

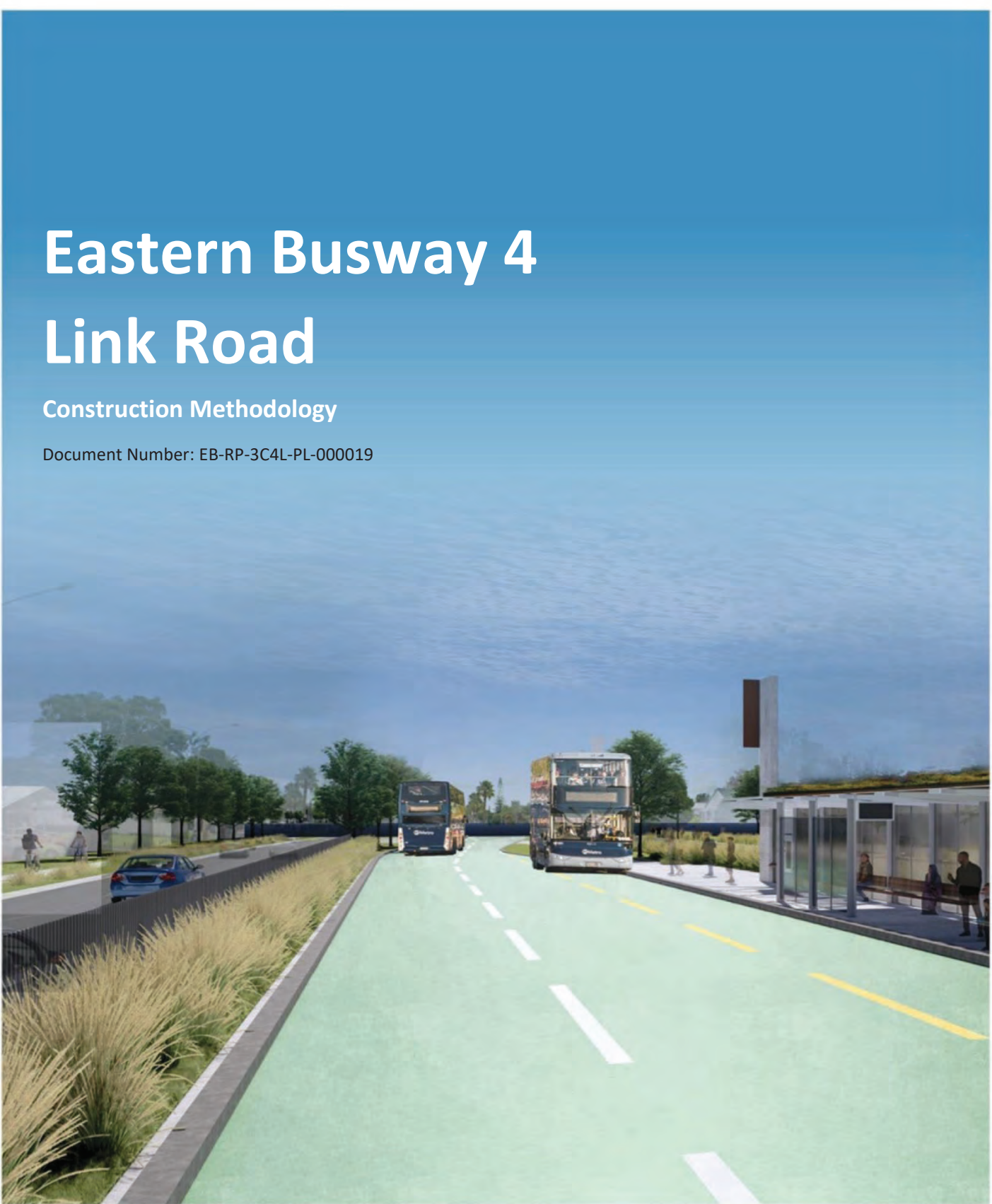
Appendix 30

Construction Methodology – EB4L

Eastern Busway 4 Link Road

Construction Methodology

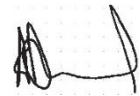
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1 Introduction

1.1 Overview of the Eastern Busway Project

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

- 5km of two-lane busway
- Two new bridges for buses across Pakuranga Creek (Bridges 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 as these are completed:

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

The Eastern Busway project consists of the following packages:

- Early Works Consents – e.g. William Roberts Road extension from Reeves Road to Tī Rākau Drive
- Eastern Busway 2 (EB2) – Pakuranga Town Centre, including the Reeves Road Flyover (RRF) and Pakuranga Bus Station. EB2 is subject to the lodged and publicly notified Notice of Requirement for a designation and associated resource consents (Council References-LUC60407134, DIS60407135, DIS60407492, CST60408360 and CST60408369) (BUN60407133)
- Eastern Busway 3 Residential (EB3R) – SEART to Gossamer Drive, including Edgewater Bus Station EB3R is subject to the lodged and publicly notified resource consents (Council References-LUC60407123, DIS60407122, DIS60407493, DIS60412893, WAT60412894 LUS60412895, CST60408460, CST60408461) (BUN60407121)
- Eastern Busway 3 Commercial (EB3 Commercial) – Gossamer Drive to Guys Reserve, including Riverhills bus station and two new bridges, and an offline bus route through Burswood.
- Eastern Busway 4 Link Road (EB4L) – Guys Reserve to the Botany Town Centre, including the Link Road through Guys Reserve and Whaka Maumahara Reserve to Te Irirangi Drive/Town Centre Drive intersection (**this construction methodology**).

The overall Project is shown in Figure 1: Project alignment below.

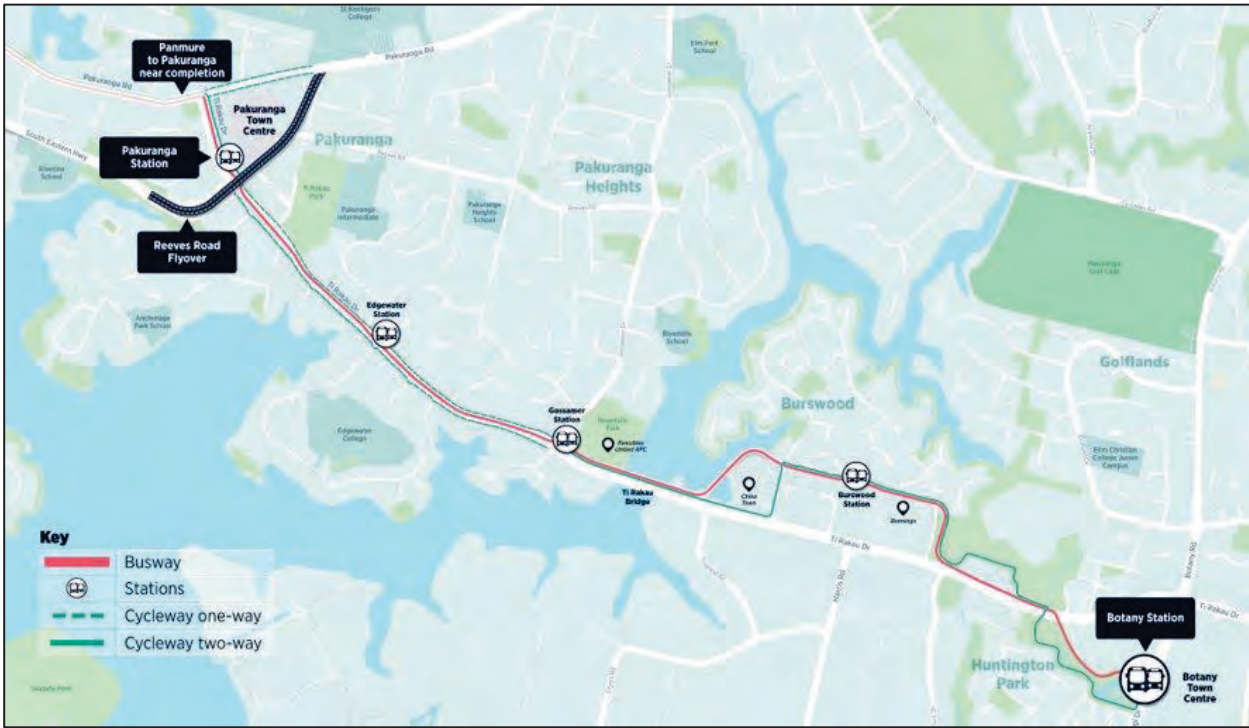


Figure 1: Project alignment

2 Proposal Description

2.1 Overview of Eastern Busway 4 Link Road (EB4L)

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 Reserve¹, Whaka Maumahara Reserve², 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 ends 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 with supporting abutments, piles and retaining walls along the embankment. This bridge is needed due to the sloping topography of the Reserves.

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

A new shared pathway and minor retaining walls will also be constructed along the southern and western boundaries of Guys Reserve and Whaka Maumahara Reserve to provide access from Tī Rākau Drive to Te Irirangi Drive. The shared pathway will connect to the existing walkways and will terminate at Te Irirangi Drive. The existing shared pathway will be realigned to avoid the piers for Bridge C and to maintain access for residents at Cottesmore Place and Kirikiri Lane.

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 rip rap) and pipeline will be constructed in 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 and adjacent to Te Irirangi Drive. This new connection will discharge via an existing outfall into the existing stormwater pond within the Whaka Maumahara 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. To avoid doubt, any signalised intersection works on Tī Rākau Drive area will be covered within EB3C.

