity flow and will be pumped out from the collection sump rather than using deep well pumping.
(2) Any excavation that extends below natural ground level, must not exceed:				
<ul style="list-style-type: none"> 1 hectare in total area; and 	✓	<p>The total Bridge B embankment area is approximately 3,000m². The footprint of the three Bridge B piers is approximately 8 m², both well below the required 1 ha maximum area. Ground improvement works (cut and replace) will extend to a maximum depth of 2 m.</p> <p>The other EB3C earthwork cuts are anticipated to exceed 1 ha but will be less than 6 m below the natural surface and comply with this rule.</p>	Exempt	No areas of cut anticipated in earthworks.
<ul style="list-style-type: none"> 6 m depth below the natural surface 				

	EB3C		EB4L	
Rule	Complies	Notes	Complies	Notes
(3) Natural groundwater level must not be reduced by more than 2 m on the boundary of any adjoining site	✓	<p>No dewatering or reduction in groundwater is anticipated with piling works.</p> <p>Wick drains only alleviate excess pore pressure generated by loading soil with embankment structure. Natural groundwater level will not be reduced by 2 m or more.</p> <p>Ground improvement of the east approach embankment of Abutment B, Bridge B will be replaced prior to advancement. Groundwater will not be reduced by more than 2 m, as excavations are a max of 2 m bgl. Other excavations associated with earthworks are not expected to extend >1 m below natural groundwater level and therefore are not likely to reduce natural groundwater level by more than 2 m on any adjoining sites. These other main areas of cut in EB3C are in Burswood Reserve (approx. 2.7m maximum cut) where groundwater is approx. 4 m bgl, and for RW305 and RW306 which are cut retaining walls of approx. 1.3m max. height where groundwater is approx. 1.8m bgl.</p>	Exempt	No areas of cut anticipated in earthworks. Topsoil stripping is anticipated to occur however, this will not reduce groundwater by more than 2m.
(4) Any structure, excluding sheet piling that remains in place for more than 30 days, that physically impedes the flow of groundwater through the site must not:				
<ul style="list-style-type: none"> Impede the flow of groundwater over a length of more than 20 m; and 	✓	<p>The three pier piles are anticipated to extend more than 2 m below natural groundwater level. However, they will not impede the flow of groundwater over a length of more than 20 m as they are anticipated to be only 1.8 m in diameter. There is also a 28.9 m space between the piers, making each pier a standalone feature.</p> <p>The east approach embankment to Bridge B is a fill embankment which will not physically impede the flow of groundwater. The associated ground improvement cut and replace will be up to 2 m below ground level and therefore cannot extend more than 2 m below natural groundwater level. Wick drains</p>	Exempt	No areas of cut anticipated in earthworks.
<ul style="list-style-type: none"> Extend more than 2 m below natural groundwater level 				

	EB3C		EB4L	
Rule	Complies	Notes	Complies	Notes
		<p>promote drainage rather than impede flow.</p> <p>MSE walls or gravity walls are expected to have an embedment of less than 2 m. Post and panel walls are exempt as per E7.6.1.10 (1)(c).</p>		
(5) The distance to any existing building or structure, excluding timber fences and small structures on the boundary, on an adjoining site from the edge of any:				
<ul style="list-style-type: none"> Trench or open excavation that extends below natural groundwater level must be at least equal to the depth of the excavation. 	✓	<p>The ground improvement for the east approach embankment to Bridge B is approximately 10 m away from the China Town Building. Max excavation depth is 2 m.</p> <p>Piles will be bored and cased and therefore there will be no trenches or open excavations associated with piling work.</p>	Exempt	No areas of cut anticipated in earthworks.
<ul style="list-style-type: none"> Tunnel or pipe with an external diameter of 0.2 m – 1.5 m that extends below groundwater level must be 2 m or greater, or 	N/A	<p>Service trenches are exempt as per E7.6.1.10(1) (d).</p>	Exempt	
<ul style="list-style-type: none"> Tunnel or pipe with an external diameter of up to 0.2 m that extends below groundwater level has no separation requirement. 	N/A		Exempt	
(6) The distance from the edge of any excavation that extends below natural groundwater level, must not be less than:				
<ul style="list-style-type: none"> 50 m from a Wetland Management Areas Overlay (WMAO) 	✓	None in project area.	Exempt	No areas of cut anticipated in earthworks.

	EB3C		EB4L	
Rule	Complies	Notes	Complies	Notes
<ul style="list-style-type: none"> 10 m from a scheduled Historic Heritage Overlay (HHO) 	x	The ground improvements of the east approach embankment to Bridge B includes cut and replacement works which are within the HHO. One Bridge B Pier (Pier 3) is within 10m of the HHO (refer Figure 15).	Exempt	N/A EB4 project area should not have any excavation extending below natural groundwater level. No areas of cut anticipated in earthworks. Piles in EB4 are not greater than 1.5m and are therefore exempt from this standard.
<ul style="list-style-type: none"> 10 m from a lawful groundwater take 	✓	Any excavation will be further than 10m from a groundwater take.	Exempt	No areas of cut anticipated in earthworks.

Based on the above, the following proposed works are exempt from Standards E7.6.10 (2)-(6) and are therefore permitted activities:

- Utility trenching in EB3C and EB4L
- Piling for Bridge A
- Piling for the Abutment Piles at Bridge B
- Piling in EB4L
- Retaining walls in EB4L.

The ground improvement works at the east approach embankment to Bridge B include cut and replacement of native soils and the installation of wick drains which are restricted discretionary activities as they exceed the 30-day water take outlined in E7.6.1.10 (2) and are also within the Historic Heritage Overlay. Other earthwork activities within EB3C were assessed against AUP (OP) Standards E7.6.1.6 and E7.6.1.10 and were found to be compliant and are therefore permitted activities.

The proposed works required for the Bridge B Pier piles were not exempt from an assessment against Standards E7.6.1. 10 (2)-(6) because the proposed pier piles at Bridge B are greater than 1.5m in diameter. One pier at Bridge B (Pier 3) (refer Figure 15) did not comply with E7.1.10 (6)(b) because it is located within 10m of the Historic Heritage Overlay Extent of Place³. Therefore, restricted discretionary consent is required under the AUP(OP) for this infringement.

³ Historic Heritage and Special Character: Historic Heritage Overlay Extent of Place-2114 Donnelly's Quarry R11_1263

5 Methodology and Analysis EB3C

Chapter Summary

This chapter provides an overview of the methodology used in this assessment as well as the relevant statutory and planning framework.

5.1 Assessment Methodology

5.1.1 Data collection

Groundwater data has been collected from six piezometers installed near Bridge B and from two piezometers in Burswood Reserve around the main areas of cut. Groundwater trends against rainfall have been plotted at a 15-minute resolution. The groundwater graphs were corrected for atmospheric pressure using a site-specific barometer located at 167 Edgewater Drive, rather than data sourced from a public climate station through the National Institute of Water and Atmospheric Research (NIWA). Daily rainfall data collected at the Auckland Aero station was also sourced from NIWA.

5.1.2 Construction Methodology

The Construction Methodology has been reviewed to determine the effects that the proposed construction activities may have on natural groundwater.

5.2 Statutory and Planning Framework

The following assessment has been provided on the actual and potential effects with consideration of the following:

1. Resource Management Act 1991
2. Auckland Unitary Plan (Operative in Part) – Chapter E7 and Chapter E2

6 Existing Environment EB3C

Chapter Summary

This chapter provides an overview of the existing geological and groundwater environments in the EB3C project area for which we are applying for restricted discretionary activity resource consents. As well as this, this chapter describes the land use of adjoining sites to the project area.

6.1 Existing Geological Environment

The published geological map⁴ for the area, Kermode 1992, suggests the site is underlain by Tauranga Group (alluvium) over Waitemata Group East Coast Bays Formation (ECBF). During deposition of the Tauranga Group soils, the Auckland Volcanic Field was active. The land areas have been mapped as basaltic lava flows from Green Hill Volcano. The extent of these lava flow deposits has been difficult to characterise due to historic quarrying, which has since been backfilled and the land area developed for commercial use with anthropogenic fill.

6.2 Existing Groundwater Environment

Proposed Bridge B is located in Pakuranga Creek and surrounds and therefore natural groundwater levels are influenced largely by the estuarine environment and rainfall (Figure 11). Groundwater is anticipated to be at, or near the surface. Interaction with surface water is not considered in this report.

