5 Sections design

This chapter describes the detailed design issues and proposals for individual sections of the route.

For each section:

- A summary of the main features of the route is presented;
- The key design issues identified through the route appreciation and multi-disciplinary design workshops are summarised;
- Design objectives which have either guided the development of the final road alignment or should guide the future detailed design of the Project are proposed; and
- Design principles for specific road components are presented.

5.1 Section 1 – MacKays Crossing

5.1.1 Local context

Topography, geology and hydrology

Section 1, MacKays Crossing area, is characterised by:

- Low-lying flat plains comprising peat lands, dune depressions and low dunes. The highest dunes rise to 15m above the surrounding flats;
- An elevated alluvial terrace with the adjacent incised Te Puka Stream within bedrock to the west, and an ancient landslide to the east; and
- The existing SH1 follows an NE-SW alignment along the edge of the coastal plain at the toe of the Ohariu Fault escarpment in the vicinity of MacKays Crossing, from where the proposed new highway will continue to follow the Ohariu fault up to the Puka Stream valley.

Landscape features

The landscape features of note in this section are:

- Plains characterised by regular patchwork of cultivated paddocks, and the inland dune fields of Queen Elizabeth Park;
- Hills characterised by steep slopes, large plantation forest on hills east of Te Puka Stream, and extensive pastoral land use on hills west of Te Puka Stream;
- Alluvial terraces and fans at the mouth of valleys, such as at the mouth of Te Puka Stream are a local feature;
- Particularly prominent terrace south-east of MacKays Crossing. Former sea cliff that forms the edge of the terrace is listed in the NZ. Geopreservation Inventory, although it has been modified by construction works for the existing SH1; and
- Paekakariki township elevated on dune landforms at location where coastal plains meet the Paekakariki Hills, seaward of proposed alignment. Paekakariki is located on seaward side of railway line and is characterised by historic railway associations.

Significant views and landmarks

- The key landmarks in the area are Kapiti Island and the Tasman Sea.
- Travelling north along Transmission Gully, the road users will emerge out of the steep Te Puka valley with extensive views out onto the Kapiti Coast dunelands, Tasman Sea and Kapiti Island.
- Travelling south towards and then onto Transmission Gully, the road users will experience views up towards and then in the valley itself.

Photo 5.1: Mackays Crossing

Photo 5.2: Sand dunes at Queen Elizabeth Park

Photo 5.3: Disused section of SH1

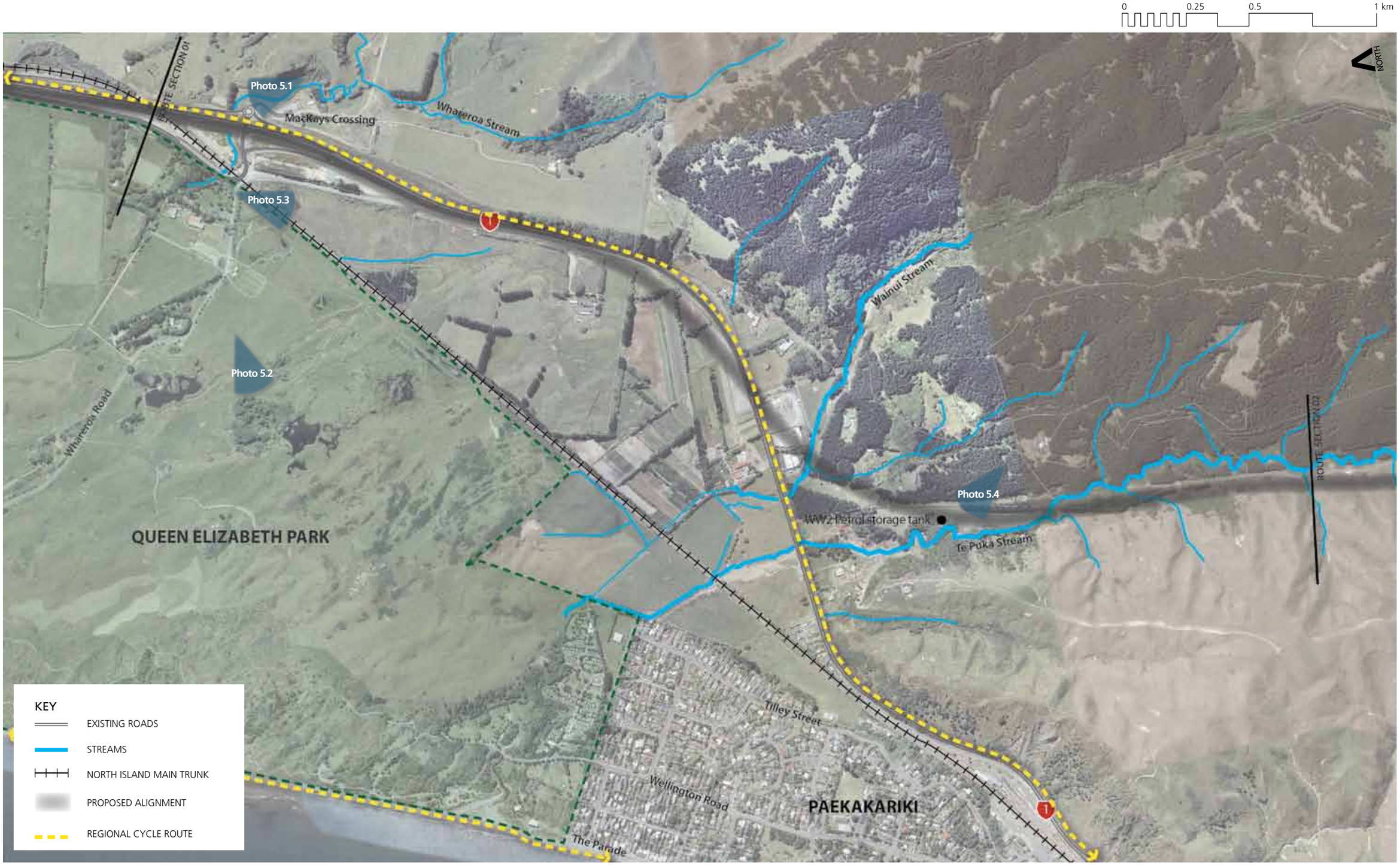


Figure 5.1: Section 1 Existing condition

Photo 5.4: WW2 Petrol storage tank

Built heritage

A WW2 brick petrol storage tank is located close to the Main Alignment in Section 1. This structure is listed in KCDC's District Plan as Heritage Register item B87.

Land uses

Existing land uses

Apart from the township of Paekakariki the land use in this section is mainly rural, with the predominant use being pastoral farming on flat dunal areas to the west of SH1. Other uses, such as market gardening and rural dwellings are also located in the area adjacent to SH1. Queen Elizabeth Park, which includes wetland areas of ecological significance, is located to the north of the Project area. Towards the Te Puka Stream valley, heading away from SH1, a large area of exotic forest exists on the eastern side of the valley, while large open pastoral paddocks are located on the western side. Few recreational activities occur in this section as the land is all in private ownership.

District Plan Zones

The land use zoning in this section of the alignment is predominantly 'Rural' under KCDC's District Plan. This zone is further divided into three policy areas. The Transmission Gully Project alignment traverses all three policy areas as follows:

- Coastal Dune environment;
- Alluvial Plains; and
- Hill Country.

West of the North Island Main Trunk Railway, the Queen Elizabeth Park is zoned 'Open Space'. A triangular area of land contained between the railway line and the former SH1 is zoned 'Conservation'.

Connections

Local roads

There are no local road connections in this section of the Transmission Gully Project. The nearest local road connections are:

- Beach Road, off the existing SH1 south of MacKays Crossing, which is the main vehicular access point to Paekakariki; and
- Poplar Avenue, off the existing SH1 north of MacKays Crossing, which provides access to Raumati South

These connections are unaffected by the Project.

Access to properties

The Transmission Gully Project alignment will sever access to a small number of properties located on the eastern side of SH1 and which currently have direct access onto the state highway. A road link under the alignment will be required to service these properties from SH1.

Pedestrian network

Queen Elizabeth Park and Paekakariki are the main pedestrian destinations in the area. The entrances to the Park are:

- Paekakariki entrance, at the end of Wellington Road;
- MacKays Crossing entrance, off SH1; and
- Raumati entrance, at the end of The Esplanade.

Pedestrian links between Paekakariki and the Park are currently provided along residential roads, namely The Parade and Wellington Road.

Cycle network

The Kapiti Coastal Cycle Route roughly follows the coastline from Paekakariki to Peka Peka. In Paekakariki, the route is accessed from Ames Street and The Parade. From there, the route enters Queen Elizabeth Park, follows off-road paths and rejoins the street network at The Esplanade in Raumati South.

Both SH1 and the coastal cycle route are part of the Regional Cycling Network identified in the Regional Cycling Plan (GWRC 2008).

There is a narrow cycle path along the Centennial highway between Paekakariki and Pukerua Bay and a shared path between Pukerua Bay and Plimmerton. There are currently no formal cycle lanes along SH1 north of Paekakariki within the Project area and cyclists use the road shoulders.

5.1.2 Design issues and objectives

Table 5.1: Section 1 MacKays Crossing – Design issues and objectives

DESIGN ISSUES	DESIGN OBJECTIVES
Integration in the landscape & response to Landscape Character	
▪ Sudden changes in landscape character from inland dunes of the landscape in Kapiti coastal plain to steep narrow Te Puka stream valley.	▪ Kapiti coastal plain - broaden batters to reflect a more rolling dune landscape, overfill if necessary. Where excess fill is placed ensure its scale and form is reflective of the inland dune landscape. Create dune like landscape features adjacent to road. ▪ Te Puka stream valley - expose and emphasise the steep linear geomorphic character of the valley.
▪ Alignment is in the vicinity of foothills and wavecut escarpment considered Outstanding Natural Landscapes in Kapiti Coast District Plan.	▪ Protect those landscape characteristics that contribute to ONL status as identified in the KCDP.
Adjoining land use and amenity	
▪ Elevation of the road above existing residential properties on both sides of the road may generate potential adverse effects in relation to noise, shading and views.	▪ Provide landscape screening between alignment and residential dwellings. ▪ Minimise overall height of road above dwellings by minimizing fill embankment height, limiting the height of barriers and avoiding noise walls. ▪ Introduce vegetation between road and dwellings to soften appearance of structural elements without contributing to additional shading.
▪ Compared with existing highway, new alignment will be closer to residential properties on western side.	▪ Provide visual screening to residential properties on western side of alignment in the form of landscaped earth bund parallel with on-ramp.
Visual Experience	
▪ Maintenance and enhancement of key views to Kapiti Island, Kapiti Coastal Plain and Tasman Sea for north bound traffic and upper Te Puka Stream Valley for southbound traffic.	▪ Earthworks, road furniture and landscape treatment to maintain and orientate views to Kapiti Island and beyond. ▪ Earthworks, road furniture and landscape treatment to allow road users to clearly appreciate the steep, wild and remote nature of the Te Puka stream valley.
Biodiversity and ecology	
▪ Crossing of Wainui and Te Puka streams	▪ Design culverts to facilitate fish passage and retain as much in-stream habitat as possible.
▪ The alignment follows Te Puka Stream and requires segments of stream diversion.	▪ Design stream diversions which closely replicate the natural in-stream features including rock cascades, riffles, pools and runs.
▪ Construction and operation of the road has the potential to impact on the stream environment through sediment and contaminant input into the waterways.	▪ Design of the sediment / erosion control and stormwater treatment devices to a high standard which minimises the input of sediment and contaminants into the streams.
▪ The alignment requires some vegetation removal in Te Puka for road construction and operation.	▪ Minimise the removal of indigenous vegetation through sensitive route alignment and construction methodology, including the location of haul roads and construction tracks. ▪ Plant stream margins, banks and floodplains areas to restore native vegetation communities in the stream corridor.

DESIGN ISSUES	DESIGN OBJECTIVES
Local connectivity / severance	
▪ Need to provide vehicular access to properties on eastern side of alignment.	▪ Provide road access under main alignment (underpass) for private land owners south / east of alignment. ▪ Underpass width and height to allow for logging vehicles needing to access pine plantations on slopes above alignment.
▪ Need to provide vehicular access to properties on western side of alignment.	▪ Provide access to road network for properties either from existing SH1 or from MacKays Crossing interchange.
▪ Potential improvements to Regional Cycle Network along part of SH1 in the vicinity of MacKays Crossing.	▪ Provide commuter cycle path between Paekakariki's Beach Road and entrance to QE Park at MacKays Crossing.
Design Continuity	
▪ Given the connection with existing SH1, the introduction of new signage, lighting and safety barriers will be necessary.	▪ Avoid clutter. Minimise the number of highway furniture elements. ▪ North of the Project, ensure that there is continuity in form, scale and location with the MacKays to Peka Peka Project highway elements.
Noise	
▪ Increases in road-traffic noise levels in this area are within appropriate limits.	▪ No specific noise mitigation is required.
Drainage	
▪ There is an opportunity to construct a wetland to the west of the alignment in the low-lying flat plains where SH1 connects to the new highway.	▪ Design wetland to treat contaminated stormwater runoff and integrate with landscape treatment.
▪ The alignment follows Te Puka Stream and requires re-alignment of several segments of the stream. The narrowness of the valley and the large cut/fill sections in this part of the alignment means space is very limited for re-aligning the stream channel and for also providing vehicle access during construction.	▪ Minimise amount of stream re-alignment through amendments of the horizontal road alignment. ▪ Preserve the channel characteristics of the streambed in the re-alignments where it is possible to do so.
▪ The steep hill faces of Te Puka valley mean that culvert slopes across the alignment are very high.	▪ Need to maintain outlet flow velocities to close to pre-construction levels through the use of drop structures, and erosion control structures.
▪ There is a major crossing of the Te Puka stream where consideration must be given to the most appropriate method of carrying flow across the alignment.	▪ Consideration of culvert or bridge structure with upstream flood mitigation as primary objective.

5.1.3 Design proposals

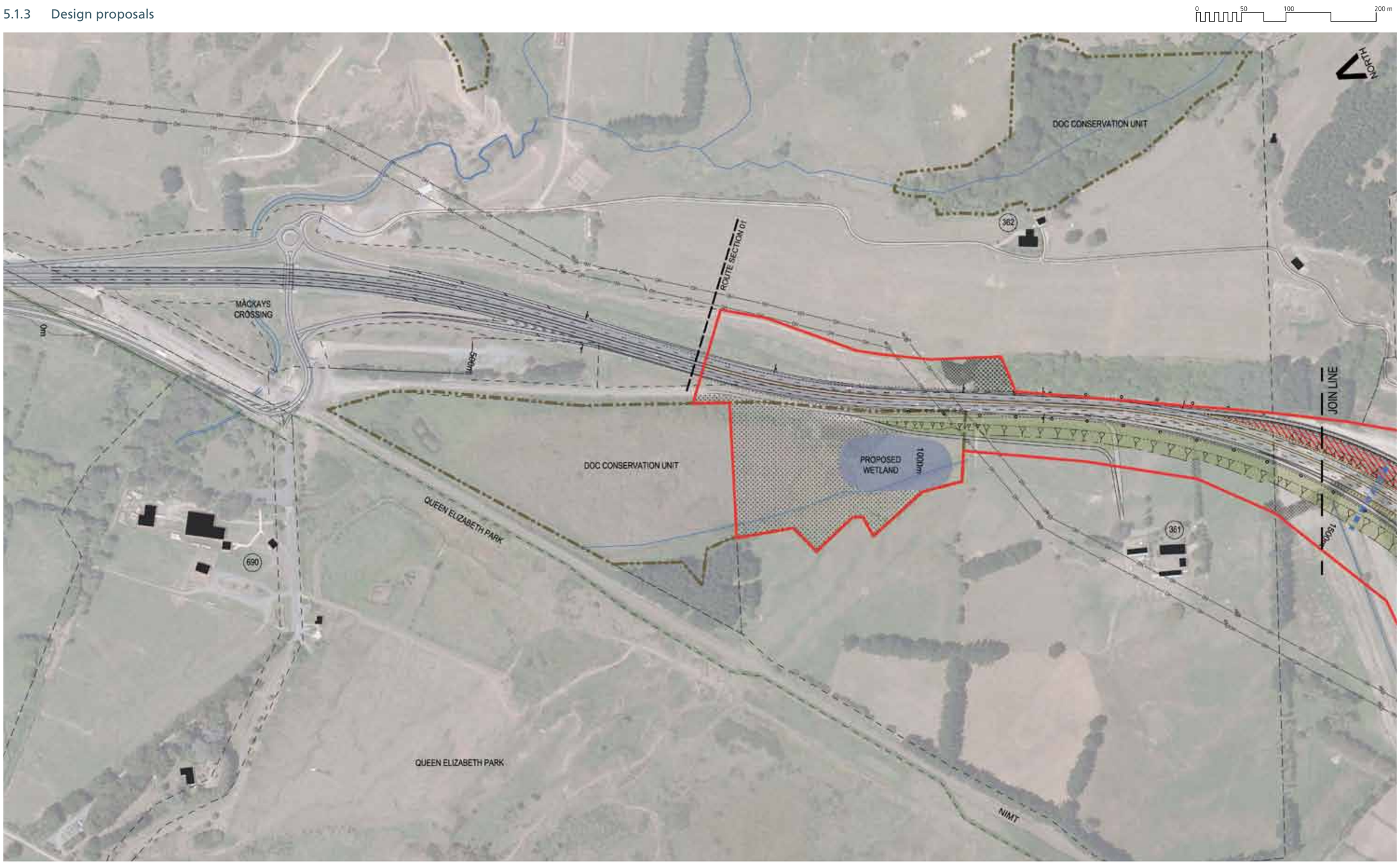
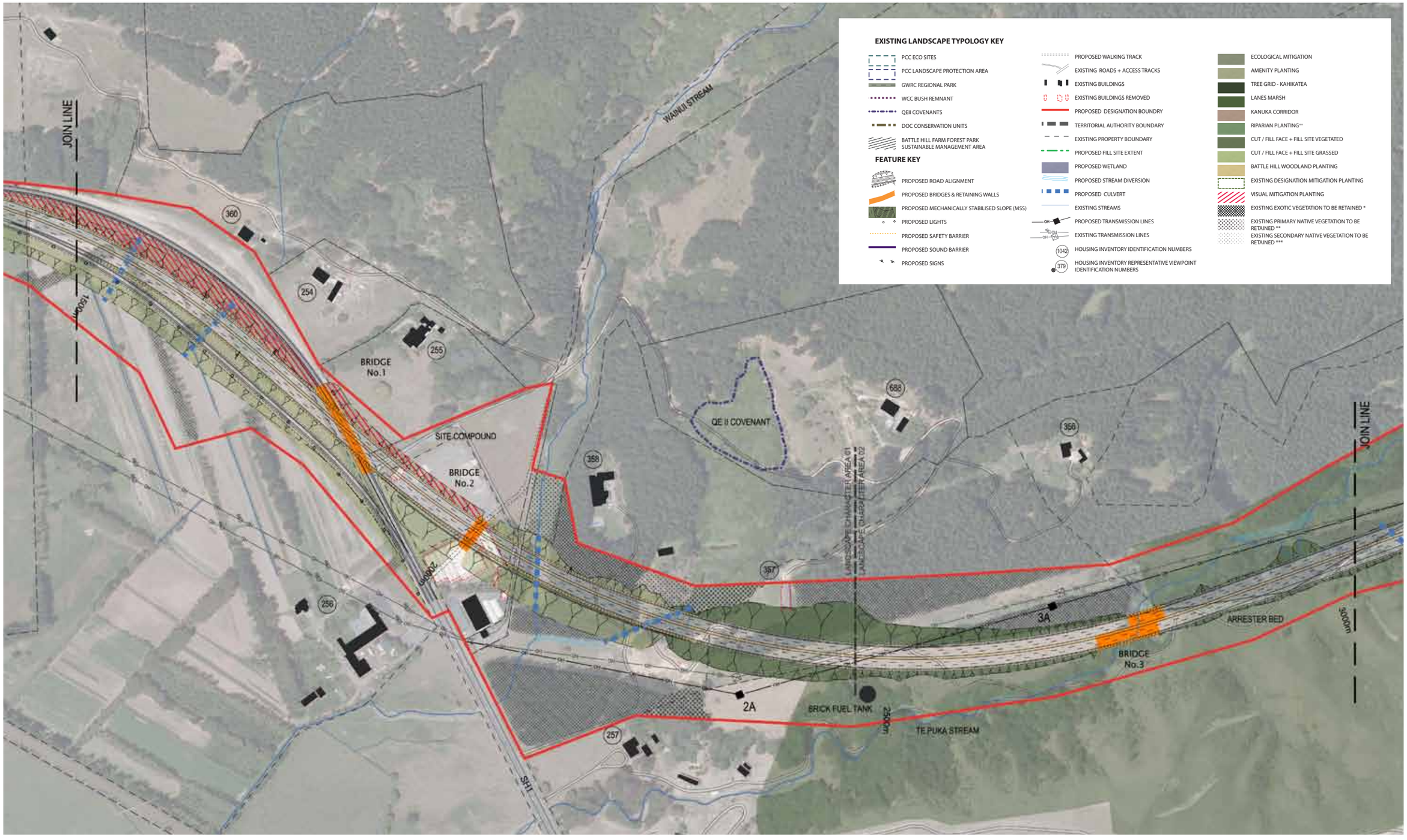


Figure 5.2: Section 1 Design Proposals

0 50 100 200 m


JOIN LINE
150000
360
254
BRIDGE No.1
255
WAIRUI STREAM
SITE COMPOUND
BRIDGE No.2
QE II COVENANT
688
358
356
357
256
257
SH1
200000
LANDSCAPE CHARACTER AREA 01
LANDSCAPE CHARACTER AREA 02
3A
ARRESTER BED
BRIDGE No.3
2A
BRICK FUEL TANK
TE PUKA STREAM
JOIN LINE
300000
EXISTING LANDSCAPE TYPOLOGY KEY
PCC ECO SITES
PCC LANDSCAPE PROTECTION AREA
GWRC REGIONAL PARK
WCC BUSH REMNANT
QEII COVENANTS
DOC CONSERVATION UNITS
BATTLE HILL FARM FOREST PARK SUSTAINABLE MANAGEMENT AREA
FEATURE KEY
PROPOSED ROAD ALIGNMENT
PROPOSED BRIDGES & RETAINING WALLS
PROPOSED MECHANICALLY STABILISED SLOPE (MSS)
PROPOSED LIGHTS
PROPOSED SAFETY BARRIER
PROPOSED SOUND BARRIER
PROPOSED SIGNS
PROPOSED WALKING TRACK
EXISTING ROADS + ACCESS TRACKS
EXISTING BUILDINGS
EXISTING BUILDINGS REMOVED
PROPOSED DESIGNATION BOUNDRY
TERRITORIAL AUTHORITY BOUNDARY
EXISTING PROPERTY BOUNDARY
PROPOSED FILL SITE EXTENT
PROPOSED WETLAND
PROPOSED STREAM DIVERSION
PROPOSED CULVERT
EXISTING STREAMS
PROPOSED TRANSMISSION LINES
EXISTING TRANSMISSION LINES
1042
HOUSING INVENTORY IDENTIFICATION NUMBERS
379
HOUSING INVENTORY REPRESENTATIVE VIEWPOINT IDENTIFICATION NUMBERS
ECOLOGICAL MITIGATION
AMENITY PLANTING
TREE GRID - KAHIKATEA
LANES MARSH
KANUKA CORRIDOR
RIPARIAN PLANTING**
CUT / FILL FACE + FILL SITE VEGETATED
CUT / FILL FACE + FILL SITE GRASSED
BATTLE HILL WOODLAND PLANTING
EXISTING DESIGNATION MITIGATION PLANTING
VISUAL MITIGATION PLANTING
EXISTING EXOTIC VEGETATION TO BE RETAINED *
EXISTING PRIMARY NATIVE VEGETATION TO BE RETAINED **
EXISTING SECONDARY NATIVE VEGETATION TO BE RETAINED ***

Earthworks

The proposed Main Alignment will follow the existing SH1 alignment for approximately 1km south of the MacKays Crossing interchange before diverging onto a ramped embankment in order to climb into Te Puka Stream valley. The road will transition from a ramped embankment to a box cut in an alluvial terrace in the lower part of Te Puka Stream valley. A 2m high safety bund will be constructed on the outside curve of the proposed new alignment's northbound lanes at the point where they transition from cutting to ramped embankment.

The following design principles apply.

Fill Batters – Rolling topography

In locations where fill batters do not extend into streams or ephemeral watercourses:

- Minimise fill batter slope in order to merge with surrounding terrain, and to facilitate re-vegetation to merge with surrounding land use.

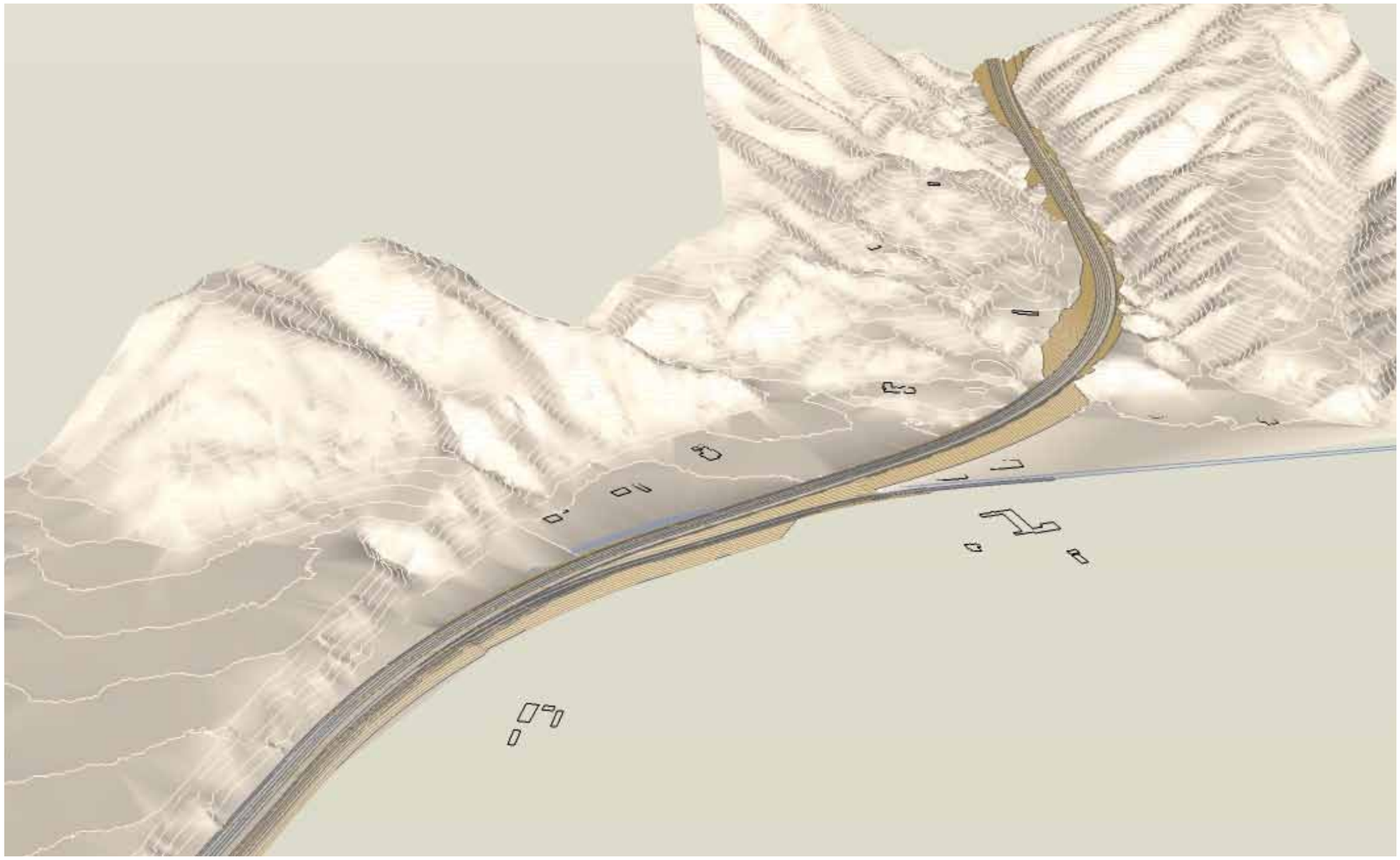


Figure 5.3: Section 1 Earthworks - View to South

Structures

SH1 Underpass (Bridge 1)

- In addition to vehicular traffic, the underpass may also be used by cyclists and pedestrians as the only alternative route is to cross under the alignment at MacKays Crossing and walk / cycle through the QE Park to Paekakariki or along the western side of the existing SH1 (see pedestrian and cycle paths proposal overleaf). Provide separation between the new carriageway and the cycle / pedestrian path through the underpass by way of kerb or slight level change;
- Design underpass to provide adequate levels of lighting for pedestrian and cyclist safety; and
- Design underpass portal to present a simple, tidy, high quality finish to road users.

Figure 5.4: Bridge 1:SH1 Underpass in context - LS01 - Location 1800m

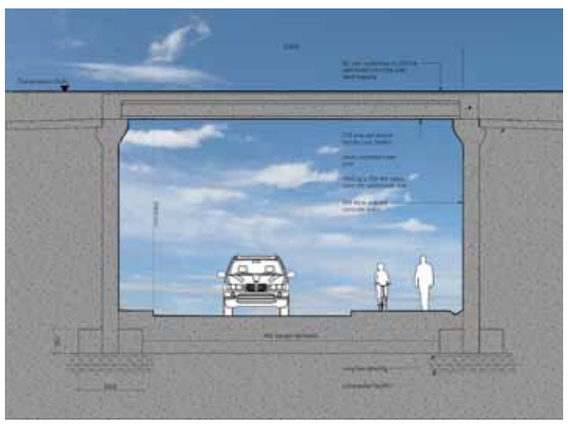


Figure 5.5: Bridge 1:SH1 Underpass - cross section

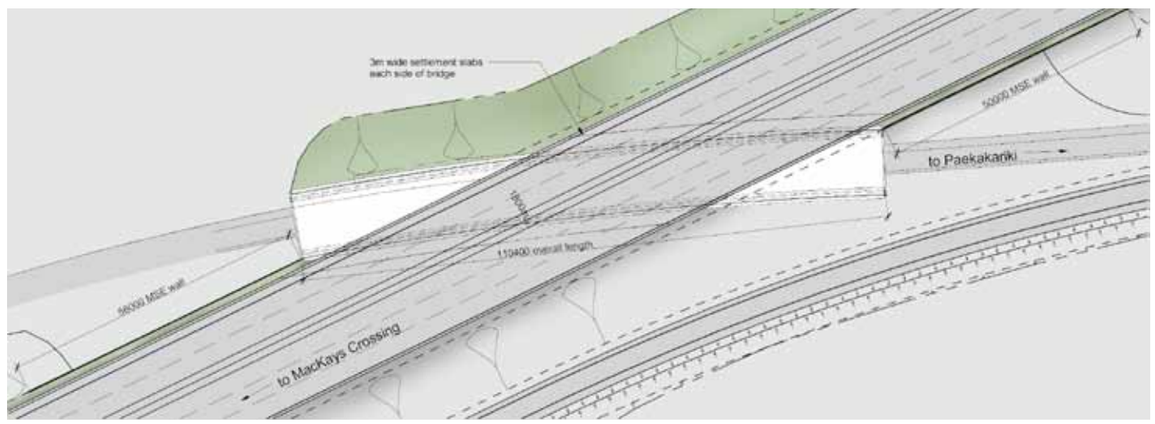


Figure 5.6: Bridge 1: SH1 Underpass - plan

Pedestrian and cycle paths

A commuter cycle link is proposed to be provided between Paekakariki's Beach Road and the entrance to QE Park at MacKays Crossing. This should consist of the following:

Western side of existing SH1:

- Cycle lane in road shoulder between Beach Road and cluster of properties north of Paekakariki. This will require surface improvements and markings (separate project) as part of the Network Plan and revocation of SH1;
- Three metre wide cycle path on west side of SH1 between cluster of properties north of Paekakariki and disused SH1 alignment at MacKays Crossing. Path should be sealed and separated from road by low mounding to enhance cyclist safety; and
- Path to follow former SH1 alignment (at grade) to by-pass MacKays Crossing bridge and rejoin SH1 north of the bridge.

Eastern side of existing SH1:

- Cycle lane in road shoulder on eastern side of off-ramp (southbound). Cycle lane will follow underpass under main alignment. Retrofit existing carriageway to remove excess black-top;
- North of Project, cycle lane to follow MacKays Crossing off- and on-ramps to bypass MacKays bridge; and
- Extend cycle lane south of Project along existing SH1's shoulder to Paekakariki Hill road (separate project) as part of the Network Plan and revocation of SH1.