¹ Guys Reserve-181R Guys Road, East Tamaki

² Whaka Maumahara Reserve-204R Guys Road, East Tamaki

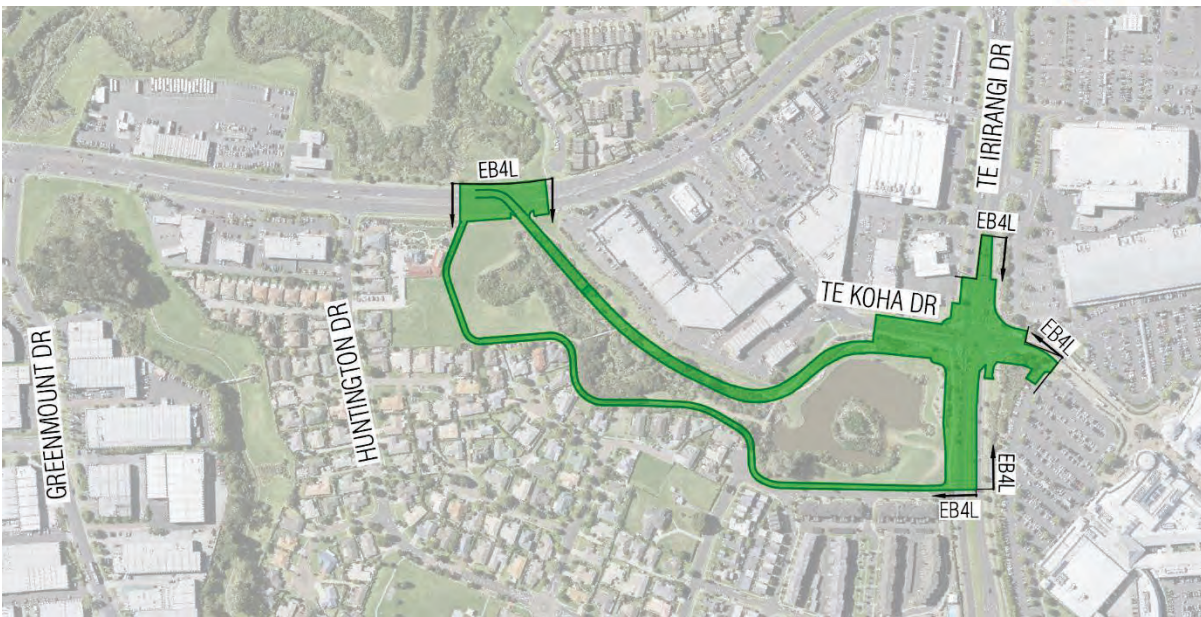


Figure 2: EB4L Project area



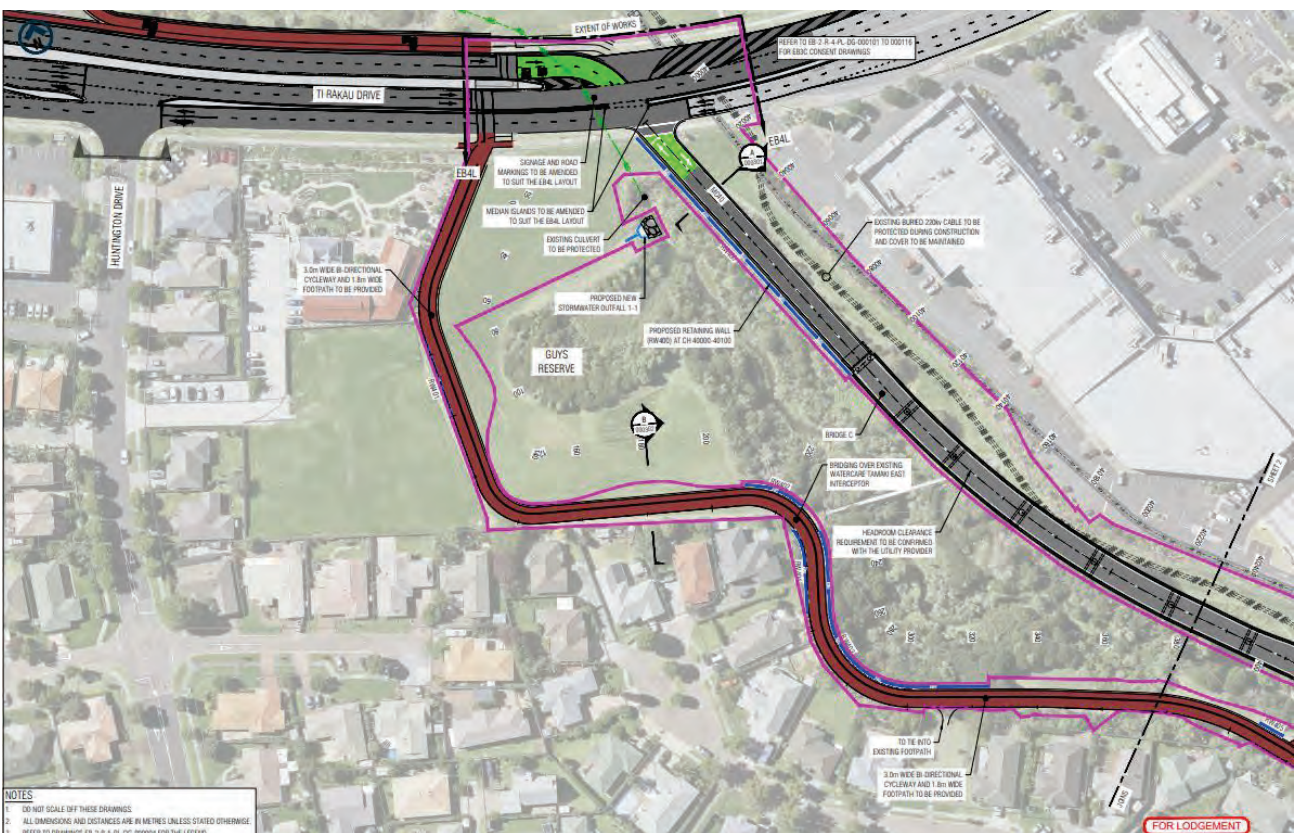
Figure 3 Aerial Image of the Guys Reserve and Whaka Maumahara



Figure 4 Extent of Guys Reserve and Whaka Maumahara (Source: Auckland Council GeoMaps)

2.2 Busway

A segregated offline and dedicated two-way busway is proposed through Guys Reserve and Whaka Maumahara Reserve to provide access for bus services between Pakuranga and Botany. This will enable safe and efficient bus movement for the busway as well as improve the reliability of bus travel times, efficiency, and reliability of the network.



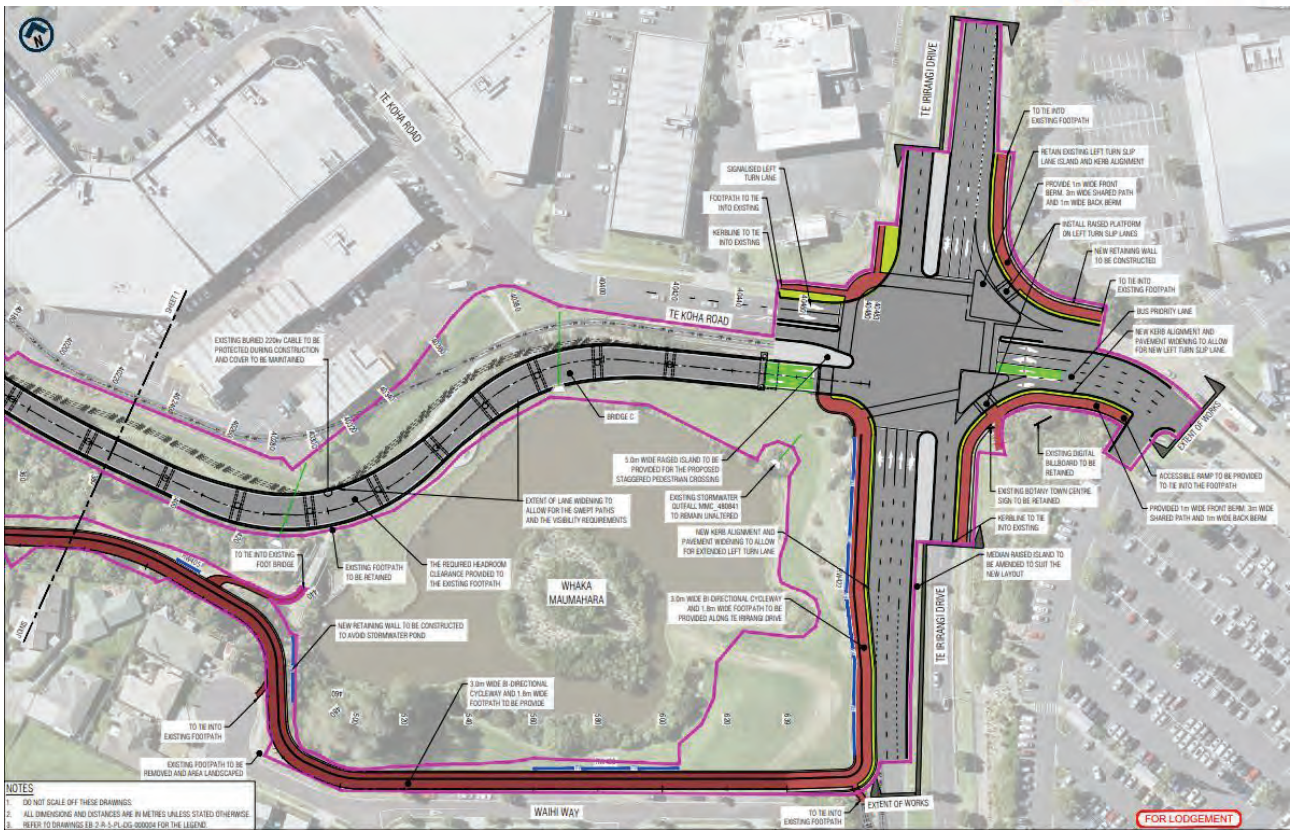
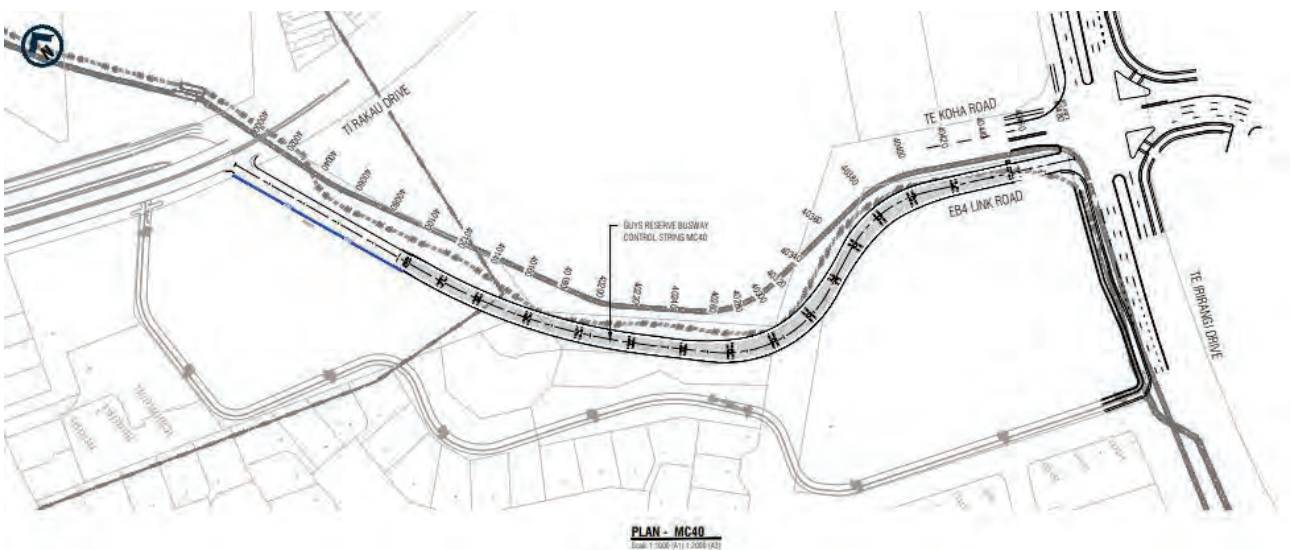


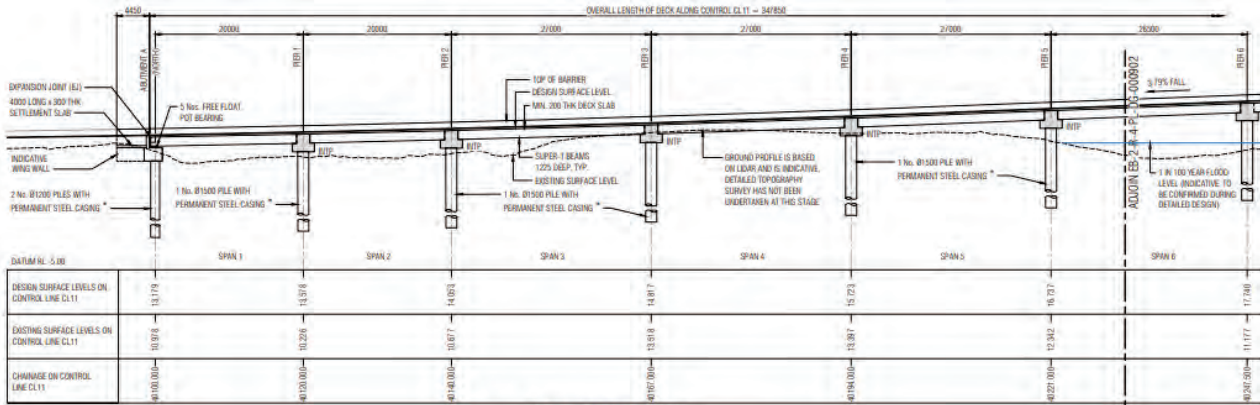
Figure 5: General Arrangement Plans showing busway alignment

2.3 EB4L Bridge (Bridge C)

Bridge C includes substructures such as piles, and superstructure piers, abutment beams, cross heads, beams, barriers, surfacing. The proposed bridge C is a concrete structure with two abutments, each supported by two piles. The bridge spans approximately 350 metres including concrete barriers on each side.