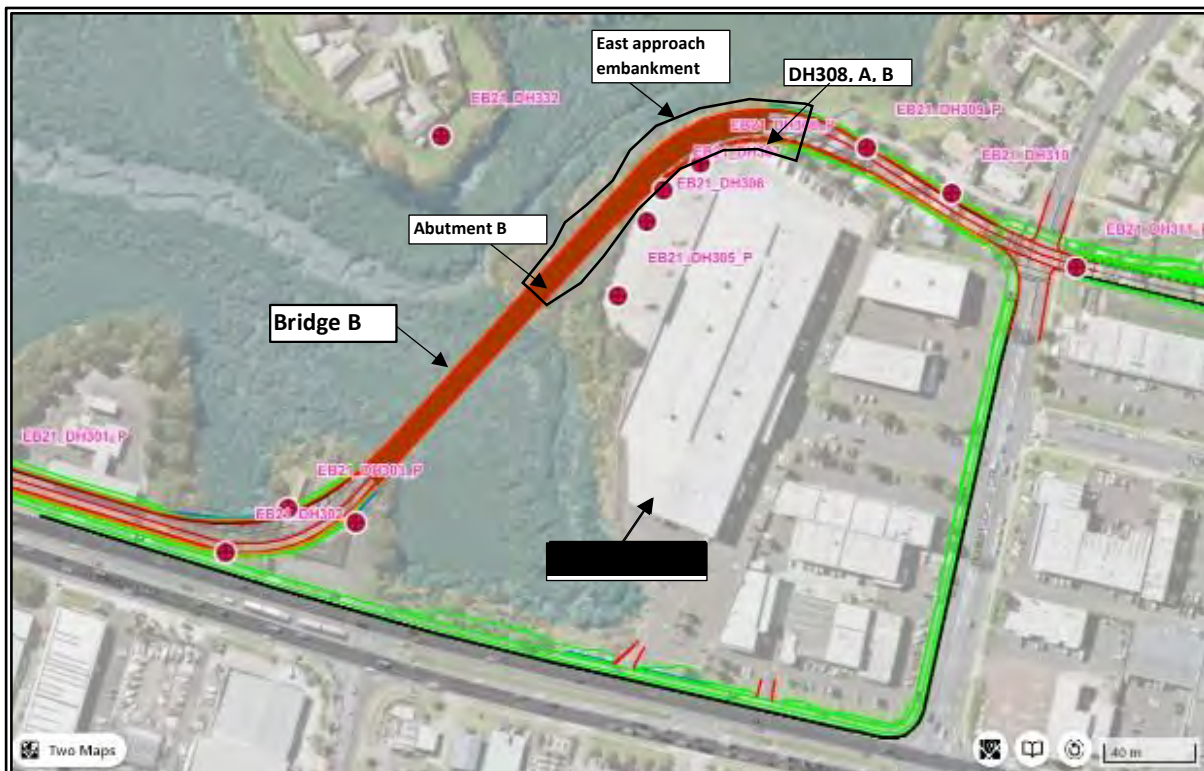


Figure 11: Map showing Bridge B location (shaded red), road design (red and green lines), retaining wall locations (blue lines) and geotechnical borehole investigations (red circle with black cross). Approximate ground improvement area below embankment superstructure is outlined in black. Figure facing north.

⁴ Kermode, Les. "Geology of the Auckland urban area." (1992).

See Figure 12 for the approximate area of ground improvements.

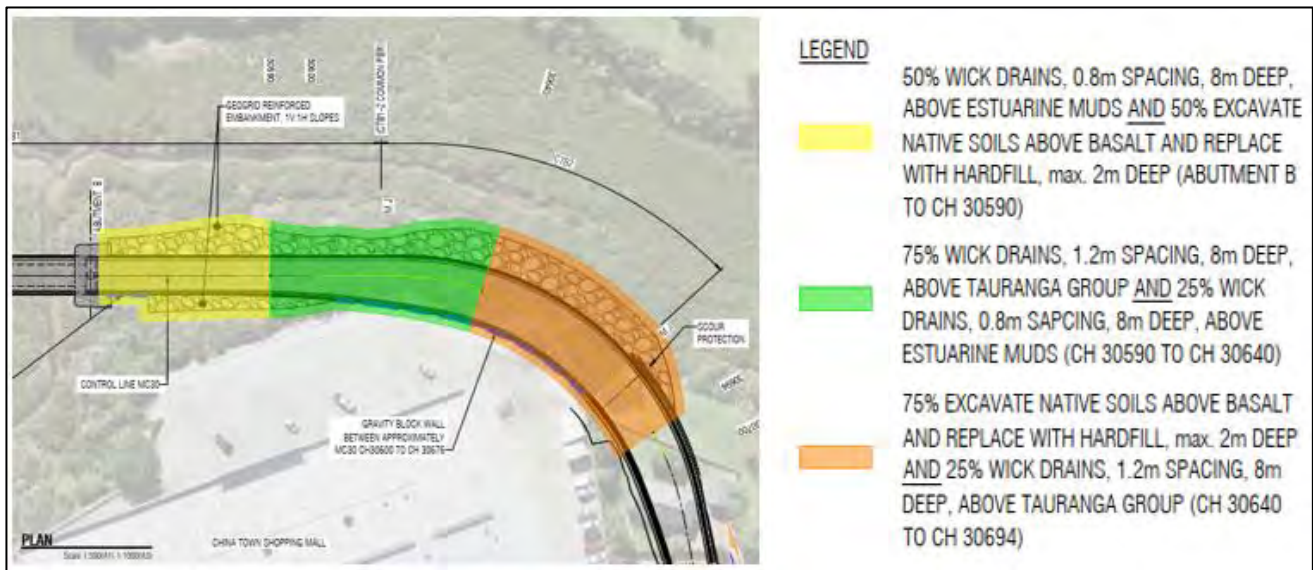


Figure 12: Excerpt showing the approximate area of cut and fill ground improvement required for East Approach Embankment to Bridge B.

Except for the ground improvements at the east approach embankment to Bridge B, the main areas of earthworks cut are located in Burswood Reserve, this area is shown in Figure 13. Groundwater in this area is anticipated to be around 4 m bgl.

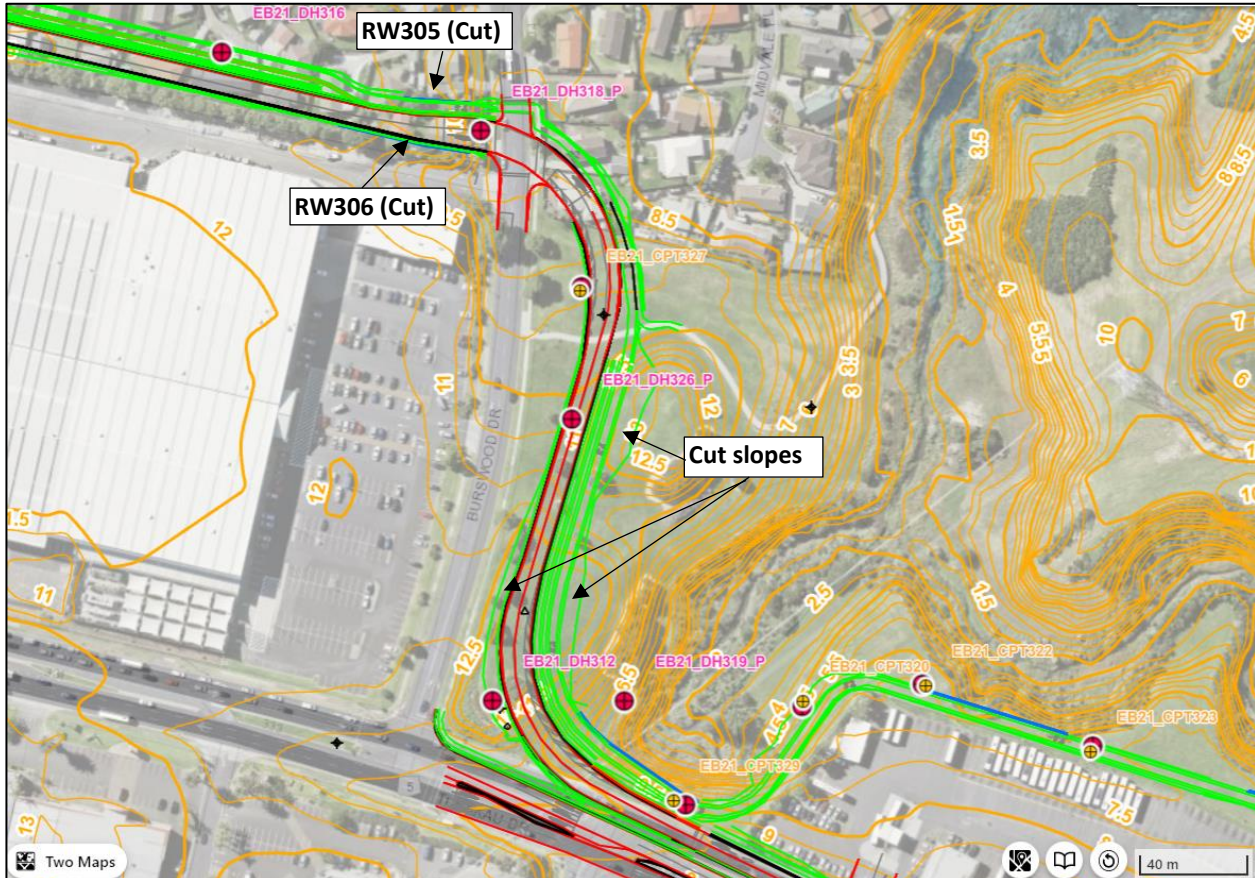


Figure 13: EB3C location of piezometers (EB21_DH326_P, EB21_DH319_P and EB21_DH318_P).