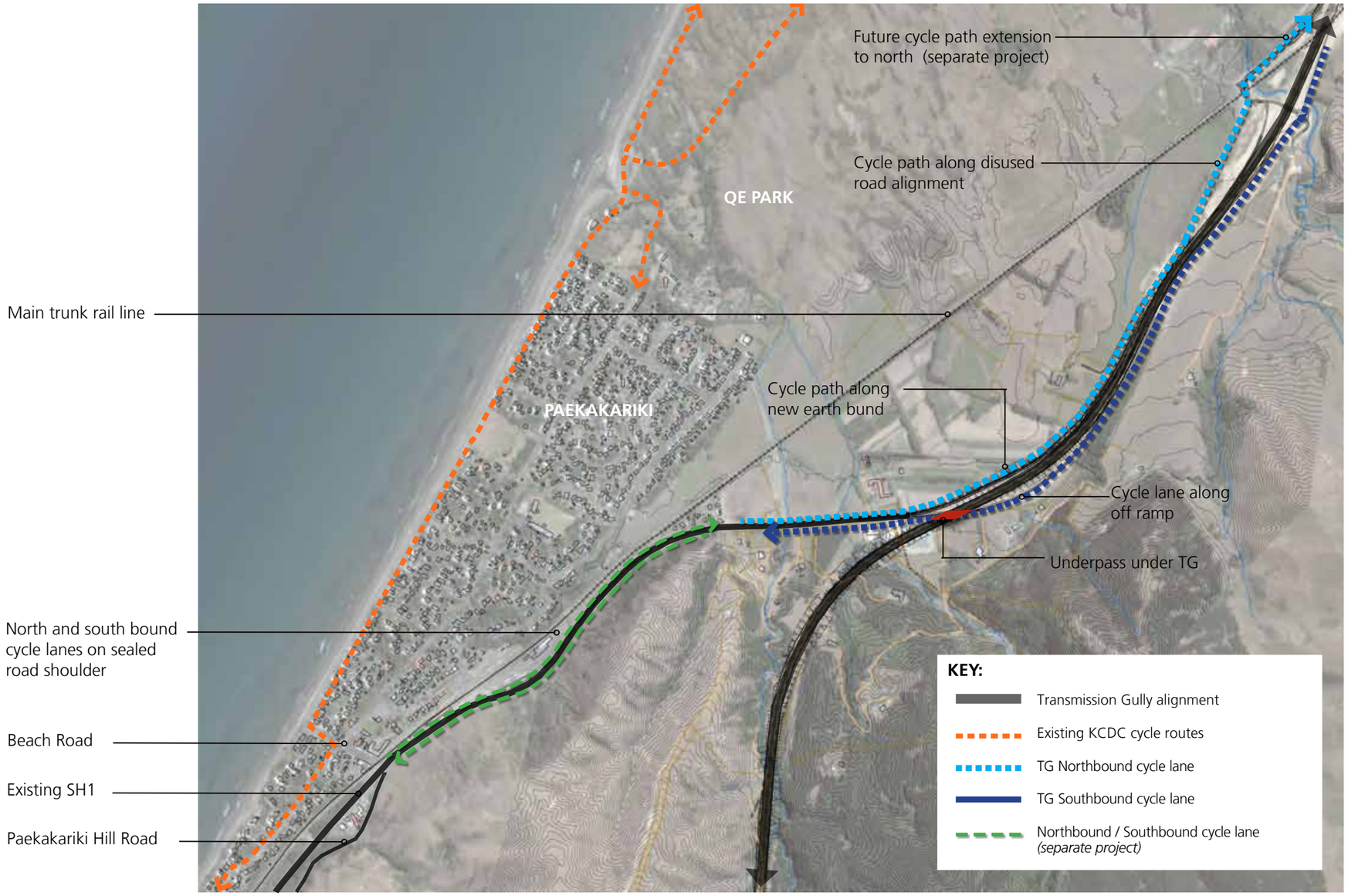


Figure 5.7: Section 1 Proposed cycle links

Landscape treatment

Table 5.2: Section 1 MacKays Crossing - Landscape Treatment

Landscape Character Area (Route Section)	Vegetation and Landform Character	Pattern of Enclosure/ Openness and Views	Design Response	Indicative plant species	
MacKays Crossing (Section 1)	Mixed land use with horticultural,; pastoral; light industrial (former); highway; and vegetated backdrop hills. Flat/ rolling inland dune field with steep backdrop hills with pine plantation; rough pasture; shelter belts; and native remnant/ revegetation.	**Semi – enclosed** – views across coastal dunes field obscured by adjacent vegetation and land use.	Plant central areas and road margins with low growing species that provide for views across dune field. Introduce taller trees and shrubs where views from existing houses exist and to frame views along the road corridor.	**Canopy species:** - Kanuka *(Kunzea ericoides)* - Kohekohe *(Dysoxolum spectabile)* - Nikau *(Rhopalostylis sapida)* - Titoki *(Alectryon excelsus)*	
				Shrubs and understorey tree species: - Cabbage tree (Cordyline australis) - Coprosma *(Coprosma robusta)* - Five Finger *(Pseudopanax arboreus)* - Karamu (Coprosma robusta)	- Koromiko *(Hebe stricta)* - Mahoe *(Melicytus ramiflorus)* - Ngaio (Myoporum laetum) - Puka *(Griselinia littorialis)* - Wineberry *(Aristotelia serrata)*
				Low shrubs/ ground cover: - Asplenium species *(e.g. A. oblongifolium, bulbifernum, & hookerianum)* - Astelia sp. *(A. fragrans and solandri)* - Blechnum sp *(e.g. B. novae-zelandiae, fluviatale & filiforme)*	- Carex sp. *(Carex secta and geminata)* - Coprosma sp. *(e.g. Coprosma propinqua)* - Flax *(Phormium tenax and cookianum)* - Meadow rice grass *(Microlaena stipoides)* - Olearia sp. *(O.solandri)* - Tauhinu *(Ozothamnus leptophyllus)*
Te Puka Stream – Wainui Saddle – Upper Horokiri Stream (Section 1, 2 & 3)	Steep sided stream valleys with narrow valley floor. Flanks characterised by rough pasture, regenerating shrubland, and isolated native remnants to the west and pine plantation and remnant/ regenerating native forest/ shrubland to the east. Exposed area with soil and climatic conditions providing challenge to establishment of plant material. Retain intervening steep gullies in rough pasture.	**Enclosed** – by steep slopes and narrow valley floor, but long views along to north and south from Wainui Saddle.	Retire existing rough pasture to encourage native revegetation and retain existing areas of remnant native forest. Rehabilitate stream margins to foster in-stream ecological values. Hydroseed cut and fill batters with simple palette of pioneer shrubland species. Rehabilitate stream margins to foster in-stream ecological values. Hydroseed cut and fill batters alongside Te Puka stream with simple palette of pioneer shrubland species.	**Canopy specieas:** - Hinau *(Elaeocarpus dentatus)* - Kamahi *(Weinmannia racemosa)* - Nikau *(Rhopalostylis sapida)* - Northern rata *(Metrosideros robusta)* - Pigeonwood *(Hedycarya arborea)* - Rewarewa *(Knightia excelsa)* - Rimu *(Dacrydium cupressinum)* - Tawa *(Beilschmeidia tawa)* - Tree Ferns *(Cyathea medullaris & cunninghamii)*	
				Shrubs and understorey tree species: - Cabbage tree *(Cordyline australis)* - Five Finger *(Pseudopanax arboreus)* - Karamu *(Coprosma robusta)* - Kawakawa *(Macropiper excelsum)* - Koromiko *(Hebe stricta)* - Mahoe *(Melicytus ramiflorus)* - Puka *(Griselinia littorialis)*	
				Low shrubs/ ground cover: - Asplenium species *(e.g. Asplenium oblongifolium, bulbifernum & hookerianum)* - Astelia sp. *(A. fragrans & solandri)* - Blechnum sp *(e.g. B. novae-zelandiae, fluviatale, filiforme)*	- Coprosma sp. *(e.g. C. propinqua)* - Flax *(Phormium tenax &cookianum)* - Kiekie *(Freycinetia banksii)* - Tauhinu *(Ozothamnus leptophyllus)*

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Figure 5.8: Looking south from southbound on-ramp at MacKays Crossing

5.2 Section 2 – Wainui Saddle

5.2.1 Local context

Topography, geology and hydrology

Section 2 is characterised by:

- The relative linear valley of the northward flowing Te Puka Stream, north of Wainui Saddle, with steep greywacke side slopes that are forested on the eastern flank and in pasture on the western slopes. There are a number of alluvial fan deposits at the mouths of main tributary streams. The steep-incised valley straddles the Ohariu Fault along this sector; and
- The relative linear southward flowing Horokiri Stream valley, south of Wainui Saddle, with steep bedrock side slopes that are forested on the eastern flank and in rough pasture on the western slopes and valley floor. The mouths of steep-sided tributary streams contain alluvial fan deposits.

Landscape features

The landscape features of note in this section are:

- Steep V-shaped valleys and saddle. Straight fault-line valley (Ohariu Fault) with truncated spurs. Steep, relatively straight stone-bed streams;
- Steep escarpment on valley's west side, short and very steep tributary streams and scree slopes. Rough pasture with extensive areas of regenerating scrub. Pockets of remnant indigenous forest;
- Steep escarpment also on valley's east side, but larger catchments, higher main ridgeline, tributary streams incised in deep valleys with inter-leaved spurs. Some areas of indigenous and second growth bush on valley side, backed by expansive plantation forest; and
- Remote, semi-wilderness character. The only structures are those associated with the transmission line (110kV double-circuit lattice towers) which follows the valley. No residences.

Significant views and landmarks

The key landmarks in the area are Wainui Saddle and the upper Te Puka Stream. The 'V' of the saddle is a distinctive landmark glimpsed in the distance from such elevated locations as Battle Hill Forest Farm Park and parts of Whitby. It is a relatively minor existing landmark but will form a distinctive 'watershed' for future travellers on the route, forming a boundary between Wellington and the Kapiti Coast, and providing elevated views in both directions.

Land uses

Existing land uses

Land use in the Wainui Saddle section is a mixture of undeveloped land, improved pasture, and both exotic and native forest. The section includes part of the Akatarawa catchment water supply reserve, and the steep topography and limited access have prevented development. Some of the section's native forest has been identified as ecologically-significant, particularly on the eastern slopes.

District Plan Zones

This section of the alignment is split between three districts:

- The northern part is zoned 'Rural: Hill Country' under Kapiti Coastal District Plan;
- The southern part is zoned 'Rural' under Porirua City District Plan; and
- The alignment clips the corner of Upper Hutt District boundary. This land is zoned 'Rural Hill' in Upper Hutt City District Plan and falls under designation WRC6 – Proposed Akatarawa and Whakatiki Water Catchment.

Photo 5.5: Wainui Saddle

Photo 5.6: View north along Te Puka valley

Photo 5.7: View of Kapiti Coast from Te Puka valley

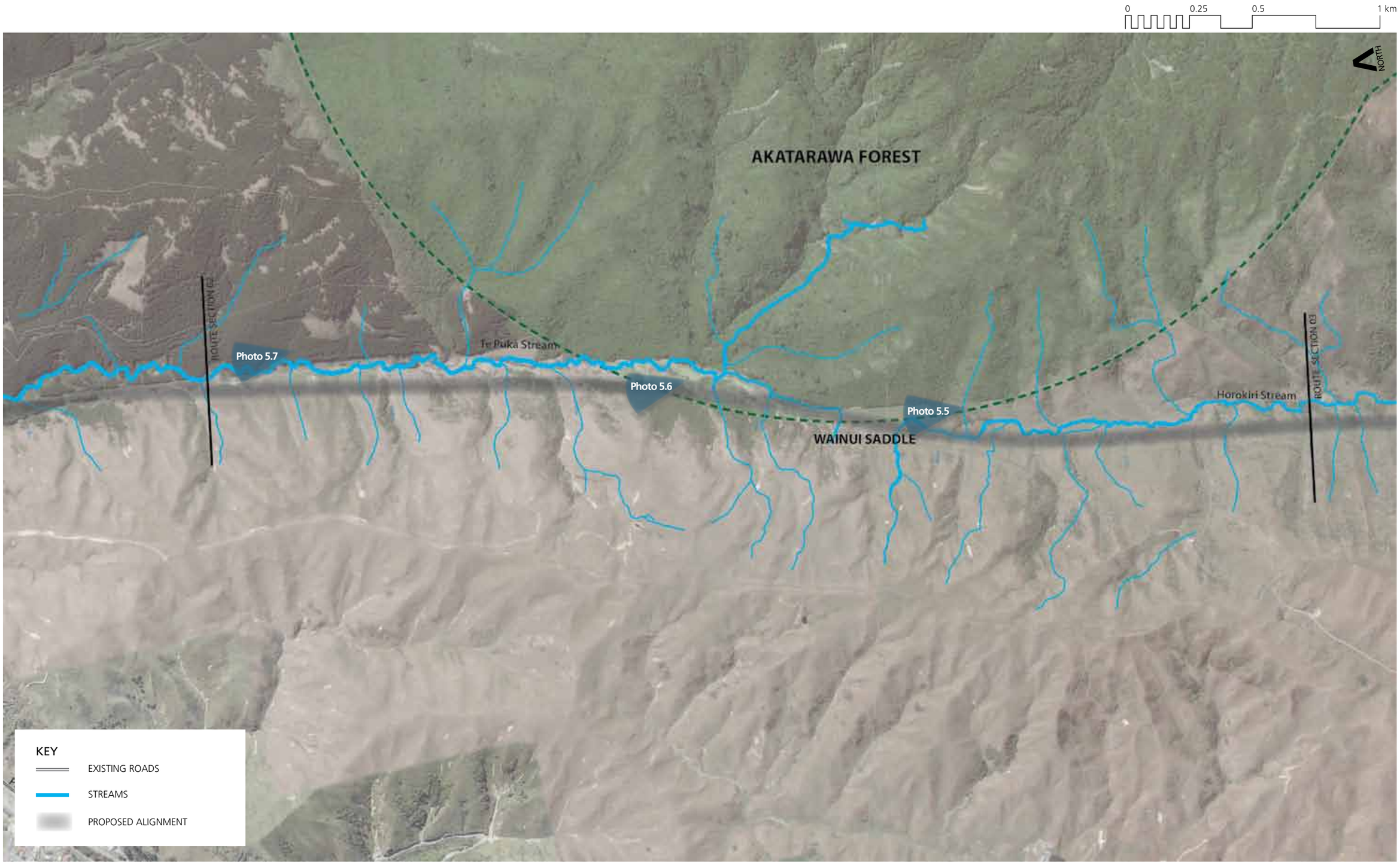

Figure 5.9: Section 2 Existing condition

Connections

Local roads

There are no local road connections in this section of the Project.

Access to properties

There are no access issues in this section of the Project.

Pedestrian / cycle networks

There are no existing public footpaths or cycle paths in this section of the Project.

Tangata Whenua

An important issue for Tangata Whenua is the separation of the different watershed at Wainui Saddle and the need not to 'mingle the waters' through stream diversion or other hydrological works.

5.2.2 Design issues and objectives

Table 5.3: Section 2 Wainui Saddle – Design issues and objectives

DESIGN ISSUES	DESIGN OBJECTIVES
Integration in the landscape & response to landscape character	
The Section 2 landscape is characterised by: ■ Narrow and steep to very steep sided stream valleys with truncated spurs and gullies ■ Naturally confined, narrow, winding and steep (Te Puka) to moderate (Horokiri) stream gradients ■ Reverting pasture with a mix of grass, invasive exotic and native species, remnants and natural regeneration ■ Low density stock grazing ■ Wainui Saddle ■ Medium to long expansive views to the wider landscape ■ Undeveloped, remote and semi-wilderness character	■ With limited opportunities to locate the road within these valleys the focus shall be on retaining and enhancing as many of the existing characteristics as possible. ■ Attention should be paid to remediating and mitigating effects on those characteristics that will be affected by the route. ■ Particular attention shall be given to the reinstatement of streams and their margins and continuity in vegetation cover throughout.
Cut Faces: ■ This section of the route comprises significant cuts in excess of 50m high. These cut faces have to potential to significantly impact both the existing character and road user experience of Section 2.	■ Minimise the overall height of cut faces where possible by steepening of slopes and tying into existing landform at the first available and practical opportunity. ■ Ensure the cut face profile and surface treatment seeks to limit potential adverse visual and route safety effects whilst orientating road user views to the wide landscape.
Fill Batters: ■ This section of the route has extensive fill batters (45 degree reinforced soil earth) which, although less visible than cut faces, may significantly affect both landscape character and in stream values.	■ Minimise the overall extent of fill batters where possible by steepening of slopes and tying into existing landform at the first available and practical opportunity. ■ Ensure continuity in vegetation treatment to ensure that fill batters visually transition into natural landform and land cover when viewed from the road.

DESIGN ISSUES	DESIGN OBJECTIVES
Adjoining land use and amenity	
■ n/a	■ n/a
Visual Experience	
■ The 'V' of the Wainui Saddle is a distinctive, distant landmark seen from number of locations in the broader landscape.	■ Ensure that the prominence of the Wainui Saddle is maintained.
■ The elevated nature of the Wainui Saddle provides clear views to the Kapiti Coastal Plain (and beyond) to the north and the Horokiri Valley (and beyond) to the south. These views provide an important visual connection between road users and the wider landscape.	■ Maintain open views out either side of Wainui Saddle for road users. Locate road signage so as not to obstruct these views. ■ Ensure that opportunities for road users to see beyond the road to the adjacent landscape are provided.
■ The visual character of the Te Puka and Horokiri Stream valleys differ.	■ Ecological and landscape treatments should acknowledge and respond to the differences in visual character across Section 2 through design and vegetation location and selection in particular.
Biodiversity and ecology	
■ The alignment follows Te Puka and Horokiri stream and requires some stream diversions.	■ Design stream diversions which closely replicate the natural in-stream features including rock cascades, riffles, pools and runs.
■ The alignment crosses a number of Te Puka and Horokiri stream tributaries.	■ Design culverts to facilitate fish passage and retain as much in-stream habitat as possible. ■ Need for management of use of concrete in the stream corridors to avoid contamination.
■ The alignment requires some vegetation removal for road construction and operation.	■ Minimise the removal of indigenous vegetation through sensitive route alignment and construction methodology, including the location of haul roads and construction tracks. ■ Plant stream margins, banks and floodplains areas to restore native vegetation communities in the stream corridor.

DESIGN ISSUES	DESIGN OBJECTIVES
■ Construction and operation of the road has the potential to impact on the stream environments through sediment and contaminant input into the waterways.	■ Design of the sediment / erosion control and stormwater treatment devices to a high standard which minimises the input of sediment and contaminants into the streams.
Local connectivity / severance	
■ n/a	■ n/a
Design Continuity	
■ Stream valleys both sides of the Wainui Saddle shares many of the same natural patterns (e.g. steep hill faces; streams; and vegetation patterns). Therefore, continuity in the design of the carriageway and associated elements (e.g. steep benched cut faces; 45 degree mechanically reinforced fill batters; stream realignment) is necessary.	■ Ensure that there is continuity in form, scale and location of recommended road elements on both sides of Wainui Saddle.
Noise	
■ n/a	■ n/a
Drainage	
■ The steep tributaries within the Te Puka and Horokiri stream valleys will require special attention for culvert design if crossing the alignment.	■ The outlet flow velocities need to maintained to close to pre-construction levels through the use of drop structures and inlet and outlet erosion control protection methods.
■ A significant part of the southern section of Te Puka stream is required to be permanently re-aligned adjacent to the alignment.	■ Maintain pre-construction stream characteristics where possible.
■ Some areas of mitigation (planting) have been identified that will reduce the risk of colluvium landslides.	■ Opportunity to extend designated planting areas to include these areas of mitigation.

5.2.3 Design proposals

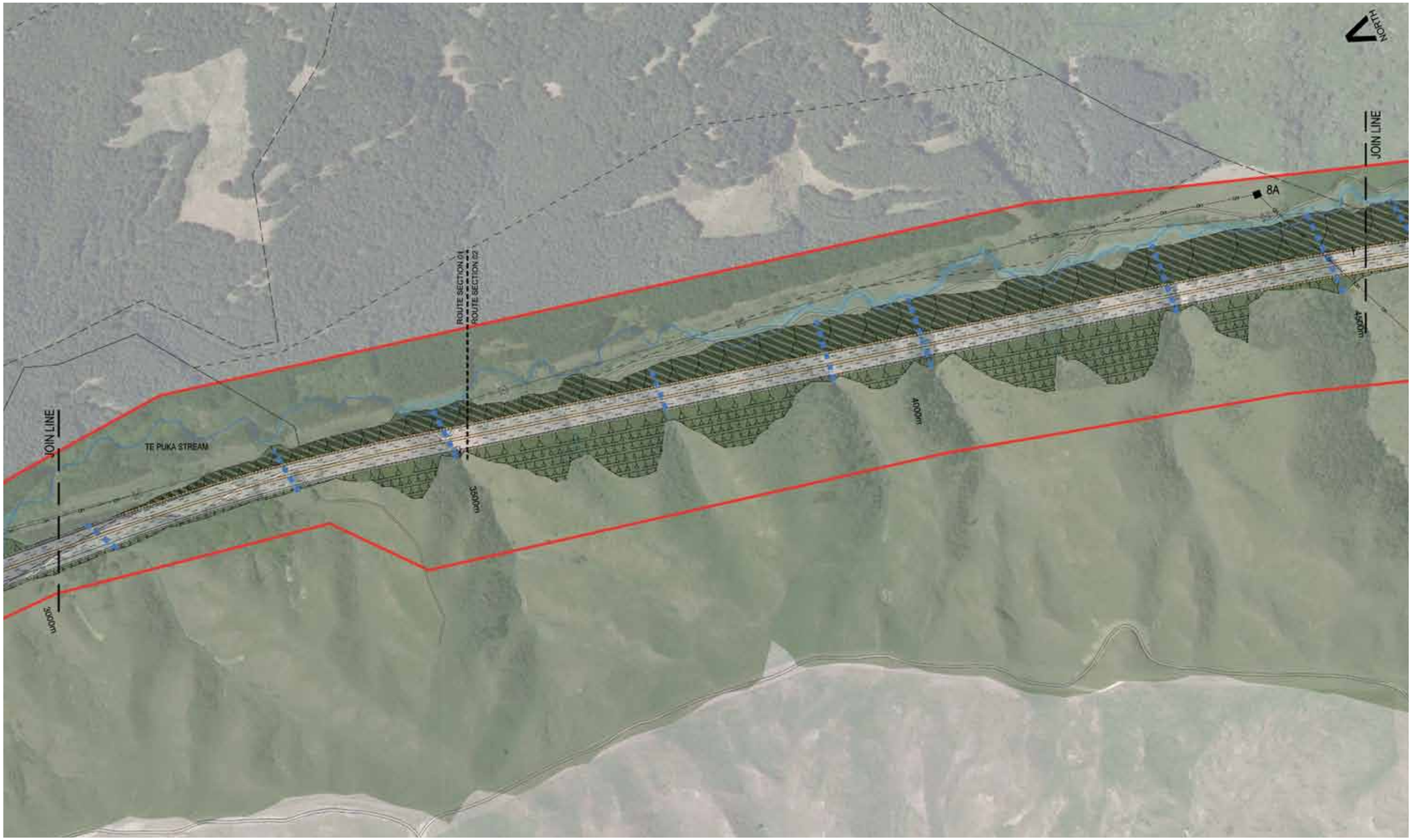

Figure 5.10: Section 2 Design Proposals

0 50 100 200 m

NORTH

JOIN LINE

JOIN LINE

AKATARAWA FOREST

PCC

UHCC

UHCC

PCC

TE PUKA STREAM

WAINUI SADDLE

12A

13A

BRAKE CHECK AREA

BRAKE CHECK AREA

PCC ECO SITE

500m

550m

600m

11A

9A

10A

EXISTING LANDSCAPE TYPOLOGY KEY

- PCC ECO SITES
- PCC LANDSCAPE PROTECTION AREA
- GWRC REGIONAL PARK
- WCC BUSH REMNANT
- QEII COVENANTS
- DOC CONSERVATION UNITS
- BATTLE HILL FARM FOREST PARK SUSTAINABLE MANAGEMENT AREA

FEATURE KEY

- PROPOSED ROAD ALIGNMENT
- PROPOSED BRIDGES & RETAINING WALLS
- PROPOSED MECHANICALLY STABILISED SLOPE (MSS)
- PROPOSED LIGHTS
- PROPOSED SAFETY BARRIER
- PROPOSED SOUND BARRIER
- PROPOSED SIGNS
- PROPOSED WALKING TRACK
- EXISTING ROADS + ACCESS TRACKS
- EXISTING BUILDINGS
- EXISTING BUILDINGS REMOVED
- PROPOSED DESIGNATION BOUNDRY
- TERRITORIAL AUTHORITY BOUNDARY
- EXISTING PROPERTY BOUNDARY
- PROPOSED FILL SITE EXTENT
- PROPOSED WETLAND
- PROPOSED STREAM DIVERSION
- PROPOSED CULVERT
- EXISTING STREAMS
- PROPOSED TRANSMISSION LINES
- EXISTING TRANSMISSION LINES
- 1042 HOUSING INVENTORY IDENTIFICATION NUMBERS
- 379 HOUSING INVENTORY REPRESENTATIVE VIEWPOINT IDENTIFICATION NUMBERS
- ECOLOGICAL MITIGATION
- AMENITY PLANTING
- TREE GRID - KAHIKATEA
- LANES MARSH
- KANUKA CORRIDOR
- RIPARIAN PLANTING++
- CUT / FILL FACE + FILL SITE VEGETATED
- CUT / FILL FACE + FILL SITE GRASSED
- BATTLE HILL WOODLAND PLANTING
- EXISTING DESIGNATION MITIGATION PLANTING
- VISUAL MITIGATION PLANTING
- EXISTING EXOTIC VEGETATION TO BE RETAINED *
- EXISTING PRIMARY NATIVE VEGETATION TO BE RETAINED **
- EXISTING SECONDARY NATIVE VEGETATION TO BE RETAINED ***

Earthworks

The recommended alignment will be benched on the west sides of Te Puka Stream valley and the head of the Horokiri Stream valley, with a box cut through the Wainui saddle.

The Main Alignment will be increased to 3 lanes in each direction by the addition of crawler lanes because of the long steep grade.

The valley is narrow and steep sided. The Project will require side cuts through a sequence of spurs on the uphill side with a number of major cuttings approximately 55m – 65m in height. Similarly the downhill side will comprise steep reinforced soil earth (RSE) fill batters with a slope of 45° extending to the valley floor, and in a number of places encroaching over the bed of Te Puka and Horokiri Streams. In Te Puka Stream valley the RSE batters will extend for nearly 2km. The Wainui Saddle itself will comprise a box cut with batters approximately 25m high.

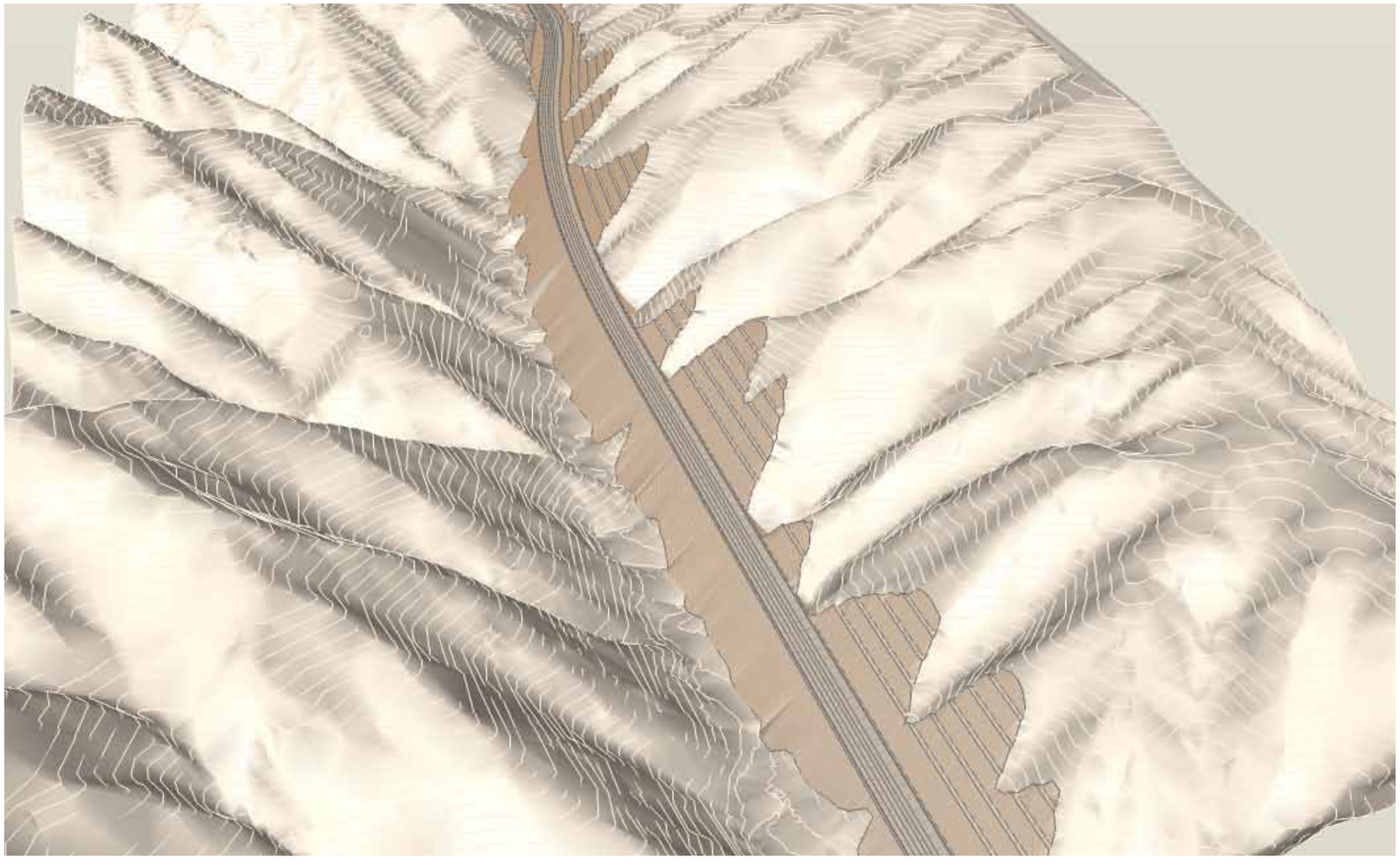

Figure 5.11: Section 2 Earthworks - View to South

Cut batters – Steep Topography

The effects of benching will be mitigated as far as possible by several techniques:

- Using horizontal benches which are considered aesthetically preferable compared with the alternative benching parallel with the carriageway;
- Increasing the height of the lowest batters nearest the road to 15m from the standard 10m;
- Extending the top batters into the adjacent slope, using a slightly shallower batter slope, in order to avoid benches near the top of the batters;
- Rounding the edges of the benches, and the side and top edges of the batters in order to visually soften the earthworks and reduce frittering; and
- Promoting re-vegetation of batters by techniques including hydro-seed and hydro-moss application. An initial cover will be established, followed by native shrub species.

Fill Batters – Steep topography

Like the cut batters, the fill batters will be high and long. However the RSE wall construction method means they will appear different from fill batters typically found on highways. The batters will be twice as steep as typical fill batters (IV:1H compared with 1V:2H) and will not be benched. The faces should be re-grassed using hydro-seed techniques. The batters will appear green, 'engineered' and relatively sculptural structures Their steepness will contribute to the impression of the alignment being 'shoe-horned' into the valley.

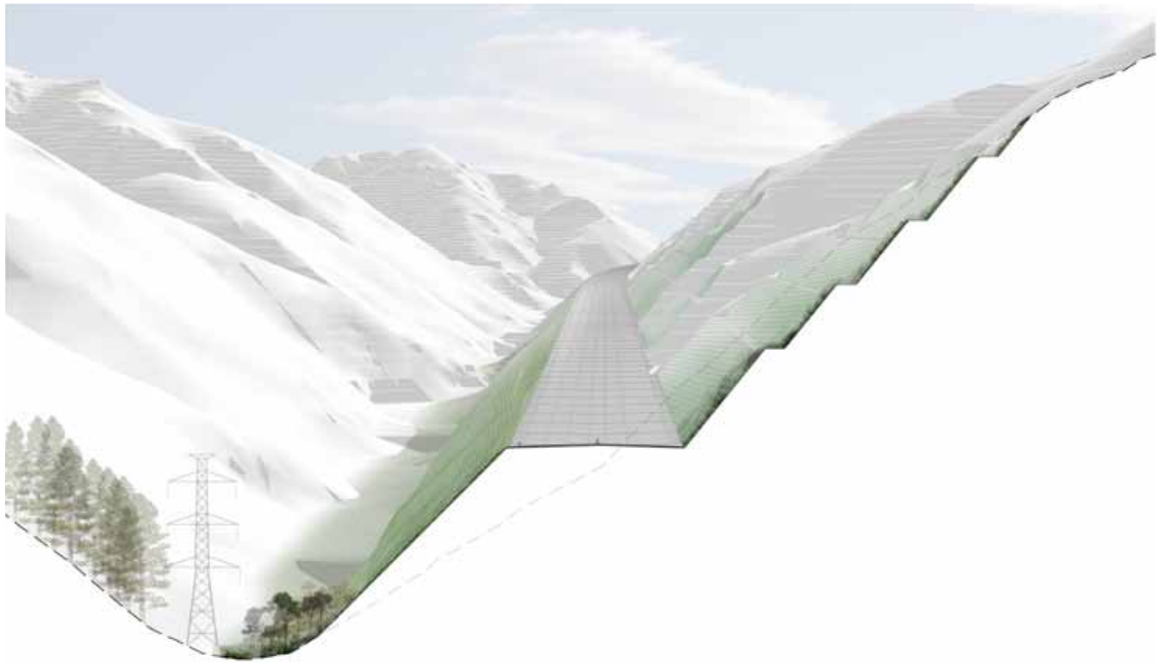

Figure 5.13: Mid Te Puka - 6 lane highway & large cut & reinforced fill batter, steep topography
LS02 - Location 3780m

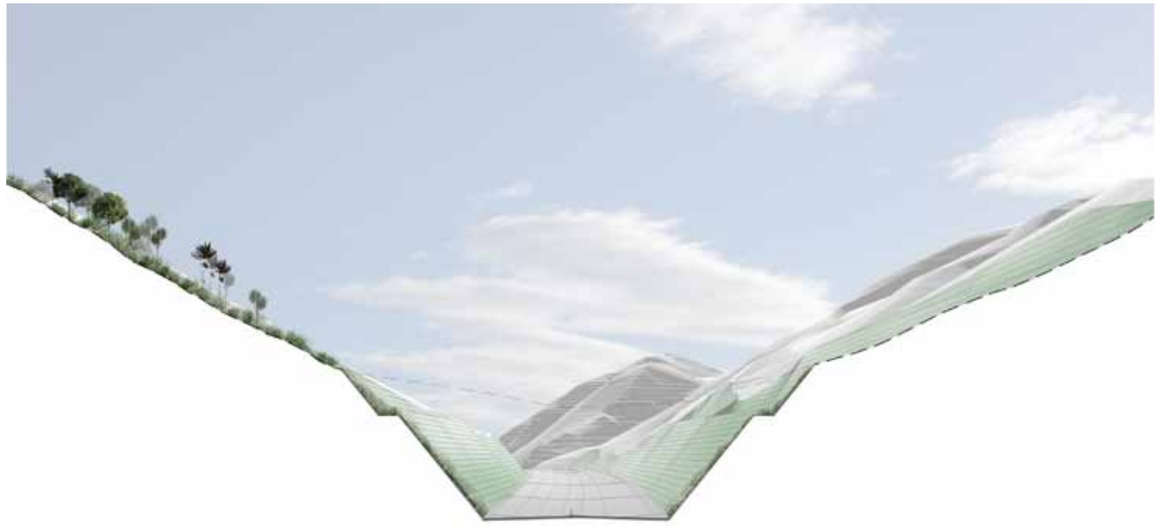

Figure 5.12: Wainui Saddle Summit, 6lane highway with narrow shoulders
LS03 - Location 5320m

Figure 5.14: Wainui Saddle - Brake Check Area, 4 lane highway
LS04 - Location 5620m

Landscape treatment

Table 5.4: Section 2 Wainui Saddle - Landscape Treatment

Landscape Character Area (Route Section)	Vegetation and Landform Character	Pattern of Enclosure/ Openness and Views	Design Response	Indicative plant species
Te Puka Stream – Wainui Saddle – Upper Horokiri Stream (Section 1, 2 & 3)	Steep sided stream valleys with narrow valley floor. Flanks characterised by rough pasture, regenerating shrubland, and isolated native remnants to the west and pine plantation and remnant/ regenerating native forest/ shrubland to the east. Exposed area with soil and climatic conditions providing challenge to establishment of plant material. Retain intervening steep gullies in rough pasture.	**Enclosed** – by steep slopes and narrow valley floor, but long views along to north and south from Wainui Saddle.	- Retire existing rough pasture to encourage native revegetation and retain existing areas of remnant native forest. - Rehabilitate stream margins to foster in-stream ecological values. - Hydroseed cut and fill batters with simple palette of pioneer shrubland species. - Rehabilitate stream margins to foster in-stream ecological values. - Hydroseed cut and fill batters alongside Te Puka stream with simple palette of pioneer shrubland species.	**Canopy specieas:** - Hinau *(Elaeocarpus dentatus)* - Kamahi *(Weinmannia racemosa)* - Nikau *(Rhopalostylis sapida)* - Northern rata *(Metrosideros robusta)* - Pigeonwood *(Hedycarya arborea)* - Rewarewa *(Knightia excelsa)* - Rimu *(Dacrydium cupressinum)* - Tawa *(Beilschmeidia tawa)* - Tree Ferns *(Cyathea medullaris & cunninghamii)* **Shrubs and understorey tree species:** - Cabbage tree *(Cordyline australis)* - Five Finger *(Pseudopanax arboreus)* - Karamu *(Coprosma robusta)* - Kawakawa *(Macropiper excelsum)* - Koromiko *(Hebe stricta)* - Mahoe *(Melicytus ramiflorus)* - Puka *(Griselinia littorialis)* **Low shrubs/ ground cover:** - Asplenium species *(e.g. Asplenium oblongifolium, bulbifernum & hookerianum)* - Astelia sp. *(A. fragrans & solandri)* - Blechnum sp *(e.g. B. novae-zelandiae, fluviatale, filiforme)* - Coprosma sp. *(e.g. C. propinqua)* - Flax *(Phormium tenax & cookianum)* - Kiekie *(Freycinetia banksii)* - Tauhinu *(Ozothamnus leptophyllus)*

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5.3 Section 3 – Horokiri Stream

5.3.1 Local context

Topography, geology and hydrology

Section 3 is characterised by:

- The relatively linear southward flowing Horokiri Stream valley, south of Wainui Saddle, with steep bedrock side slopes that are forested on the eastern flank and in rough pasture on the western slopes and valley floor. The mouths of steep-sided tributary streams contain alluvial fan deposits.