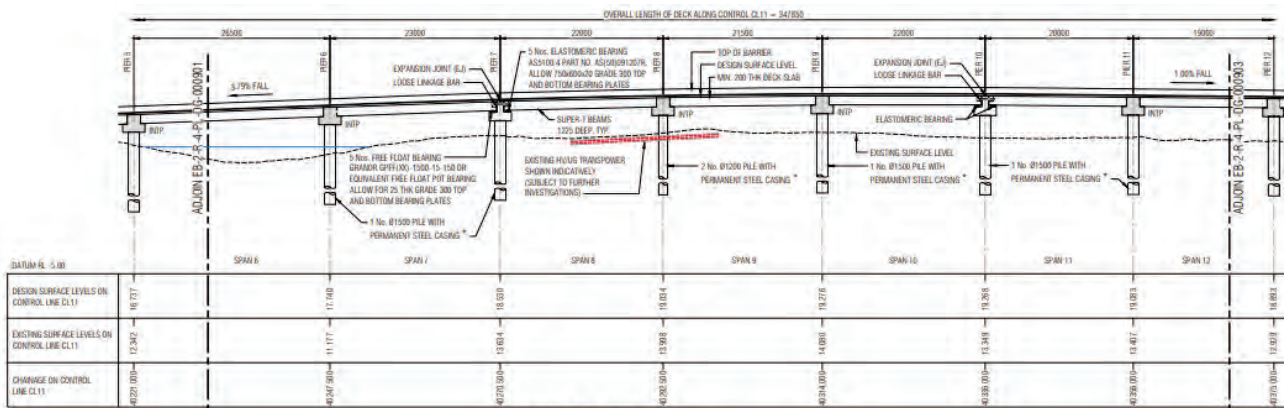
Dewatering of the piles will be required during construction and will be undertaken in accordance with the ESCP.





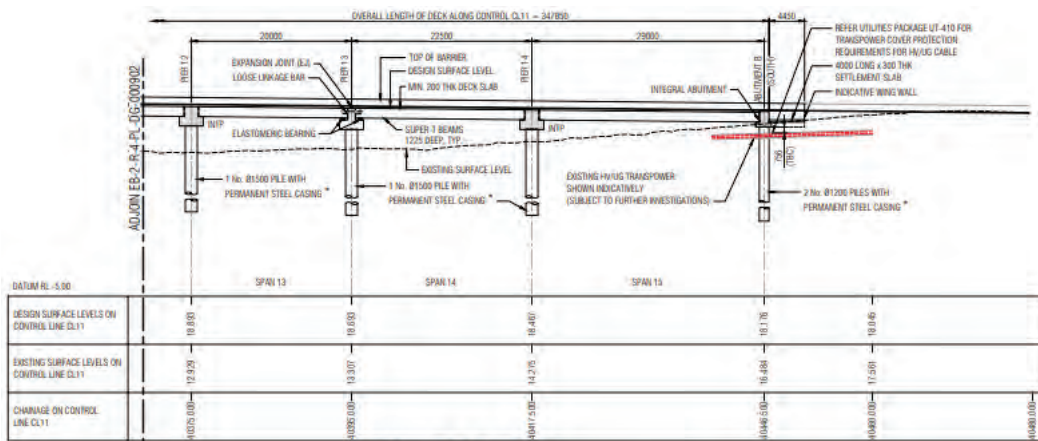
ELEVATION ON CONTROL CL11

* PILE STEEL CASING TO TERMINATE 50mm BELOW SOFFIT OF ABUTMENT CAP OR PIER CAP, BEYOND THE TOP 2000mm OF CASING WITH SKA BLACKSEAL.



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ELEVATION ON CONTROL CL11

* PILE STEEL CASING TO TERMINATE 50mm BELOW SOFFIT OF ABUTMENT CAP OR PIER CAP, BEYOND THE TOP 2000mm OF CASING WITH SKA BLACKSEAL.

Figure 6: Bridge C drawings



Figure 7: Example of a Super Tee bridge form

2.4 Walking and cycling facilities

A new shared pathway (walking and cycling facilities) and minor retaining walls will also be constructed along the southern and western boundaries of the Guys Reserve and Whaka Maumahara Reserve. The new shared pathway will connect to existing walkways and to provide access from Tī Rākau Drive to Te Irirangi Drive. The existing pedestrian pathway in the reserves will be realigned to avoid the piers for the EB4L bridge and to maintain access for residents at Cottessmore Place and Kirikiri Lane.

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

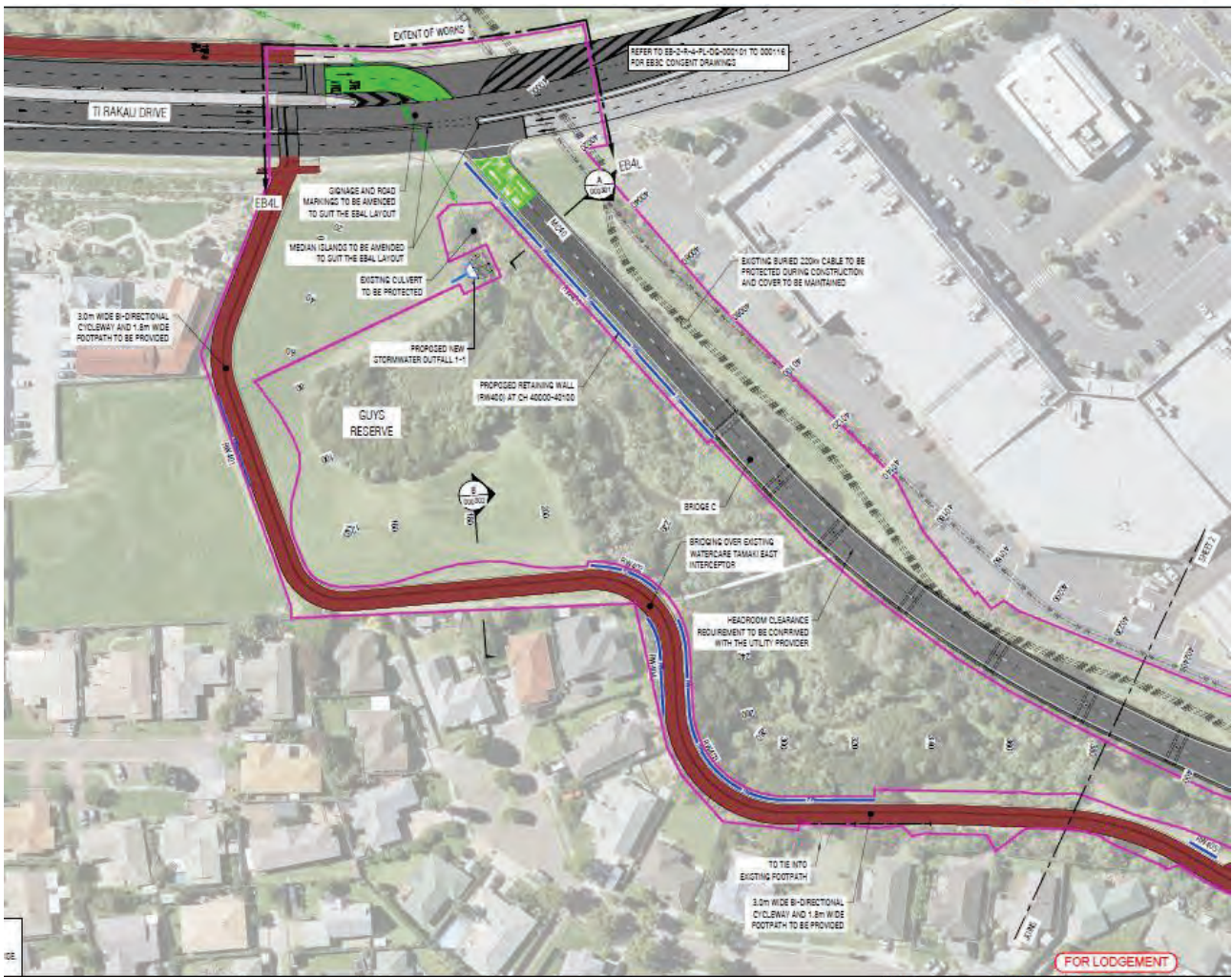


Figure 8: Shared pathway alignment

2.5 Retaining Walls

A post and panel (precast concrete) retaining wall will be constructed along the west embankment of the busway which is approximately 90m in length from Tī Rākau Drive with a maximum height of 3.5 m. This is a fill retaining wall.

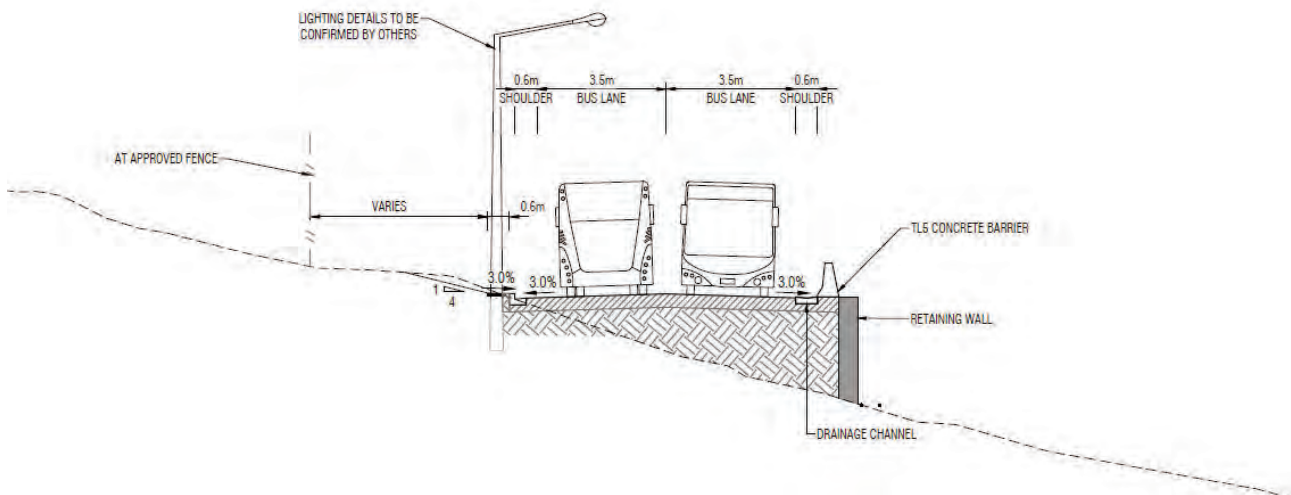


Figure 9: Typical retaining wall cross section

Other minor/small retaining walls are also anticipated along the shared pathway in the reserve.

2.6 Other works

In addition to primary construction activities, a range of ancillary works will be required to support the project. These will include the installation of drainage systems (including subsoil drainage and Kerb and Channel), construction of road pavements and traffic islands, installation of barriers, and clearance of the site and demolition of existing structures.

2.7 Tī Rākau Drive and Town Centre Drive Intersection Works

The proposed offline busway will connect to Te Irirangi Drive, following improvements to the intersection of Te Irirangi Drive and Town Centre Drive.

The Town Centre Drive intersection improvement works is shown in *Figure 10* below will include features such as new retaining wall, shared pathway, retaining the existing left turn slip lane at the north-east corner, and new left turn slip lane at the south corner. To improve pedestrian safety on these slip lanes, raised platforms will be provided. This intersection will enable the busses to cross at this intersection and into the Botany Town Centre. The intersection will provide safe and efficient transportation for both buses and other vehicles.