Groundwater Levels

Groundwater levels in the EB3C area are interpreted based on data recorded from 16 standpipe piezometers installed during the 2021 to 2023 investigations (Table 2, see Figure 11 and Figure 13. Graphs showing groundwater levels recorded in the relevant piezometers are included in Appendix 1.

Of the piezometers listed in Table 2, five are screened in Tauranga Group alluvium, one in Auckland Volcanic Group and one in East Coast Bays Formation (ECBF). The maximum and minimum recorded groundwater levels from these piezometers (from transducer installation to 8 March 2023) are presented in Table 3.

Table 2 Standpipe Piezometer Summary

Drillhole ID	Collar Elevation [m RL*]	Top of Slotted Screen (m RL/ m BGL)	Base of Slotted Screen (m RL / m BGL)	Piezometer Base (manual dip) (m RL)	Response Zone (m RL)	Screened Geology
EB21_DH305_p	8.74	3.34 / 5.4	1.34 / 7.4	1.74	3.84 to 0.83	Silty CLAY [Tauranga Group alluvium]
EB21_DH308_P	8.88	-4.12 / 13	-6.62 / 15.5	-6.67	-3.42 to - 7.12	Highly to slightly weathered SANDSTONE and SILTSTONE [ECBF]
EB21_DH308A_P	8.88	3.38 / 5.5	1.38 / 7.5	1.47	3.88 to 0.88	Silty CLAY and CLAY [Tauranga Group alluvium]
EB21_DH308B_P	8.88	6.88 / 2	4.38 / 4.5	4.41	7.18 to 3.88	Slightly weathered BASALT [Auckland Volcanic Group]
EB21_DH309_P	8.20	6.20 / 2	2.25 / 5.95	2.06	6.40 to 1.90	Silty CLAY [Tauranga Group alluvium]
EB21_DH318_P	8.82	4.02 / 4.8	1.02 / 7.8	0.92	4.62-0.52	PEAT with some wood [Tauranga Group alluvium]
EB21_DH319_P	6.61	1.21 / 5.4	0.21 / 6.4	0.06	1.71-(- 0.29)	Silty fine SAND with minor organics [Tauranga Group alluvium]
EB21_DH326_P	10.02	5.72 / 4.3	3.22 / 6.8	3.16	6.12-2.72	PEAT [Tauranga Group alluvium]

*Collar elevation was surveyed in Auckland Vertical Datum 2016, taken from the top of the piezometer lid.

Table 3 Maximum and minimum recorded groundwater levels (from transducer installation to 2 Feb 2023)

Drillhole ID	Max groundwater level recorded [m RL / m BGL]	Min groundwater level recorded [m RL / m BGL]
EB21_DH305_p	3.54 / 5.2	2.96 / 5.8
EB21_DH308_P	2.30 / 6.6	2.09 / 6.8
EB21_DH308A_P	5.15 / 3.7	3.83 / 5.05
EB21_DH308B_P	5.50 / 3.4	4.48 / 4.4*
EB21_DH309_P	4.59 / 3.6	4.12 / 4.1
EB21_DH318_P**	7.02 / 1.8	6.89 / 1.93

Drillhole ID	Max groundwater level recorded [m RL / m BGL]	Min groundwater level recorded [m RL / m BGL]
EB21_DH319_P	4.42 / 2.19	1.93 / 4.68
EB21_DH326_P	6.11 / 3.9	5.63 / 4.39

*The minimum groundwater level cannot exceed the transducer depth as the transducer must be installed below the water level. The value at DH308B is limited by the transducer depth of 4.4mbgl. All other transducers were below minimum groundwater level.

** Transducer has only recorded for 7 days, 1 March 2023 to 8 March 2023

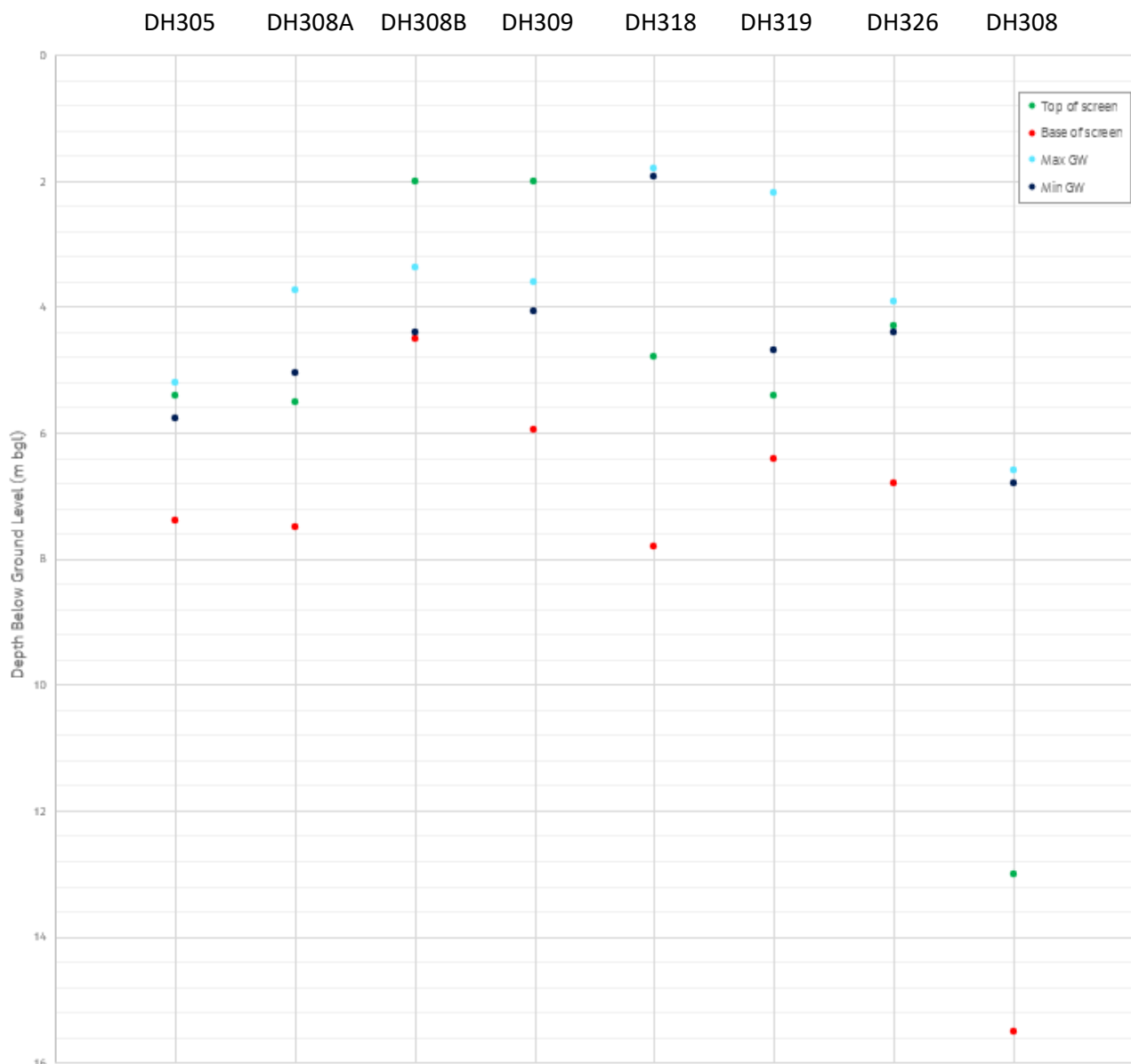


Figure 14: Graph showing piezometer screens and measured water levels in m BGL

6.3 Adjacent Land Use and Sites

Bridge B is proposed to extend along the western boundary of the Chinatown site as shown in Figure 11. The Chinatown site is used for commercial activities, including restaurants and retail stores. The southern end of Bridge B has a proposed abutment at what is currently a PetStop retail store and neighbours the Mobil branded service station. Bridge B traverses across Pakuranga Creek between the Burswood residential area and the Tī Rākau commercial sites.

Auckland Council records indicate that there are no consented groundwater takes in EB3C as of 7 February 2023. The closest consented groundwater take is located at 45 Cryers Road and is approximately 1k m away from the project area.

7 Assessment of Effects EB3C

Chapter Summary

This chapter provides an assessment of the relevant construction activities and their groundwater related effects on the Historic Heritage Overlay (HHO). It provides an overview of the archaeological site that is located closest to the project area. This chapter also provides a direct assessment against E7.8.2 from the AUP (OP).

7.1 Construction methodology

This section describes the activities that were identified, from the initial screening and assessment of relevant planning requirements, as triggering requirements for consent.