Landscape features

The landscape features of note in this section are somewhat similar to Section 2:

- Steep V-shaped valley. Straight fault-line alignment with truncated spurs. Steep, straight, stone-bed stream;
- Steep escarpment on valley's west side, short and very steep tributary streams and scree slopes. Rough pasture with extensive areas of regenerating scrub. Pockets of remnant indigenous forest;
- Steep escarpment also on valley's east side, but larger catchments, higher main ridgeline, tributary streams incised in deep valleys with inter-leaved spurs. Some areas of indigenous and second growth bush on valley side, backed by expansive plantation forest; and
- Remote, semi-wilderness character. As above, only structures are those associated with the transmission line (110kV double-circuit lattice towers) which follows the valley, and farm tracks, fences etc. No residences.

Land uses

Existing land uses

The land use in this section is predominantly pastoral and forest. The Horokiri Stream valley is steep-sided, and there are limited opportunities for access. Consequently, little development has taken place in the area.

District Plan Zones

This section of the alignment is zoned as 'Rural' under Porirua City District Plan.

Significant views and landmarks

The key landmarks in the area are Wainui Saddle and the upper Horokiri Stream. The 'V' of the saddle is a distinctive landmark glimpsed in the distance from such elevated locations as Battle Hill Farm Forest Park and parts of Whitby. It is a relatively minor existing landmark but will form a distinctive 'watershed' for future travellers on the route, forming a boundary between Wellington and the Kapiti Coast, and providing elevated views in both directions.

Connections

Local roads

There are no local road connections in this section of the Project.

Access to properties

There are no access issues in this section of the Project.

Pedestrian / cycle networks

There are no existing public footpaths or cycle paths in this section of the Project.

Photo 5.8: Horokiri valley looking south

Photo 5.9: Horokiri valley looking north

Photo 5.10: Wanui Saddle

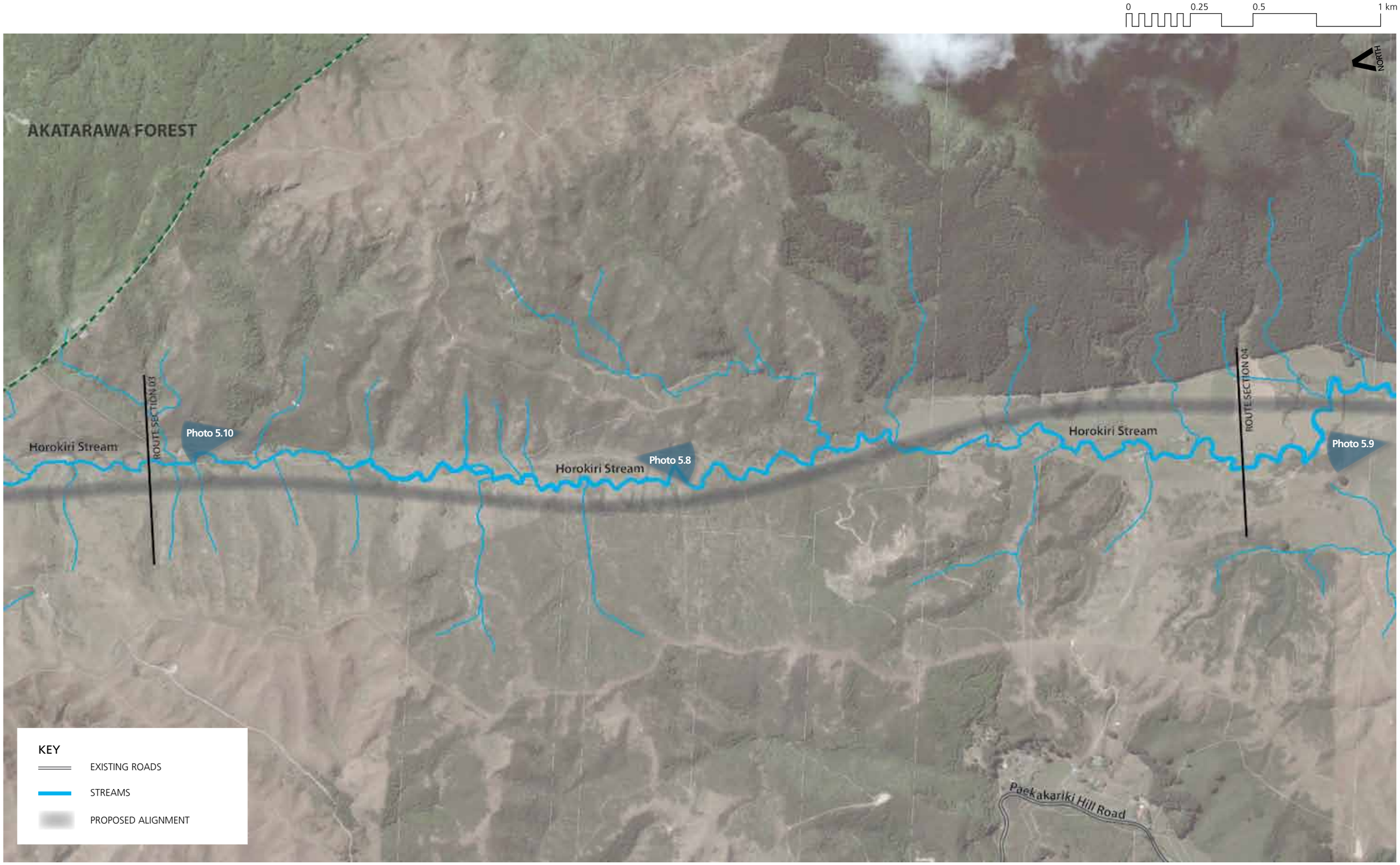

Figure 5.15: Section 3 Existing condition

5.3.2 Design issues and objectives

Table 5.5: Section 3 Horokiri Stream – Design issues and objectives

DESIGN ISSUES	DESIGN OBJECTIVES
Integration in the landscape & response to landscape character	
The Section 3 landscape is characterised by: ■ Narrow and steep to very steep sided stream valleys with truncated spurs and gullies ■ Naturally confined, narrow, winding and moderate stream gradients ■ Pastoral valley floor with reverting pasture, invasive exotic and native species, remnants and natural regeneration. Large production forest to the east. ■ Low density stock grazing ■ Confined views to north and south. ■ Undeveloped, remote and semi-wilderness character	The lower Horokiri Valley provides a form of transition between the upper valley and pastoral Battle Hill Farm Forest Park to the south. Design responses (vegetation in particular) should respond to this character.
Cut Faces: ■ This section of the route comprises significant cuts in excess of 50m high. These cut faces have the potential to signicantly impact both the existing character and road user experience of Section 3.	■ Minimise the overall height of cut faces where possible by steepening of slopes and tying into existing landform at the first available and practical opportunity. ■ Ensure the cut face profile and surface treatment seeks to limit potential adverse visual and route safety effects whilst orientating road user views to the wide landscape.
Fill Batters: ■ This section of the route has extensive fill batters (including 45 degree reinforced soil slopes) which, although less visible than cut faces, may significantly affect both landscape character and in stream values.	■ Minimise the overall extent of fill batters where possible by steepening of slopes and tying into existing landform at the first available and practical opportunity. ■ Ensure continuity in vegetation treatment to ensure that fill batters visually transition into natural landform and land cover when viewed from the road.
Adjoining land use and amenity	
■ Farm operations and plantation forest harvesting	■ Existing access should be maintained or re-provided.
Visual Experience	
■ Views from within the lower Horokiri Valley are relatively confined to the valley itself, although views from the road to Wainui Saddle will exist.	■ Ensure that design responses promote visual continuity between new and existing landscape patterns (e.g. vegetation) and maintain uninterrupted views to Wainui Saddle where possible.
Biodiversity and ecology	
■ The alignment follows Horokiri stream and requires some stream diversions.	■ Design stream diversions which closely replicate the natural in-stream features including rock cascades, riffles, pools and runs.
■ The alignment crosses a number of Horokiri Stream tributaries.	■ Design culverts to facilitate fish passage and retain as much in-stream habitat as possible. ■ Need for management of use of concrete in the stream corridors to avoid contamination.
■ The alignment requires some vegetation removal for road construction and operation.	■ Minimise the removal of indigenous vegetation through sensitive route alignment and construction methodology, including the location of haul roads and construction tracks. ■ Plant stream margins, banks and floodplains areas to restore native vegetation communities in the stream corridor.
■ Construction and operation of the road has the potential to impact on the stream environments through sediment and contaminant input into the waterways.	■ Design of the sediment / erosion control and stormwater treatment devices to a high standard which minimises the input of sediment and contaminants into the streams.
Local connectivity / severance	
■ Opportunity to accommodate a tramping track across or within the designation corridor.	■ Maintain possibility for trampers to walk from the existing GW track at Mount Wainui to the existing Transmission Gully Puketiro Loop track at Battle Hill.
■ Land east of the alignment (owned by NZTA) can be used for forestry under current 'Rural' zoning but is landlocked.	■ Retire land from productive uses.
Design Continuity	
■ See comments re: Visual Experience.	■ See comments re: Visual Experience.
Noise	
■ No issues	
Drainage	
■ The steep tributaries within the Horokiri stream valleys will require special attention for culvert design if crossing the alignment.	■ The outlet flow velocities need to be maintained to close to pre-construction levels through the use of drop structures (fish friendly where appropriate) and inlet and outlet erosion control protection methods.
■ Several segments of the Horokiri stream require permanent re-alignment.	■ Maintain pre-construction stream characteristics where it is possible.

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5.3.3 Design proposals

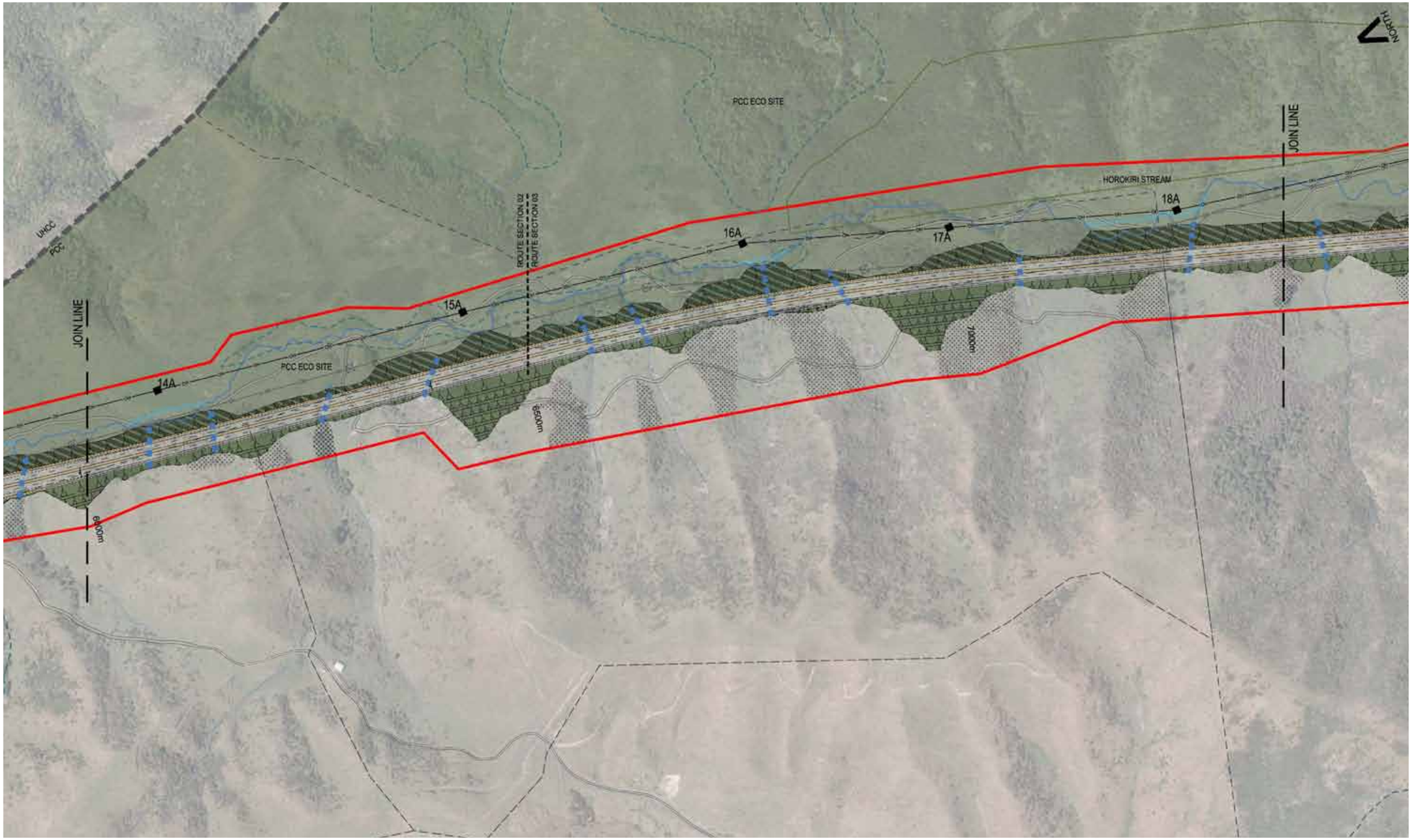

Figure 5.16: Section 3 Design Proposals

0 50 100 200 m

NORTH

JOIN LINE

22A

BRIDGE No. 4

6400m

HOROKIRI STREAM

PROPOSED WETLAND

6600m

JOIN LINE

1540m

EXISTING LANDSCAPE TYPOLOGY KEY

- PCC ECO SITES
- PCC LANDSCAPE PROTECTION AREA
- GWRC REGIONAL PARK
- WCC BUSH REMNANT
- QEII COVENANTS
- DOC CONSERVATION UNITS
- BATTLE HILL FARM FOREST PARK SUSTAINABLE MANAGEMENT AREA

FEATURE KEY

- PROPOSED ROAD ALIGNMENT
- PROPOSED BRIDGES & RETAINING WALLS
- PROPOSED MECHANICALLY STABILISED SLOPE (MSS)
- PROPOSED LIGHTS
- PROPOSED SAFETY BARRIER
- PROPOSED SOUND BARRIER
- PROPOSED SIGNS
- PROPOSED WALKING TRACK
- EXISTING ROADS + ACCESS TRACKS
- EXISTING BUILDINGS
- EXISTING BUILDINGS REMOVED
- PROPOSED DESIGNATION BOUNDRY
- TERRITORIAL AUTHORITY BOUNDARY
- EXISTING PROPERTY BOUNDARY
- PROPOSED FILL SITE EXTENT
- PROPOSED WETLAND
- PROPOSED STREAM DIVERSION
- PROPOSED CULVERT
- EXISTING STREAMS
- PROPOSED TRANSMISSION LINES
- EXISTING TRANSMISSION LINES
- 1042 HOUSING INVENTORY IDENTIFICATION NUMBERS
- 379 HOUSING INVENTORY REPRESENTATIVE VIEWPOINT IDENTIFICATION NUMBERS
- ECOLOGICAL MITIGATION
- AMENITY PLANTING
- TREE GRID - KAHIKATEA
- LANES MARSH
- KANUKA CORRIDOR
- RIPARIAN PLANTING**
- CUT / FILL FACE + FILL SITE VEGETATED
- CUT / FILL FACE + FILL SITE GRASSED
- BATTLE HILL WOODLAND PLANTING
- EXISTING DESIGNATION MITIGATION PLANTING
- VISUAL MITIGATION PLANTING
- EXISTING EXOTIC VEGETATION TO BE RETAINED *
- EXISTING PRIMARY NATIVE VEGETATION TO BE RETAINED **
- EXISTING SECONDARY NATIVE VEGETATION TO BE RETAINED ***

Earthworks

This section of the route is similar in nature to Section 2, but the topography is less severe, the Main Alignment is two lanes in either direction (there are no crawler lanes as in Te Puka Stream valley), and cut and fill batters are generally smaller.

Between 6500m and 8500m the alignment will be benched on the west side of the valley with a sequence of side cuts on the uphill side, and extensive fill batters on the downhill side. The cut batters will be typically up to 25m – 35m high, with the exception of one batter up to 65m (at 7000m). The fill batters will be up to approximately 25m high, will use RSE wall construction and have batter slopes of 1V:1H. However they do not encroach into the Horokiri Stream and to a large extent do not extend as far as the valley floor, the Main Alignment being largely benched on the hill face.

Between 8500m and 9500m the Main Alignment crosses to the east side of the Horokiri Stream valley and descends onto a narrow flood plain. A bridge is used to cross the stream but there are three short sections of stream diversion required downstream of the bridge where fill batters encroach into loops of the stream. There are two side cut batters up to 30m – 35m high on the east side of the valley. In other respects the earthworks in this section are comparatively small.

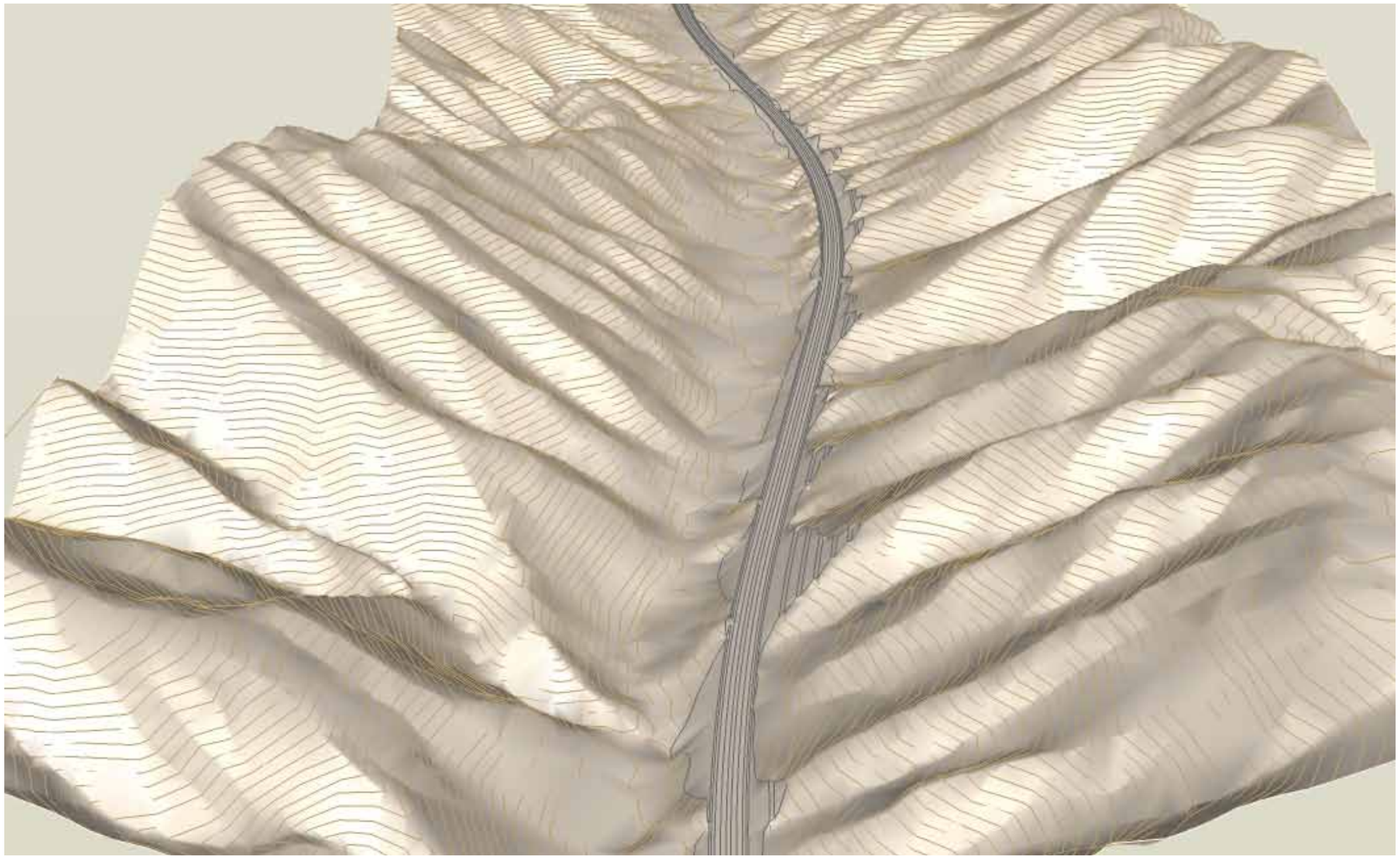

Figure 5.17: Section 3 Earthworks - View to South

Cut batters – Steep Topography

With the exception of the 65m batter at 7000m (at the north end of the section) it should be possible to limit each cut batter to a single bench. Although a number of the batters are 30m-35m high which would normally require two benches, the upper bench might be avoided by laying the top batter back at a slightly less steep angle and feathering the edges into the slope. Other mitigation measures for the cut batters include:

- Using horizontal benches which are considered aesthetically preferable compared with the alternative benching parallel with the carriageway;
- Increasing the height of the lowest batters nearest the road to 15m from the standard 10m;
- Rounding the edges of the benches, and the side and top edges of the batters in order to visually soften the earthworks and reduce frittering; and
- Promoting re-vegetation of batters by techniques including hydro-seed and hydro-moss application. An initial cover will be established, followed by native shrub species.

Fill Batters – Steep topography

Apply the following principles in areas where there are environmental constraints:

- Maximise the fill batter slope in order to reduce the footprint of earthworks and to reflect the steepness of adjacent natural slopes. For instance 1H:1V fill batter slopes achieved by use of reinforced soil earth batters; and
- Re-grass fill batter slopes using hydro-seed techniques.

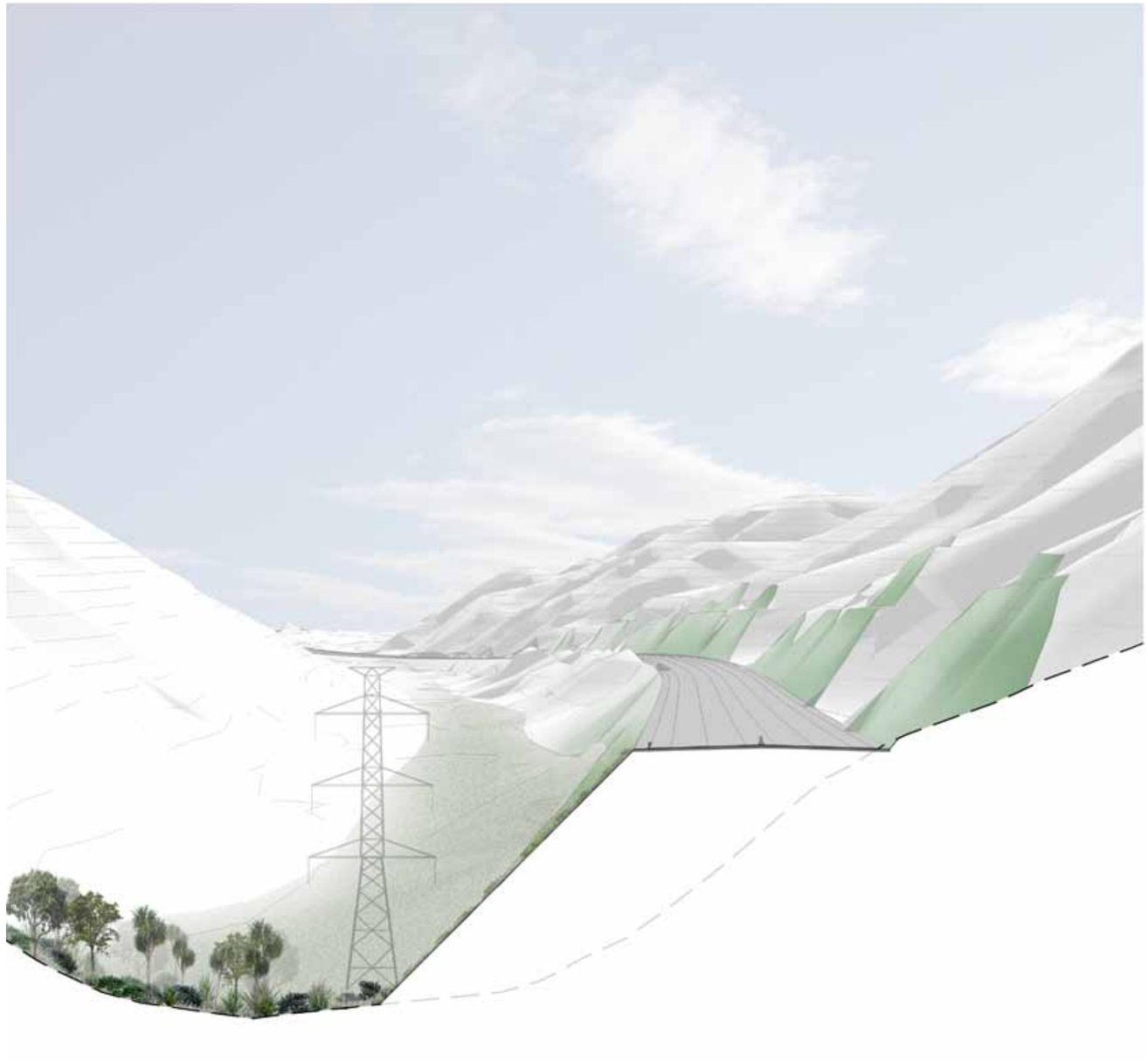

Figure 5.18: Horokiri Stream - 4 lane highway
LS05 - Location 7220m

Landscape treatment

Table 5.6: Section 3 Horokiri Stream - Landscape Treatment

Landscape Character Area (Route Section)	Vegetation and Landform Character	Pattern of Enclosure/ Openness and Views	Design Response	Indicative plant species
Te Puka Stream – Wainui Saddle – Upper Horokiri Stream (Section 1, 2 & 3)	Steep sided stream valleys with narrow valley floor. Flanks characterised by rough pasture, regenerating shrubland, and isolated native remnants to the west and pine plantation and remnant/ regenerating native forest/ shrubland to the east. Exposed area with soil and climatic conditions providing challenge to establishment of plant material. Retain intervening steep gullies in rough pasture.	**Enclosed** – by steep slopes and narrow valley floor, but long views along to north and south from Wainui Saddle.	Retire existing rough pasture to encourage native revegetation and retain existing areas of remnant native forest. Rehabilitate stream margins to foster in-stream ecological values. Hydroseed cut and fill batters with simple palette of pioneer shrubland species. Rehabilitate stream margins to foster in-stream ecological values. Hydroseed cut and fill batters alongside Te Puka stream with simple palette of pioneer shrubland species.	**Canopy specieas:** - Hinau *(Elaeocarpus dentatus)* - Kamahi *(Weinmannia racemosa)* - Nikau *(Rhopalostylis sapida)* - Northern rata *(Metrosideros robusta)* - Pigeonwood *(Hedycarya arborea)* - Rewarewa *(Knightia excelsa)* - Rimu *(Dacrydium cupressinum)* - Tawa *(Beilschmeidia tawa)* - Tree Ferns *(Cyathea medullaris & cunninghamii)* **Shrubs and understorey tree species:** - Cabbage tree *(Cordyline australis)* - Five Finger *(Pseudopanax arboreus)* - Karamu *(Coprosma robusta)* - Kawakawa *(Macropiper excelsum)* - Koromiko *(Hebe stricta)* - Mahoe *(Melicytus ramiflorus)* - Puka *(Griselinia littorialis)* **Low shrubs/ ground cover:** - Asplenium species *(e.g. Asplenium oblongifolium, bulbifernum & hookerianum)* - Astelia sp. *(A. fragrans & solandri)* - Blechnum sp *(e.g. B. novae-zelandiae, fluviatale, filiforme)* - Coprosma sp. *(e.g. C. propinqua)* - Flax *(Phormium tenax & cookianum)* - Kiekie *(Freycinetia banksii)* - Tauhinu *(Ozothamnus leptophyllus)*

Landscape Character Area (Route Section)	Vegetation and Landform Character	Pattern of Enclosure/ Openness and Views	Design Response	Indicative plant species
Battle Hill Farm Forest Park (Section 3, 4 & 5)	Moderately sloping stream valley opening out to broader Battle Hill river plain and rolling hills to the west. Lower Hororkiri Stream valley characterised by rough pasture and regenerating shrubland to the west and regenerating shrubland and pine plantation (Akatarawa Forest) to the east. Broader pastoral river flats at Battle Hill.	**Semi-open to open** – views to the south along valley floor. Steadily constrained to the north and Upper Horokiri Stream valley.	Emphasise alluvial floodplain landform by retaining pastoral land cover adjacent to the highway. Rehabilitate stream margins and restore pastoral floodplain character.	**Canopy species:** - Hinau *(Elaeocarpus dentatus)* - Kahikatea (Dacrydium dacrydioides) - Kanuka (Kunzea ericoides) - Lacebark *(Hoheria populnea)* - Pukatea *(Laurelia novaezelandiae)* - Titoki (Alectryon excelsus) - Totara *(Podocarpus totara)* **Shrubs and understorey tree species:** - Cabbage tree *(Cordyline australis)* - Five Finger *(Pseudopanax arboreus)* - Karamu *(Coprosma robusta)* - Koromiko *(Hebe stricta)* - Kowhai *(Sophora chathamica)* - Mahoe *(Melicytus ramiflorus)* - Pittosporum sp. *(P. euginoides & tenufolium)* - Puka (Griselinia lucida) - Tree fuschia *(Fuschia excorticata)* - Wineberry *(Aristotelia serrata)* **Low shrubs/ ground cover:** - Astelia sp. *(Astelia solandri)* - Bush rice grass (M*icrolaena avenacea)* - Coprosma sp. *(e.g. C. propinqua)* - Flax *(Phormium tenax & cookianum)* - Juncus sp *(J. gregiflorus, pallidus & planifolius)* - Olearia sp. *(Olearia solandri)* - Tauhinu *(Ozothamnus leptophyllus)* - Toe toe *(Cortaderia fulvida)* - Umbrella sedge *(Cyperus ustulatus & eragrostis)*

5.4 Section 4 – Battle Hill

5.4.1 Local context

Topography, geology and hydrology

Section 4 is characterised by:

- A wide, gently sloping alluvial basin of the Horokiri Stream in the Battle Hill area, with relatively steep side slopes planted in pine forest on the eastern flank, and in improved pasture on the valley floor and western hills.