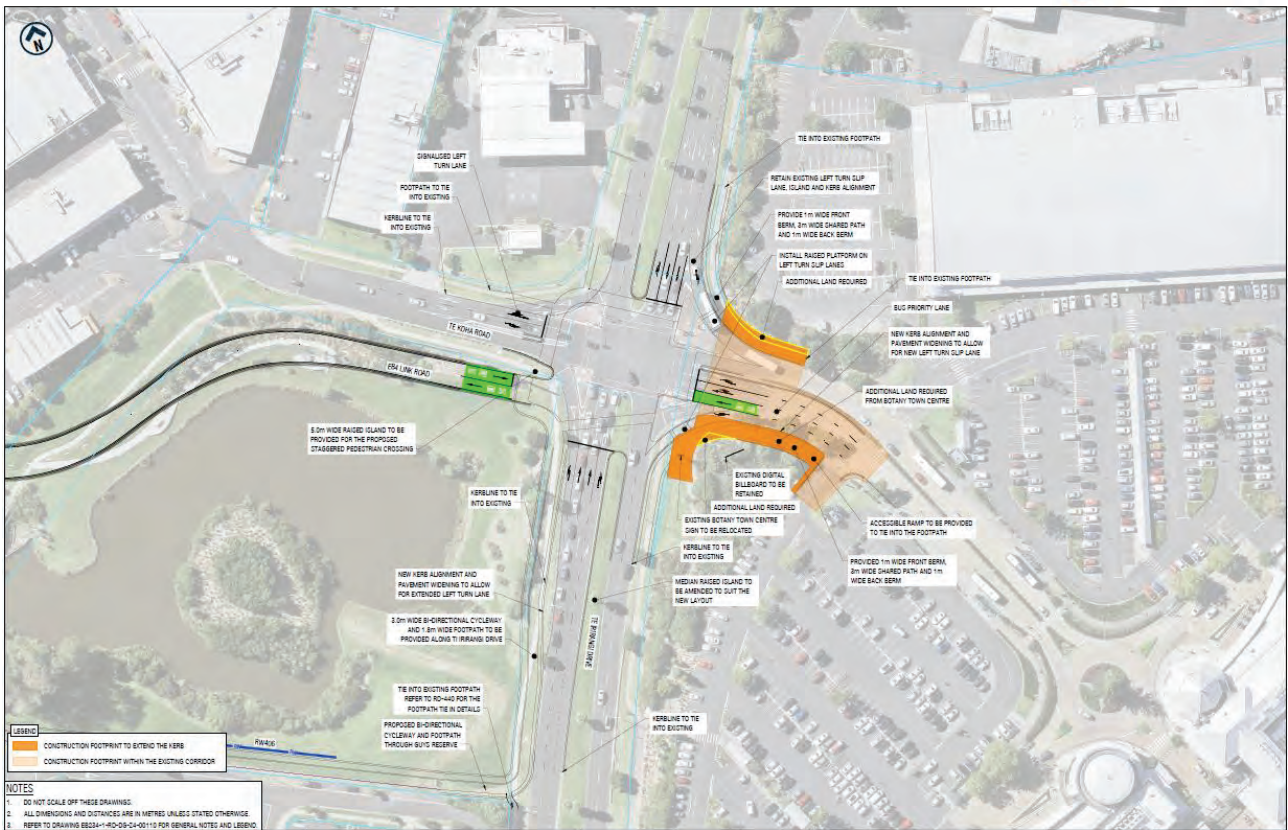


Figure 10: Te Irirangi Drive and Town Centre Drive intersection sketch design

3 Site Establishment

3.1 Site Access Points (SAP's) and fencing

Site Access Points (SAP) from the local roading networks are essential for the project and will be managed through the project's Construction Traffic Management Plan (CTMP). An SAP is a controlled interface between the public and construction activities.

A SAP can either involve the construction of new permanent egress facilities such as pull-off lanes, turning bays, signalled intersections, and driveway crossings, or a temporary traffic management egress point onto and off the site. It also serves as an authorized entry/exit checkpoint, coordinating the entry and exit of deliveries and ensuring the roadworthiness of existing vehicles (such as clean tyres).

SAP's will be among the first items constructed on-site, along with safety and security fencing around works areas and compounds. The fencing will provide a physical barrier between the works and the public.

SAPs consist of:

- Either a permanent or temporary traffic management egress setup
- Sealed entry way off the adjacent carriageway
- Lockable gate and perimeter fencing around the circumference of the compound or works area
- A sign-in / sign-out station, including safety and environmental protocols within
- Wheel washing facilities
- The final locations of SAPs and the facilities and activities within each may change depending on the final design.

SAP's will be individually numbered to allow efficient wayfinding for site traffic planning and communications.

3.2 Existing network services

As part of the enabling works, and before any setup or construction works commence on the Project, existing network services will be located and identified by either the provider themselves or specially trained utility location personnel. Once identified, each service will be potholed or measured to determine the exact location and depth / height. Potholing and measuring are permitted activities under the AUP(OP) and will be supervised by the network utility provider(s) and follow the Auckland Council codes of practices for working around live services.

3.3 Construction laydown areas, compounds, site offices

A construction laydown area will be established 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 near VTNZ's vehicle inspection premise.

The compound locations have been chosen after considering proximity to the works, possible access routes, and with consideration to minimising noise affects and disruption to the residents of the nearby residential area.

An example of a potential site layout plan for the compounds is shown below in Figure 11 and Figure 12.

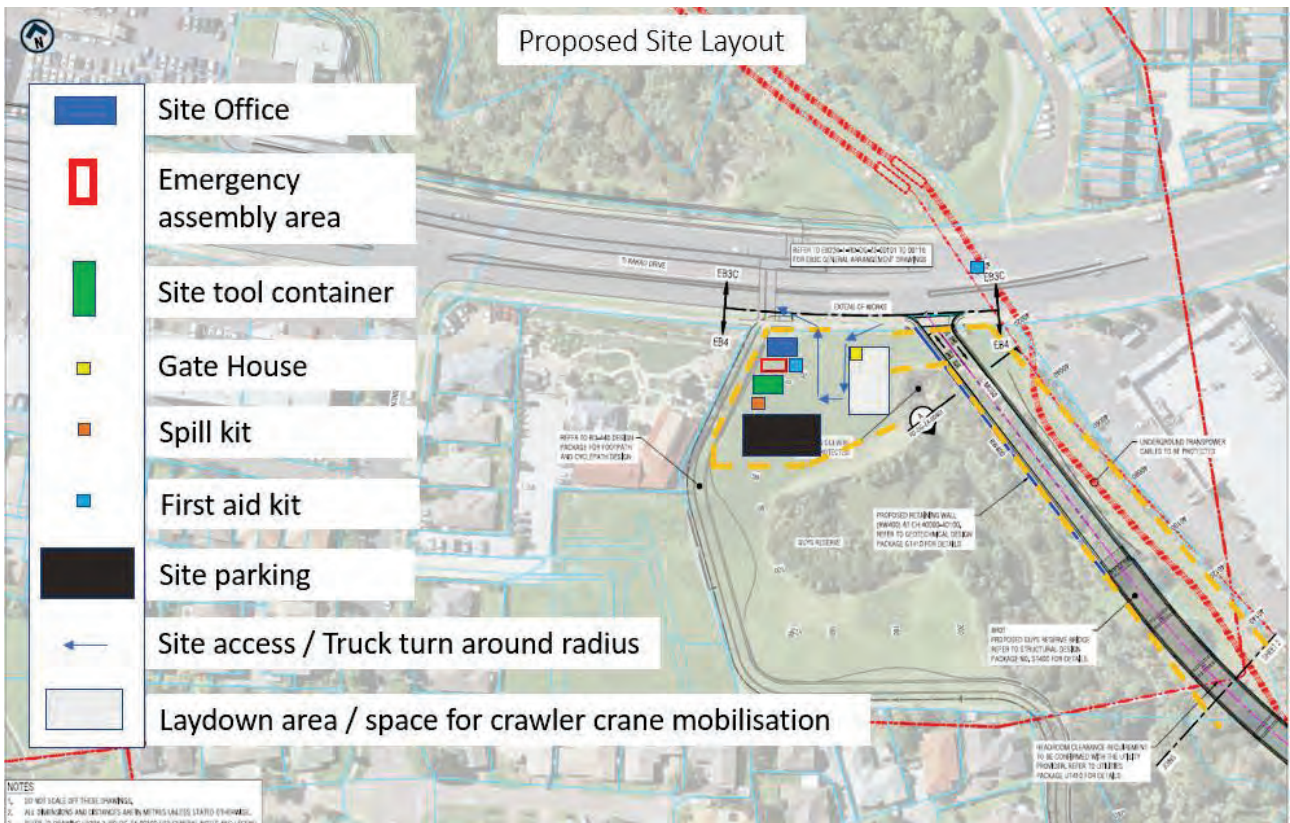


Figure 11: Indicative potential layout of compound near Ti Rākau Drive

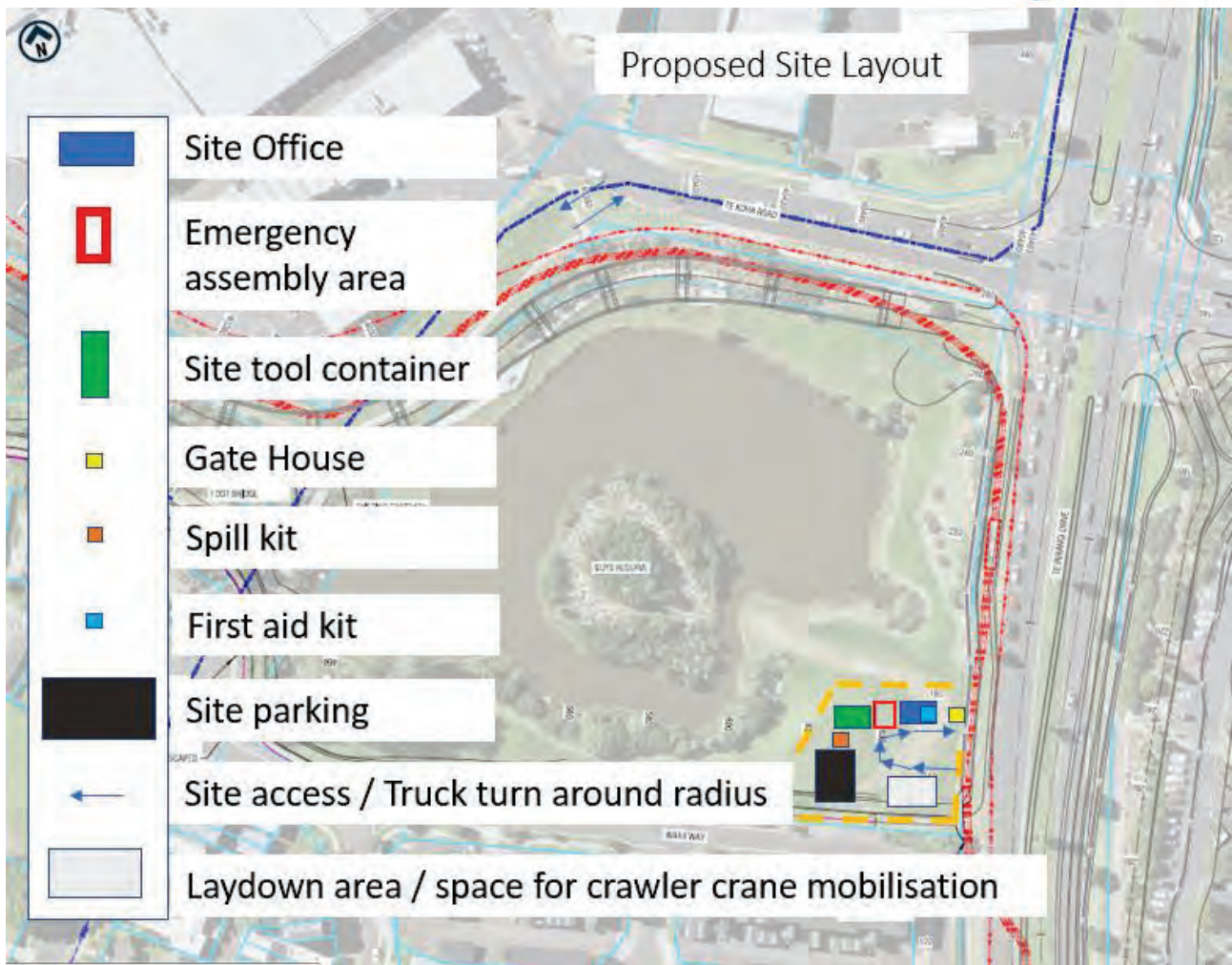


Figure 12: Indicative potential layout of compounds near Te Irirangi Drive

The construction compounds will contain a range of activities typically associate with construction, such as:

- Temporary site buildings – workers' facilities, site offices and meeting rooms
- Plant and equipment maintenance facilities
- Fuel storage and minor refuelling facilities in accordance with Hazardous Substances and New Organisms (HSNO) regulations 1996 – 20ft max bunded containers
- Material laydown areas including stockpiling of materials and spoil
- 10ft, 20ft and 40ft material storage containers
- Wheel washing and cleaning facilities
- Lighting / fencing / security temporary mesh panels 1.8m high/ hoarding
- Vehicle parking
- Plant and equipment parking.