Bridge B Pier piles are proposed to be bored and cased and will be rock socketed. Concrete will be poured using the tremie method, with no groundwater take or use anticipated. Socketing the pier piles into rock creates a negligible settlement risk for the surrounding area. Therefore, groundwater diversion due to construction related activities of Pier 3 should not impact the historic heritage site (R11_1263) within the HHO.

As explained in Section 3.3.5, wick drains are prefabricated vertical drains installed using a wick drain rig which pushes them down to their target depth. The proposed wick drains (ALIDRAIN, AD200) have a discharge capacity of $\geq 100 \times 10^{-6} \text{ m}^3/\text{s}$ and will be installed with a triangular spacing ranging from 0.8 m (when above estuarine muds) to 1.2 m (when above Tauranga Group soils) and with depths of up to 8 m. Wick drains will be used to establish the embankment required for the eastern approach to Bridge B.

7.2 Archaeological site R11_1263 within the HHO

Bridge B, Abutment B piles have a diameter of 1.5 m and are therefore permitted.

Pier 3 at bridge B is located within 10m of the HHO extent and requires consent (Figure 15). The other two piers are not within 10m of the HHO and do not require further assessment. Ground improvement works including the cut and replacement of native soils and wick drain installation are also located within the HHO and require assessment.

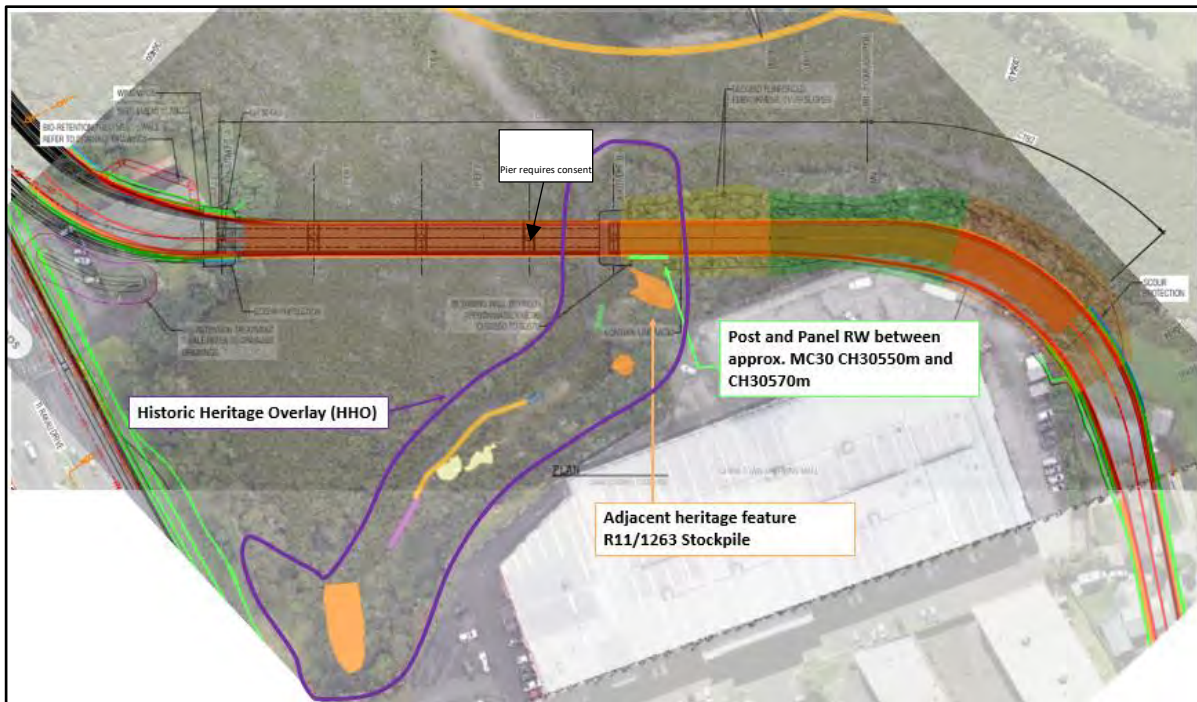


Figure 15: Historic Heritage Overlay (HHO) of Bridge B (outlined in purple). Pier 3 requiring consent is marked. Pier piles are ~29m apart. See Figure 12 for information about the ground improvement areas.

An Archaeological Assessment (EB234-1-PL-RP-Z3-000004) was completed for EB3C which included mapping of the features of R11_1263. The Bridge B piles have been designed and located to avoid the known elements of this heritage site. Figure 15 shows the proposed structural layout plan overlain with the mapped heritage features.

7.3 E7.8.2 Restricted Discretionary assessment criteria

The relevant assessment criteria from E7.8.2 have been extracted and discussed.

As discussed in this report, wick drains only accelerate the natural process of consolidation which would occur regardless. They do not permanently change the groundwater regime, but rather allow pore water pressure (generated by loading the soil with an embankment) to dissipate at a faster rate. Water is not taken for use, therefore most of the assessment criteria from E7.8.2 are not applicable: E7.8.2 (2)-(9) and (11).

E7.8.2 Assessment criteria

The Council will consider the relevant assessment criteria below for restricted discretionary activities:

(1) all restricted discretionary activities:

(a) the extent to which any effects on Mana Whenua values are avoided, remedied, or mitigated

Auckland Transport have been working with Mana Whenua throughout the development of the project. Please refer to the relevant sections of this AEE (section 8.2) which detail the consultation and engagement of Mana Whenua and their input to adhering to kaitiakitanga, manaakitanga and tikanga.

(b) N/A

E7.8.2 (10) Whether the proposal to divert groundwater will ensure that:

(a) the proposal avoids, remedies, or mitigates any adverse effects on:

(i) scheduled historic heritage places and scheduled sites; and

(ii) people and communities;

Cut and replacement works near the historic heritage place R11/1263, will be done progressively so that excavations are backfilled prior to advancement. A currently unnamed post and panel retaining wall is proposed at Bridge B, Abutment B and will support the embankment and protect the heritage feature (Figure 15). No impacts to people or communities are expected.

(b) the groundwater diversion does not cause or exacerbate any flooding;

Groundwater taken from wick drains will discharge the same volume of water that would naturally occur but at a faster rate. The removal of excess pore water is caused by gravity, is not for consumptive use, and is not done for land drainage (rather the removal of excess porewater pressure generated by loading the soil). Wick drains will be installed in Tauranga Group soil, where the water table is anticipated to be naturally at or near surface.

Any accumulated excess pore water will be diverted into a drainage system, therefore it will not cause, or exacerbate any flooding (Figure 16).

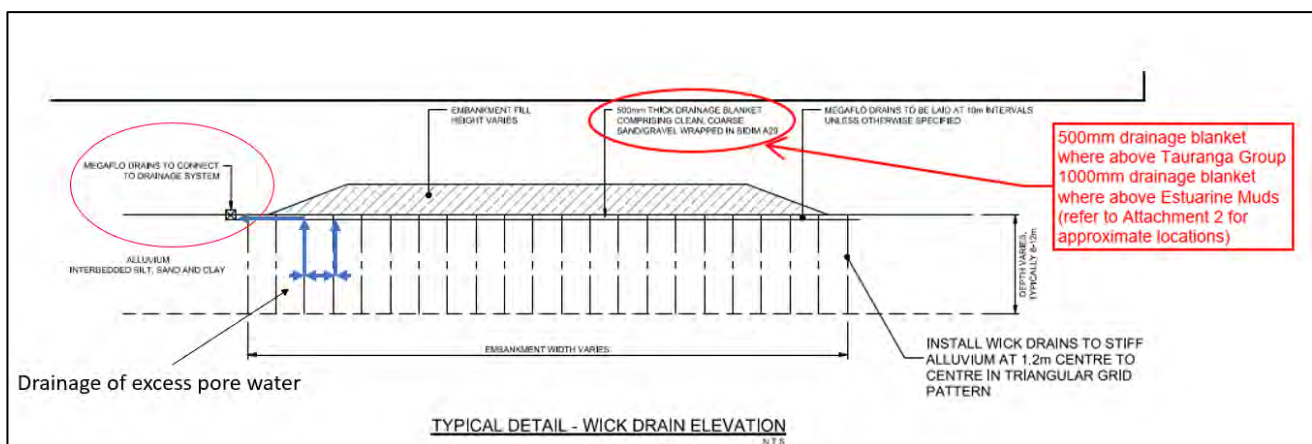


Figure 16: Typical details of anticipated wick drains.

(c) monitoring has been incorporated where appropriate, including:

(i) measurement and recording of water levels and pressures; and

(ii) measurement and recording of the movement of ground, buildings and other structures.

Three piezometers will be installed across the embankment, two of which are expected to be installed during further site investigations, and prior to preloading. These will be vibrating wire piezometers, recording live time data. There are also four existing piezometers in the China Town carpark which are monitored on a regular basis (approximately every 1-2 months the transducer data is downloaded, and a manual measurement is taken).