Landscape features

The landscape features of note in this section are:

- Wider valley, river terraces on valley floor. Straight fault-line valley (splinter fault on north-south alignment), but stream is able to meander across its small flood plain, shallower gradient. Stony bed stream. Valley floor characterised by improved pasture, cropping for hay;
- Steep hill country backdrop to the east, characterised by extensive plantation forest (Akatarawa Forest);
- Rolling country on west side of valley has improved pasture. Managed as a Regional Farm Park with a comparatively manicured rural character. High aesthetic value. Contrast in character with the more wild character of the Wainui Saddle area;
- Structures include the transmission line, which continues within the valley. Cluster of heritage buildings at homestead site, but on opposite side of ridge from proposed alignment. No dwellings visible from alignment; and
- Historical associations with the site of the 1846 battle during the New Zealand Wars. The battle site is on a ridge approximately 1km west of the valley.

Land uses

Existing land uses

The area through Battle Hill Farm Forest Park (BHFFP) is relatively undeveloped. On the eastern side of the valley is a large area of exotic forest. The park provides for a range of recreation activities and includes several historic sites. It also provides access into the Akatarawa Ranges. There is no development within the park, although there are a small number of rural residential subdivisions located off Paekakariki Hill Road.

District Plan Zones

This section of the alignment falls under two zones in Porirua City District Plan:

- Part of Battle Hill Farm Forest Park is zoned as 'Open space'. This includes all the park land contained between Paekakariki Hill Road and the forested block to the east; and
- All surrounding areas, including the forested block within the Park, are zoned as 'Rural'.

Connections

Local roads

There are no local road connections in this section of the Project. The nearest local road is Paekakariki Hill Road which runs west of the alignment and comes to within 200m of the route at its nearest point just south of Battle Hill Farm Forest Park.

Access to properties

A number of large properties located east of the route which currently have access to Paekakariki Hill Road will have their access severed by the alignment. Alternative access routes needs to be provided.

Pedestrian / cycle / bridleway networks

Battle Hill Farm Forest Park is the main destination for pedestrians, cyclists and horse riders in this area. The Park is accessed from Paekakariki Hill Road. The Park entrance is approximately 6km north of SH58 at Pauatahanui. A number of walking and multi-use (walking, mountain biking and horse riding) tracks are provided within the park. All but one track sit completely on the western side of the alignment. The 'Transmission Gully Puketiro Loop' track crosses the alignment and will require access under it. This crossing point should be designed to accommodate pedestrians, cyclists and horse riders.


Photo 5.11: Battle Hill Farm Forest Park and Wainui Saddle


Photo 5.12: Horokiri stream through Battle Hill Farm Forest Park


Photo 5.13: Gasline Ridge

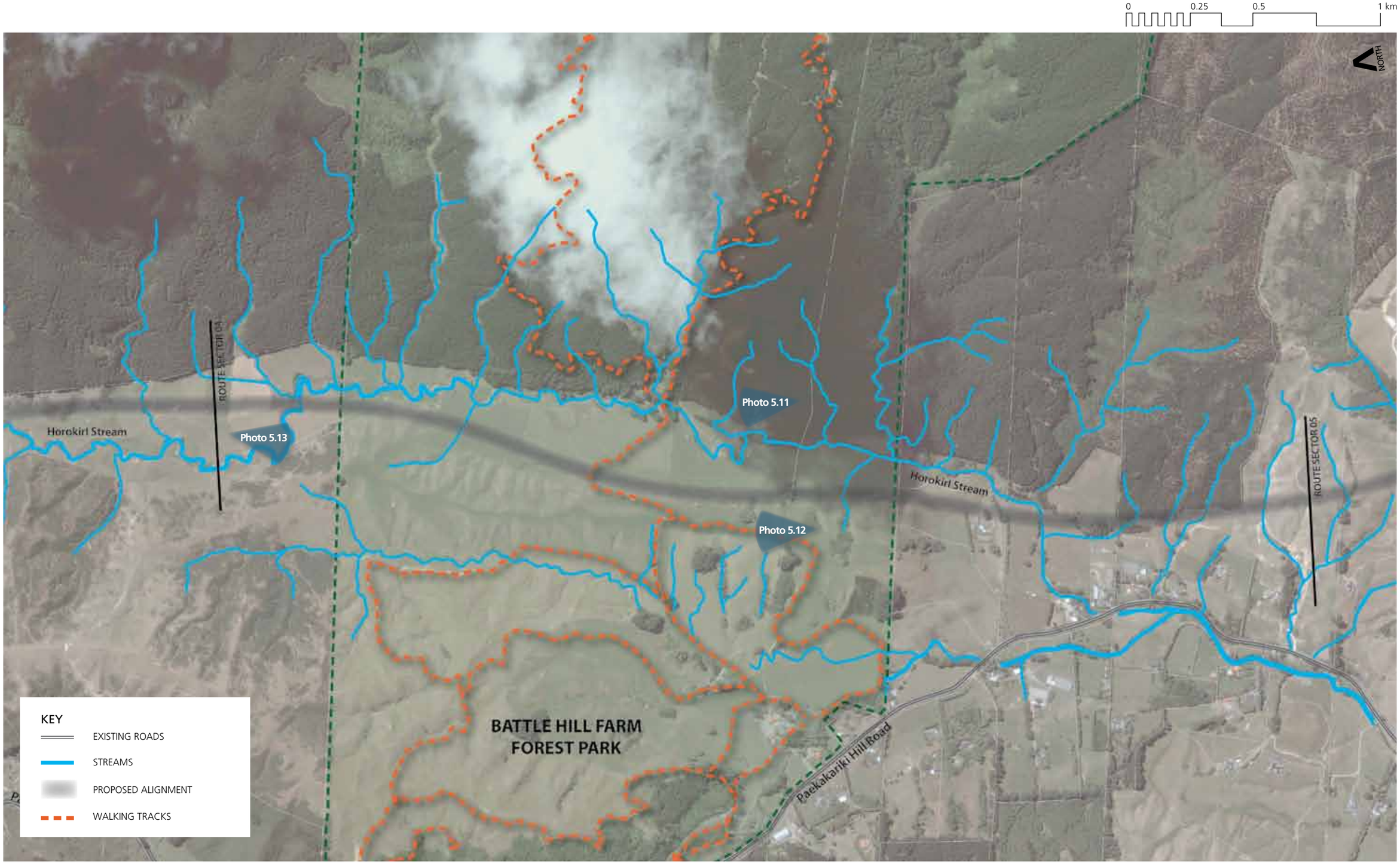

Figure 5.19: Section 4 Existing Condition

5.4.2 Design issues and objectives

Table 5.7: Section 4 Battle Hill – Design issues and objectives

DESIGN ISSUES	DESIGN OBJECTIVES
Integration in the landscape & response to Landscape Character	
The Section 4 landscape is characterised by: ▪ Wider valley floor and river terrace/ flood plain ▪ Meandering stream with shallow stream ▪ Improved pasture with grazing and cropping for hay. ▪ Confined views to north (end of Section 3) and south. ▪ Manicured rural character with pastoral hills to west and extensive production forestry to the east. ▪ Widely recognised historical and recreational values.	▪ Landform alteration and treatment shall respond to the existing character of Battle Hill as the only flat, open, pastoral section of the 27km route. ▪ Specific emphasis shall be given to the flat broad character of the valley and its pastoral and recreational use. ▪ Ensure consistency with existing GWRC development and management initiatives for Battle Hill Farm Forest Park.
Fill Disposal Sites ▪ There is a fill disposal site identified for Battle Hill in the existing valley floor.	▪ The extent, form and nature of recommended landscape treatment of fill disposal sites shall respond to and be consistent with existing landform, vegetation and in stream ecological values as well as overall identity and visual character of Battle Hill.
Adjoining land use and amenity	
▪ Amenity for visitors of Battle Hill Park.	▪ Alignment to hug hillside to west to reduce severance of the valley floor and to retain a visually and productively contiguous unit. ▪ Landscape treatment (including fill disposal sites, stream realignment, constructed wetlands, cut/ fill batter profile and surface treatment and vegetation) shall consider the key landscape (including visual) characteristics of Battle Hill. ▪ Maintain access across alignment for pedestrians, cyclists and horse riders [see connectivity objective below]. ▪ Ensure high level of amenity for park visitors in and around underpass connecting both sides of the park.
Visual Experience	
▪ The flat open valley floor and uninterrupted (yet relatively confined) views could be significantly impacted by physical changes outside of the road corridor.	▪ Reduce visual clutter and ensure that landscape treatments maintain the open rural character of the valley floor.

DESIGN ISSUES	DESIGN OBJECTIVES
Biodiversity and ecology	
▪ The alignment follows Horokiri stream and requires some stream diversions.	▪ Design stream diversions which closely replicate the natural in-stream features including rock cascades, riffles, pools and runs.
▪ The alignment crosses a number of Horokiri Stream tributaries.	▪ Design culverts to facilitate fish passage. and retain as much in stream habitat as possible.
▪ Construction and operation of the road has the potential to impact on the stream environments through sediment and contaminant input into the waterways and estuarine environment.	▪ Design of the sediment / erosion control and stormwater treatment devices to a high standard which minimises the input of sediment and contaminants into the streams and estuary.
▪ Construction of bridges may result in vegetation removal and disturbance to areas adjacent to the stream.	▪ Minimise the removal of native vegetation. ▪ Locate piers as far back on the stream bank as practicable. ▪ Adequate sediment / erosion control and stormwater treatment devices to minimise the input of sediment and contaminants into the streams.
Local connectivity / severance	
▪ A number of properties located east of the route have their access severed by the alignment.	▪ Provide alternative vehicular access across the alignment through underpasses.
▪ Within Battle Hill Farm Forest Park, the 'Transmission Gully Puketiro Loop' multi-use track is severed by the alignment.	▪ Multi-use access to be provided under alignment (underpass) to enable use of the track. This crossing point should be designed to accommodate pedestrians, cyclists and horse riders, and separate alternative access provided for vehicles and heavy logging trucks.
▪ Opportunity to accommodate walking and horseriding track within the designation corridor to link BHFFP and SH58.	▪ Maintain possibility for trampers and horse riders to go from the existing Transmission Gully Puketiro Loop track at Battle Hill to the end of Flighty's Road to reach SH58.
Design Continuity	
▪ If not carefully addressed, the combination of various design elements within this section could detract from the existing landscape character around Battle Hill. ▪ Allow unrestricted views from the road to ensure that road users have the ability to connect with this unique location along the route.	▪ Minimise or eliminate road furniture (including central median barriers and side protection) and signage where possible. ▪ Landscape treatment to reinforce the unique identity of Battle Hill whilst being visually subdued. ▪ Maximise views out from the road.
Noise	
▪ The new road will change the acoustic amenity in this Section from predominantly natural sounds to noticeable road-traffic.	▪ Maintain alignment close to gasline ridge (west of valley) to provide maximum acoustic screening for visitor centre.
Drainage	
▪ Parts of the terrain are flat enough for the consideration of grass swales to be used on either side of the alignment for collection and conveyance of contaminated stormwater runoff from the highway.	▪ Maintain possibility of increasing the width of the shoulders of the alignment to allow for use of swales. ▪ Recommended swales will be part of a wider 'treatment train' process in accordance with NZTA's stormwater treatment philosophy.

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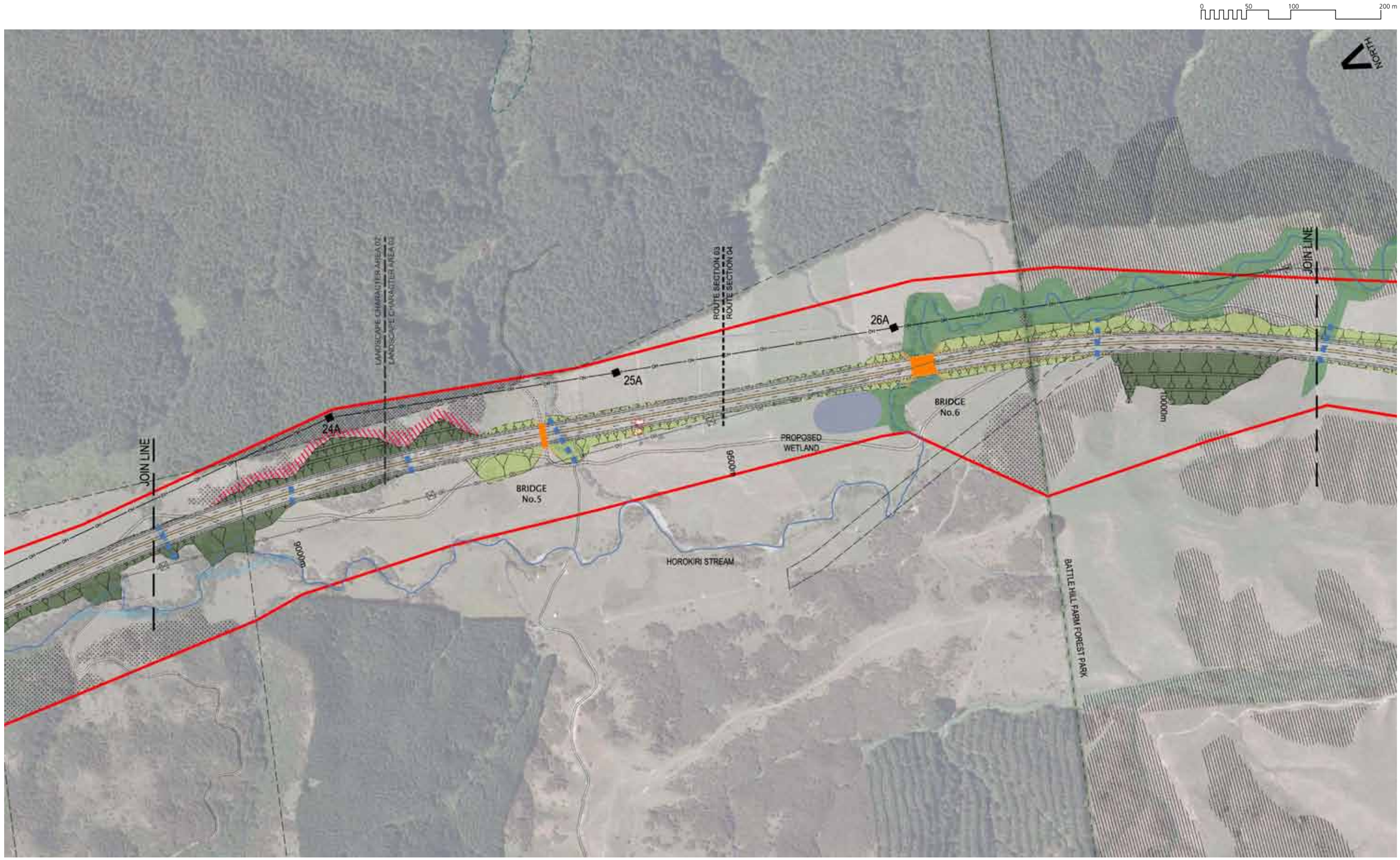
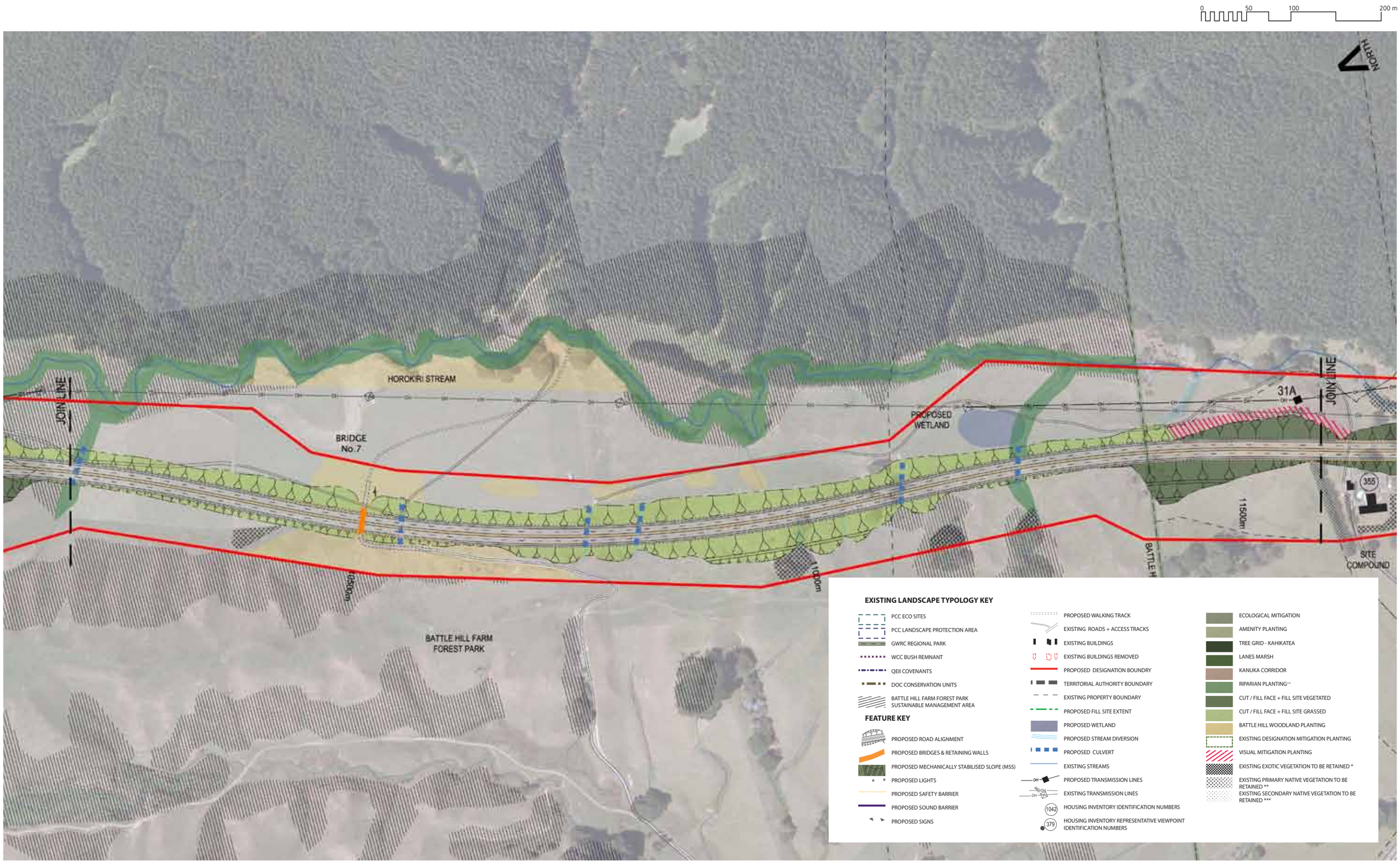


Figure 5.20: Section 4 Design proposals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50
100
200 m
NORTH
JOIN LINE
HOROKIRI STREAM
BRIDGE
No.7
PROPOSED
WETLAND
31A
JOIN LINE
355
11500m
11600m
11700m
BATTLE HILL FARM
FOREST PARK
SITE
COMPOUND
EXISTING LANDSCAPE TYPOLOGY KEY
PCC ECO SITES
PCC LANDSCAPE PROTECTION AREA
GWRC REGIONAL PARK
WCC BUSH REMNANT
QEII COVENANTS
DOC CONSERVATION UNITS
BATTLE HILL FARM FOREST PARK SUSTAINABLE MANAGEMENT AREA
FEATURE KEY
PROPOSED ROAD ALIGNMENT
PROPOSED BRIDGES & RETAINING WALLS
PROPOSED MECHANICALLY STABILISED SLOPE (MSS)
PROPOSED LIGHTS
PROPOSED SAFETY BARRIER
PROPOSED SOUND BARRIER
PROPOSED SIGNS
PROPOSED WALKING TRACK
EXISTING ROADS + ACCESS TRACKS
EXISTING BUILDINGS
EXISTING BUILDINGS REMOVED
PROPOSED DESIGNATION BOUNDRY
TERRITORIAL AUTHORITY BOUNDARY
EXISTING PROPERTY BOUNDARY
PROPOSED FILL SITE EXTENT
PROPOSED WETLAND
PROPOSED STREAM DIVERSION
PROPOSED CULVERT
EXISTING STREAMS
PROPOSED TRANSMISSION LINES
EXISTING TRANSMISSION LINES
1042
HOUSING INVENTORY IDENTIFICATION NUMBERS
379
HOUSING INVENTORY REPRESENTATIVE VIEWPOINT IDENTIFICATION NUMBERS
ECOLOGICAL MITIGATION
AMENITY PLANTING
TREE GRID - KAHIKATEA
LANES MARSH
KANUKA CORRIDOR
RIPARIAN PLANTING++
CUT / FILL FACE + FILL SITE VEGETATED
CUT / FILL FACE + FILL SITE GRASSED
BATTLE HILL WOODLAND PLANTING
EXISTING DESIGNATION MITIGATION PLANTING
VISUAL MITIGATION PLANTING
EXISTING EXOTIC VEGETATION TO BE RETAINED *
EXISTING PRIMARY NATIVE VEGETATION TO BE RETAINED **
EXISTING SECONDARY NATIVE VEGETATION TO BE RETAINED ***

5.4.3 Design proposals

Earthworks

Between chainage 9500m and 11500m, the alignment follows the valley floor through Battle Hill Farm Forest Park parallel to the Horokiri Stream. The alignment re-crosses to the west side of the valley and follows the edge of a small alluvial flood plain at the base of low rolling hills. The alignment will be slightly elevated above the floodplain on a low embankment. There are two side cuts: one up to 35m high into the side of a distinctive small hill referred to as 'Gasline Ridge' at 10000m, and the other approximately 25m high into rolling hill face further south at 11000m. There is box cut approximately 15m-25m deep through the ridge at the southern end of the Park at 11500m.

Spoil disposal sites are identified on the river terraces between the Main Alignment and the toe of adjacent hills (8600m to 9800m) and stream-ward of the Main Alignment (10100m to 11300m). The intention is that excess fill material would be contoured to resemble natural terraces and would tie in to adjacent slopes.

Between chainage 11500 and 12500, the alignment follows a change in topography between rolling hills to the west and steeper hills to the east. The Main Alignment is benched around the base of the steeper hills with several side cuts up to 15m to 35m high.

Figure 5.21: Section 4 Earthworks - View to North

Cut Batters – Rolling topography

The design should seek to limit each cut batter to a single bench, with the possible exception of the batter on the side of Gas Line Ridge (10000m). Gas Line Ridge is a distinctive knoll which forms a localised landmark within the valley. It is recommended that detail design explore means to soften the earthworks by reducing the slope at the top of the batter in order to avoid the need for a top bench and to round the batter into the adjacent knoll.

A number of the other batters are approximately 30m high which would normally require two benches, but the upper bench can be avoided by laying the top batter back at a slightly less steep angle and feathering the edges into the slopes.

Fill Batters – Rolling topography

In locations where fill batters do not extend into streams or ephemeral watercourses:

- Minimise fill batter slope in order to merge with surrounding terrain, and to facilitate re-vegetation to merge with surrounding land use.

Figure 5.22: Lower Horokiwi - 4 lane highway
LS06 - Location 11800m

Structures

Battle Hill Farm Forest Park underpass (Bridge 7)

This underpass connects both sides of the Regional Park and will provide pedestrian, cycle and horse riding access to the 'Transmission Gully Puketiro Loop'. Separate access across the Main Alignment for vehicular traffic (including heavy logging trucks) is to be provided elsewhere. The design of the underpass should provide good amenity for park visitors, maximise natural light penetration and ensure safe access for all types of users.

More specifically:

- The height of the underpass should be sufficient to allow equestrian riders to remain on horseback through it;
- The slow moving pedestrians should be separated from faster moving users (mountain bikers and horse riders). This could be achieved by raising the level of the pedestrian path slightly, delineating it with a raised kerb to deter bike intrusion and using different paving materials to clearly distinguish both paths;
- If practicable, provide sufficient median space between the highway's northbound and southbound carriageways to accommodate a light well for the underpass below;
- The internal surfaces of the underpass (walls and ceiling) should have good design, detailing and finish, and present a high quality aspect to users. Opportunities for involving the Park staff in the design of the internal surfaces should be explored in consultation with the GWRC. The design could include park interpretation material; and
- The underpass wing walls should present a high quality finish to park visitors. The design of the wing walls should relate to the treatment of the underpass' internal surfaces to create a coherent overall design.

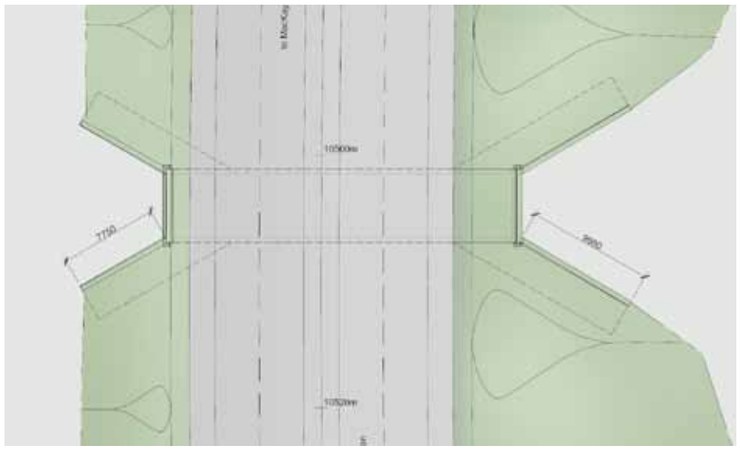

Figure 5.23: Bridge 7: Battle Hill Farm Forest Park (BHFFP) underpass plan

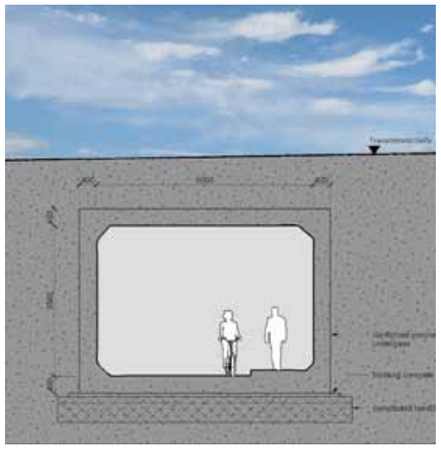

Figure 5.24: Bridge 7: BHFFP underpass cross-section

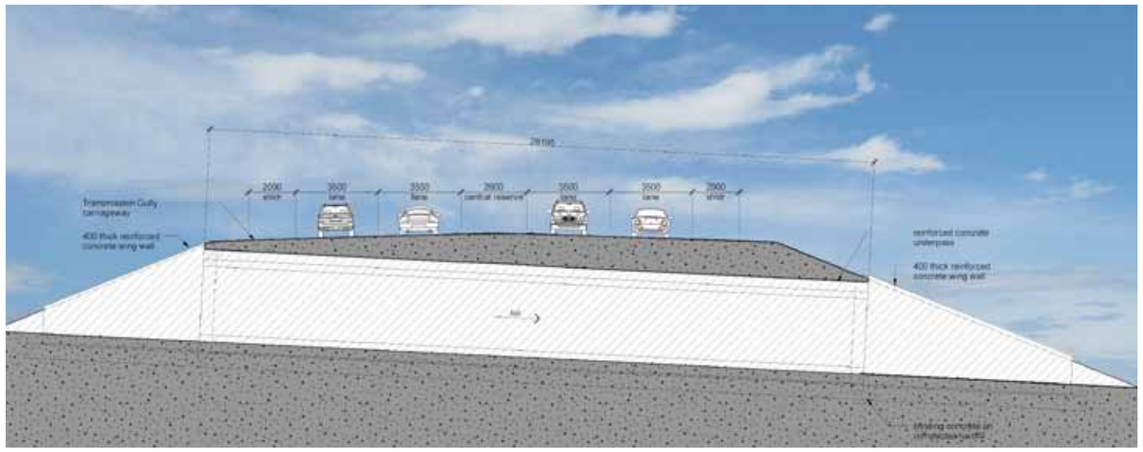

Figure 5.25: Bridge 7: BHFFP underpass long section

Landscape treatment

Table 5.8: Section 4 Battle Hill – Landscape treatment

Landscape Character Area (Route Section)	Vegetation and Landform Character	Pattern of Enclosure/ Openness and Views	Design Response	Indicative plant species
Battle Hill Farm Forest Park (Section 3, 4 & 5)	Moderately sloping stream valley opening out to broader Battle Hill river plain and rolling hills to the west. Lower Hororkiri Stream valley characterised by rough pasture and regenerating shrubland to the west and regenerating shrubland and pine plantation (Akatarawa Forest) to the east. Broader pastoral river flats at Battle Hill.	**Semi-open to open** – views to the south along valley floor. Steadily constrained to the north and Upper Horokiri Stream valley.	Emphasise alluvial floodplain landform by retaining pastoral land cover adjacent to the highway. Rehabilitate stream margins and restore pastoral floodplain character.	**Canopy species:** - Hinau *(Elaeocarpus dentatus)* - Kahikatea *(Dacrydium dacrydioides)* - Kanuka *(Kunzea ericoides)* - Lacebark *(Hoheria populnea)* - Pukatea *(Laurelia novaezelandiae)* - Titoki *(Alectryon excelsus)* - Totara *(Podocarpus totara)* **Shrubs and understorey tree species:** - Cabbage tree *(Cordyline australis)* - Five Finger *(Pseudopanax arboreus)* - Karamu *(Coprosma robusta)* - Koromiko *(Hebe stricta)* - Kowhai *(Sophora chathamica)* - Mahoe *(Melicytus ramiflorus)* - Pittosporum sp. *(P. euginoides & tenufolium)* - Puka *(Griselinia lucida)* - Tree fuschia *(Fuschia excorticata)* - Wineberry *(Aristotelia serrata)* **Low shrubs/ ground cover:** - Astelia sp. *(Astelia solandri)* - Bush rice grass *(Microlaena avenacea)* - Coprosma sp. *(e.g. C. propinqua)* - Flax *(Phormium tenax & cookianum)* - Juncus sp *(J. gregiflorus, pallidus & planifolius)* - Olearia sp. *(Olearia solandri)* - Tauhinu *(Ozothamnus leptophyllus)* - Toe toe *(Cortaderia fulvida)* - Umbrella sedge *(Cyperus ustulatus & eragrostis)*

Figure 5.26: Visual simulation of highway through Section 4 looking north

Figure 5.27: Visual simulation of highway through Section 4 looking south

Figure 5.28: Visual simulation of highway through Section 4 looking north

5.5 Section 5 – Golf Course

5.5.1 Local context

Topography, geology and hydrology

Section 5 is characterised by:

- Undulating river terraces, gullies and gentle hilltops in pasture and plantation pine, lying between Horokiri Stream and SH58 in the vicinity of the Pauatahanui Golf Course.

Landscape features

The landscape features of note in this section are:

- Rolling topography lacking strong pattern. Watershed between Horokiri Stream and headwaters of Ration Stream;
- Backdrop higher hills to the east characterised by plantation forest and areas of extensive pasture.
- Rolling topography characterised by a fragmented patchwork pattern of lifestyle properties and golf course. Pastoral land-cover, but with a variety of exotic shelter belts, shelter trees, amenity planting, and small plantations; and
- Relatively close settlement pattern with houses and outbuildings generally clustered parallel with either Flighty's Road (east of proposed alignment) or the Paekakariki Hill Road (west of proposed alignment).

Land uses

Existing land uses

Land use within this section is a mix of rural activities and relatively recent rural residential subdivisions. Residential dwellings are located on both sides of the alignment and accessed via Paekakariki Hill Road on the western side and off Flighty's Road on the eastern side. There are large areas of forestry either side of the Ration Stream. The Pauatahanui Golf Course, accessed off Paekakariki Hill Road, occupies a large area of this section.

District Plan Zones

All areas along this section of the alignment are zoned as 'Rural' in Porirua City District Plan.

Connections

Local roads

There are no local road connections in this section of the Project. The nearest local road is Flighty's Road which runs east of the alignment and ends approximately 200m away from the route.

Access to properties

A number of rural lifestyle properties are accessed via private roads linking to the northern end of Flighty's Road. Access to some of these properties will be severed by the alignment and will need to be re-provided.

There are a number of properties bi-sected by the designation and access to Flighty's Rd and/or Paekakariki Hill Rd will need to be maintained by way of an underpass at this location.

Pedestrian / cycle / bridleway networks

There are no existing public footpaths or cycle paths in this section of the Project.

A number of rural lifestyle properties along Flighty's Road have horses. It has been suggested that horse owners in the area currently transport their animals on trailers to Battle Hill via Paekakariki Hill Road to ride. The potential to provide a bridleway linkage between the end of Flighty's Road and Battle Hill, possibly linking with the Transmission Gully Puketiro Loop track, has been investigated as part of the Project.