In addition to these compounds, various construction activities such as stockpiling, laydown and assembly areas, plant and equipment storage will occur throughout the construction footprint. To ensure environmental compliance, the compounds and storage areas will be regularly monitored in accordance with the Erosion and Sediment Control Effects Assessment. The works are generally planned to be completed during daytime however occasional night-time works may be required (refer to section 5.7 Night works) and the compounds will be used to support these activities.

Site establishment activities for the construction compound areas will include site clearance, ground preparation, and establishing erosion and sediment control measures prior to any construction activities occurring. Upon completion of the works, the construction compounds will be disestablished.

The compounds will be provided with water, telecommunications and power connections, and where required wastewater connections. In most cases, these services can be connected directly to the existing adjacent networks. Where there is no existing network adjacent to the yard, a temporary connection will be made which will be removed upon completion of construction. Alternatively, these services will be provided using self-sufficient means such as generators and tanker supply.

Within each compound, designated carparking areas will be set up for construction staff and visitors. Parking on side streets by construction staff will be discouraged and monitored to ensure minimum disruption to the community and users of sports fields, public reserves, and townships on event/opening day(s).

The final location of construction compounds and the activities undertaken within each area will be confirmed in the Construction Environment Management Plan (CEMP).

3.4 Temporary Access

To facilitate the construction of the EB4 Link Road, a temporary access track will be required to provide personnel and machinery with access to the site. One potential route for this track is illustrated in

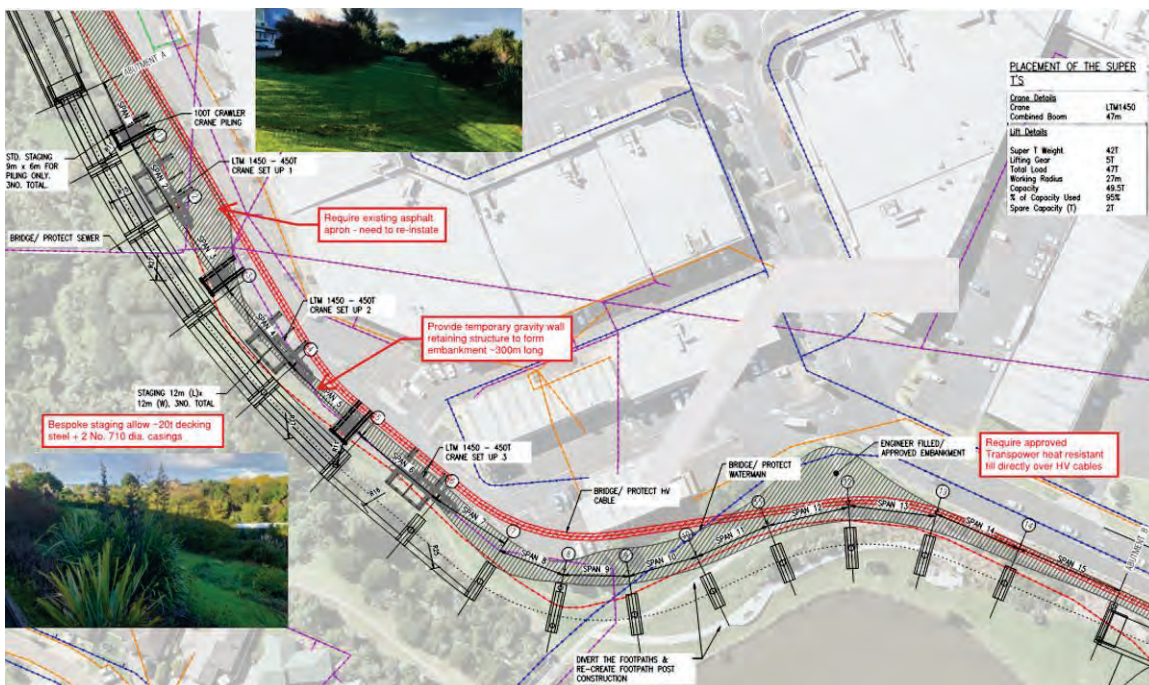


Figure 13. The

access track will likely involve the construction of a temporary embankment and some retaining walls. The access track is expected to be built progressively over a 6-month period. Once the link road is completed, the temporary works will be removed from above ground level, and the affected area will be remediated.

Figure 13: Proposed location of the temporary access track

3.5 Main Laydown areas and site deliveries

Construction materials and waste exports will be primarily transferred to and from the site using designated access points located north of the site via Tī Rākau Drive or from the east via To Koha Road. Trucks and other typical construction equipment will transport materials between site specific locations within EB4L throughout the project’s duration. Site traffic movements will be defined by the CTMP(s).

Generally during the initial stages of the construction project, traffic volumes are expected to be relatively low, however, as construction progresses, the volume of traffic will increase due to the movement of equipment and materials as well as the departure of workers and vehicles. Approximate traffic volumes are shown in Table 1 - Vehicle .

Type of Vehicle	Approx Number of vehicles per day	Approx Number of Movements per day	Approx Duration (in months)	Timeframe
Truck and Trailer	2	4	12	Year 1
Oversize deliveries (bridge beams)	3	6	2	Year 2
6w Truck	5	10	6	Year 1
LV	10	40	30	Year 1-3

Table 1 - Vehicle movements

The vehicles will use the temporary access track, designated parking areas, and laydown areas. These surfaces will feature low silt, compacted hardstand material to ensure stable and durable driving and parking as well as minimising sediment runoff.

3.6 Site clearance

Site clearance will involve the removal of vegetation, park furniture, waste, and debris, along with existing structures such as fencing. Some vegetation clearance will be required for the construction of the project. This involves using specialized tools and equipment, such as chainsaws, brush cutters, stump grinders and excavators. The process will vary depending on the size and location of the vegetation. For example, for small trees or shrubs, hand tools such as pruning saws and loppers may be used, while larger trees may require the use of heavy equipment such as tree fellers or excavators.

Before vegetation clearance begins, the site will be assessed to identify any protected species of plants or wildlife that may be present. Any permits or approvals required will be obtained prior to commencement of vegetation clearance.

Vegetation clearance will be carried out in a way that minimises the impact on the surrounding environment.

After the vegetation has been cleared, the debris and waste material will be disposed of responsibly. This may involve recycling, chipping, or burning the wood, or transporting the waste material to an approved landfill site.

3.7 Erosion and sediment control

To prevent erosion and sedimentation during the Project, a range of effective measures will be implemented. These measures are thoroughly described in the Erosion and Sediment Control Effects Assessment. Some of the key measures include:

- Staging the works appropriately to limit the amount of exposed earth at any given time, thus reducing the area vulnerable to weather elements
- Installing perimeter controls, such as earth bunds and drains, to divert clean runoff from the disturbance area and channel sediment-laden runoff to sediment retention devices
- Utilising various erosion protection techniques, such as geotextiles, aggregate stabilisation, hay mulching, and grassing
- Implementing sediment control devices, such as decanting earth bunds, container sediment units, sediment fences, and silt socks.

These measures will help minimise the environmental impact of the Project by reducing soil erosion and sediment runoff. They will be carried out in accordance with relevant safety and environmental regulations to ensure the health and safety of workers and the environment.

4 Protection and/or relocation of existing network services

The Project traverses a highly modified urban environment and as a result there are numerous network utilities within and crossing the alignment. These services range from major arterial networks (such as water supply mains, electricity transmission, telecommunications, and gas) to local reticulation services.

Construction methodologies for each service will be developed in consultation with each operator. Service relocations are typically done as early works to ensure that service is maintained during construction.

Discussions have been undertaken with network utility operators and agreements are being developed with each operator regarding their assets. Services will be either protected or relocated to the relevant provider's standards and where possible located within dedicated service corridors. Services will be constructed and tested in the realigned position to enable a short switch-over timeframe with minimal disruption to users.

The key services within the Project include:

- High voltage transmission underground cables
- Fibre optic cables
- Medium pressure gas mains
- Water transmission (watermain), water distribution and wastewater infrastructure
- Fibre optic communication cables and telephone lines
- Electricity and gas distribution
- Stormwater drainage

4.1 High Voltage transmission underground cables

There is two major electricity transmission lines, owned and operated by Transpower New Zealand Limited located in the Guys Reserve and Whaka Maumahara Reserve. Figure 14: *Extent of the underground electricity transmission of a 220kV cable located within the Guys Reserve and Whaka Maumahara Reserve* provides an aerial with an overlay of the underground 220kV voltage cable to convey electricity between the Pakuranga substation and substation at Brownhill Road. It also contains a buried fibre optic cable and power cables. Due to the critical and sensitive nature of these transmission lines, protective measures will be implemented to ensure safe digging practices and prevent damage.

Industry best practices for working near underground cables will be followed, and approval will be sought from Transpower to guarantee the safety of the cables and ensure that the works can progress without incident.

Prior to undertaking any works within the electricity transmission designation, a s178 approval will be sought from Transpower.



Figure 14: Extent of the underground electricity transmission of a 220kV cable located within the Guys Reserve and Whaka Maumahara Reserve

4.2 Medium pressure gas pipelines

Along Tī Rākau Drive, there is an existing medium pressure gas main, refer to Figure 15: Vector gas network (green). The design has sought to avoid these gas mains wherever possible.

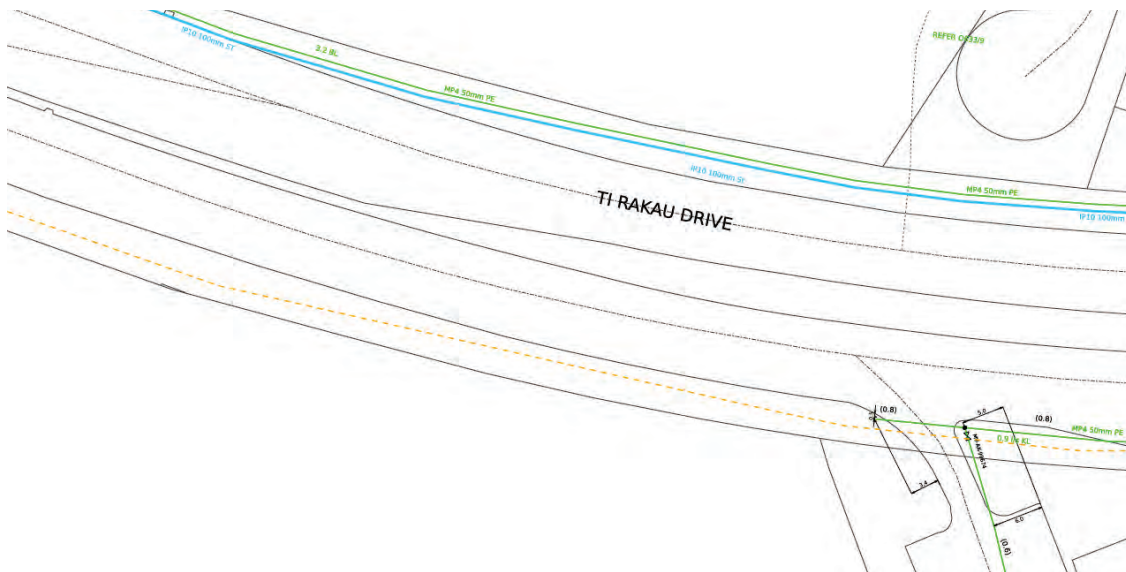


Figure 15: Vector gas network (green)

4.3 Water Supply and Wastewater Infrastructure

The project intersects the Howick watermain, which is essential for maintaining water supply to the area. It is critical to protect this transmission line, and the project team will take necessary measures to protect and maintain it during construction.