Settlement of the embankment fill is expected to occur during preloading, while the embankment is consolidating. The China Town building is approximately 11 m away at the nearest point to the embankment.

The zone of influence around the embankment will be estimated during design phase, and if required a monitoring plan will be implemented.

(d) mitigation has been incorporated where appropriate including:

(i) minimising the period where the excavation is open/unsealed;

The excavation during cut and replace of native soils will be backfilled prior to advancement.

(ii) use of low permeability perimeter walls and floors;

N/A

(iii) use of temporary and permanent systems to retain the excavation; and

A post and panel retaining wall is planned to support the embankment and protect the R11_1263 stockpile feature.

(iv) re-injection of water to maintain groundwater pressures;

N/A. Wick drains only relieve excess porewater pressure.

8 Conclusions and Recommendations

8.1 EB3C

To conclude, the proposed utility trenching works are permitted activities. The piling works for Bridge A and abutments piles at Bridge B are exempt from standards AUP (OP) E7.6.1.10 (2)-(6) and are permitted activities.

The three Bridge B piers are not exempt from an assessment against the Standards E7.1.10 (2)-(6) because they have a diameter greater than 1.5 m. One of the Bridge B piers (Pier 3) does not comply with AUP (OP) Standard E7.6.1.10 (6)(b) because it is located within 10m of a scheduled Historic Heritage Overlay. As the piling construction methodology does not require dewatering and piles will be cased and socketed into rock, groundwater and settlement implications are expected to be negligible. Therefore, no effects from construction related groundwater diversions at Bridge B (Pier 3) are anticipated on the Historic Heritage site R11_1263, and no further mitigation measures or conditions are required.

The ground improvement works for the east approach embankment of Bridge B, Abutment B include cut and replace of native soils (up to 2 m depth) and wick drains. The wick drains do not comply with E7.6.1.6 (2) as they will be in place permanently, however as the drains are vertical, after the consolidation process is complete the drains serve no function. Water take from these drains occurs under gravity, and only accelerate the natural process of consolidation which would occur regardless. Cut and replacement works were assessed against E7.1.10 (2)-(6) and were found to not comply with Standard E7.6.1.10 (6)(b) as it was located within a scheduled Historic Heritage Overlay. Cut and replacement works near the historic heritage place will be done progressively so that excavations are backfilled prior to advancement. A currently unnamed post and panel retaining wall is proposed at Bridge B Abutment B and will support the embankment and protect the heritage feature.

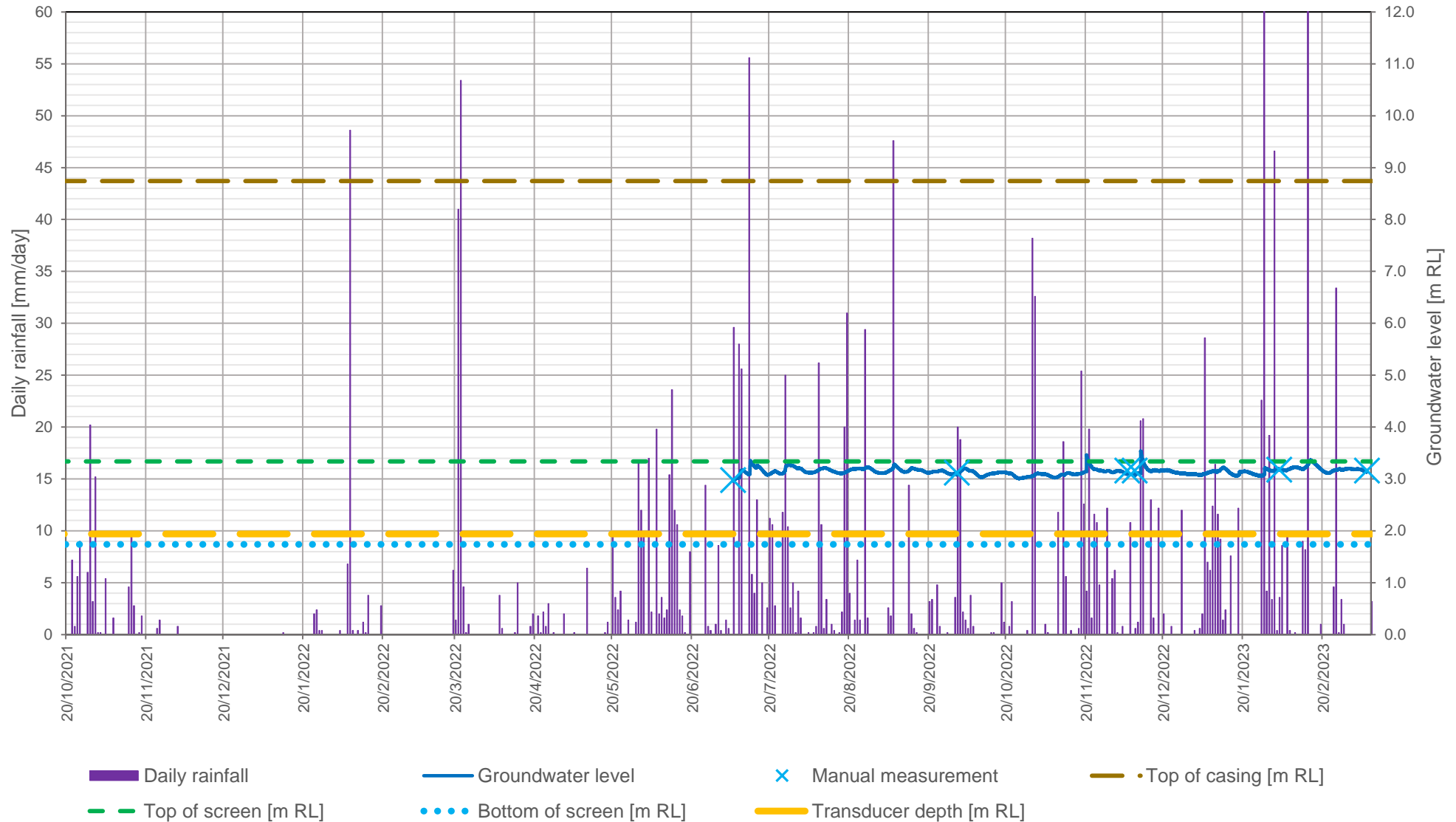
Additional earthwork activities in EB3C were assessed to be permitted activities as they comply with standards E7.6.1.10 (2)-(6).

Due to the proposed design and construction methodology no mitigation measures are required for EB3C.

8.2 EB4L

To conclude, the proposed construction and operation of the EB4L project area complies with the permitted activities in E7.6.1.6 and E7.6.1.10 and therefore a groundwater consent is not required for this section of the Eastern Busway. Due to the proposed construction methodology and design no further mitigation measures or conditions are required.

Appendix 1: Groundwater Graphs



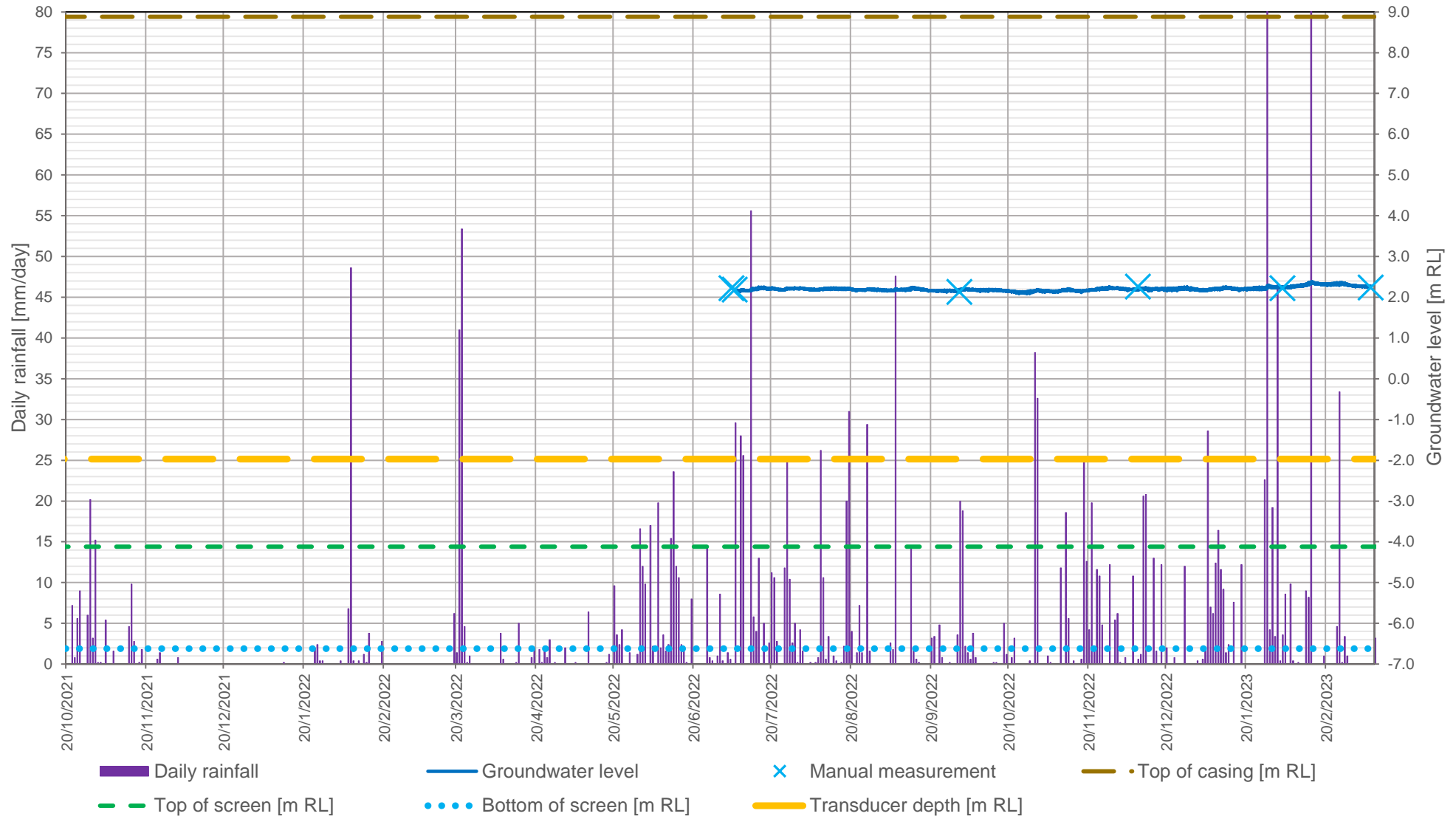
Prepared by:	G.W
Checked by:	
Date:	30/03/2023
Figure No.:	1