Photo 5.14: Rolling topography along Flighty's Road

Photo 5.15: Aerial view of the golf course

Photo 5.16: Golf course

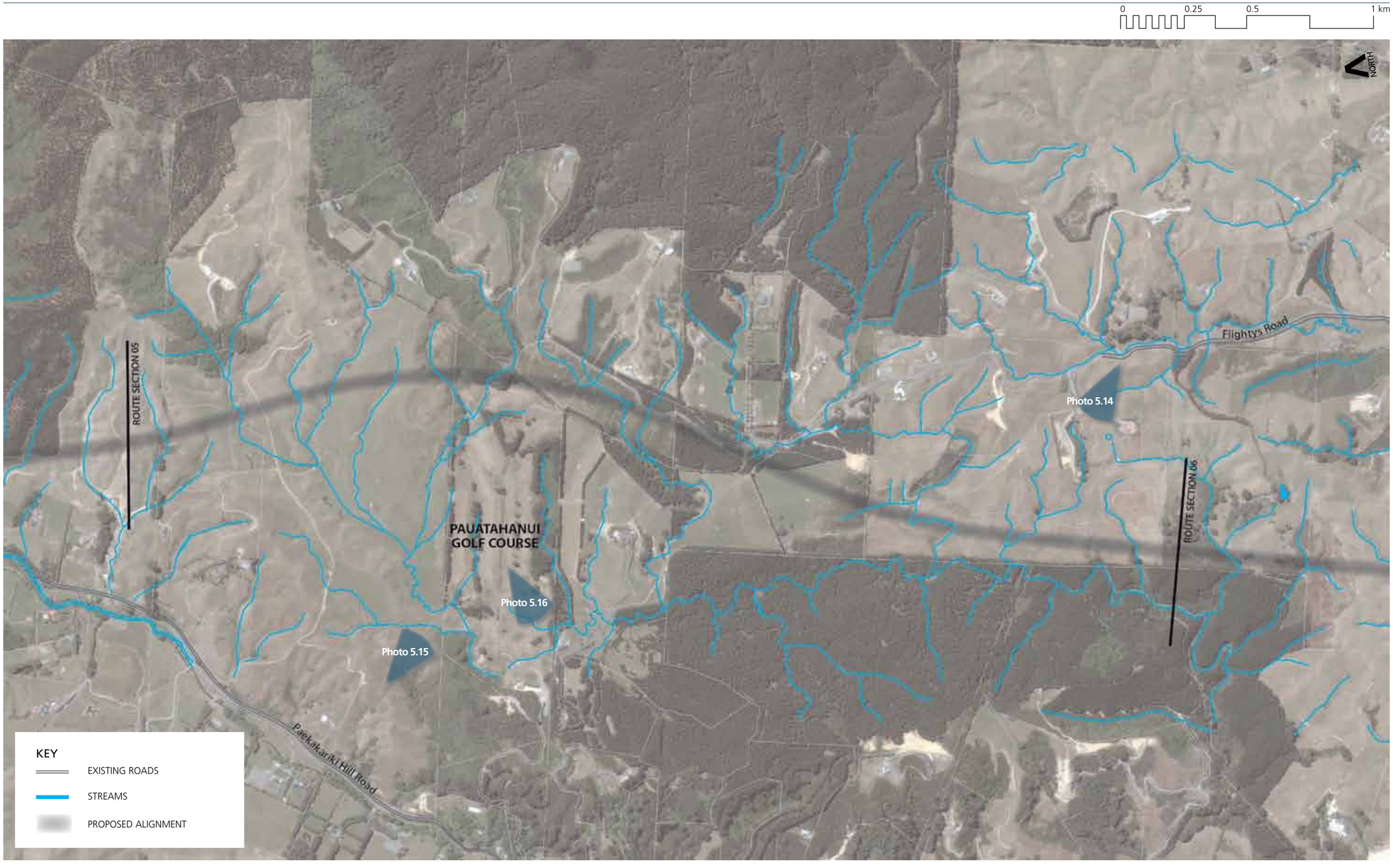

Figure 5.29: Section 5 Existing condition

5.5.2 Design issues and objectives

Table 5.9: Section 5 Golf Course – Design issues and objectives

DESIGN ISSUES	DESIGN OBJECTIVES
Integration in the landscape & response to Landscape Character	
The Section 5 landscape is characterised by: ■ Rolling, fragmented topography lacking any strong pattern; ■ Predominantly lifestyle development, some in close proximity to the road; and ■ Largely pastoral land cover with patches of native revegetation, exotic shelter belts and woodlots.	■ Design responses shall respond to the existing landscape character primarily through the profile and scale of cut/ fill batters and selection and spatial distribution of vegetation in proximity to the road.
Adjoining land use and amenity	
■ The road and associated works are located in (often) close proximity to existing lifestyle dwellings and may result in adverse effects on existing amenity values as well as potentially severing property units. ■ The majority of lifestyle dwellings located in proximity to the road were established after the consenting of the existing designation and some have existing agreements with regard to mitigation of potential effects.	■ The alignment of the road should seek to minimise potential adverse effects on existing properties in the first instance. Following this, measures (e.g. planting and buffer zones) to mitigate any effects should be implemented where possible. ■ Recommended mitigation and design responses should recognise and seek to implement and/or integrate existing agreements with property owners.
Visual Experience	
■ The extent of the road visible from existing lifestyle dwellings will be limited by the rolling and fragmented topography and vegetation patterns. In some cases residents may see small sections of the road and adjacent cut/ fill batters. ■ The visual experience of the road user will be one of regularly alternating open (yet limited in extent) and closed view sheds. Middle to distant views to the landscape are non-existent.	■ Consider the extent of views of the road from existing dwellings and soften/ screen where necessary. Discussions with individual property owners may be required to achieve a suitable outcome. ■ Ensure that limited views beyond the carriageway are retained and the visual quality of the 'in road' experience is as high as possible. (see Design Continuity).
Biodiversity and ecology	
■ The alignment crosses a number of Ration Creek tributaries.	■ Design culverts to facilitate fish passage. and retain as much in stream habitat as possible.
■ Construction and operation of the road has the potential to impact on the stream environments through sediment and contaminant input into the waterways and the estuarine environment.	■ Design of the sediment / erosion control and stormwater treatment devices to a high standard which minimises the input of sediment and contaminants into the streams and estuary.
Local connectivity / severance	
■ A number of properties currently accessed off Flighty's Road have their access severed by the alignment.	■ Provide alternative vehicular access to affected properties, including an extension to Fligthy's Road.
■ Access to a number of private properties from Paekakariki Hill Road will be severed by the alignment.	■ Alternative vehicular access to be provided under the alignment (underpass).
■ Horse riders located along Flighty's Road, Murphy's Road and other lifestyle areas currently take their horses to Battle Hill Park on floats via Paekakariki Hill Road due to lack of safe bridleway connection to the park.	■ Provide bridleway linkage between the end of Flighty's Road and Battle Hill within the designation corridor. Protect future right of access along this route to be shared by trampers and horse riders.
■ Opportunity to accommodate a tramping track across or within the designation corridor.	■ As above - Provide shared track for trampers and horse riders to go from Battle Hill to the end of Flighty's Road to reach SH58.
Design Continuity	
■ Given the relatively confined nature of views to the surrounding landscape a lack of continuity in road elements has the potential to result in a messy and confused road user experience.	■ Ensure that the number and changes in road elements are kept to a minimum. Use elements that are of a consistent character (e.g. safety barriers – earth bunds vs structural barriers).
Noise	
■ A number of rural residential properties will become affected by road-traffic noise.	■ Two metre high road-side bunding to be provided between cut faces at the north end of Flightys Road, to achieve appropriate noise levels. In addition to its acoustic screening effect, the bund will also provide benefits in terms of headlignt screening, it will provide a canvas for planting and limit the rapid cut/fill effects for road users.
Drainage	
■ The terrain is flat enough for the consideration of grass swales to be used on either side of the alignment for collection and conveyance of contaminated stormwater runoff from the highway.	■ Maintain possibility of increasing the width of the shoulders of the alignment to allow for use of swales. ■ Recommended swales will be part of a wider 'treatment train' process in accordance with NZTA's stormwater treatment philosophy.

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5.5.3 Design proposals

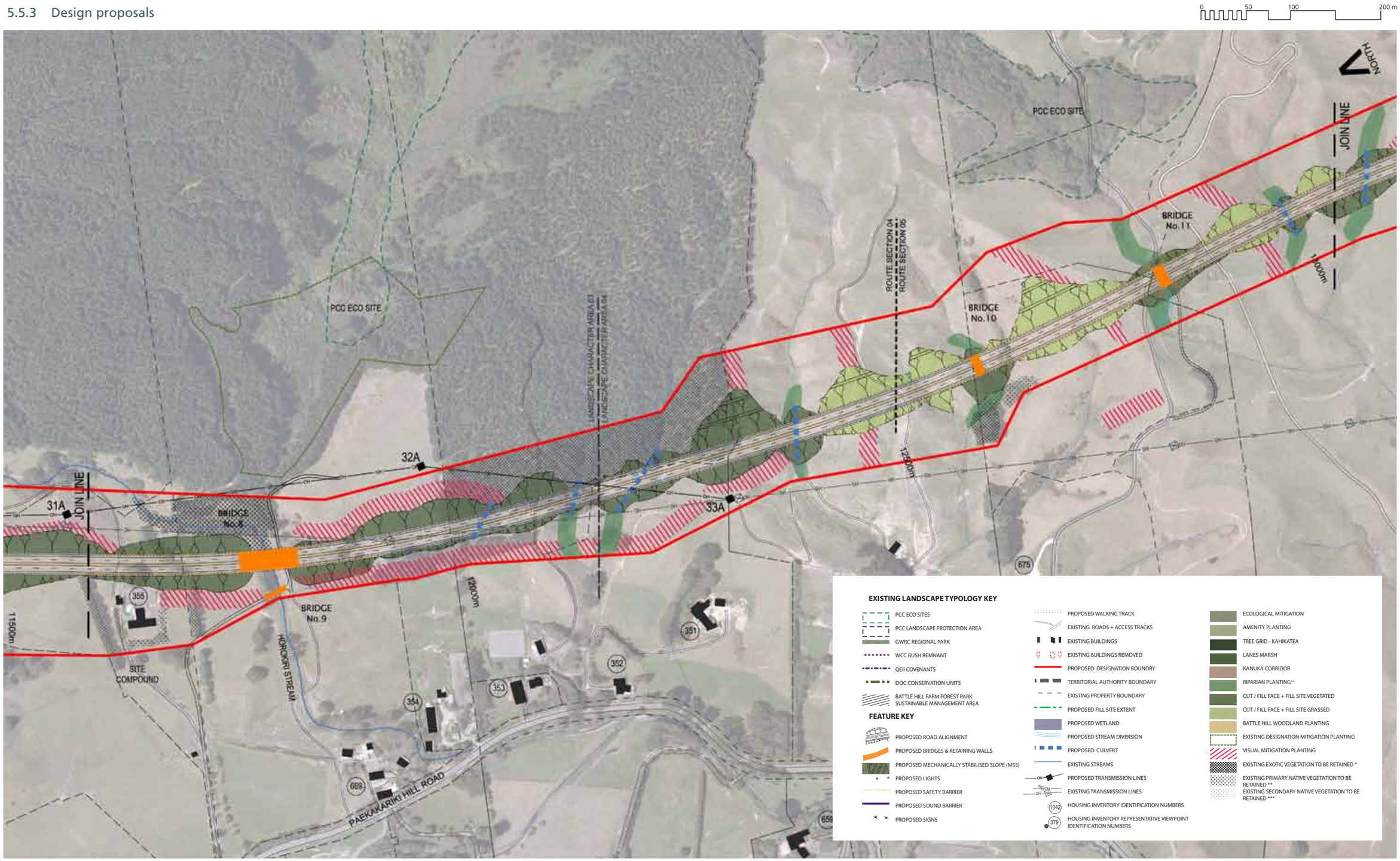
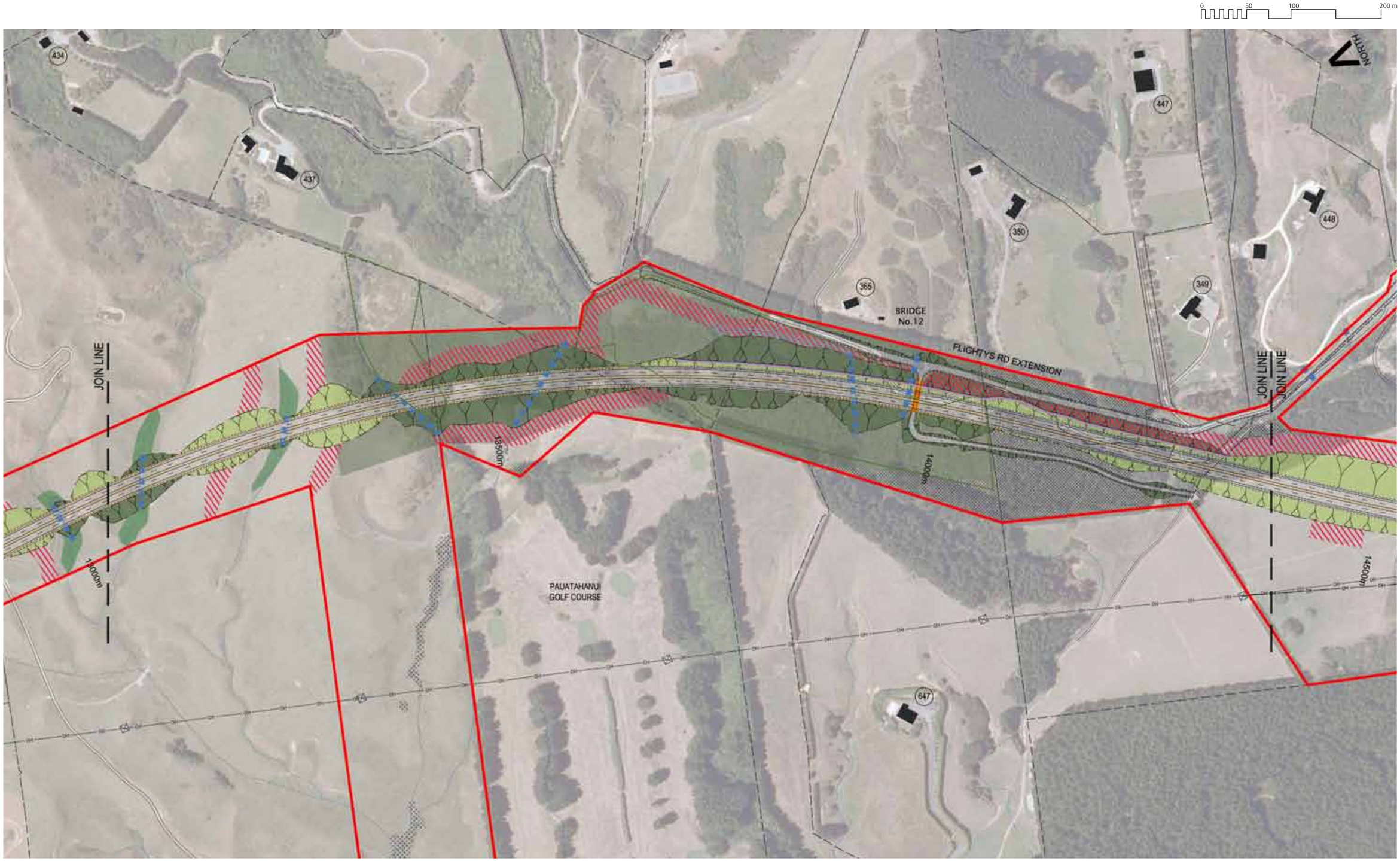


Figure 5.30: Section 5 Design proposals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14500m
15000m
PAUATAHANUI
GOLF COURSE
647

Earthworks

This section traverses rolling topography against a backdrop of steeper hills to the east. The earthworks typically comprise a sequence of box cuts and embankments through the rolling terrain. Two of the cut batters near 12500m are approximately 20m and 30m high respectively, while for the remainder of the section they are less than 15m high therefore avoiding the need for benching. Fill sites are located south of 13000m and in the vicinity of 14500m, in both instances on areas of rolling pasture.

With the exception of two batters in the vicinity of 12500m, the cut batters in this section will not require benching so that they will appear less 'engineered'. The gentler topography also provides opportunities to use gentler slopes in places for both cut and fill batters with the intention that the earthworks merge more readily with the terrain.

The following design principles apply:

- Fine-tune the batter designs in the vicinity of 12500m in order to avoid the top benches;
- Use low bunds and overfill batters on the embankments in order to reduce prominence of the carriageway and traffic from adjacent properties. This should also reduce the need for short lengths of guardrail in between areas of cut. The bund slope should match that of adjoining cuts to present a continuous and seamless surface to road users. The landscape treatment of the cut slopes should be extended across the bunds; and
- Place spoil along low ridges and contour to reflect and accentuate the underlying topography, This section traverses rolling topography against a backdrop of steeper hills to the east.

Figure 5.31: Section 5 Earthworks - View to North

Noise barriers

One residential property requires noise mitigation in this section of the route:

- Due to the local character of rolling topography and lifestyle properties, a bund is considered the most appropriate solution. The bund should be 2m high and bridge the gaps between sections of cut;
- In order to provide effective acoustic screening, the bund requires a roughly 1:1 slope from the road to keep the crest close to the road. The precise slope of the bund should follow the slope of adjoining cuts to present a continuous surface to road users;
- The road side of the bund should have the same landscape treatment as the adjoining cut faces; and
- The property side of the bunds should be planted to merge seamlessly with the adjoining areas.

Figure 5.32: Noise bund location

Landscape treatment

Table 5.10: Section 5 Golf Course - Landscape treatment

Landscape Character Area (Route Section)	Vegetation and Landform Character	Pattern of Enclosure/ Openness and Views	Design Response	Indicative plant species
Battle Hill Farm Forest Park (Section 3, 4 & 5)	Moderately sloping stream valley opening out to broader Battle Hill river plain and rolling hills to the west. Lower Hororkiri Stream valley characterised by rough pasture and regenerating shrubland to the west and regenerating shrubland and pine plantation (Akatarawa Forest) to the east. Broader pastoral river flats at Battle Hill.	**Semi-open to open** – views to the south along valley floor. Steadily constrained to the north and Upper Horokiri Stream valley.	Emphasise alluvial floodplain landform by retaining pastoral land cover adjacent to the highway. Rehabilitate stream margins and restore pastoral floodplain character.	**Canopy species:** - Hinau *(Elaeocarpus dentatus)* - Kahikatea *(Dacrydium dacrydioides)* - Kanuka *(Kunzea ericoides)* - Lacebark *(Hoheria populnea)* - Pukatea *(Laurelia novaezelandiae)* - Titoki *(Alectryon excelsus)* - Totara *(Podocarpus totara)* **Shrubs and understorey tree species:** - Cabbage tree *(Cordyline australis)* - Five Finger *(Pseudopanax arboreus)* - Karamu *(Coprosma robusta)* - Koromiko *(Hebe stricta)* - Kowhai *(Sophora chathamica)* - Mahoe *(Melicytus ramiflorus)* - Pittosporum sp. *(P. euginoides & tenufolium)* - Puka *(Griselinia lucida)* - Tree fuschia *(Fuschia excorticata)* - Wineberry *(Aristotelia serrata)* **Low shrubs/ ground cover:** - Astelia sp. *(Astelia solandri)* - Bush rice grass *(Microlaena avenacea)* - Coprosma sp. *(e.g. C. propinqua)* - Flax *(Phormium tenax & cookianum)* - Juncus sp *(J. gregiflorus, pallidus & planifolius)* - Olearia sp. *(Olearia solandri)* - Tauhinu *(Ozothamnus leptophyllus)* - Toe toe *(Cortaderia fulvida)* - Umbrella sedge *(Cyperus ustulatus & eragrostis)*

Landscape Character Area (Route Section)	Vegetation and Landform Character	Pattern of Enclosure/ Openness and Views	Design Response	Indicative plant species
Flightys Road Area (Section 5 & 6)	Rolling and largely enclosed landform with numerous streams and ephemeral water courses. Rural – residential/ lifestyle development with associated exotic shelter belts and small pine/ eucalyptus plantations of exotic trees.	**Semi-enclosed.** Short views.	Planting to emphasise cultural patterns of pastoral landuse and settlement and to reinforce rolling topography and network of streams. Extend existing mitigation planting to include cut and fill batters. Rehabilitate stream margins and integrate visual mitigation within a cohesive planting framework where required.	**Canopy species:** - Hinau *(Elaeocarpus dentatus)* - Kahikatea *(Dacrydium dacrydioides)* - Lowland ribbonwood (Plagianthus regius) - Pigeonwood *(Hedycarya arborea)* - Pukatea *(Laurelia novaezelandiae)* - Rewarewa *(Knightia excelsa)* - Totara *(Podocarpus totara)* **Shrubs and understorey tree species:** - Cabbage tree *(Cordyline australis)* - Five Finger *(Pseudopanax arboreus)* - Karamu *(Coprosma robusta)* - Koromiko *(Hebe stricta)* - Kowhai *(Sophora chathamica)* - Mahoe *(Melicytus ramiflorus)* - Ngaio *(Myoporum laetum)* - Pittosporum sp. *(P. euginoides &tenufolium)* - Tree fuschia *(Fuschia excorticata)* - Wineberry *(Aristotelia serrata)* **Low shrubs/ ground cover:** - Carex sp. *(C. secta & virgata)* - Flax *(Phormium tenax and cookianum)* - Juncus sp *(J. gregiflorus, pallidus, planifolius)* - Toe toe *(Cortaderia fulvida)* - Umbrella sedge *(Cyperus ustulatus & eragrostis)*

5.6 Section 6 – State Highway 58

5.6.1 Local context

Topography, geology and hydrology

This section of the route extends through rolling rural and rural residential land north of SH58, crosses SH58 and a low-lying estuarine plain associated with the Pauatahanui Inlet, then climbs the moderately-steep, weathered greywacke terrain to the south. SH58 runs along the low grounds alongside Pauatahanui Stream (5m AMSL) which meanders at the foot of the hills. The Silverwood Estate (residential subdivision) lies on high grounds south-west of the stream with a high point of approx. 110m AMSL along Endeavour Drive.

Landscape features

This section of the route traverses three landscape character areas as follows:

- Pauatahanui Rolling Hill Country (Flighty's Road lifestyle area): Rolling topography characterised by fragmented patchwork of relatively small rural properties. Variety of mainly exotic shelter belts, amenity planting and small plantations. Relatively close pattern of rural residential settlement with houses and outbuildings clustered generally parallel with Flighty's Road;
- Pauatahanui Stream Flats: Broad valley perpendicular to the proposed Transmission Gully Project alignment. Open flood plain and former head of Pauatahanui Inlet. Tidal influenced stream incised along southern edge of valley. Artificial drains and open pasture on flood plain ('Lanes Flat'). Pauatahanui Village located in flood plain downstream of proposed alignment. Band of kanuka on southern hill face. Overlooked by Whitby suburban residential area on south side, and by rural residential properties on north side. Built elements include small substation and transmission line, and historic St Joseph's Church on hill above valley east of proposed alignment; and
- Bradey Road lifestyle area: Small tributary valley of Pauatahanui Stream enclosed by rolling topography. Fragmented patchwork of rural lifestyle properties. Variety of mainly exotic shelter belts, amenity planting and small plantations. Relatively close pattern of rural residential settlement with houses parallel with Bradey Road. Steeper hill face on western side of valley with regenerating kanuka scrubland. Overlooked by suburban lots in recently developed perimeter of Whitby (Silverwood subdivision).

Area of Significant Conservation Value

The section is located within the catchment of the Pauatahanui Inlet. The inlet is defined as an Area of Significant Conservation Value (ASCV) in the Regional Coastal Plan for the Wellington Region for reasons of its Natural, conservation, geological and scientific values. It is a wildlife reserve with a diverse waterfowl and wading-bird habitat (local and migratory), threatened fish species (including Galaxias spp) and endangered vegetation. The reserve contains significant salt marsh vegetation. (Extract from Battle Hill Farm Forest Park Management Plan)

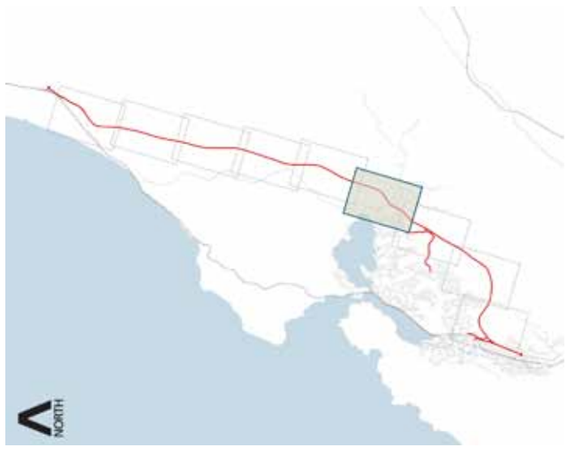


Photo 5.17: SH58 and Bradey Road (on the right)

Photo 5.18: St. Joseph's Church

Photo 5.19: Whitby and Pauatahanui Inlet

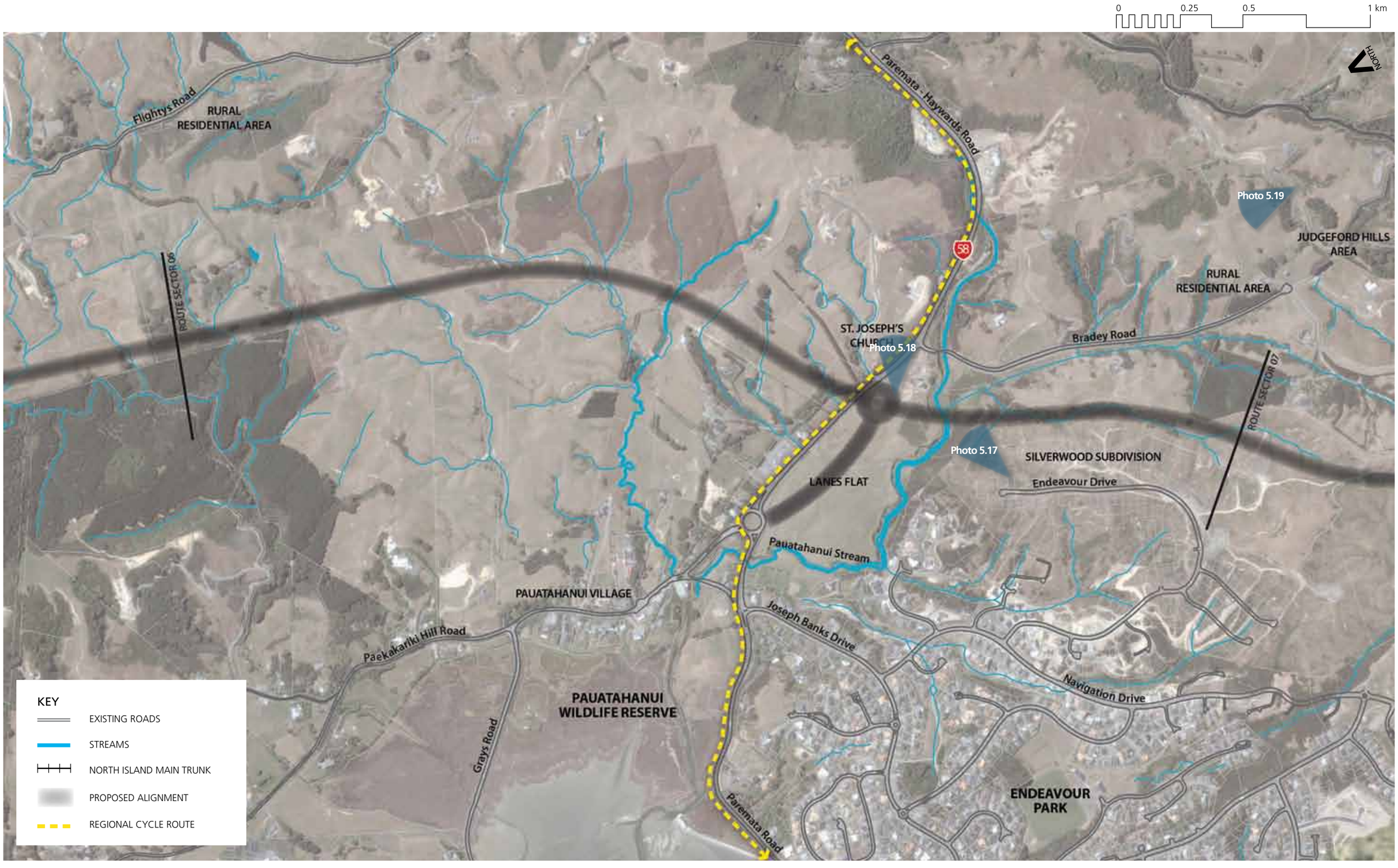


Figure 5.33: Section 6 Existing condition

Land uses

Existing land uses

There are a number of different land uses within this section, including a cluster of residential dwellings and some commercial activities in Pauatahanui Village, north of the intersection of Paekakariki Hill Road and SH58. The Pauatahanui Inlet is located west of the Village. The Pauatahanui Wildlife Reserve, situated at the head of the inlet, has ecological and recreational value. East of the Village, land is generally rural and includes a forested area east of Jones Deviation. An electricity sub-station and a historic church are located east of the intersection of SH58 and Paekakariki Hill Road.

A number of areas to the south of SH58 have been or are being developed for residential use, including the Silverwood Forest subdivision site and land on either side of Bradey Road.

District Plan Zones

The land north of SH58 is zoned 'Rural' in Porirua City District Plan.

South of SH58, a number of land use zones are present:

- The 'Rural' zone covers Lanes Flat, the land east of Bradey Road and a strip of land west of Bradey Road;
- The 'Judgeford Hills' zone covers an area of land south of Bradey Road. This zone allows the creation of up to 40 dwellings within five separate clusters;
- The part of the Transmission Gully Project designation corridor adjacent to Silverwood Estate is zoned Suburban, as it the Estate itself;
- The Whitby Land Protection Area overlay covers Resolution Ridge which coincides with part of the designation land south of SH58 and part of the Silverwood Estate; and
- A narrow strip on either side of Pauatahanui Stream east of Bradey Road is zoned 'Open Space'.

Significant views and landmarks

The Pauatahanui Stream valley will be a landmark on the proposed alignment because it is the only major valley that crosses the alignment at right angles, its openness will contrast to the enclosed valleys of the Horokiri Stream and Duck Creek, and because it is marked by SH58 and glimpses of Pauatahanui Village.

Although Pauatahanui Inlet itself may only be glimpsed from the route, its presence will be implied by the openness of views in the direction of the inlet and by views of the backdrop Paekakariki Hills.

Connections

Local roads

The Transmission Gully Project alignment will connect with SH58 via a grade separated roundabout interchange. The interchange will be located close to the junction of SH58 with Bradey Road which it will need to maintain.

Access to properties

One property is bisected by the designation and will have its access to Paekakariki Hill Road severed by the route. An underpass will need to be provided to restore access to land east of the alignment.

A number of private properties will have their access onto SH58 affected by the interchange. Reconfigured access to SH58 will be provided for these properties.

Pedestrian network

There are no existing public footpaths in this section of the Project.

The Judgeford Structure Plan makes provision for future pedestrian access to Belmont Regional Park through the Structure Plan area with links to both Belmont Road and Bradey Road. This may encourage people from Pauatahanui / Whitby to access the Park via SH58 and Bradey Road, and increase the number of pedestrians walking through the Transmission Gully Project / SH58 interchange.

Cycle network

SH58 is part of the Regional Cycling Network identified in the Regional Cycling Plan (GWRC 2008). There are currently no formal cycle lanes or paths along SH58 and cyclists share the carriageway with vehicles.

5.6.2 Design issues and objectives

Table 5.11: Section 6 SH58 – Design issues and objectives

DESIGN ISSUES	DESIGN OBJECTIVES
Integration in the landscape & response to Landscape Character	
There are three distinct character areas within Section 6:	
Flightys Road Lifestyle Area: ■ Rolling, fragmented topography lacking any strong pattern; ■ Predominantly lifestyle development, some in close proximity to the road; and ■ Largely pastoral land cover with patches of native revegetation and exotic shelter belts.	■ Design solutions shall respond to the existing landscape character primarily through the profile and scale of cut/ fill batters and selection and spatial distribution of vegetation in proximity to the road.
Pauatahanui Valley (Lanes Flat): ■ Broad, open, tidal influenced flood plain and former head of Pauatahanui inlet; and ■ Significant human alteration (e.g pasture, substation, surface drains, SH58). The development of Lanes Flat needs to consider a number of complex design issues including: ■ Flood storage and sedimentation; ■ SH58 realignment; ■ Potential site compound during construction and weigh bridge post construction; ■ PCC's desire to extend existing public open space and create a continuous 'green corridor' along Pauatahanui stream; ■ Maintenance and enhancement of landscape character and visual amenity for this key location along the route; and ■ The elevated nature of the SH58 interchange will result in a unique and readily identifiable built feature in the landscape.	■ Ensure that final design solution acheives a suitable balance between the technical considerations specific to this key location. ■ In particular, ensure that the technical requirements for flood and storm water systems are developed with the open character of Lanes Flat in mind. ■ Design crossing of Pauatahanui Stream to maintain connectivity between possible 'open space' corridor on either side of alignment through the provision of a shared pedestrian and cycle path. ■ Provide pedestrian connection to the wider network around Lanes Flat, including possible boardwalk through Lanes Flat wetland (see Drainage issues). ■ Ensure that the final design solution for this key location 'beds' the interchange into the landscape and Lanes Flat retains its open character and identity as an extension of the Inlet.
Bradey Road Lifestyle Area: ■ Small tributary valley of Pauatahanui Stream enclosed by rolling topography. ■ Fragmented patchwork of rural lifestyle properties. ■ Variety of mainly exotic shelter belts, amenity planting and small plantations. ■ Relatively close pattern of rural residential settlement with houses parallel with Bradey Road	■ Design solutions shall respond to the existing landscape character primarily through the profile and scale of cut/ fill batters and selection and spatial distribution of vegetation in proximity to the road.

DESIGN ISSUES	DESIGN OBJECTIVES
Adjoining land use and amenity	
■ The road and associated works are located in (often) close proximity to existing lifestyle properties and may result in adverse effects on existing amenity values as well as potentially severing property units.	■ The alignment of the road should seek to minimise potential adverse effects on existing properties in the first instance. Following this, measures (e.g. planting and buffer zones) to mitigate any effects shall be implemented where possible.
■ There are a number of dwellings located in and around the north eastern end of Whitby that derive visual amenity from views to the inlet and Lanes Flat. In some instances these dwellings are located low on adjacent hillsides and are oriented towards the future SH58 interchange.	■ Ensure that any design solution considers the role Lanes Flat plays in the amenity of adjoining residential areas and seek to 'bed' the road into the landscape, soften its overall appearance and maintain a continuous identity for Lanes Flat and its connection with the inlet.
■ The land adjoining the proposed road is in private ownership and offers little in the way of public amenity outside of people driving along SH58.	■ Ensure current levels of public amenity are maintained and enhanced where possible
Visual Experience	
■ Views to the road from adjoining lifestyle properties are largely restricted to short isolated sections due to intervening topography and vegetation. However, there is the potential for construction works and cut/ fill batters to cause adverse visual effects.	■ Ensure that views from adjacent dwellings are considered when locating and designing cut/batters and associated planting. ■ Ensure that limited views beyond the carriageway are retained and the visual quality of the 'in road' experience is as high as possible. (see Design Continuity).
■ Given the elevated topography to the south of SH58 (Bradey Road/ Silverwood) and the elevation of the interchange itself, northbound road users will experience views of Lanes Flat, Pauatahanui Inlet and hills beyond. There is the potential for these key view shafts to be negatively affected by works associated with the road.	■ Ensure that any design solutions along this section of the route recognise the important visual characteristics of the route and the positive contribution they will make to road user experience (i.e. retain, maximise and enhance key views).
Biodiversity and ecology	
■ The alignment crosses Pauatahanui Stream and requires some stream diversions.	■ Design stream diversions which closely replicate the natural in-stream features including rock cascades, riffles, pools and runs.
■ The alignment crosses a number of Pauatahanui Stream tributaries.	■ Design culverts to facilitate fish passage and retain as much in stream habitat as possible. ■ Need to manage the use of concrete in the stream corridors to avoid contamination.
■ The alignment requires some vegetation removal for road construction and operation.	■ Minimise the removal of indigenous vegetation through sensitive route alignment and construction methodology, including the location of haul roads and construction tracks. ■ Plant stream margins, banks and floodplains areas to restore native vegetation communities in the stream corridor.