In addition, the EB4L footprint also contains local water and wastewater reticulation systems, which may require removal, relocation, or protection during construction. However, it is expected that the water and wastewater infrastructure will be kept operational during construction, or an alternative arrangement will be agreed with the utility owner.

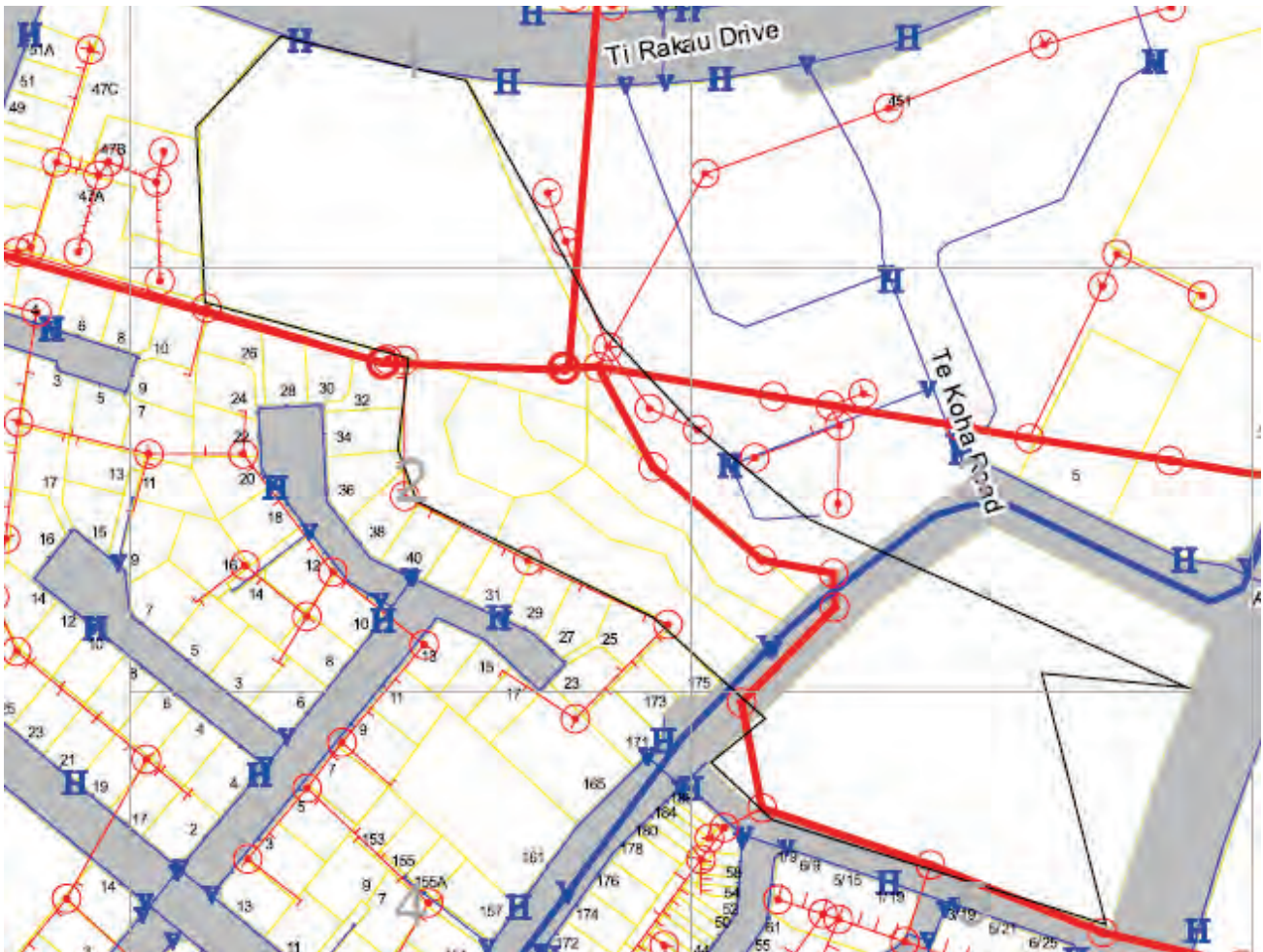


Figure 16: Water supply network (shown in blue) and wastewater (shown in red) networks

4.4 Communication Cables

There are some below ground fibre optic and copper cables in the vicinity of the Project and these may require relocation/ protection during construction. These networks are owned by Chorus and Vector.

4.5 Electricity and Gas Distribution

The project intersects with medium voltage (11kV) cables, which are owned by Vector and carried by the pedestrian bridge from Guys Road to Te Koha Road. These cables will require protection during the construction phase. Furthermore, low voltage (400V) cables run along Ti Rākau Drive which will also be protected during construction of the Project.

4.6 Stormwater drainage

The existing stormwater network will need to be either protected, modified or upgraded to accommodate the Project. The methodology for these works will be undertaken in accordance with Auckland Council Healthy Waters' Network Discharge Consent and the NoR/regional consent applications.

5 Main Construction Activities

5.1 Earthworks

Earthworks are an important part of the construction process, involving the excavation, movement, and shaping of soil and rock to create a suitable foundation or landscape for a construction site. Heavy machinery, such as excavators, bulldozers and trucks are commonly used to carry out these tasks.

EB4L earthwork operations includes approximately 1,150m³ of cut to fill over the EB4L project footprint of approximately 0.9ha. In addition, approximately 21,330m³ of hardfill is proposed to construct retaining walls, the site yards and site access with an additional construction footprint of approximately 1.5ha. The works are to occur on generally flat to sloping existing site contours through Guys Reserve and Whaka Maumahara Reserve. The approximate earthworks are detailed in Table 2 below.

Area	Cut Material (m ³)	Fill Material (m ³)
Busway (including Bridge C)	200	2,960
Shared pathway and retaining walls along the southern and western boundaries of Guys Reserve and Whaka Maumahara Reserve	200	620
Temporary Access Embankment	0	17,000
Temporary construction laydown areas	500	500
Te Irirangi Drive/Town Centre Drive intersection works	250	250
Total	1,150	21,330

Table 2 – Approximate Volume of earthworks required for temporary and permanent works for EB4L.

5.2 Contaminated materials

There are locations along the alignment where there is the potential of encountering contaminated soil and groundwater during construction. The activities undertaken in areas with contaminated soil and groundwater and the handling of contaminated material requires management during construction to minimise potential risks to human health and the environment. The location and nature of contaminated material and the measures to be adopted during construction are set out in the Contaminated Land Effects Assessment. The assessment details the following:

- Containment handling and disposal of contaminated soil during construction
- Discharges of dust generated by land disturbance activities
- Discharge of potentially contaminated sediment from land disturbance activities
- Potential human health risks for the construction workforce.

5.3 Civil Works

Construction of the Project will involve the installation of new civil infrastructure throughout the alignment.

Installation of new civil infrastructure will involve, but not be limited to:

- Utilities relocation (water, wastewater, electrical, communication, gas etc.)
- Utilities protection (water, wastewater, electrical, communication, gas etc.)
- ITS ducting
- Street lighting

- Shared paths
- Traffic services
 - Barriers
 - Signals
 - Signage
 - Lighting
 - CCTV
- Urban design
 - Open spaces
 - Seating
- Landscaping
 - Planting and grassing

The construction activities will primarily occur within dedicated permanent work zones; however, some temporary activities/or permanent works within temporary occupation zones will need to occur under additional traffic management operations either through the day shift or at night. Those activities will involve but are not limited to:

- Streetlight pole installation
- Gantry / large signage
- Craneage needs for urban design items
- Connections to existing services located in live traffic
- Paving and construction of traffic islands

Though construction sequencing and traffic management switches, temporary traffic diversions will be managed in accordance with the Project's CTMP(s).

5.4 Drainage works

Drainage works will comprise the excavation and installation of pipes, culverts and other drainage structures. It may also include swales, ditches, or other types of drainage channels. The project includes a new pipeline, outfall (1-1) (including riprap) near Tī Rākau Drive (refer to Figure 18 and 18) and a new pipeline near Te Irirangi Drive as shown in Figure 17. No changes are proposed to the existing outfalls near Ti Irirangi Drive.

During construction, diversion may be required for network utilities and road network linear trenching activities, with the trenching work being progressively opened, closed, and stabilized. In any given period, the open section of the trench will not exceed 10 days.