**Eastern Busway
Groundwater Level Monitoring**

EB21_DH305_P Piezometer Results

*top of casing is surveyed point on Toby lid

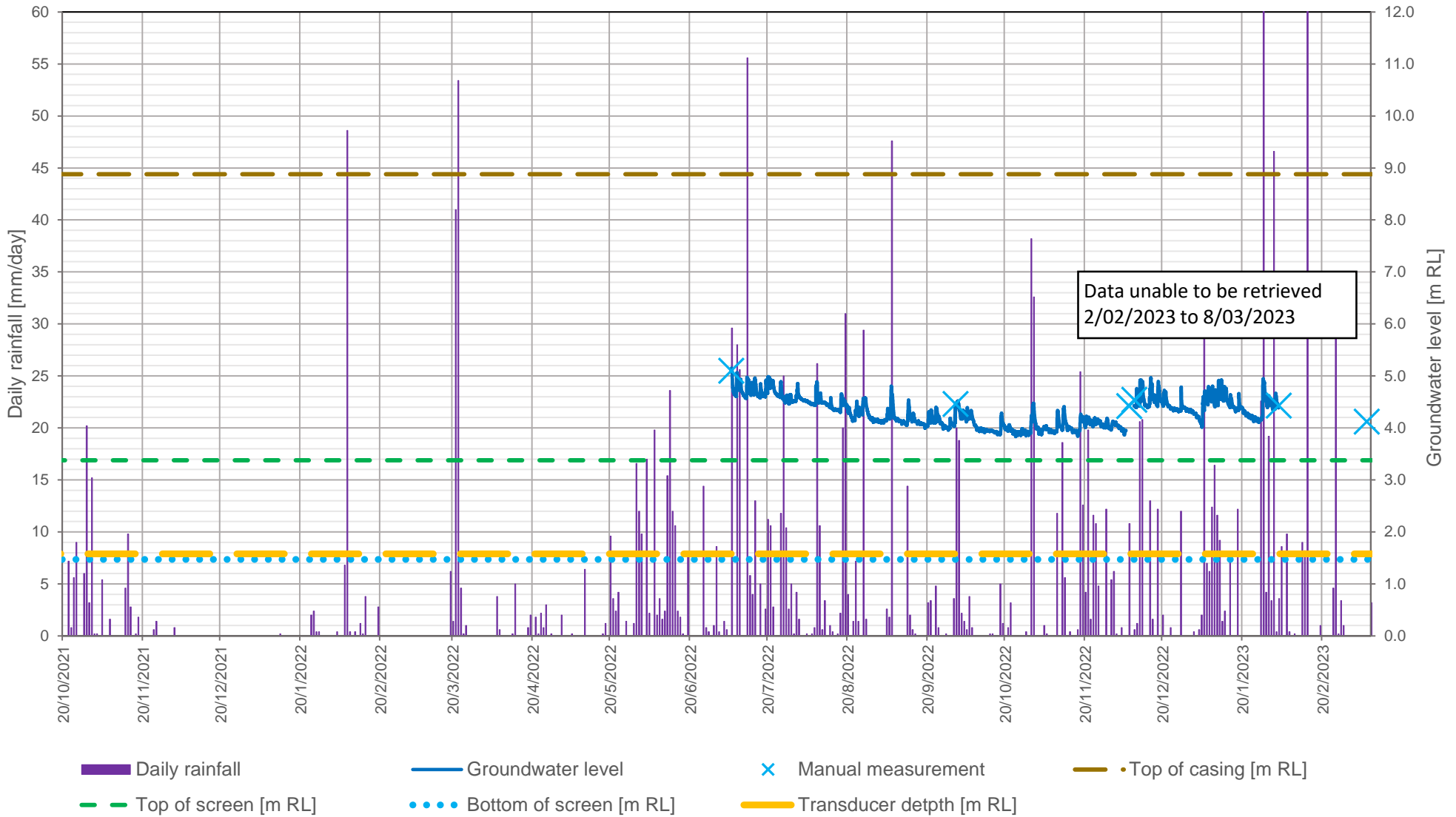


Prepared by:	G.W
Checked by:	
Date:	30/03/2023
Figure No.:	1

**Eastern Busway
Groundwater Level Monitoring**

EB21_DH308_P Piezometer Results

*top of casing is surveyed point on Toby lid



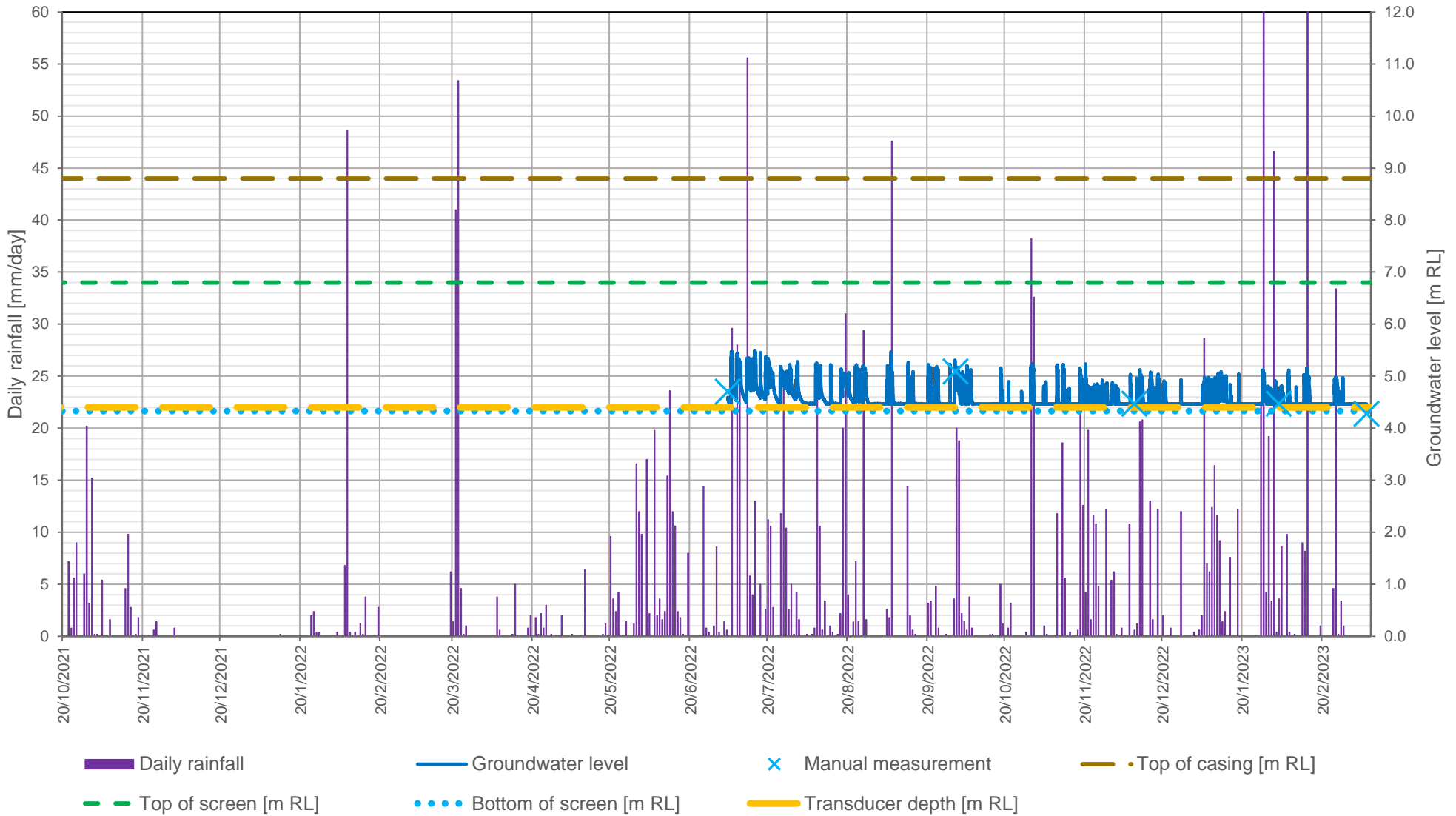
Prepared by:	G.W
Checked by:	
Date:	30/03/2023
Figure No.:	1