DESIGN ISSUES	DESIGN OBJECTIVES
▪ Construction and operation of the road has the potential to impact on the stream environments through sediment and contaminant input into the waterways and the estuarine environment.	▪ Design of the sediment / erosion control and stormwater treatment devices to a high standard which minimises the input of sediment and contaminants into the streams and estuary.
Local connectivity / severance	
▪ One property is bisected by the designation and will have its access to Paekakariki Hill Road severed by the route.	▪ Provide an underpass to restore access to land east of the alignment.
▪ Private properties will have their access onto SH58 altered by the interchange.	▪ Reconfigure access to SH58 for these properties.
▪ SH58 is part of regional cycle network and is used by a large number of sports cyclists.	▪ Provide access for sports cyclists on suitable road shoulders through interchange. ▪ Provide off-road alternative access for recreational cyclists. This could take the form of a shared pedestrian and cycle path along Pauatahanui Stream.
▪ Pedestrian access to the Catholic church and Bradey Road from Pauatahanui Village will be impacted by the interchange.	▪ Provide off-road shared pedestrian and cycle path potentially utilising boardwalk within a new Lanes Flat wetland.
Design Continuity	
▪ Given the relatively confined nature of views to the surrounding landscape through the Flightys Road and Bradey Road sections of the route a lack of continuity in road elements has the potential to result in a messy and confused road user experience.	▪ Ensure that the number and changes in road elements are kept to a minimum. Focus on using elements that are of a consistent character (e.g. safety barriers – earth bunds vs structural barriers).
▪ A wide variety of road furniture will be required in the vicinity of the SH58 interchange including signage, lighting and safety barriers.	▪ Ensure that all road furniture is considered part of a 'family' and continuity is acheived with regard to road furniture location, form, scale and materials both within this section and across the wider route.
Noise	
▪ Increases in road-traffic noise levels in this area are generally within applicable standards.	▪ No specific noise mitigation is required.

DESIGN ISSUES	DESIGN OBJECTIVES
Drainage	
▪ There is a major bridge crossing of the Pauatahanui stream 200m south of the intersection. Pauatahanui stream requires realignment in the vicinity of the new bridge crossing and there are potential flooding impacts upstream caused by the new bridge constraining flow in extreme flood events.	▪ It is recommended that the lower SH58 level of the interchange is to be used as a secondary flowpath in extreme events to reduce upstream flooding effects.
▪ There is an opportunity to construct a wetland to the north west of the intersection adjacent to the Pauatahanui stream. This would treat contaminated stormwater runoff from the intersection and highway, and provide some flood attenuation.	▪ Provide new mulit-purpose wetland at Lanes Flat.

5.6.3 Design proposals

Figure 5.34: Section 6 Design proposals

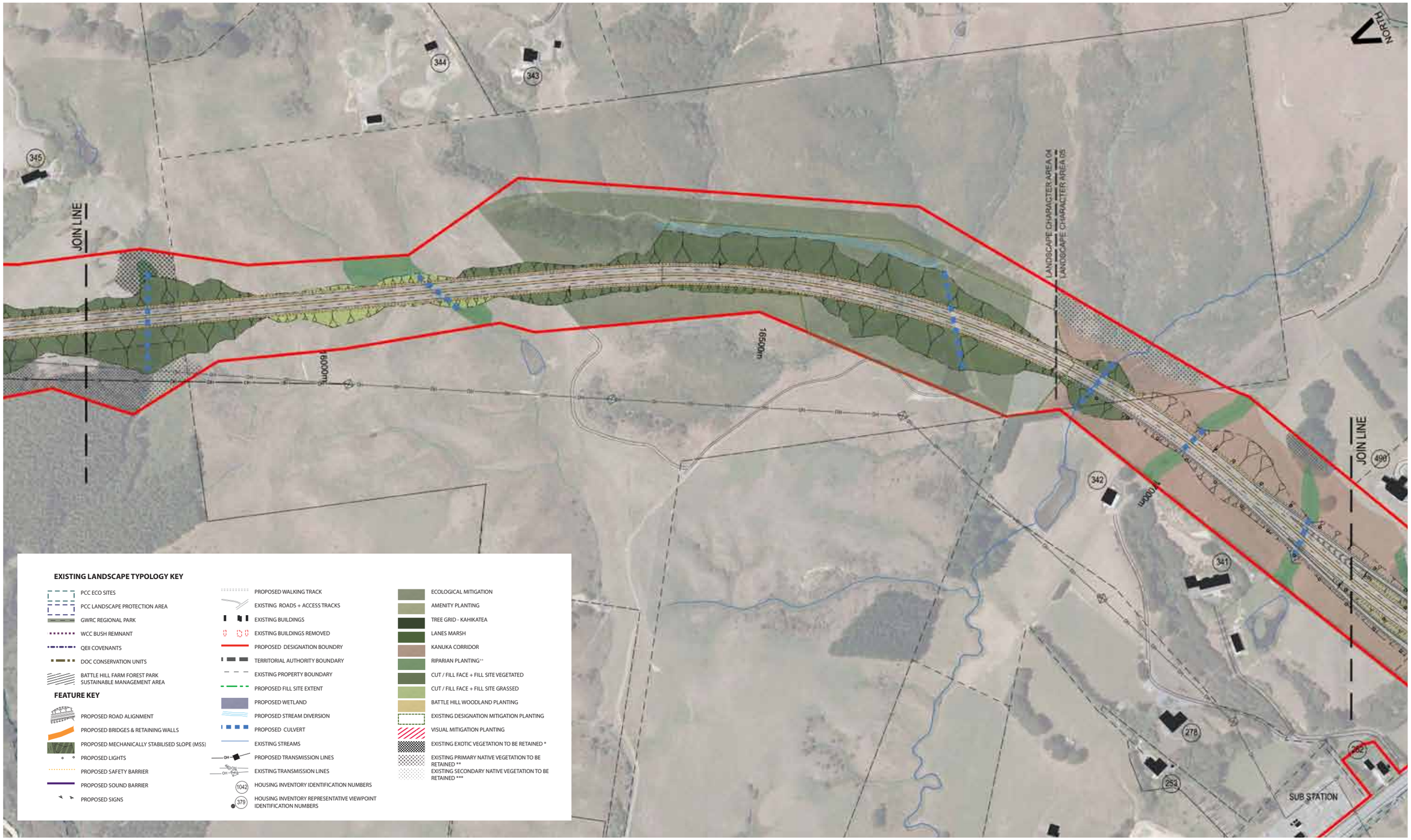
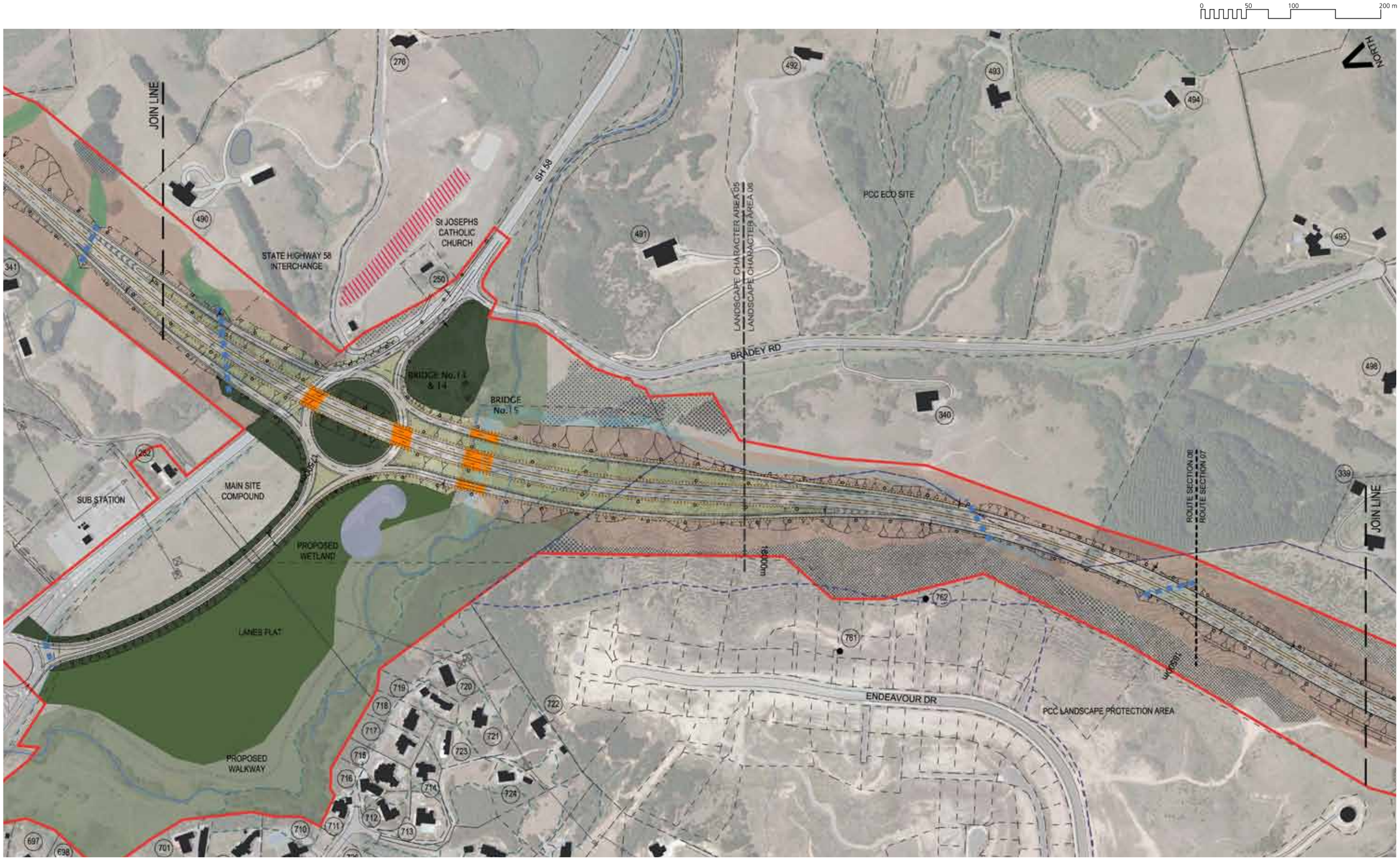


Figure 5.35: Section 6 Design proposals (continued)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50
100
200 m
NORTH
JOIN LINE
STATE HIGHWAY 58 INTERCHANGE
St JOSEPHS CATHOLIC CHURCH
SH 58
LANDSCAPE CHARACTER AREA 05
LANDSCAPE CHARACTER AREA 06
PCC ECO SITE
BRADEY RD
BRIDGE No.13 & 14
BRIDGE No.15
SUB STATION
MAIN SITE COMPOUND
PROPOSED WETLAND
LANES FLAT
PROPOSED WALKWAY
ENDEAVOUR DR
PCC LANDSCAPE PROTECTION AREA
ROUTE SECTION 06
ROUTE SECTION 07
JOIN LINE
490
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Earthworks

North of SH58 Interchange (chainage 15500 to 17000m) the route continues the patterns of Section 5. The landscape has a similar rolling topography, and the alignment follows a sweeping curvilinear path through rolling topography, with a sequence of box cuts and embankments. All of the cuts are less than 15m high and therefore do not require benching.

North of the interchange, earthworks should use low bunds and overfill batters on the embankments in order to reduce prominence of the carriageway and traffic from adjacent properties

Through and south of SH58 Interchange (chainage 17000 to 18500m) the Main Alignment will cross the head of Lanes Flat on an embankment, with the SH58 interchange roundabout occupying part (110m wide) of the valley floor width at that location. Pauatahanui Stream will be bridged by the Main Alignment and by both the adjacent on and off ramps.

SH58 will be realigned within Lanes Flat. It will be shifted from its current location against one side of the valley to a low embankment further out into the flood plain. The area between the new alignment and the edge of the valley will be filled in order to provide a platform for the Project's main construction site.

The Main Alignment will feature three lanes in both directions between the SH58 Interchange and James Cook Interchange approximately 1km to the south.

Through and south of SH58 Interchange, the generic fill and cut batters design principles for rolling topography apply (see Chapter 4).

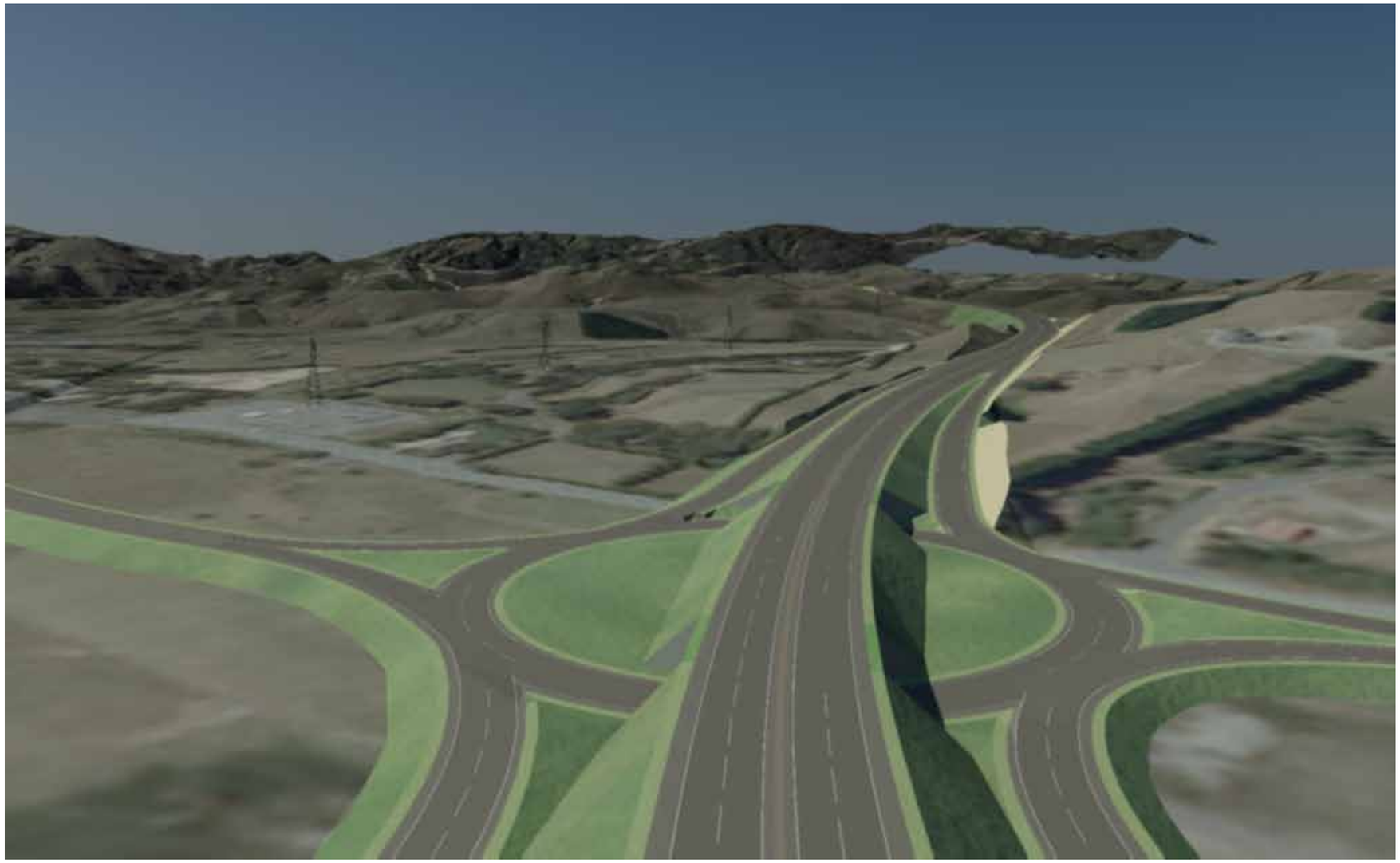

Figure 5.36: Section 6 Earthworks - View to North

Figure 5.37: Bridge 13: SH58 Interchange - 4 lane highway + on & off ramps
LS09 - Location 17460m

Pedestrian and cycle paths

- An off-road shared pedestrian and cycle path is recommended to be provided along Pauatahanui Stream, crossing the alignment under Bridge 15 (Figure 5.38). The shared path should run along the stream and join the existing pedestrian network at Paremata Road, north of the SH58 / Paekakariki Hill Road roundabout; and
- Provision for sport cyclists should be made on road shoulders of suitable width through the interchange.

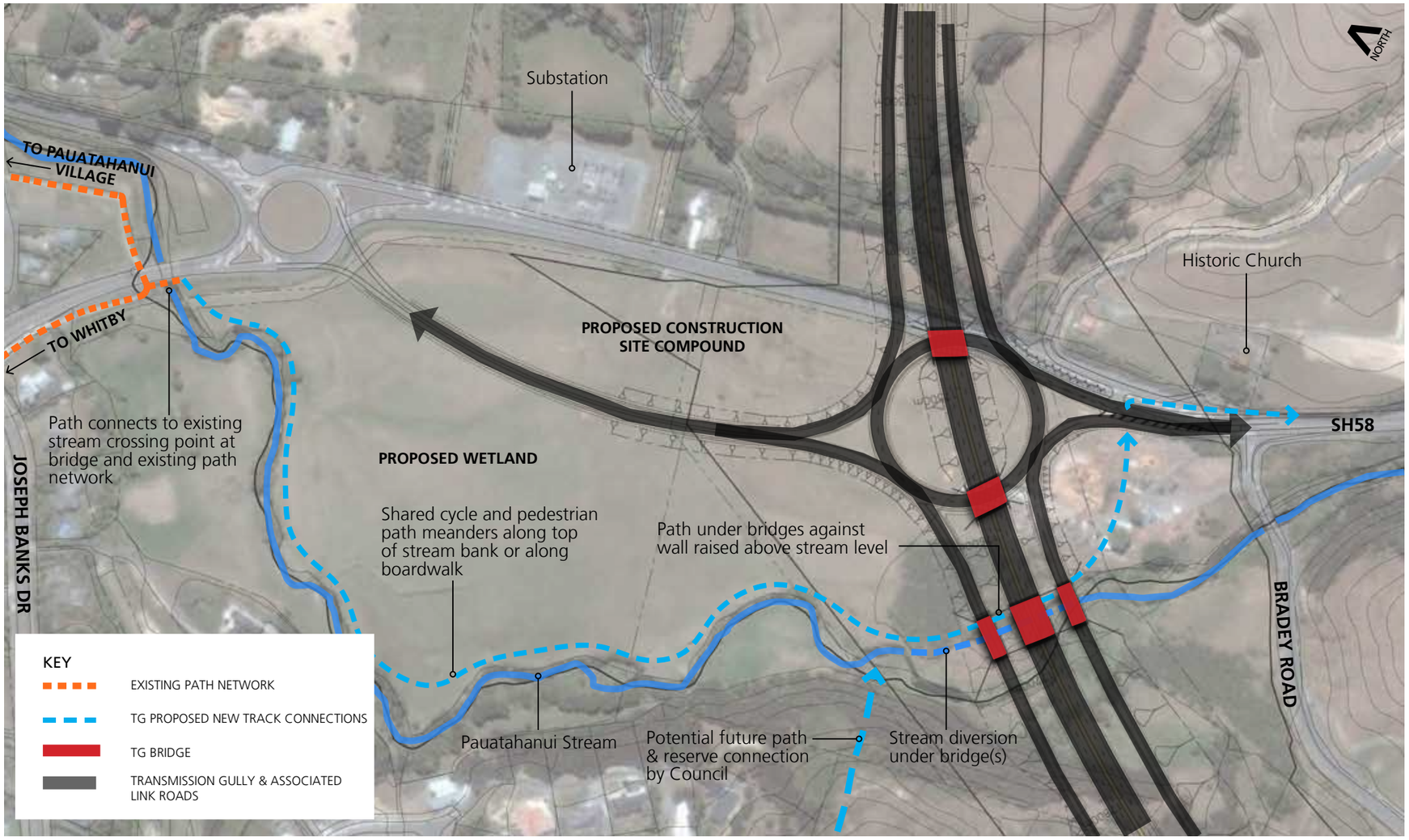

Figure 5.38: Proposed shared pedestrian and cycle path around SH58 interchange

Lanes Flat wetland

The SH58 interchange and the main construction site compound will occupy part of Lanes Flat. It is recommended to restore the balance of Lanes Flat to a continuous wetland between the proposed interchange / Main Alignment and Pauatahanui. The existing drains will be removed and sedge / reed wetland established interspersed with areas of open water. Some of the wetland will also function as permanent stormwater treatment devices into which runoff from the project will be directed.

The wetland could include paths and boardwalks connecting with the footpath/cycleway which is proposed to pass under the Main Alignment bridge at Pauatahanui Stream (Bridge 15).

It is recommended to plant the gaps between the stream and existing hillside kanuka on the south side of the valley. In other words the stream will form the boundary between the Lanes Flat wetland and regenerating bush backdrop. The kanuka vegetation type would also continue on either side of the Main Alignment between Pauatahanui Stream and the Duck Creek catchment south of the James Cook Interchange.

It is recommended to plant kahikatea-mix vegetation along the opposite (north) side of the valley to frame the opposite side of Lanes Flat. Kahikatea will be planted around the perimeter of the construction site compound, within the interchange roundabout, and between the interchange and Bradey Road.

Structures

SH58 interchange (Bridges 13 & 14)

These two bridges will be mostly visible to SH58 road users, to local pedestrian and cyclists and to some nearby residents. The design of MSE walls, bridge barriers and landscape treatment of the fill batters will be the most noticeable features of the bridges.

- In order to achieve an elegant and simple bridge elevation, extend side barrier skirt down to cover full depth of bridge deck (both hollowcore units and reinforced concrete topping slab) and to conceal drainage pipes;
- The detailed design of the side barriers (to be developed during the next project stage) could include three dimensional or textural treatment but must be consistent with the corridor-wide landscape concept, in particular, the emphasis on horizontal lines, sharp edges and avoidance of ornamentation; and
- The gap between the bridge elevation and MSE retaining wall must be minimised, subject to constructability and cost considerations.

Figure 5.39: Bridges 13 & 14: SH58 Interchange cross section

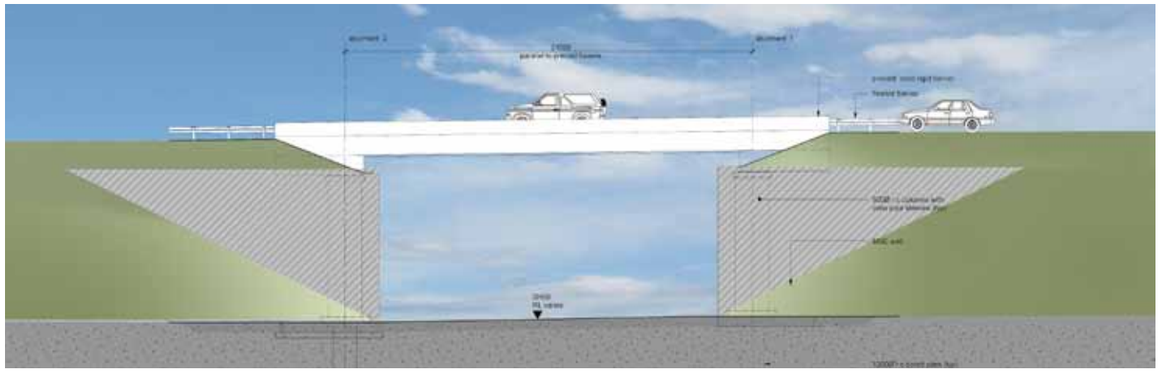

Figure 5.40: Bridges 13 & 14: SH58 Interchange west elevation

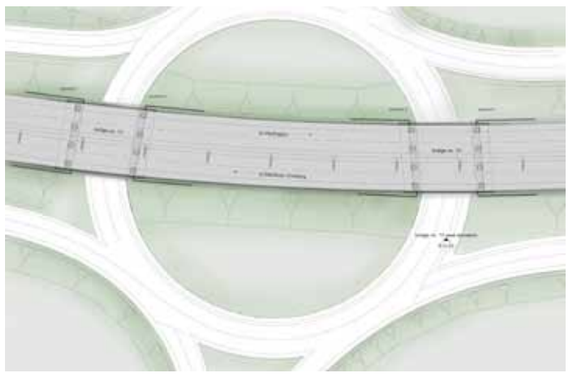

Figure 5.41: Bridges 13 & 14: SH58 Interchange plan

Pauatahanui Stream Crossing (Bridge 15)

The crossing of the Pauhatahanui Stream involves three separate bridge decks spanning approximately 25m between two parallel vertical MSE walls. PCC have indicated their desire to see the public open space strip along the stream extended to follow the stream and a public footpath provided alongside the stream. The bridge will therefore be visible both from a distance to vehicular traffic using SH58 and at close range to pedestrians and cyclists using the future path under the bridge. To respond to this context, the bridge design should comply with the following principles:

- The three bridge decks should be separated and the gaps between them maximised to provide natural light to the stream and shared path below;
- The underside of the bridge decks must be tidy and the connection with the abutment wall concealed by the MSE wall;
- In order to acheive an elegant and simple bridge elevation, extend side barrier skirt down, as per detail of other bridges in the Project;
- Angle the MSE wing walls outwards to minimise any 'tunnel' effect and visually open up the stream corridor;
- The MSE walls should have good design, detailing and finish, and present a high quality aspect to pedestrians and cyclists; and
- Locate light columns symetrically in reference to bridges mid-span.

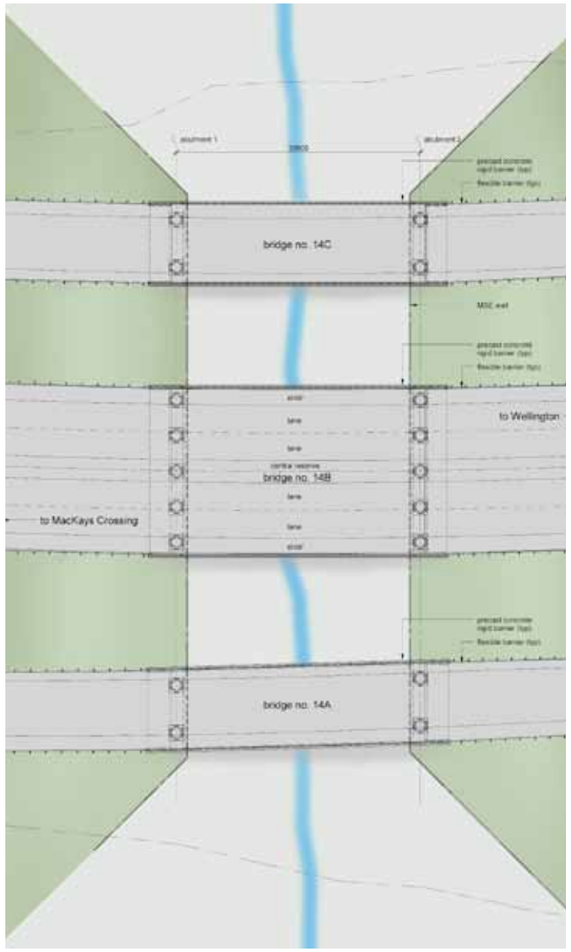

Figure 5.42: Bridge 15: Pauatahanui Stream Crossing plan

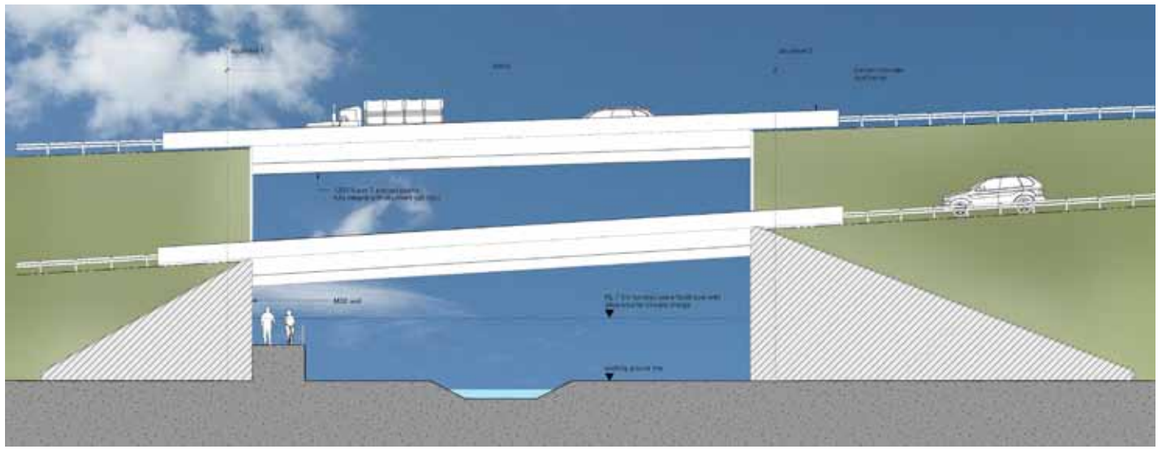

Figure 5.43: Bridge 15: Pauatahanui Stream Crossing west elevation

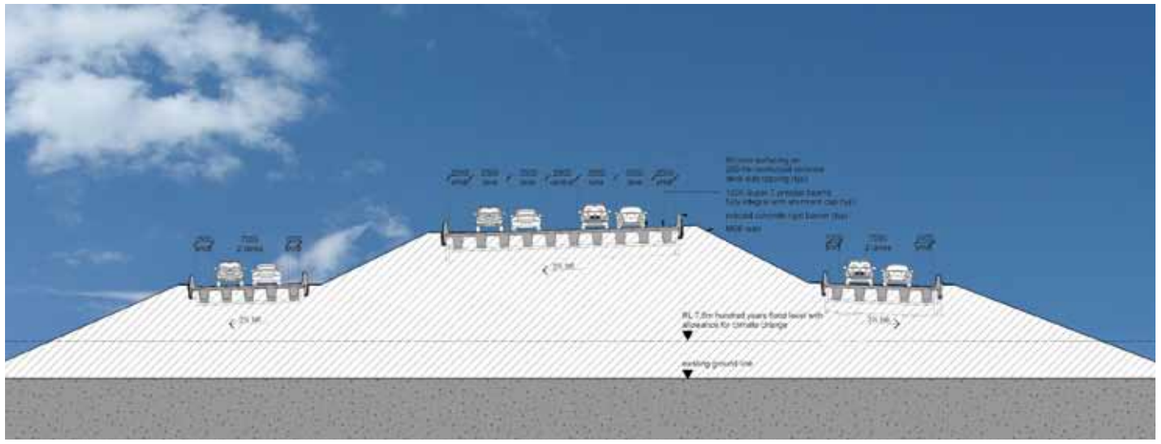

Figure 5.44: Bridge 15: Pauatahanui Stream Crossing long section

Landscape treatment

Table 5.12: Section 6 SH58 - Landscape treatment

Landscape Character Area (Route Section)	Vegetation and Landform Character	Pattern of Enclosure/ Openness and Views	Design Response	Indicative plant species
Flightys Road Area (Sections 5 & 6)	Rolling and largely enclosed landform with numerous streams and ephemeral water courses. Rural – residential/ lifestyle development with associated exotic shelter belts and small pine/ eucalyptus plantations of exotic trees.	**Semi-enclosed.** Short views.	Planting to emphasise cultural patterns of pastoral landuse and settlement and to reinforce rolling topography and network of streams. Extend existing mitigation planting to include cut and fill batters. Rehabilitate stream margins and integrate visual mitigation within a cohesive planting framework where required.	**Canopy species:** - Hinau *(Elaeocarpus dentatus)* - Kahikatea (Dacrydium dacrydioides) - Lowland ribbonwood *(Plagianthus regius)* - Pigeonwood *(Hedycarya arborea)* - Pukatea *(Laurelia novaezelandiae)* - Rewarewa *(Knightia excelsa)* - Totara *(Podocarpus totara)* **Shrubs and understorey tree species:** - Cabbage tree *(Cordyline australis)* - Five Finger *(Pseudopanax arboreus)* - Karamu *(Coprosma robusta)* - Koromiko *(Hebe stricta)* - Kowhai *(Sophora chathamica)* - Mahoe *(Melicytus ramiflorus)* - Ngaio *(Myoporum laetum)* - Pittosporum sp. *(P. euginoides &tenufolium)* - Tree fuschia *(Fuschia excorticata)* - Wineberry *(Aristotelia serrata)* **Low shrubs/ ground cover:** - Carex sp. *(C. secta & virgata)* - Flax *(Phormium tenax and cookianum)* - Juncus sp *(J. gregiflorus, pallidus, planifolius)* - Toe toe *(Cortaderia fulvida)* - Umbrella sedge *(Cyperus ustulatus & eragrostis)*

Landscape Character Area (Route Section)	Vegetation and Landform Character	Pattern of Enclosure/ Openness and Views	Design Response	Indicative plant species
SH58 (Section 6)	'Lanes Flat' and adjacent slopes located 1km from Pauatahanui Inlet. Flood plain formerly part of the tidal inlet (brackish water). Land use consists of pasture; former light industrial; residential, rural residential development; SH58; and transmission lines/ substation. Pauatahanui Stream located along toe of kanuka covered hill slope at the southern edge of Lanes Flat. Vegetation characterised by pasture; kanuka belt; exotic shelter belts; and some riparian vegetation along stream.	**Open** – views to Pauatahanui Inlet (west) framed by rolling hills to north and south. Views to the east along Pauatahanui Stream restricted by narrow stream valley and flanking hills.	Extension of existing kanuka belt as key landscape element framing views to inlet and providing visual mitigation. Incorporate constructed wetlands and extensive wetland planting including canopy trees that retain the visual coherency of Lanes Flat and enhance the ecological quality of the both the stream and estuarine environments. Plant road margins with low growing species that provide for views to inlet.	**Canopy species:** - Kahikatea *(Dacrydium dacrydioides)* - Lowland ribbonwood *(Plagianthus regius)* - Pukatea *(Laurelia novaezelandiae)* - Rewarewa *(Knightia excelsa)* - Totara *(Podocarpus totara)* **Shrubs and understorey tree species:** - Cabbage tree *(Cordyline australis)* - Five Finger *(Pseudopanax arboreus)* - Karamu *(Coprosma robusta)* - Koromiko *(Hebe stricta)* - Kowhai *(Sophora chathamica)* - Ngaio *(Myoporum laetum)* - Pittosporum sp. *(P. euginoides & tenufolium)* - Puka *(Griselinia littoralis)* **Low shrubs/ ground cover:** - Carex sp. *(C. secta, dissita & virgata)* - Flax *(Phormium tenax & cookianum)* - Juncus sp *(J. gregiflorus, pallidus, planifolius)* - Toe toe *(Cortaderia fulvida)* - Umbrella sedge *(Cyperus ustulatus & eragrostis)*
SH58 to James Cook Interchange (Sections 6 & 7)	Steep hill slopes adjacent to residential and lifestyle properties (Bradey Road and Silverwood) with former production forestry reverting to exotic and native land cover. James Cook Interchange located on shallow basin at southern end of Resolution Ridge	**Open and enclosed** – with adjacent hills and proposed cuttings and blocking views to the east and west except from elevated James Cook Interchange.	Extension of existing kanuka belt as key landscape element to emphasise feeling of enclosure and to mitigate for adverse visual effects from adjoining properties. Planting to reinforce sudden and expansive views of inlet and defining landforms from James Cook and SH58 Interchanges.	**Canopy species:** - Kanuka *(Kunzea ericoides)* - Rewarewa *(Knightia excelsa)* - Totara *(Podocarpus totara)* **Shrubs and understorey tree species:** - Five Finger *(Pseudopanax arboreus)* - Karamu *(Coprosma robusta)* - Koromiko *(Hebe stricta)* - Mahoe *(Melicytus ramiflorus)* - Pittosporum sp. *(P. euginoides & tenufolium)* - Puka *(Griselinia littoralis)* **Low shrubs/ ground cover:** - Carex sp. *(C. secta, dissita & virgata)* - Flax *(Phormium cookianum)* - Toe toe *(Cortaderia fulvida)*

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5.7 Section 7 – James Cook

5.7.1 Local context

Topography, geology and hydrology

Section 7 is characterised by:

- The flanks of a small tributary stream to Pauatahanui Stream, rising to a saddle with Duck Creek, and thence traversing south along the recently deforested west-facing flank of the Duck Creek valley, crossing a number of steep-banked tributary streams.