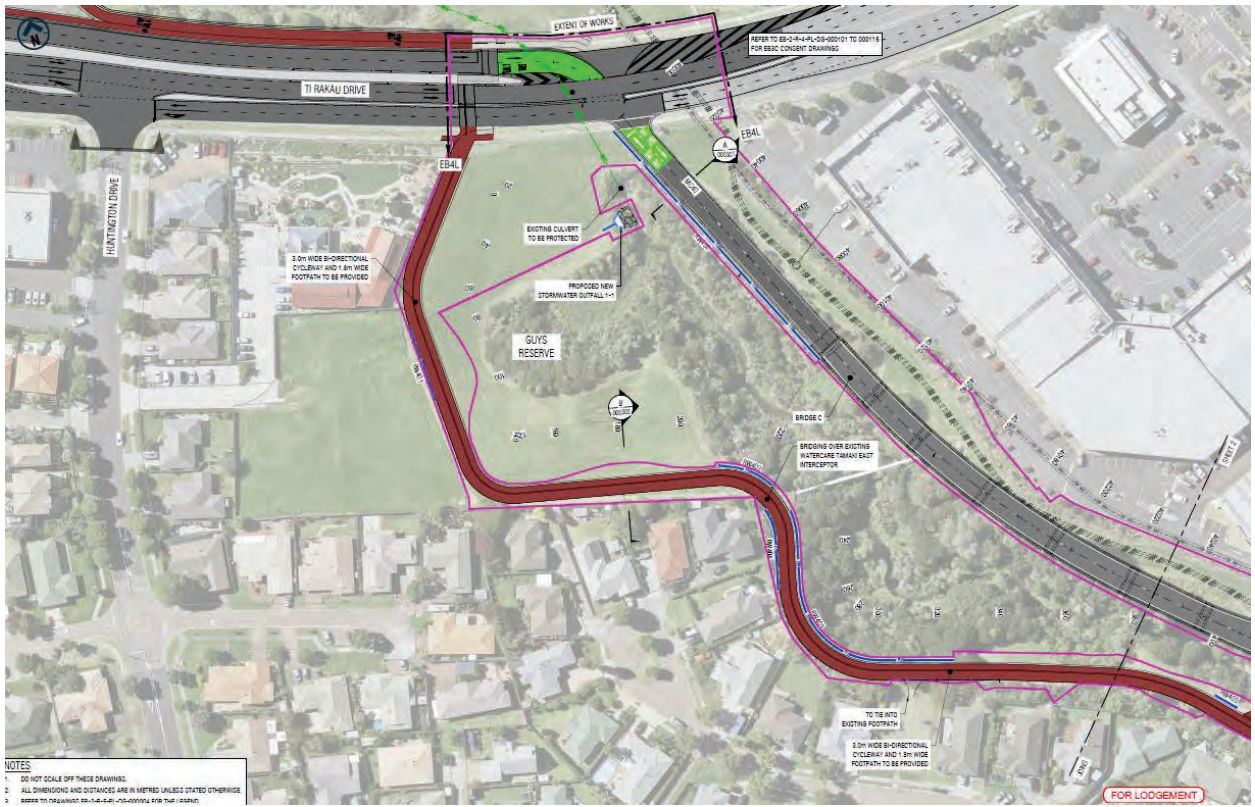


Figure 17: Existing and new stormwater infrastructure for EB4L

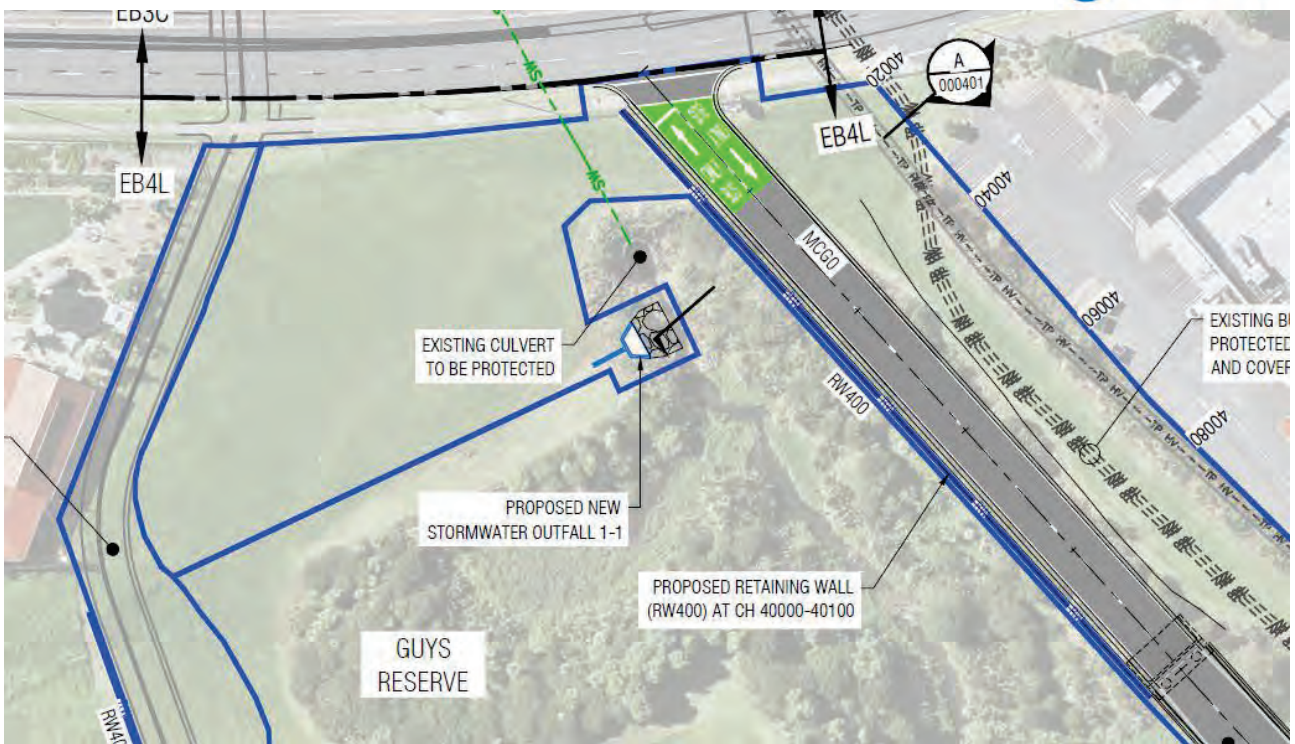


Figure 18: Proposed stormwater works for a new outfall (1-1)

5.5 Pavement works

Construction of the Project will involve the construction of new pavements. Construction of new pavements will involve:

- Subgrade preparation, including subgrade improvement works after civils activities and site access use, plus final trimming ready for granular layers
- Installation of geogrids and or geotextiles
- Placement of the subbase granular layer
- Alternatively, placement of lean mix concrete as subbase layer
- Installation of pavement drains and kerbing
- Placement of the basecourse granular layer
- Membrane chip-seal sealing of the basecourse
- Placement of structural asphalt layers
- Construction of subsoil drainage.

5.6 Structures

Bridge construction will involve:

- Relocation and / or protection of existing network utility services
- De-construction of existing structures, full or part thereof
- Temporary works, including amongst others, crane pads and access tracks. These will be removed at the completion of the project.
- Mechanically stabilized earth walls (MSE), abutment and approach ramp construction
- Bored piles at each pier position comprising temporary steel casings
- Columns and pier headstocks, constructed at each pier location and at the abutments
- Bridge beam erection, one span at a time and possibly installed at night to allow for lane closures for beam delivery and crane positioning for lifting

- In situ deck pours, followed by ancillary works, including amongst others, barriers, movement joints, drainage, services and surfacing works.

Due to the topography of the site, a retaining wall is proposed along the embankment of the proposed busway and other retaining walls are required along the shared path.

These retaining walls are subject to detailed design, but they may comprise of:

- Mechanically stabilised earth walls (MSE), mainly for approach embankments to bridge structures
- L shaped walls, (e.g. precast segments), tending to retain small heights
- Gravity walls, (e.g. mass blocks or components of), tending to retain small heights.

During the piling works for both the bridge and retaining walls, it is anticipated that dewatering of the piles will be necessary. This process is necessary to prevent the concrete from becoming diluted or contaminated by groundwater during the installation process. When concrete is poured into the hole while it is still wet, if the borehole is filled with water, it can mix with the concrete and weaken its strength. Dewatering is an effective way to prevent this from happening and ensure that the concrete is of the highest quality.

In addition, dewatering is also essential to ensure a dry and stable working area for the piling operation. A stable working area is necessary to ensure the safety of the workers and the accuracy of the piling process. Without proper dewatering, unstable conditions may occur, making it difficult to control the drilling process and achieve the desired depth.

5.7 Night works

In general, construction works will take place between 0700 and 1800 Monday to Friday, and 0700 to 1500 on Saturdays. It should be noted that construction shift arrivals and departures will occur outside of these hours, as will the setup and pack up of construction traffic management measures (e.g., road cones and temporary barriers).

Some activities are likely to require partial/full road closure, decreasing the number of lanes, or additional clearance for safety and thus will need to be undertaken at night. This may include (amongst others) the following construction activities:

- Temporary Traffic Management including installation of hard barrier lines
- Site investigation works within carriageway and roadside corridors
- Utilities cut overs as required during periods of low operations
- Tying the road into the existing road network
- Traffic services (streetlights, signage, signals, road markings, ITS systems), investigations, protections, relocations, and new installation works
- Delivery of bulk materials, plant, equipment and resources unable to be delivered, relocated or removed without effect on daytime public and traffic movements and flow
- Some aspects of bridge construction including beam deliveries and installation, major concrete pours, precast barrier and component installations.

5.8 Dis-Establishment

As sections of the works are completed, dis-establishment of construction support facilities will commence.

These activities include, but are not limited to:

- Dismantling and uplifting of site compounds and SAP egress points
- Making good temporary occupied land, through either landscape planting, grassing or agreed usage
- Re-installation of facilities and traffic services temporarily removed or relocated
- Uplifting and removal off-site, of construction plant and equipment, surplus materials and spoil, temporary works items and perimeter fencing, lighting and signage.
- Uplifting, removal and making good temporary traffic management and pedestrian/cyclist deviations.

Where practicable these activities will be undertaken within dedicated works areas, but as dis-establishment works progress, activities will need to be undertaken within day and night-time lane and road closures.

5.9 Testing and commissioning

The following steps will be followed to ensure a safe and efficient opening:

- Commissioning and acceptance testing of all systems and components where required
- Confirmation and sign-off that the scope of works has been completed as designed and specified
- Completion of an independent safety audit
- Completion of public / traffic notifications of the opening and new lane layouts
- Removal of all construction support facilities, plant and equipment, and surplus materials and spoil from the site, including, the dismantling and uplifting of compounds and SAP's.

Once completed and over a single nightshift road closure, the following opening night activities will be undertaken:

- Uplifting and removal of temporary traffic management
- Installation of final line marking, and signage required
- Switching on of traffic services for the new layout, (e.g. signals, lightings etc)
- Uplifting and removal of any temporary traffic services.

6 Anticipated Construction Programme

The indicative construction programme for EB4L is approximately for 24 months and commencing late 2024, subject to obtaining the required RMA approvals and funding approval. Multiple aspects of the project will likely occur concurrently or sequentially during construction. It is anticipated that EB4L will be completed by 2027.

Below is an indicative timeline of works:

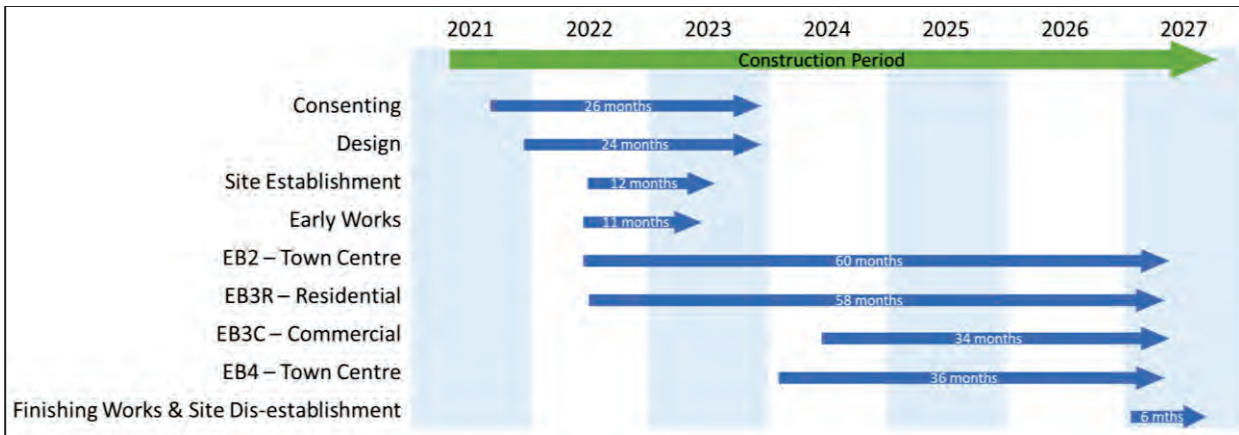


Figure 19: Proposed construction programme timeline

7 Development of Construction Methodology

The construction methodology and activities outlined in this section have been developed through an iterative process by the EBA that has involved several rounds of multidisciplinary reviews and workshops. The intention of this methodology is to balance the cost, programme implications and likely adverse impacts of various construction activities to achieve a methodology that, as far as practical, avoids or where avoidance is not possible, minimises construction impacts. This includes consideration of the following:

- The location and extent of construction compounds, satellite offices, laydown areas and construction egress points
- Minimise disturbance and vegetation clearance where possible
- Minimisation of land acquisition and adverse construction impacts on neighbouring properties
- Construction programme and timing of activities to take advantage of seasonal weather conditions
- Auckland Transport's construction guidelines and standards relevant to the avoidance and minimisation of adverse effects on the environment.

While aiming to avoid adverse construction impacts and taking into consideration social, environmental, and cultural constraints, the methodology aims to maximise flexibility so as not to unduly restrict or constrain construction activities. The construction methodology will be further refined and developed during the detailed design phase of the Project and this document will be updated as construction progresses. This will be undertaken with consideration of the designation and resource consent conditions, environmental management plans, as well as balancing cost and programme, environmental and social outcomes.

8 Construction Plant and Equipment

The following section provides an overview of the type of plant and heavy machinery anticipated to be required to undertake the construction activities described in this report for all stages.