**Eastern Busway
Groundwater Level Monitoring**

EB21_DH308A_P Piezometer Results

*top of casing is surveyed point on Toby lid

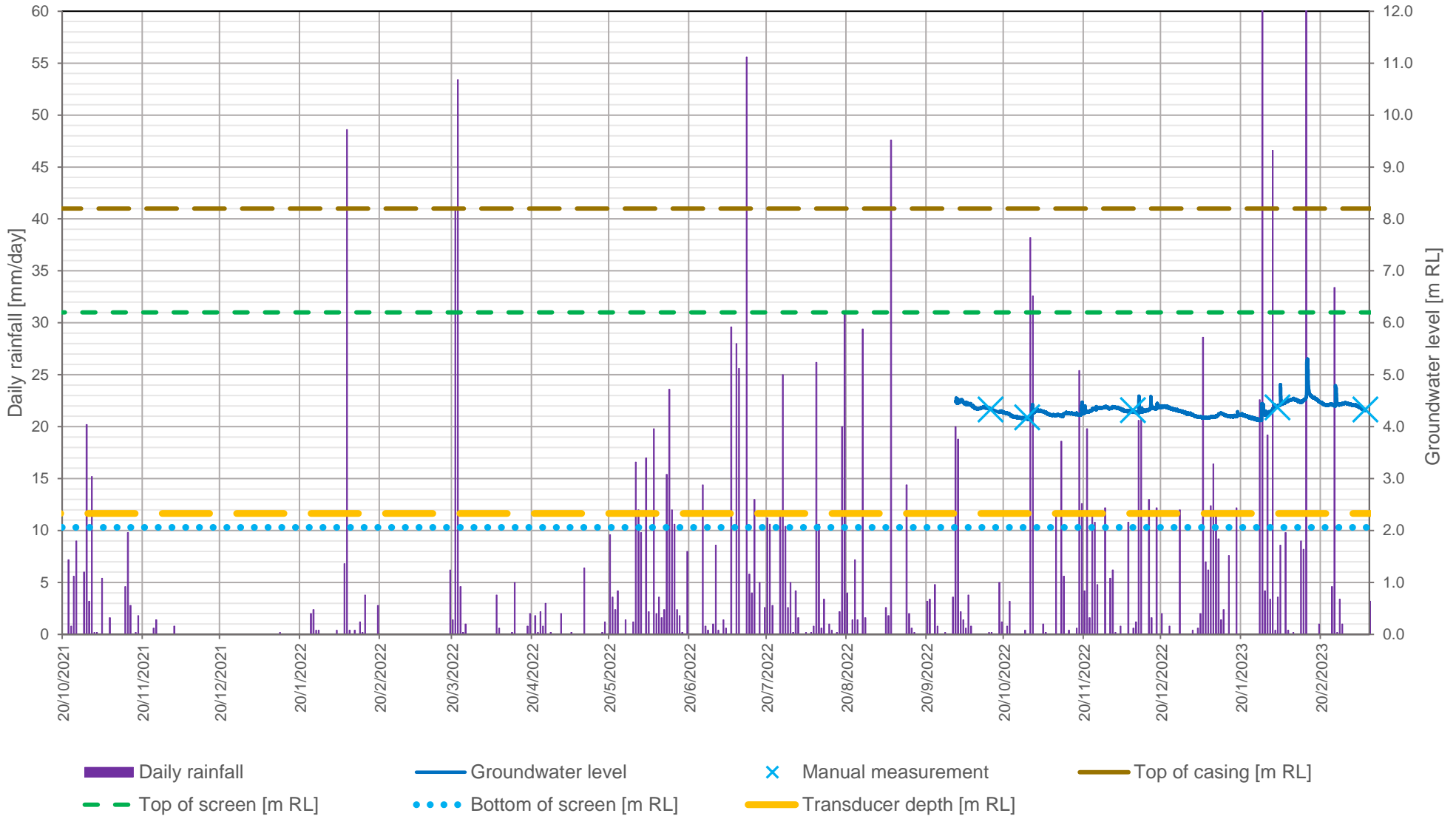


Prepared by:	G.W
Checked by:	
Date:	30/03/2023
Figure No.:	1

**Eastern Busway
Groundwater Level Monitoring**

EB21_DH308B_P Piezometer Results

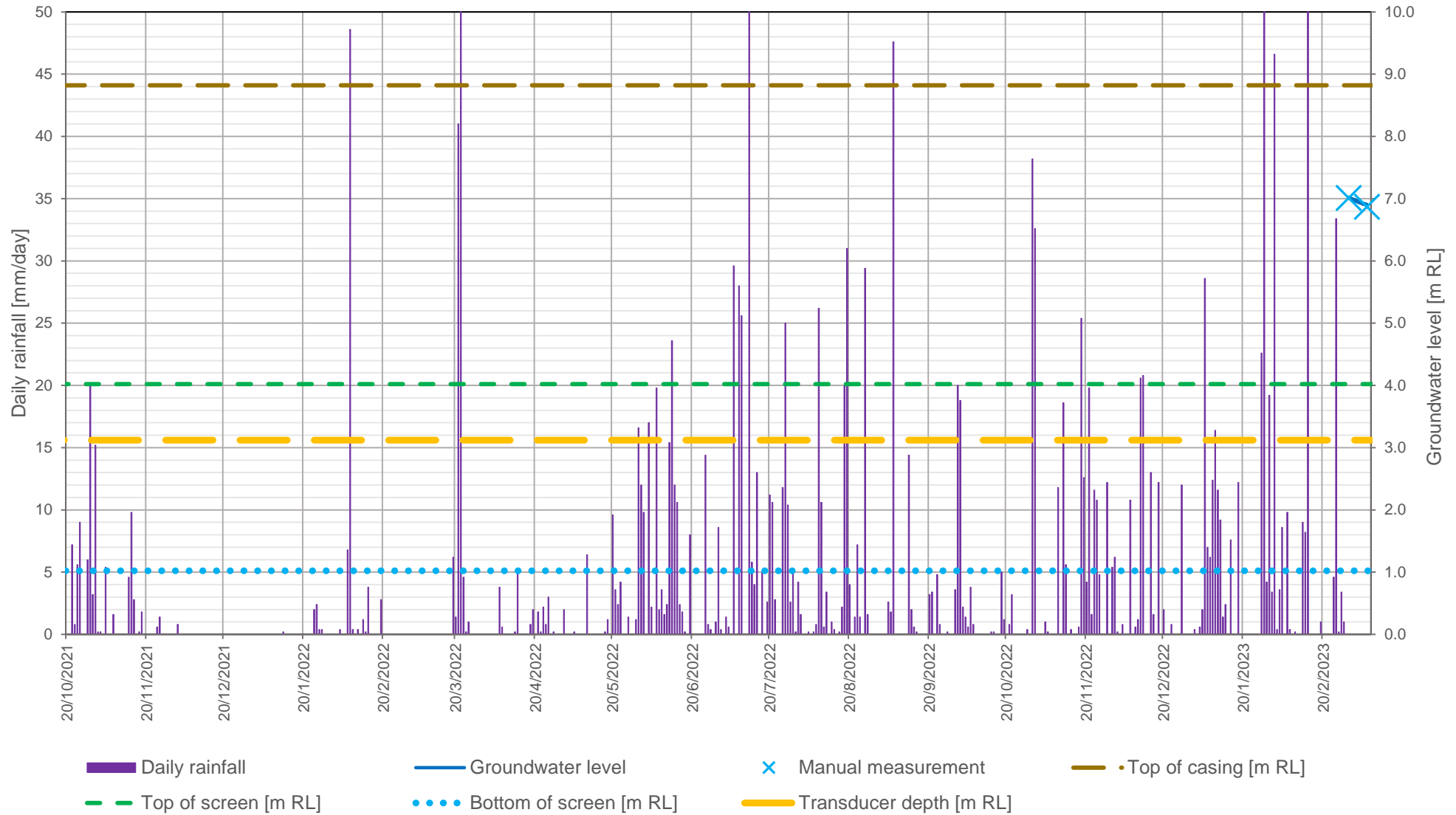
*top of casing is surveyed point on Toby lid