Landscape features

The landscape features of note in this section are as follows:

- Location of proposed interchange: Rolling hill-top watershed ridge and boundary between suburban Whitby to the west, rural lifestyle properties to the north-east, and extensive pasture of Belmont Regional Park to the south-east. Wide views including views to the south along Duck Creek escarpment, glimpses to the north toward Wainui Saddle, glimpses to the north-west to Pauatahanui Inlet and Paekakariki Hills. Characterised by extensive pasture to the east, mosaic of lifestyle properties to the north-east, reverting scrubland (gorse, tauhinu, manuka) and remnant rough pasture to the west; and
- Duck Creek Area: Straight fault-line valley aligned NE-SW (Moonshine Fault). Steep, straight stream with stoney bed. Escarpment on west side. Short, very steep tributary streams and watercourses. Broader dip-slope hills on east side with longer streams, larger catchments, deeply incised valleys generally oriented north-south, separated by steep sided spurs. Hills rise on east side to high backdrop ridge (360m-410m). Bold topography. Extensive pastoral land-use with occasional small pockets of remnant native vegetation, some restoration planting, and some areas of regenerating scrub. Overall a bold, coherent landscape.

Significant views and landmarks

The key landmarks in this section are the Round Knob and the Belmont Hills ridge. The hills to the east of the Duck Creek section of the route are memorable landmarks because of their bold scale and the sculptural qualities of the valleys on the open hillsides.

Land uses

Existing land uses

The land in the vicinity of the alignment in this section is mostly undeveloped except for rural residential subdivisions on the eastern side of the alignment accessed off Bradey Road and a mix of suburban and rural residential subdivisions in the Silverwood Forest estate on the western side of the alignment.

The residential suburbs of Whitby and Waitangirua are located west of the alignment. Both suburbs feature a neighbourhood centre with shops and other community facilities.

The Waitangirua neighbourhood centre is located where the proposed link road joins the urban area and intersects Warspite Avenue. The centre includes a shopping mall which is mostly vacant except for a number of small retail units and a bar along the eastern façade. A number of community facilities are located around the neighbourhood centre including the Maraeroa Marae and associated health centre; the Tokelau Christian Centre, the North City Oasis community centre and Wesleyan Methodist Church (in old bottle store), Save Mart, an Indian temple, Waitangirua Pharmacy and Police station. Mana Coach Services bus depot is situated north-east of the neighbourhood centre within a cluster of small-scale industrial activities.

Photo 5.20: Duck Creek

Photo 5.21: Waitangirua neighbourhood centre

Photo 5.22: Maraeroa Marae

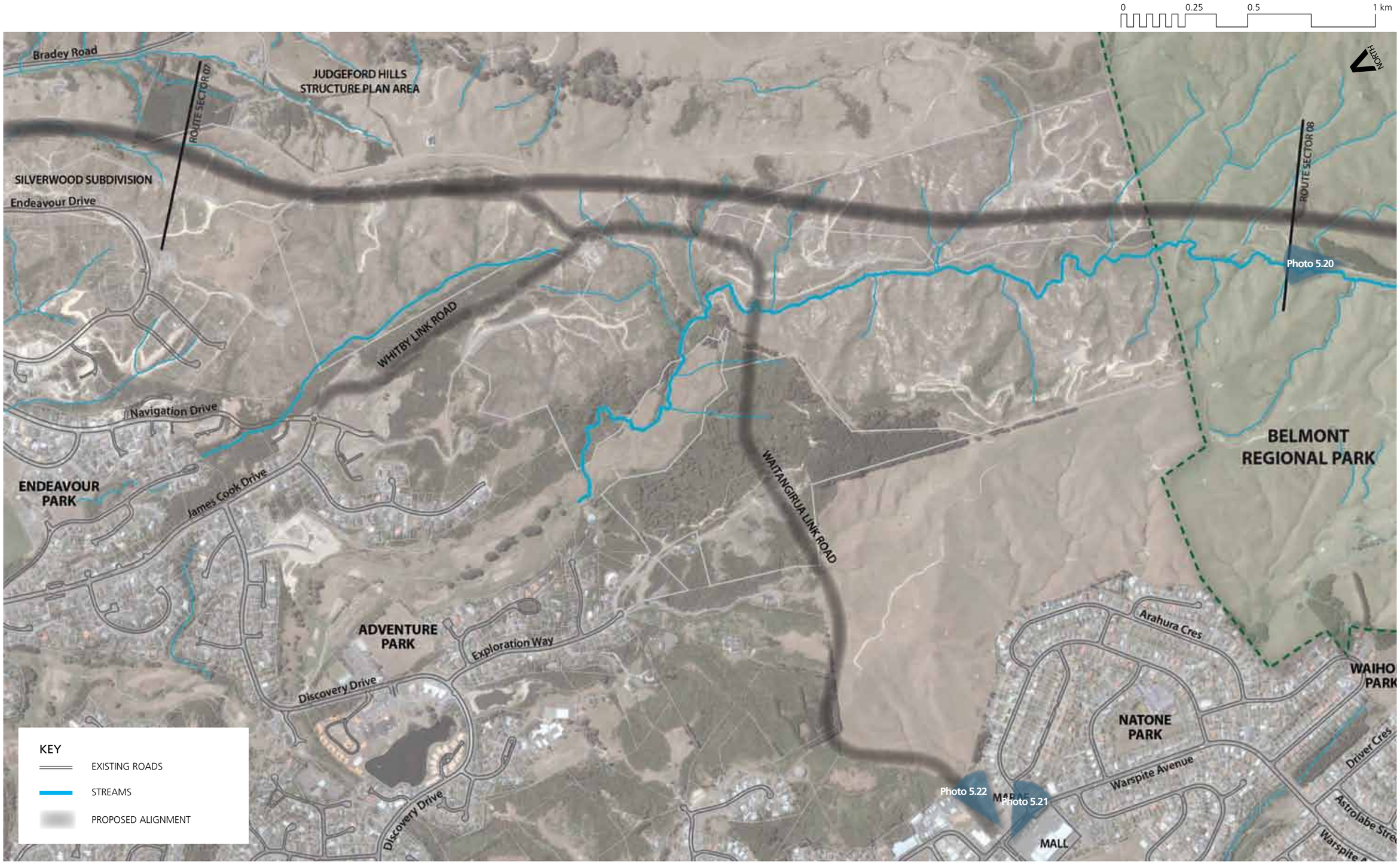


Figure 5.45: Section 7 Existing condition

District Plan Zones

A number of land use zones are present in this section of the alignment:

- Much of the alignment traverses land zoned 'Rural' in Porirua City District Plan;
- The 'Judgeford Hills' zone covers an area of land east of the alignment. This zone allows the creation of up to 40 dwellings within five separate clusters. These will be accessed off new roads connecting to Bradey Road and Belmont Road;
- The urban areas of Waitangirua and Whitby are zoned Suburban, as is the undeveloped land contained between the existing Whitby urban area and the alignment;
- The Whitby Land Protection Area overlay covers parts of the Silverwood Estate; and
- Belmont Regional Park is zoned 'Open Space'.

Connections

Local roads and access to properties

Properties to the west of the alignment are currently accessed from existing residential streets in Whitby and Waitangirua which ultimately connect with either SH58 or SH1. The Transmission Gully Project will connect with James Cook Drive and Warspite Avenue via a single interchange and two PCC link roads. These will provide alternative and improved access to the regional road network for these urban areas. Both link roads will be designed to local road (50km/h) standards to integrate with the local road network. The link roads bisect land owned by Silverwood Forest. Direct access onto the link roads will be possible from the adjoining land.

Properties to the east of the alignment are accessed via Bradey Road and its proposed extension (see Judgeford Structure Plan). There is no planned connection between this road extension and the Project.

Pedestrian network

There are no existing public footpaths in this section of the Project.

East of the alignment, the Judgeford Structure Plan makes provision for future pedestrian access to Belmont Regional Park through the Structure Plan area with links to both Belmont Road and Bradey Road.

West of the alignment, pedestrian footpaths will need to be provided along the link road as and when development occurs.

The Comprehensive Development Plan for Duck Creek within Whitby Coastal Estate makes allowance for reserves along the banks of Duck Creek Stream and associated walking and cycling paths. This brings pedestrian and cycle networks to the southern boundary of the subdivision and within proximity of the Waitangirua Link Road. It is understood that PPC's intention is to gain a continuous pedestrian and cycle route into Belmont Regional Park along Duck Creek to be implemented in parallel with the subdivision of the adjoining land. Such a route would need to cross the Waitangirua Link Road to reach the Park.

Cycle/mountain bike network

There are no existing cycleways in this section of the Project.

Cycle movement will need to be accommodated along the two link roads.

An allowance will need to be made for the planned Duck Creek pedestrian and cycle path (see above) to cross the Waitangirua Link Road safely.

5.7.2 Design issues and objectives

Table 5.13: Section 7 James Cook – Design issues and objectives

DESIGN ISSUES	DESIGN OBJECTIVES
Integration in the landscape & response to Landscape Character	
There are two distinct character areas within Section 7: ■ North of James Cook Interchange, the landscape is characterised by a leading ridge ('Resolution Ridge') and rolling topography; ■ Resolution Ridge separates urban Whitby from the lifestyle and rural land uses at the southern end of Bradey Road and beyond; and ■ Vegetation consists of a patchwork of regenerating native scrub and invasive exotics where pine plantations once stood; pasture; and patches of amenity and shelter planting on lifestyle properties.	■ Reinforce and enhance existing vegetation patterns with a particular focus on extending regenerating scrub and utilising for both ecological and visual amenity enhancement and mitigation. ■ Retain the overall physical character of the landform and leading ridgeline. ■ Recognise and seek to limit any negative adverse effects that the Interchange may have of the character of the broader landscape unit.
■ South of James Cook Interchange, the landscape is characterised by the steep Moonshine fault escarpment and tributaries on the western side of Lower Duck Creek; Duck Creek itself; and the longer bold hills of Belmont Hill Country to the east. ■ This section of the route is within Belmont Regional Park. Land cover is dominated by grazed pasture; regenerating scrub to the west; and occasional small pockets of remnant native vegetation and some restoration planting. ■ The highway will cut across the intervening gullies and spurs of the Belmont Hill Country and has the potential to have significant adverse effects on the coherence and overall character of this part of the wider Belmont Regional Park.	■ Limit the overall footprint of the road both during and following construction to ensure the retention of as much existing landform as possible. ■ Recognise and reinforce the natural landscape patterns of alternating gullies and spurs perpendicular to the road through limiting land form alteration and placement of vegetation within gullies. ■ Ensure that the existing profile of Duck Creek stream valley is retained.
Adjoining land use and amenity	
■ The alignment runs between two future residential areas – Judgeford Hills Structure Plan area to the east and the Silverwood Estate to the west. Both areas are to be established after the current designation was consented.	■ Landscape treatments will need to be consistent with existing agreements and will need to respond to any significant adverse effects.
■ The Whitby link road runs through land zoned 'Suburban' which is expected to be developed for residential use, potentially ahead of the construction of the Project.	■ The designation width and the design of the link road should not preclude direct access to serve residential properties in the future.
■ The Waitangirua Link Road runs mostly through land zoned 'Rural' which could be developed for rural residential uses, subject to resource consent.	■ The designation width and the design of the link road should not preclude direct access to serve residential properties in the future.

DESIGN ISSUES	DESIGN OBJECTIVES
Visual Experience	
■ The interchange will be located on an elevated section of the route and will be visible from elevated locations in the Whitby basin and lifestyle properties along Bradey Road to a lesser degree.	■ The interchange will be viewed in the context of existing and recently developed residential development. The final form and appearance of the interchange will seek to reduce the prominence of the road and 'bed' the interchange into the landform through earthworks and vegetation. Night time lighting will need to be carefully considered.
■ The interchange is on elevated ground and will provide road users with views of the Moonshine Fault Escarpment and Belmont Hill Country to the south and Pauatahanui Inlet and hills beyond to the north. There is the potential for these key view shafts to be negatively affected by works associated with the road.	■ Ensure that any design solutions along this section of the route recognise the important visual characteristics of the route and the positive contribution they will make to road user experience (i.e. retain, maximise and enhance key views)
■ The link roads need to provide a transition between the motorway environment and the suburban environment.	■ Design link roads as 50km/h local roads with pedestrian and cycle facilities, streetscape and other features to complement existing road network and clearly indicate the transition from the 100km/h motorway environment to the suburban environment.
Biodiversity and ecology	
■ The alignment follows Duck Creek and requires some stream diversions.	■ Design stream diversions which closely replicate the natural in-stream features including rock cascades, riffles, pools and runs.
■ Sections of Duck Creek will need to be culverted.	■ Design culverts to facilitate fish passage and retain as much in stream habitat as possible.
■ The alignment requires some vegetation removal for road construction and operation.	■ Minimise the removal of indigenous vegetation through sensitive route alignment and construction methodology, including the location of haul roads and construction tracks.
Local connectivity / severance	
■ Link roads to integrate with the local road network in terms of streetscape and landscape treatment.	■ Both Whitby and Waitangirua Link Roads to be designed to permit access to adjoining land and future pedestrian and cycle facilities. ■ Junctions of link roads and local road networks should reflect local context and cater for pedestrian and cycle movements. ■ Incorporate street trees, street lighting and other street furniture elements in the design of the link roads to fit in with the adjoining local road network.
■ Need to provide for pedestrians and cyclists at Waitangirua Link Road / Warspite Avenue intersection which sits within the Waitangirua neighbourhood centre and next to a new community park.	■ Provide a pedestrian phase at the traffic signals. ■ Cater for cyclists within appropriately dimensioned and paved road shoulders around the junction. ■ Consider the layout of the newly constructed community park in locating new pedestrians crossings.
■ Need to allow for future pedestrian and cycle movements along Waitangirua and James Cook Link Roads.	■ Allow width in legal road corridor for future footpaths to be implemented in tandem with adjoining development. ■ Cater for cyclists within appropriately dimensioned and paved road shoulders along the link roads.
■ PCC is planning a continuous pedestrian and cycle route into Belmont Regional Park along Duck Creek to be implemented in tandem with the subdivision of the adjoining land. Such a route will cross the Waitangirua Link Road.	■ Make allowance for the planned Duck Creek pedestrian and cycle path to cross the Waitangirua Link Road safely either at grade or through a dedicated underpass.
Design Continuity	
■ A wide variety of road furniture will be required in the vicinity of the James Cook Interchange including signage, lighting and safety barriers.	■ Ensure that the number and changes in road elements are kept to a minimum. Use elements that are of a consistent character (e.g. safety barriers – earth bunds vs structural barriers). ■ Ensure that all road furniture is considered part of a 'family' and that the location, form, scale and materials of road furniture both within this section and across the wider route are consistent.
Noise	
■ Silverwood subdivision has been designed taking into account future road-traffic noise.	■ No noise barrier to be provided by NZTA.
■ The residential buildings at the rear of the marae by the Waitangirua Link Road are affected by increased road-traffic noise.	■ Consult with the marae and its neighbours about a suitable treatment of the boundary fencing to achieve suitable noise attenuation and amenity outcomes.
Drainage	
■ There will be increased impermeable surfaces leading to greater and more rapid stormwater run-off.	■ Provide peak flood storage along Duck Creek to ensure increased runoff from the proposed highway does not increase existing flood flows.

5.7.3 Design proposals

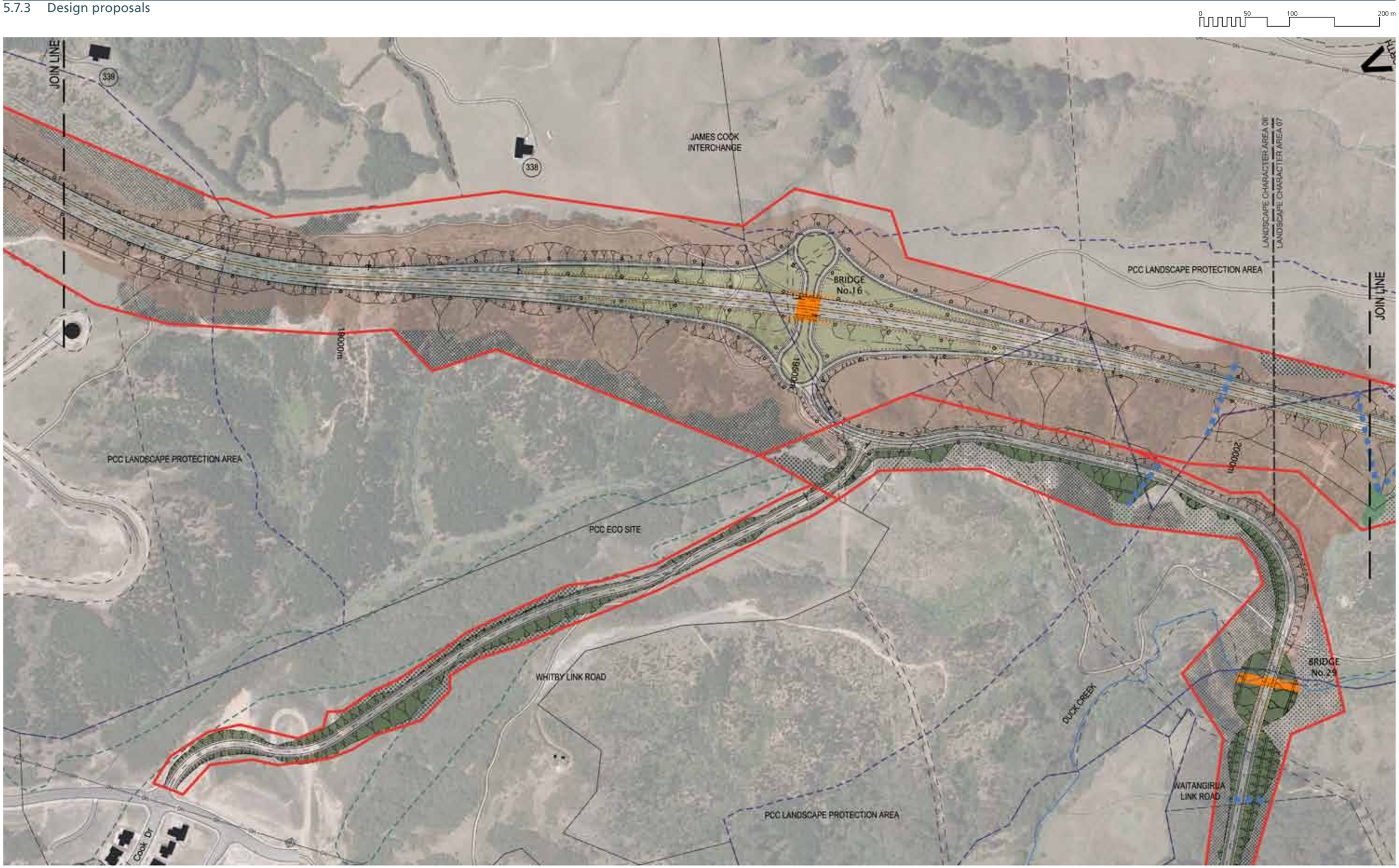
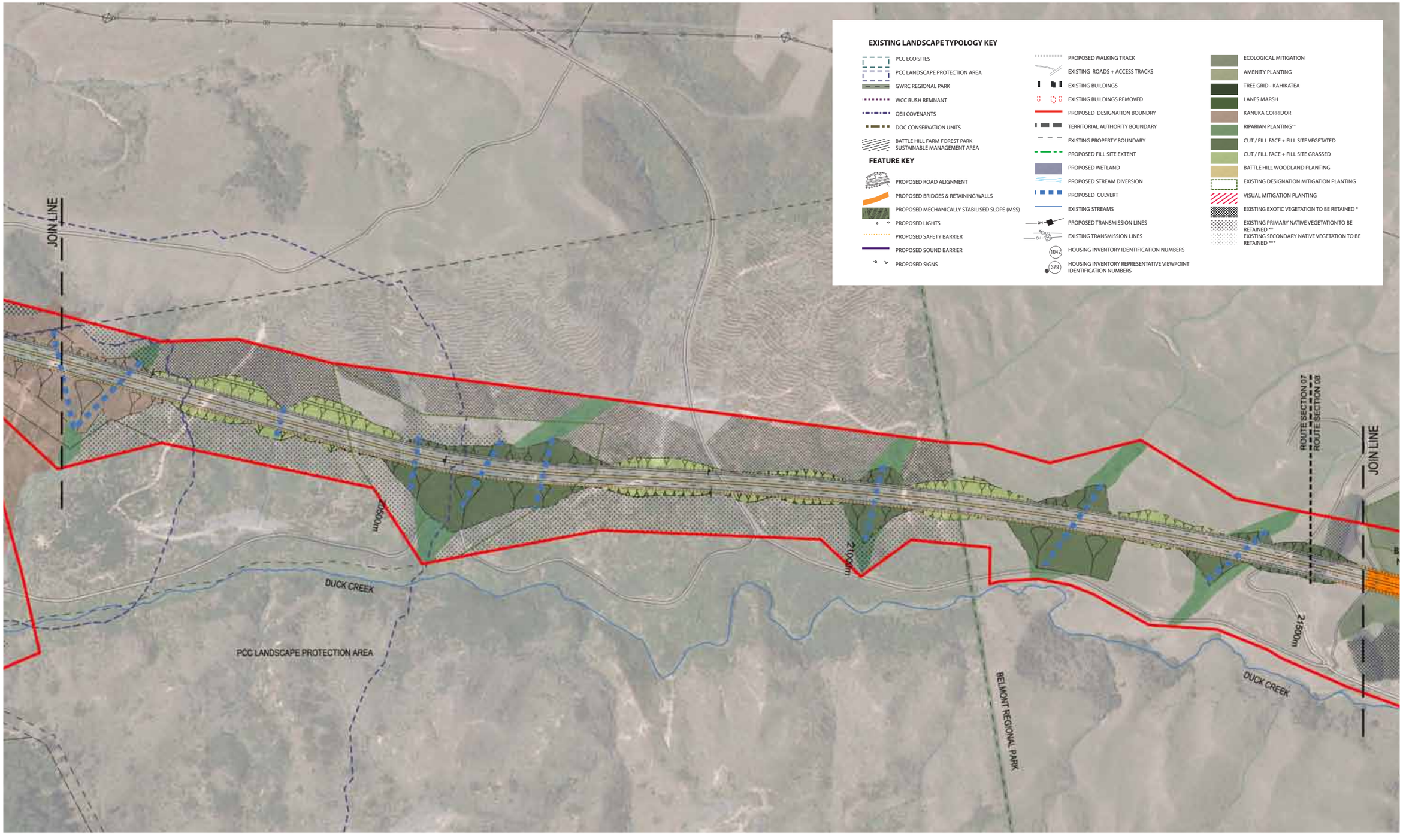


Figure 5.46: Section 7 Design proposals

0 50 100 200 m


JOIN LINE
DUCK CREEK
PCC LANDSCAPE PROTECTION AREA
2050m
2100m
BELMONT REGIONAL PARK
DUCK CREEK
2150m
ROUTE SECTION 07
ROUTE SECTION 08
JOIN LINE
EXISTING LANDSCAPE TYPOLOGY KEY
PCC ECO SITES
PCC LANDSCAPE PROTECTION AREA
GWRC REGIONAL PARK
WCC BUSH REMNANT
QEII COVENANTS
DOC CONSERVATION UNITS
BATTLE HILL FARM FOREST PARK SUSTAINABLE MANAGEMENT AREA
FEATURE KEY
PROPOSED ROAD ALIGNMENT
PROPOSED BRIDGES & RETAINING WALLS
PROPOSED MECHANICALLY STABILISED SLOPE (MSS)
PROPOSED LIGHTS
PROPOSED SAFETY BARRIER
PROPOSED SOUND BARRIER
PROPOSED SIGNS
PROPOSED WALKING TRACK
EXISTING ROADS + ACCESS TRACKS
EXISTING BUILDINGS
EXISTING BUILDINGS REMOVED
PROPOSED DESIGNATION BOUNDRY
TERRITORIAL AUTHORITY BOUNDARY
EXISTING PROPERTY BOUNDARY
PROPOSED FILL SITE EXTENT
PROPOSED WETLAND
PROPOSED STREAM DIVERSION
PROPOSED CULVERT
EXISTING STREAMS
PROPOSED TRANSMISSION LINES
EXISTING TRANSMISSION LINES
1042
HOUSING INVENTORY IDENTIFICATION NUMBERS
379
HOUSING INVENTORY REPRESENTATIVE VIEWPOINT IDENTIFICATION NUMBERS
ECOLOGICAL MITIGATION
AMENITY PLANTING
TREE GRID - KAHIKATEA
LANES MARSH
KANUKA CORRIDOR
RIPARIAN PLANTING**
CUT / FILL FACE + FILL SITE VEGETATED
CUT / FILL FACE + FILL SITE GRASSED
BATTLE HILL WOODLAND PLANTING
EXISTING DESIGNATION MITIGATION PLANTING
VISUAL MITIGATION PLANTING
EXISTING EXOTIC VEGETATION TO BE RETAINED *
EXISTING PRIMARY NATIVE VEGETATION TO BE RETAINED **
EXISTING SECONDARY NATIVE VEGETATION TO BE RETAINED ***

0 50 100 200 m

EXISTING LANDSCAPE TYPOLOGY KEY

- PCC ECO SITES
- PCC LANDSCAPE PROTECTION AREA
- GWRC REGIONAL PARK
- WCC BUSH REMNANT
- QEII COVENANTS
- DOC CONSERVATION UNITS
- BATTLE HILL FARM FOREST PARK SUSTAINABLE MANAGEMENT AREA

FEATURE KEY

- PROPOSED ROAD ALIGNMENT
- PROPOSED BRIDGES & RETAINING WALLS
- PROPOSED MECHANICALLY STABILISED SLOPE (MSS)
- PROPOSED LIGHTS
- PROPOSED SAFETY BARRIER
- PROPOSED SOUND BARRIER
- PROPOSED SIGNS
- PROPOSED WALKING TRACK
- EXISTING ROADS + ACCESS TRACKS
- EXISTING BUILDINGS
- EXISTING BUILDINGS REMOVED
- PROPOSED DESIGNATION BOUNDRY
- TERRITORIAL AUTHORITY BOUNDARY
- EXISTING PROPERTY BOUNDARY
- PROPOSED FILL SITE EXTENT
- PROPOSED WETLAND
- PROPOSED STREAM DIVERSION
- PROPOSED CULVERT
- EXISTING STREAMS
- PROPOSED TRANSMISSION LINES
- EXISTING TRANSMISSION LINES
- HOUSING INVENTORY IDENTIFICATION NUMBERS
- HOUSING INVENTORY REPRESENTATIVE VIEWPOINT IDENTIFICATION NUMBERS
- ECOLOGICAL MITIGATION
- AMENITY PLANTING
- TREE GRID - KAHIKATEA
- LANES MARSH
- KANUKA CORRIDOR
- RIPARIAN PLANTING**
- CUT / FILL FACE + FILL SITE VEGETATED
- CUT / FILL FACE + FILL SITE GRASSED
- BATTLE HILL WOODLAND PLANTING
- EXISTING DESIGNATION MITIGATION PLANTING
- VISUAL MITIGATION PLANTING
- EXISTING EXOTIC VEGETATION TO BE RETAINED *
- EXISTING PRIMARY NATIVE VEGETATION TO BE RETAINED **
- EXISTING SECONDARY NATIVE VEGETATION TO BE RETAINED ***

Figure 5.47: Section 7 / Link Roads Design proposals

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PCC Link Roads

Two link roads are proposed to connect the Main Alignment to the eastern Porirua suburbs of Whitby and Waitangirua. The Porirua Link Roads will be local roads designed to the following standards:

- Two lanes (one in each direction);
- Design speeds of 50km/h;
- Maximum gradient of 1:10; and
- Some side access will be permitted.

Both link roads should be designed as local roads with pedestrian and cycle facilities, streetscape and/or other features to clearly communicate the transition from the 100km/h highway environment to the suburban environment.

Waitangirua Link Road

The Waitangirua Link Road will be approximately 2.5km long and runs from the James Cook Interchange to the existing intersection of Niagara Street and Warspite Avenue. There will be traffic signals at this upgraded intersection. The Waitangirua Link Road crosses five waterways. The most significant of these is a crossing of Duck Creek requiring a culvert. The Waitangirua Link Road ties into the eastern side of the dumbbell interchange.

The section of the link road nearest Warspite Avenue must be designed to merge with the surrounding suburban environment and provide early warning that road users are approaching a neighbourhood centre. The last 180m (minimum) of the link road should feature the following elements (Figure 5.48):

- Narrowing of the carriageway to encourage safe driver behaviour;
- Landscaped verge with street trees;
- Cycle lanes along the road shoulder. An acceptable alternative to the provision of cycle lanes is the provision of an off-road shared pedestrian and cycle path along the berm;
- Street lighting in the vicinity of Warspite Avenue intersection; and
- In consultation with the marae, church and local community, consideration should be given at the detailed design stage to the creation of a gateway feature to mark the entrance into Waitangirua from the link road. This could take the form of 'pou', public art or landscape feature. A local artist could be engaged to develop the concept design for the gateway feature.

Marae interface

- Treatment of marae interface with the link road to include boundary wall or fence and landscape planting on both sides of the fence. The location of the fence must avoid creating 'no man's land' areas, that is, areas which are not clearly associated with the road or the adjoining uses as these areas tend to encourage dumping and anti-social behaviour. The final location, height, landscape planting and aesthetic treatment of the fence should be agreed in consultation with the marae at the Outline Plan of Works phase.

Church interface

- Treatment of church interface with the link road to include boundary fence with landscape planting on both sides to reduce the opportunities for graffiti. The final location, height, landscape planting and aesthetic treatment of the fence should be agreed in consultation with the church at the Outline Plan of Works phase.

Warspite Avenue junction

The design of the Waitangirua Link Road / Warspite Avenue junction should respond to its location within the Waitangirua neighbourhood centre by catering to pedestrian and cycle movements across all four legs of the intersection. This should include:

- Pedestrian phases in the traffic lights; and
- Clearly delineated crossing points with road markings, dropped kerbs and tactile paving for the visibility impaired.

Whitby Link Road

The Whitby Link Road will run from the existing intersection of James Cook Drive and Navigation Drive and connect to the Waitangirua Link Road. The existing James Cook and Navigation Drive intersection has a roundabout which will be retained. The new intersection of the proposed Waitangirua and Whitby link roads will be an unsignalised T-intersection with traffic from the Whitby Link Road giving way to Waitangirua Link Road traffic.

The link road should merge seamlessly with the local road network it connects with. This will include:

- Extending the footpaths out from the James Cook and Navigation Drive intersection as and when urban development take place along the link road;
- Continuing the existing pattern of grassed verge separating the footpath from the edge of the carriageway;
- Street lighting; and
- Cycle lanes along the road shoulder. An acceptable alternative to the provision of cycle lanes is the provision of an off-road shared pedestrian and cycle path along the berm.