6.1 Structures

The construction process will require standard equipment, such as cranes, for the assembly of the structures. Key plant and equipment will include:

- Cranes; Crawler 100t
- Cranes; Mobile 450t
- forklift
- Piling rig
- Vibrohammer
- Franna 25t
- JLG (elevated work platform)
- Excavators; 20t (with breaker) and 10t
- 6-wheel trucks
- Overhead gantry at precast yard off-site
- Jinker transporter 60t
- Concrete hammer drills
- Generators
- Water pumps
- Lighting towers
- Concrete pumps

6.2 Earthworks

Normal construction plant will be required for earthworks activities, including excavators, trucks, and compactors. Cut material to be removed from site will be loaded by excavators into trucks while imported fill will be delivered by trucks, spread out into layers by excavator or graders and compacted with rollers and compactors.

Key plant and equipment will be:

- Concrete saws
- 2t to 10t excavators
- 10t to 14t excavators – including track and rubber tyre machines
- 20t to 30t excavators - including track and rubber tyre machines
- 1t to 3t skid loaders
- 1t to 5t wheeled dumpers
- 4-wheeler and 6-wheeler watercarts
- 4-wheeler tip trucks, delivery trucks
- 6-wheeler tip trucks, concrete trucks, delivery trucks
- Truck and trailer tip trucks
- Articulated truck and trailer units

- 2t to 5t rollers and compactors
- 10t to 20t rollers and compactors
- 2.5t to 6t loaders
- 10t to 14t loaders
- 4Kw to 9Kw towable diesel light tower
- 10 to 15 cfm petrol compressors
- 250 to 500 cfm diesel compressor
- 10kg to 34kg air breaker heavy
- 2000 to 3000 psi water blaster towable
- 3 kVA to 8kVA portable generators
- 8kVA to 20kVA generators
- 50kg to 500kg plate compactors
- 60kg to 75kg tamping rammers
- 400kg to 650kg pedestrian rolling drum
- 10t to 25t roller static multi tyre
- Light vehicles and 3t site trucks
- Hydroseed spraying plant
- Mulch blowers
- Stump grinders

6.3 Pavements

It is anticipated that graders, trucks, and compactors will be required for granular pavement layers. Ready mix concrete trucks and concrete placing plant will be used for the lean-mix concrete sub-base layer, while pavers and compactors will be required for the asphalt pavement layers and surfacing. Works associated with the paving and surfacing may also require removal or shaping existing pavements using an asphalt miller.

Key plant and equipment will be:

- 10t to 14t excavators – including track and rubber tyre machines
- 1t to 3t skid loaders
- 4-wheeler and 6-wheeler watercarts
- 6-wheeler tip trucks, concrete trucks, bitumen sprayers
- 8-wheeler bitumen sprayers
- Truck and trailer tip trucks
- Articulated truck and trailer units
- 14G to 18G Graders
- W100 to W150 Fi Wirtgen Road miller
- W200 to W250 Fi Wirtgen Road miller
- Vogeles 2.5m to 13m asphalt pavers
- 2.5t to 6t loaders
- 4Kw to 9Kw towable diesel light tower
- 50kg to 500kg plate compactors
- 400kg to 650kg pedestrian rolling drum
- 5t to 10t smooth drum rollers
- 10t to 25t roller static multi tyre

- 4-wheeler road sweeper trucks
- Light vehicles and 3t site trucks.

6.4 Other specialized plant

Truck-mounted attenuators will be utilised throughout the duration of the works to deploy traffic management equipment and act as shadow vehicles when required. Traffic management barriers will be deployed and shifted with the use of truck mounted hi-ab cranes and flat deck trucks.

Hydro excavation and/or high air pressure excavation plant will be used for pilot holes and when working around services. Transportation trucks and Hiab's will be required to move various materials around site.

Key plant and equipment will be:

- 4-wheeler transporter truck
- Truck and trailer transporter
- 6-wheeler truck mount Hiab
- 8-wheeler truck mount Hiab
- Trombone semi-trailer Hiab truck
- 4-wheeler traffic attenuator trucks
- 8-wheeler hydro excavation trucks

9 Construction Footprint

Figure 20 shows the permanent (shown in blue) and temporary (shown in orange) areas required for the construction, operation and maintenance of the busway, walking and cycling facilities, minor retaining walls and associated ancillary works (e.g. earthworks, stormwater infrastructure) for EB4L.

The temporary construction areas for EB4L are required to facilitate the construction of the busway, shared pathway, minor retaining walls, stormwater infrastructure and intersection improvement works at Te Irirangi Drive and Town Centre Drive (which includes works on Town Centre Drive and Botany Town land), and any ancillary works. The construction area also includes the site compounds, offices, construction laydown areas, and demountable buildings. It is worth noting that the Te Irirangi Drive intersection will also be occupied during the construction phase.

The permanent area for EB4L is required for the operation and maintenance of the busway and minor retaining walls within the Guys Reserve and Whaka Maumahara Reserve. It is noted that the shared pathway along the western boundary of Guys Reserve and Whaka Maumahara Reserve will be maintained by Auckland Council as its part of their reserve therefore not shown as permanent area.

Following the completion of works, any land that is not permanently required for the on-going operation, maintenance, or mitigation of EB4L will be reinstated. In particularly, the construction area in Guys Reserve and Whaka Maumahara will be reinstated in consultation with Auckland Council, and for intersection works within Town Centre Drive and Botany Town land will be reinstated in consultation with the landowners.

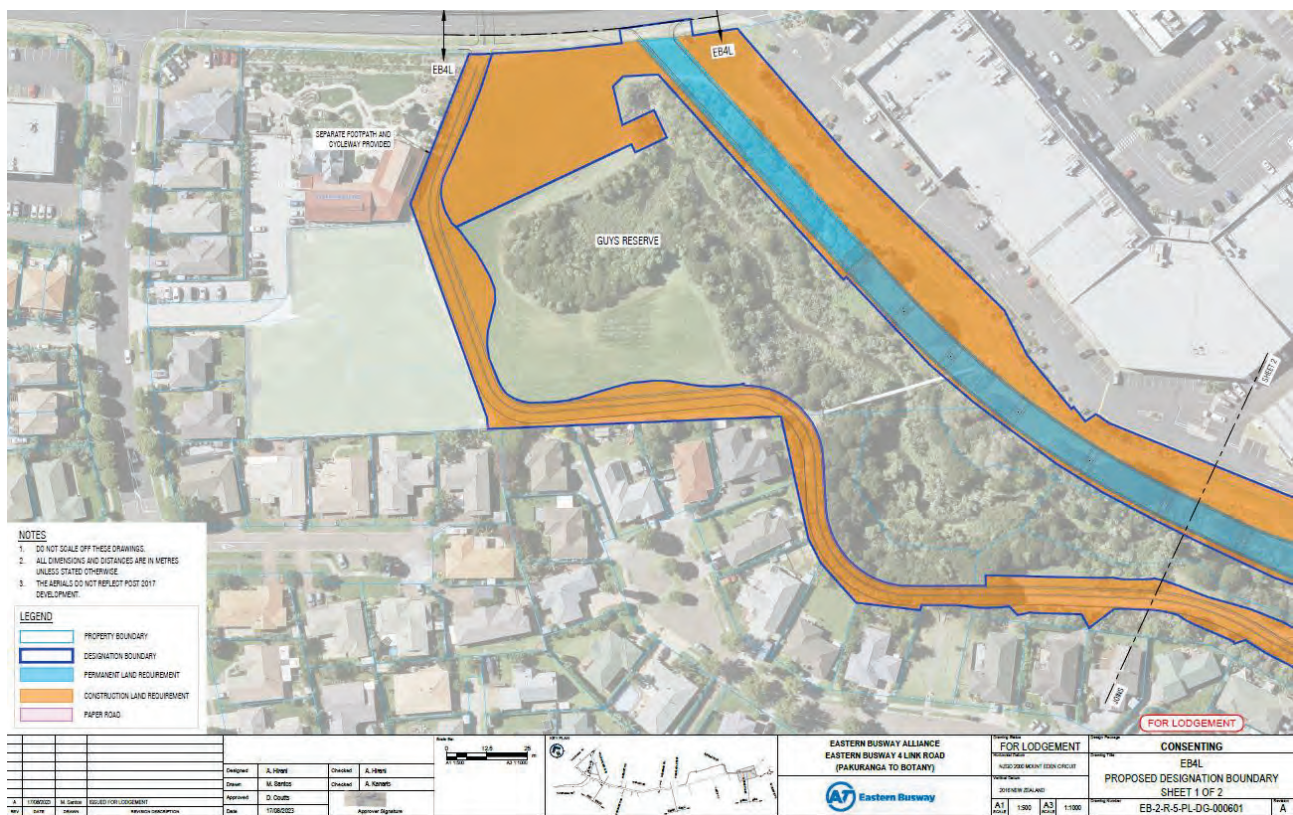




Figure 20: EB4L Designation Plan which shows the permanent and temporary land required for EB4L

10 Traffic Management

The safety and protection of the public, traffic, and construction team is paramount, and all site operations are focused on zero harm to all involved, associated with travelling through this Project. This is essential to the Project.

During construction, communication and consultation will be undertaken with the community and public, as detailed within the Communication and Consultation Plan (CCP) on temporary traffic management measures and indicative timeframes.

Temporary traffic management measures may include, but are not limited to:

- Park closures
- Footpath closures / deviations / detours
- Safe measures for vehicles, pedestrians and cyclists
- Hard barricades
- Pedestrian crossing closures / deviations / detours
- Cycle lane and / or path closures / deviations / detours
- Bus diversions/temporary bus stops
- Property access closures / deviations /detours
- Parking closures (off-street and on-street)
- Shoulder and lane closures / deviations
- Road closures / detours
- Site access arrangements
- Temporary speed limits
- Temporary traffic services, including line markings, signals, streetlights and signage
- Wider network performance - communications to encourage alternative routes.

All construction related temporary traffic management requirements will also be managed through the Project's construction traffic management plans (CTMPs). Wheel washes may be required at site exit points during the earthworks phase to avoid tracking material onto local roads.

11 Specialist Assessment

11.1 Vegetation Clearance

Vegetation removal will be required to be for the operation and construction of EB4L, which includes approximately 70m² for the intersection improvement works of Te Irirangi Drive and Town Centre Drive. Refer to the Arboricultural and Ecological Assessment for the effects associated with vegetation removal.

11.2 Freshwater/Terrestrial Ecology

Table 3 shows the temporary and permanent areas of vegetation loss required for the EB4L alignment, and associated stormwater works.

Vegetation clearance is required for the EB4L alignment and associated stormwater works. This is approximately 0.552 ha of permanent vegetation loss, and 0.355 ha of temporary vegetation loss. Permanent loss includes all mixed native and exotic tree land and planted vegetation loss under the EB4L alignment and the stormwater outfall. Temporary loss includes all mixed native and exotic, and planted vegetation within the EB4L construction area and around stormwater outfalls.

Location	Area of Permanent Vegetation Loss (m ²)	Area of Temporary Vegetation Clearance (m ²)
EB4L		
EB4L Alignment (including bridge C works and Te Irirangi Drive/Town Centre Drive intersection improvement works)	5,491	3,478
Stormwater Infrastructure		
New Outfall (1-1) (including rip rap and pipeline) at Ti Rakau Drive	25	75
New Pipeline (37-3) at Te Irirangi Drive	0	0
Total	5,516	3,553

Table 3: Summary of temporary and permanent vegetation clearance within freshwater/terrestrial ecology environment

To minimize sediment runoff during the construction project, a construction methodology will be employed when relocating or protecting existing services. This methodology involves progressively opening, closing, and stabilizing the affected areas, to minimize the amount of sediment that may be disturbed and washed away.

11.3 Archaeology

To ensure the protection of any unrecorded archaeology on the site, an archaeological assessment has been prepared. In the event of any accidental discoveries during the construction project, a discovery protocol will be implemented to ensure the proper handling and protection of any archaeological finds that may be uncovered.