Prepared by:	G.W
Checked by:	
Date:	30/03/2023
Figure No.:	1



**Eastern Busway
Groundwater Level Monitoring
EB21_DH309_P Piezometer Results**

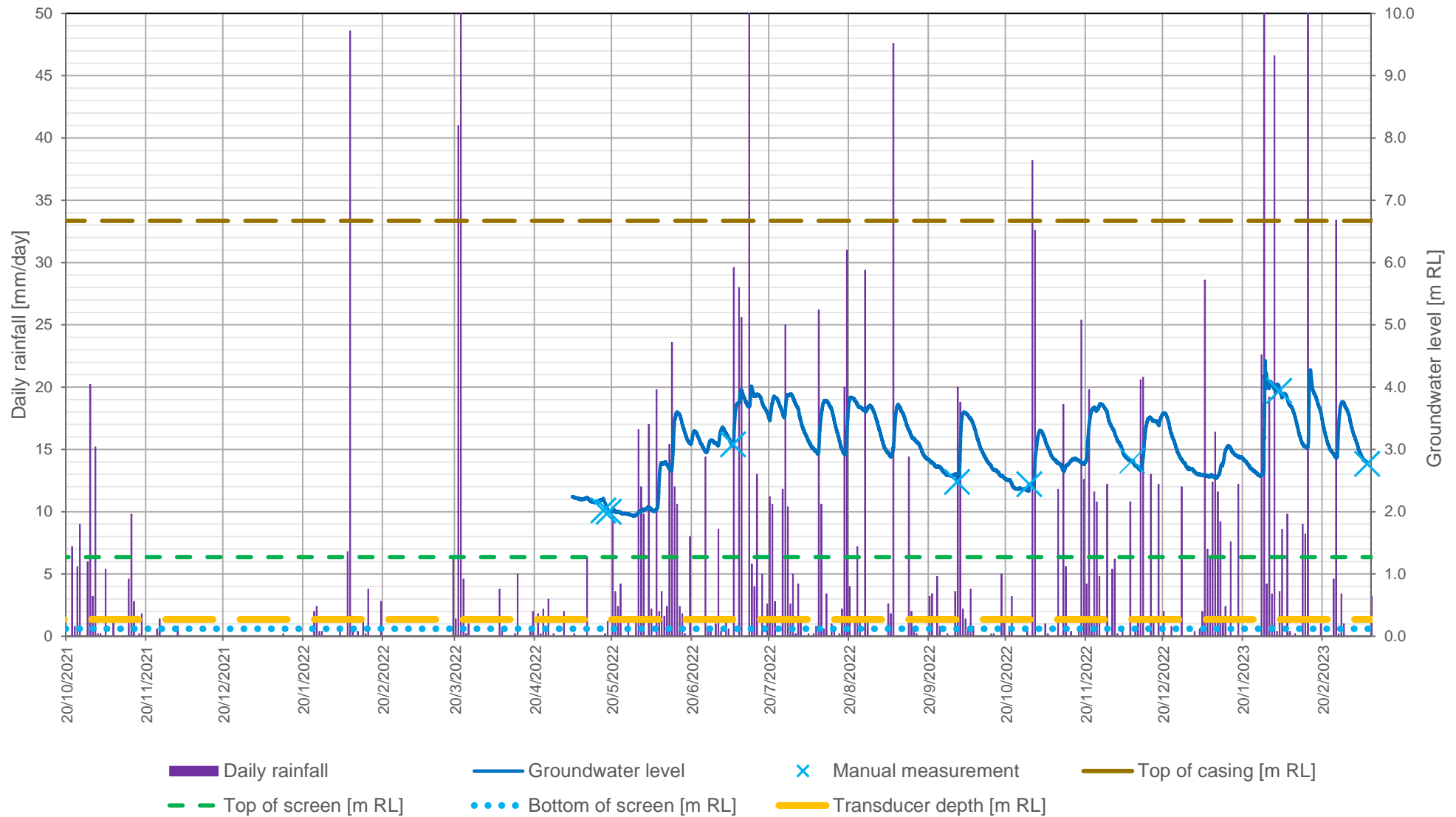


Prepared by:	GW
Checked by:	
Date:	30/03/2023
Figure No.:	1

**Eastern Busway
Groundwater Level Monitoring**

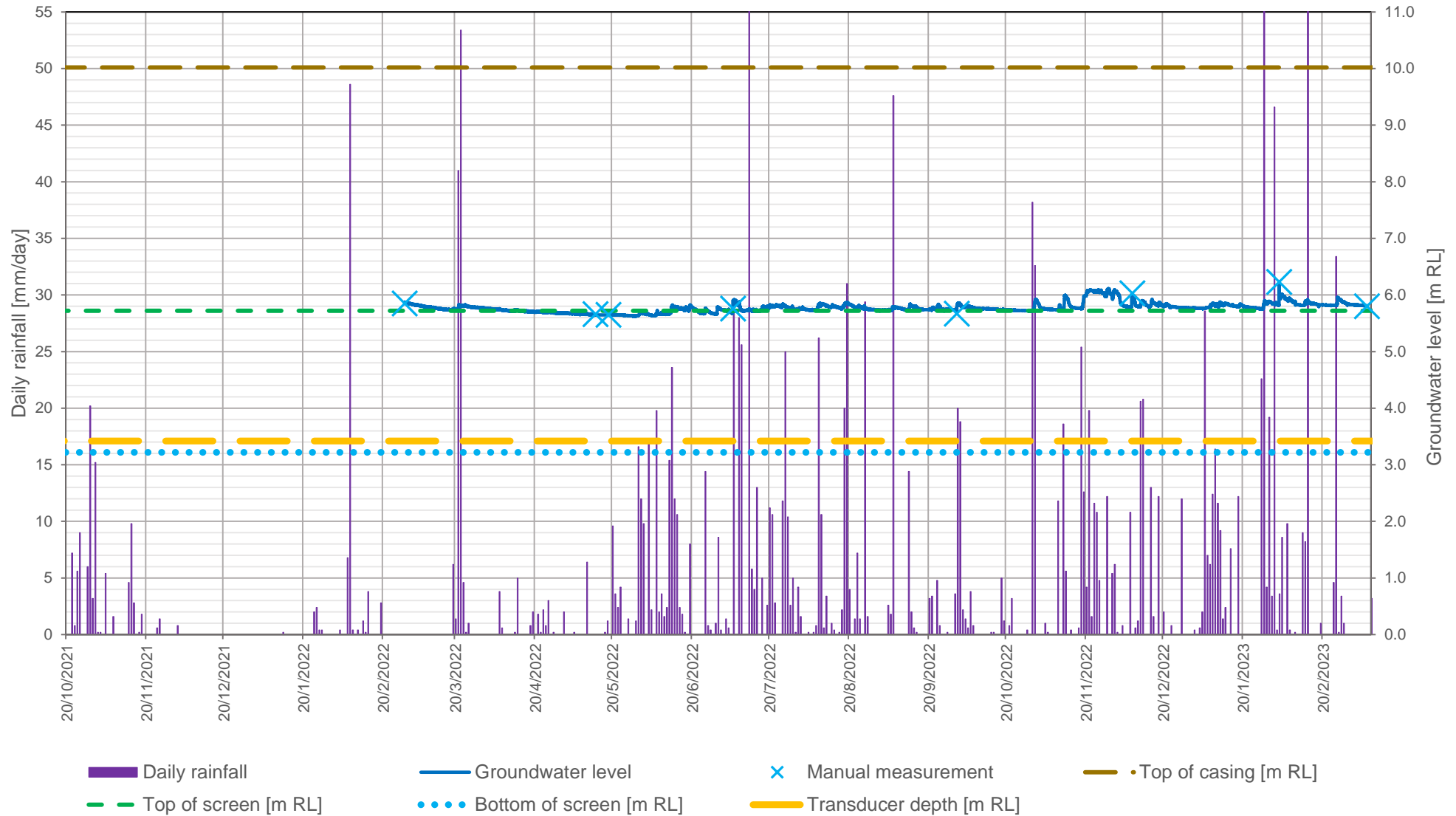
EB21_DH318_P Piezometer Results

*top of casing is surveyed point on Toby lid



Prepared by:	GW
Checked by:	
Date:	30/03/2023
Figure No.:	1

Eastern Busway
Groundwater Level Monitoring
EB21_DH319 Piezometer Results



Prepared by:	GW
Checked by:	
Date:	30/03/2023
Figure No.:	1



**Eastern Busway
Groundwater Level Monitoring**

EB21_DH326_P Piezometer Results

*top of casing is surveyed point on Toby lid