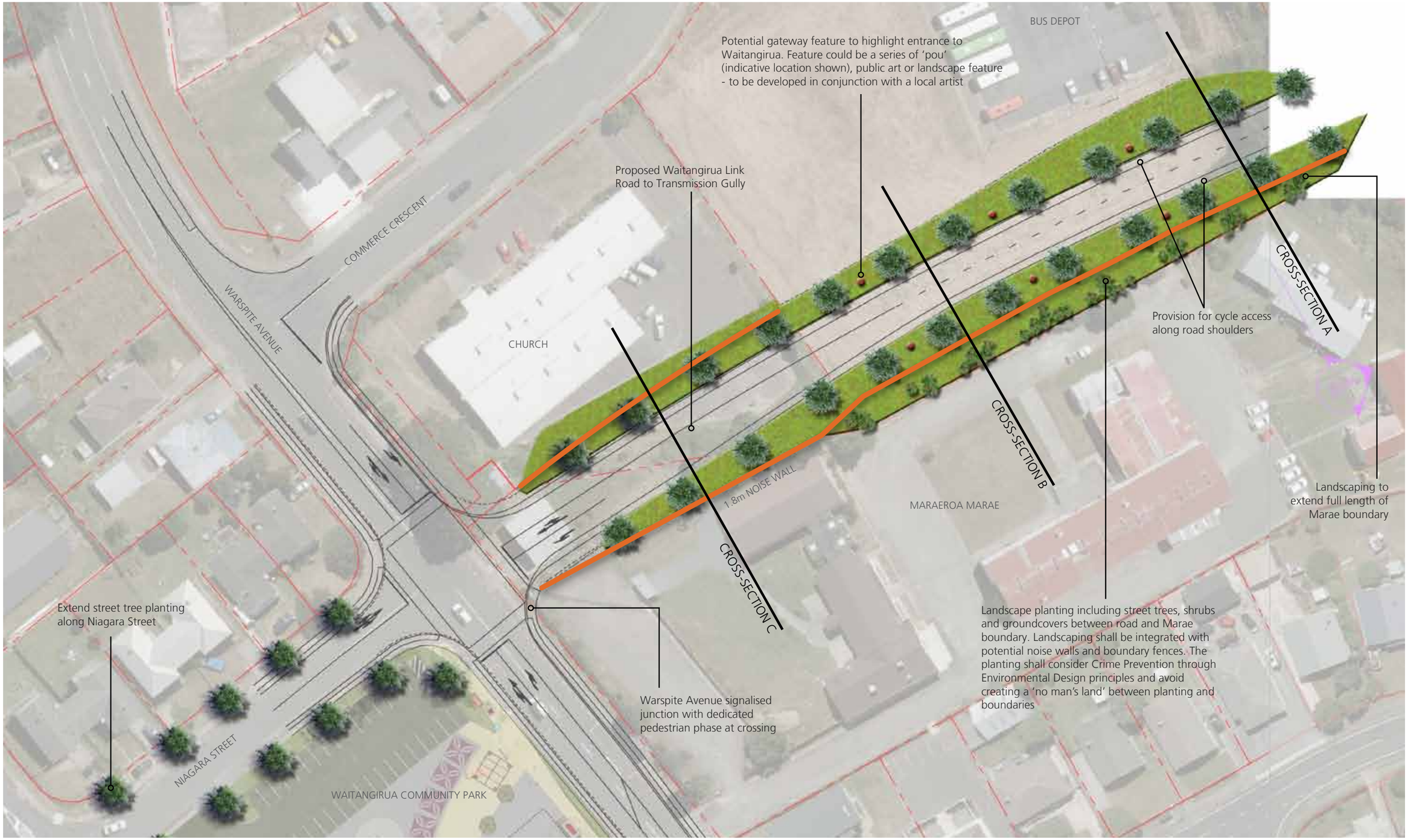


Figure 5.48: Conceptual landscape treatment around Waitangirua Link Road / Warspite Avenue Junction

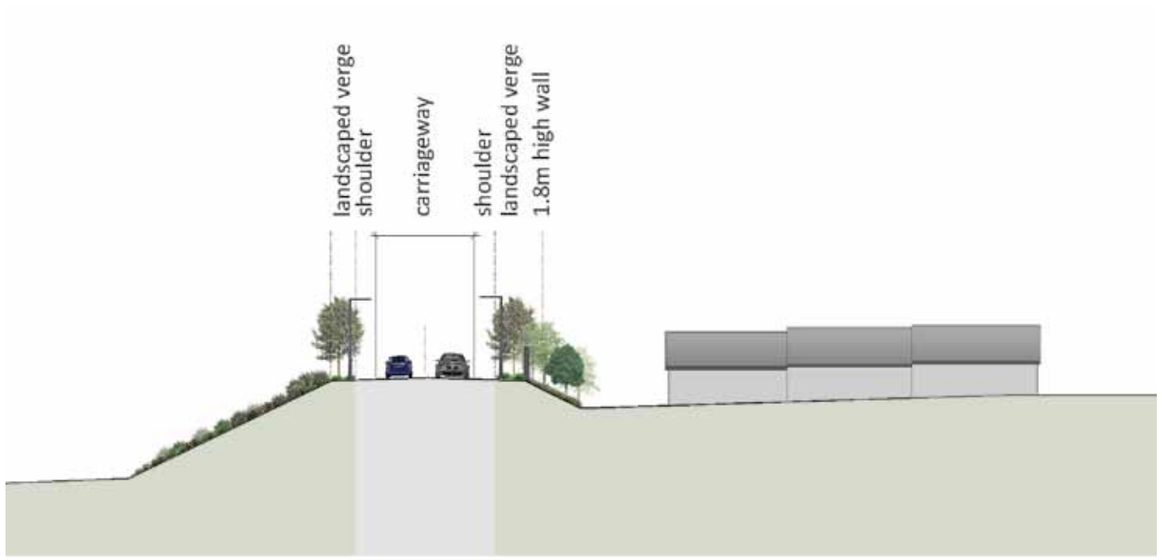


Figure 5.49: Waitangirua Link Road - Cross section A

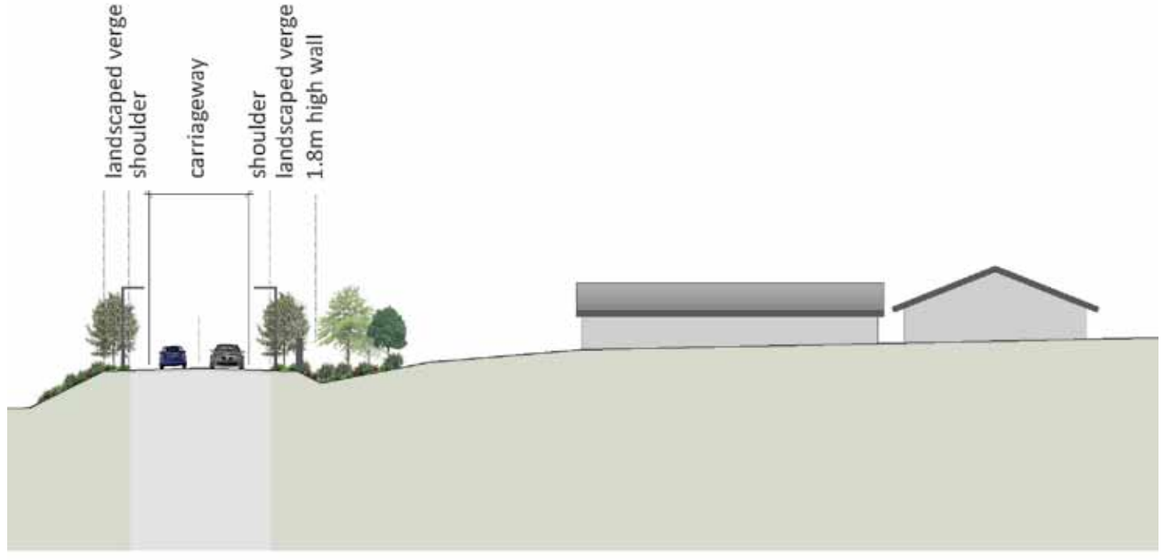


Figure 5.50: Waitangirua Link Road - Cross section B

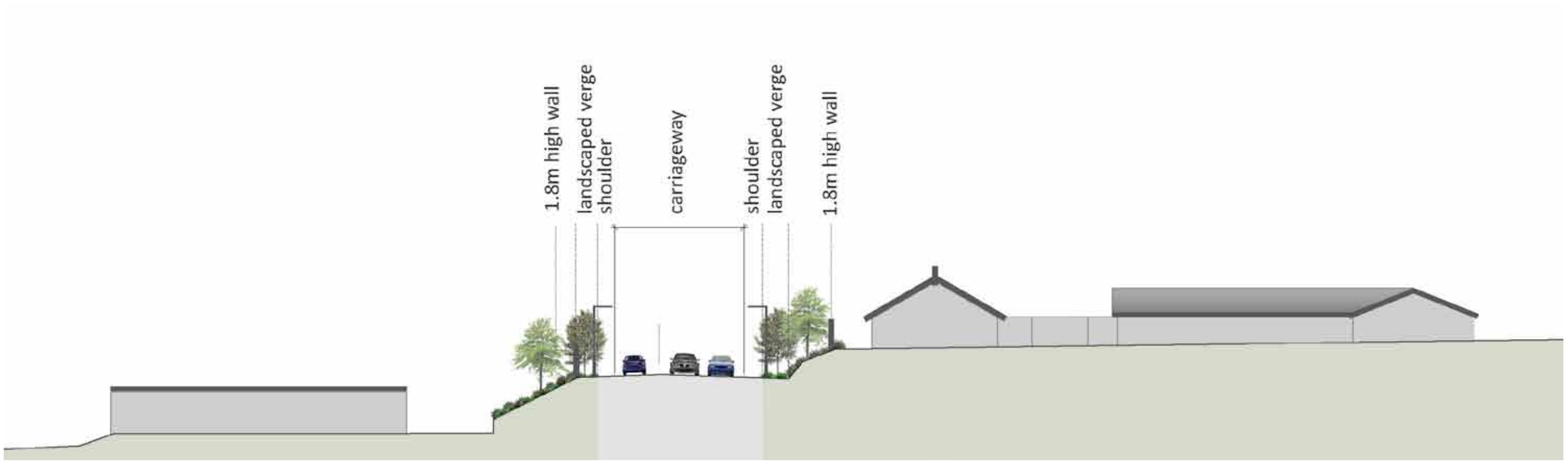


Figure 5.51: Waitangirua Link Road - Cross section C

Earthworks

North of James Cook interchange (chainage 18500 to 19500m) the Main Alignment crosses the minor ridge ('Resolution Ridge') west of Bradey Road by way of a long box cut with batters up to 25m/35m high.

The 'James Cook Interchange' (19000m) is on the west side of the ridge in a shallow hill-top basin. The Main Alignment passes over the dumbbell-shaped roundabouts connecting the ramps with the Link Roads. The roundabouts and ramps are within box cut on three sides (NW, NE and SE).

The Main Alignment approaches to the interchange are benched on the west facing hill-slope. In this stretch there is an almost continuous cut batter (less than 15m high) on the uphill side and intermittent fill batters across the heads of narrow gullies on the downhill side. The alignment is a short distance below the ridge.

South of the James Cook interchange (chainage 19500 to 21500m) the Main Alignment is benched on the upper slopes between 19500 and 20500, continuing the pattern of extensive cut batters on the uphill side and more intermittent fill batters into gullies on the downhill side. There is an extensive fill batter that 'chases' the slope between the main carriageway and the Waitangirua Link Road. The Main Alignment then transitions to a sequence of box cuts and embankments above Duck Creek.

A spoil disposal site is proposed on a broad spur east of the alignment at 21000m.

Figure 5.52: Section 7 James Cook Interchange Earthworks - View to North

The Waitangirua Link Road generally follows the contours around the steep hills behind southern Whitby in a sequence of deep box cuts and high embankments. The two largest fill embankments will have batters up to 15m and 20m high respectively, including one across Duck Creek. The two largest cuts have batters up to 20m and 30m respectively, including a long 'S'-shaped box cut through the spur behind Waitangirua. At the western end the Link Road descends the hill face behind Waitangirua to Warspite Avenue.

The Whitby Link Road is benched within the head of a small valley east of a distinctive hill surmounted with a telecommunications tower and large water tank. The earthworks include embankments and cuttings of short to medium length. There is also a small section (approximately 20m) with cut and fill embankments on the uphill and downhill sides respectively.

The following design principles apply:

- Fine-tune the batter on the eastern side of the box cut at 18900m and the two shorter cut batters at 20400m, with a view to avoiding the need for the top benches;
- Apply the general design principles for cut and fill batters in steep topography presented in chapter 4; and
- Contour the fill on the broad spur surface (spoil disposal site) in a way that echoes and accentuates the underlying landform. Establishing pasture grasses on the completed spoil disposal site in order to merge with adjacent pasture.

Figure 5.53: Bridge 17- 4 lane highway
LS13 - Location 21600m

Figure 5.54: Duck Creek - 4 lane highway
LS12 - 20520m

Structures

James Cook Interchange - Bridge 16

This bridge will be mostly visible to road users approaching the motorway from the Porirua Link Roads. The design of MSE walls, bridge barriers and landscape treatment of the fill batters will be the most noticeable features of the bridge.

- In order to achieve an elegant and simple bridge elevation, extend side barrier skirt down to conceal the reinforced concrete deck / superstructure joint and any drainage pipes. The detail of the drop down skirt should be consistent with the detail of other bridge side barriers in the Project.
- The detailed design of the side barriers (to be developed during the Outline Plan of Works phase) could include three dimensional or textural treatment but should avoid applied decorative motifs. The design of side barriers must be consistent with the corridor-wide landscape concept, in particular, the emphasis on horizontal lines, sharp edges and avoidance of ornamentation.
- The gap between the bridge elevation and MSE retaining wall must be minimised, subject to constructability and cost considerations.

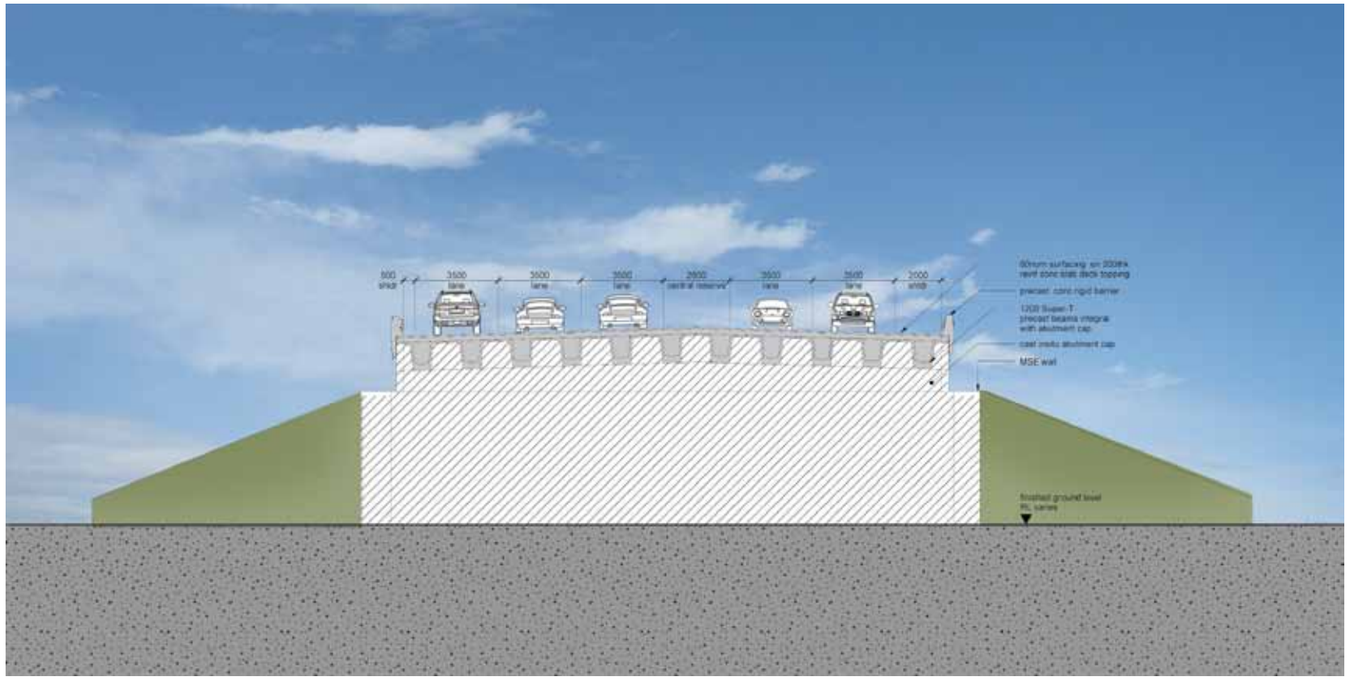


Figure 5.55: Bridge 16 James Cook Interchange cross section

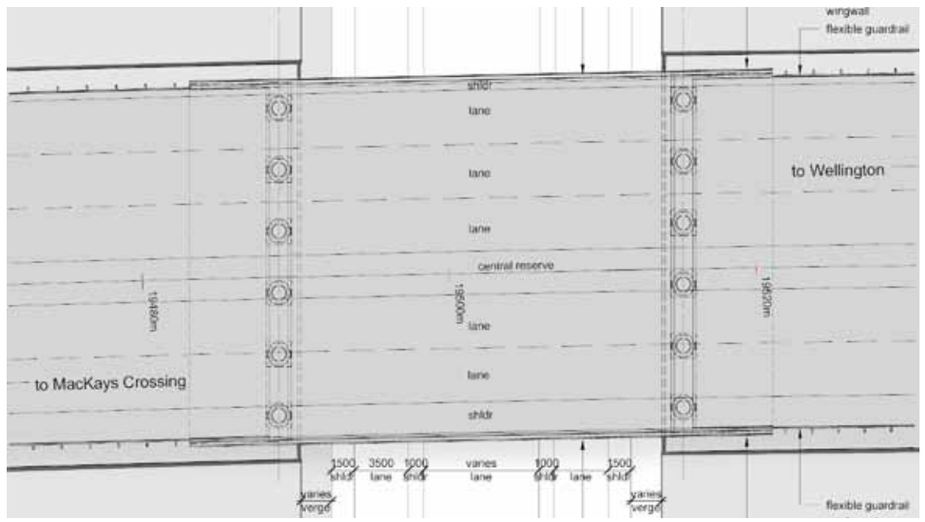


Figure 5.57: Bridge 16 James Cook Interchange plan

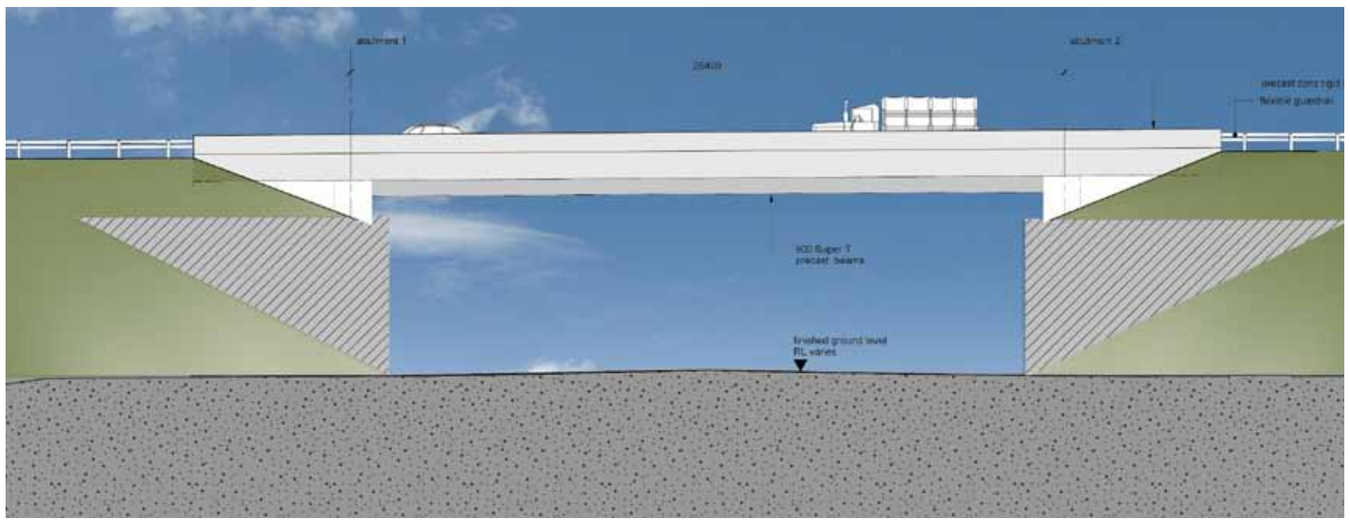


Figure 5.56: Bridge 16 James Cook Interchange elevation

Figure 5.58: Bridge 16 James Cook Interchange - 4 lane highway
LS11 - Location 19500m

Landscape treatment

Table 5.14: Section 7 James Cook - Landscape treatment

Landscape Character Area (Route Section)	Vegetation and Landform Character	Pattern of Enclosure/ Openness and Views	Design Response	Indicative plant species
SH58 to Whitby Interchange (Section 6 & 7)	Steep hill slopes adjacent to residential and lifestyle properties (Bradey Road and Silverwood) with former production forestry reverting to exotic and native land cover. James Cook Interchange located on shallow basin at southern end of Resolution Ridge.	**Open and enclosed** – with adjacent hills and proposed cuttings and blocking views to the east and west except from elevated James Cook Interchange.	Extension of existing kanuka belt as key landscape element to emphasise feeling of enclosure and to mitigate for adverse visual effects from adjoining properties. Planting to reinforce sudden and expansive views of inlet and defining landforms from James Cook and SH58 Interchanges.	**Canopy species:** - Kanuka *(Kunzea ericoides)* - Rewarewa *(Knightia excelsa)* - Totara *(Podocarpus totara)* **Shrubs and understorey tree species:** - Five Finger *(Pseudopanax arboreus)* - Karamu *(Coprosma robusta)* - Koromiko *(Hebe stricta)* - Mahoe *(Melicytus ramiflorus)* - Pittosporum sp. *(P. euginoides & tenufolium)* - Puka *(Griselinia littoralis)* **Low shrubs/ ground cover:** - Carex sp. *(C. secta, dissita & virgata)* - Flax *(Phormium cookianum)* - Toe toe *(Cortaderia fulvida)*
Duck Creek (Section 7 & 8)	Duck Creek narrow stream valley oriented north-south with steep moonshine scarp to the west and steep/ rolling Belmont Hills to the east. Reverting plantation forest at northern end of Character Area with reverting native scrub across the moonshine fault scarp and pasture to the east. Several of the existing mitigation planting areas are located to the east of Duck Creek.	**Semi Enclosed** – Sequence of enclosed cuttings and open views along Duck Creek valley to Moonshine fault scarps.	Rehabilitate streams that run perpendicular to the corridor to reinforce natural landform patterns. Retain spurs in open pasture. Retire western fault scarp to promote natural succession.	**Canopy species:** - Kanuka *(Kunzea ericoides)* - Lowland ribbonwood *(Plagianthus regius)* - Rewarewa *(Knightia excelsa)* - Tawa *(Beilschmeidia tawa)* - Titoki *(Alectryon excelsus)* - Tree Ferns *(Cyathea medullaris & cunninghamii)* **Shrubs and understorey tree species:** - Cabbage tree *(Cordyline australis)* - Five Finger *(Pseudopanax arboreus)* - Karamu *(Coprosma robusta)* - Koromiko *(Hebe stricta)* - Kowhai *(Sophora chathamica)* - Mahoe *(Melicytus ramiflorus)* - Ngaio *(Myoporum laetum)* - Pittosporum sp. *(P. euginoides & tenufolium)* - Puka *(Griselinia littoralis)* **Low shrubs/ ground cover:** - Carex sp. *(C. secta, dissita & virgata)* - Coprosma sp. *(e.g. Coprosma propinqua)* - Flax *(Phormium cookianum)* - Olearia sp. *(Olearia solandri)* - Tauhinu *(Ozothamnus leptophyllus)* - Toe toe *(Cortaderia fulvida)*

5.8 Section 8 – Cannons Creek

5.8.1 Local context

Topography, geology and hydrology

Section 8 is characterised by:

- An undulating plateau between Duck Creek and Cannons Creek, with a crossing of the deep, forested Cannons Creek gorge.

Landscape features

The landscape features of note in this section are:

- Duck Creek Valley (Belmont Hill Country): Straight fault-line valley (Moonshine Fault) on NE-SW alignment. Steep stream, straight alignment, stoney bed. Steep escarpment on west side with short, steep tributaries. Broader dip-slope hills on east side with longer streams, larger catchments, deeply incised valleys generally oriented north-south, separated by steep sided spurs with rounded crests. Hills rise on east side to high backdrop ridge, with highest point 'Round Knob' at 410m ASL. Extensive pastoral land-use with occasional small pockets of remnant native vegetation, some restoration planting, and some areas of regenerating scrub. The only structures are several transmission lines (including 220kV double circuit lattice tower lines) converging on Takapu substation at head of Takapu Valley, and minor farm structures. No dwellings in this section of the route, with the exception of dwellings associated with the Takapu substation; and
- Cannons Creek area (Porirua East basin): Southern perimeter of Porirua East basin. Rolling to steep hills, backdrop to suburban areas of Cannons Creek and Waitangirua. Characterised by mosaic of regenerating native bush and shrubland (mainly in the Cannons Creek valley), regenerating scrub, rough pasture, and exotic shelter belts. Cannons Creek forms a deeply incised gorge through perimeter hills (its headwaters are beyond hills encircling the Porirua East basin). The only structures in the vicinity of the route are minor farm structures (fences, stockyard), although the route is visible from the urban area further to the north.

Significant views and landmarks

The main landmark in this section is Cannons Creek. Even though the alignment only clips the upper section of the creek proper, the valley is a widely recognised landscape feature – giving rise to the name of the lower lying suburb. In addition the creek/ alignment relationship gives rise to the largest and potentially most identifiable structure along the route, Cannons Creek bridge.

Land uses

Existing land uses

Land use in this section is predominantly rural and includes semi-improved pasture and a few remnants of native vegetation. The residential suburbs of Waitangirua and Cannons Creek are situated to the west of the Project area. This section of the route bisects Belmont Regional Park, which provides recreational activity opportunities including walking, mountain biking and horse back riding tracks.

District Plan Zones

This section of the alignment traverses two land use zones:

- Belmont Regional Park is zoned 'Open Space'; and
- Land south-east of Belmont Regional Park is zoned 'Rural' in Porirua City District Plan

The alignment also runs in proximity to Cardiff Park which is zoned for 'Recreation', and the Cannons Creek urban area which is zoned 'Suburban'.

Photo 5.23: Cannons Creek gorge

Photo 5.24: Belmont Regional Park

Photo 5.25: Cannons Creek suburb

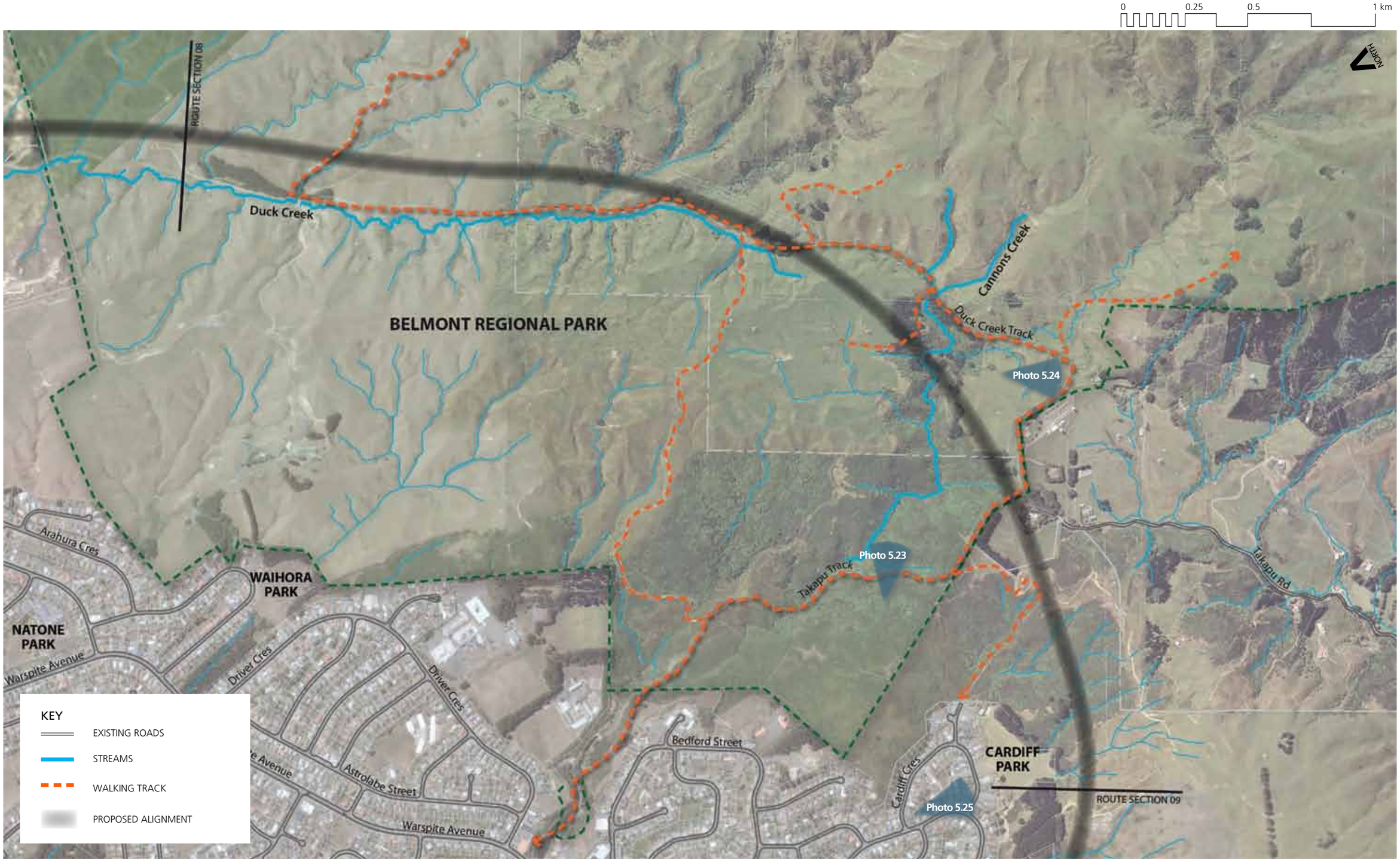


Figure 5.59: Section 8 Existing condition

Connections

Local roads

There are no local road connections in this section of the Project.

Access to properties

Land on both sides of the alignment through this section is part of Belmont Regional Park. All vehicular access routes to the park are located on the eastern side of the alignment and will not be affected by the Project.

Pedestrian / Cycle / Bridleway network

The Park is bisected by the designation and two of its tracks (Takapu and Duck Creek tracks) will be severed by the route. Most of the Park area is to the east of the Transmission Gully Project alignment and accessed by a number of entrances including one at the end of Belmont Road and one at the end of Takapu Road which gives access to both Takapu Track and Duck Creek Track.

On the western side of the Transmission Gully Project alignment, access to the Park is from Cannons Creek via Warspite Avenue and the Cannons Creek Lakes Reserve (Takapu Track).

Some track re-alignment, including re-routing tracks under proposed bridges, will be needed to restore connectivity between the eastern and the western parts of the Park along both tracks.

Mountain bikes are not currently allowed along Duck Creek Track which links Takapu Road and the eastern part of the park as it is the main farm access road for vehicles and livestock. This restriction may be lifted as farming in certain parts of the park is reassessed as part of the Sustainable Farm Management Plan process.

5.8.2 Design issues and objectives

Table 5.15: Section 8 Cannons Creek – Design issues and objectives

DESIGN ISSUES	DESIGN OBJECTIVES
Integration in the landscape & response to Landscape Character	
■ To the north the landscape is characterised by the steep Moonshine fault escarpment and tributaries on the western side of Lower Duck Creek; the creek itself; and the longer bold hills of Belmont Hill Country to the east. ■ This section of the route is within Belmont Regional Park. Land cover is dominated by grazed pasture; regenerating scrub to the west; and occasional small pockets of remnant native vegetation and some restoration planting. ■ The road will cut across the intervening gullies and spurs of the Belmont Hill Country and has the potential to have significant adverse effects on the coherence and overall character of this part of the wider Belmont Regional Park.	■ Limit the overall footprint of the road both during and following construction to ensure the retention of as much existing landform as possible. ■ Recognise and reinforce the natural landscape patterns of alternating gullies and spurs perpendicular to the road through limiting land form alteration and placement of vegetation within gullies. ■ Ensure that the existing profile of Duck Creek stream valley is retained.
■ To the south beyond Cannons Creek, the Section is characterised by steep to rolling hills that form the backdrop to the Eastern Porirua Basin. ■ Vegetation consists of a mosaic of regenerating native bush and shrubland (mainly in the Cannons Creek valley), regenerating scrub, rough pasture, and exotic shelter belts.	■ Ensure that existing well-established native vegetation is retained to the highest degree possible and seek to reinforce existing vegetation patterns following construction. ■ Seek to limit the overall footprint and prominence of the road to ensure that the largely undeveloped 'green' matrix of the backdrop hills is maintained.
Fill Disposal Sites	
■ A fill disposal site is located within Section 8. The location, extent and final form of this area has the potential to result in significant adverse effects on existing landscape character, visual amenity and terrestrial and in stream ecological values.	■ The location, extent, form and nature of recommended landscape treatment of fill disposal sites shall respond to and be consistent with existing landform, vegetation and in stream ecological values as well as overall identity and visual character of the Belmont and Porirua East Hill Country.

DESIGN ISSUES	DESIGN OBJECTIVES
Adjoining land use and amenity	
▪ The northern part of Section 8 passes through a section of Belmont Regional Park that provides access for pedestrians and cyclists to the wider park from Porirua East and Takapu Road. The road will alter the overall experience of this part of the Park and has the potential to impact of existing levels of access.	▪ Ensure that pedestrian and cycle access points and tracks are maintained or enhanced.
▪ Cannons Creek consists of a steep sided, heavily vegetated, incised gorge and is a readily identifiable local landmark. ▪ The crossing of the creek gives rise to the largest and potentially most identifiable structure along the Project - Cannons Creek bridge.	▪ Ensure that bridge design, earthworks and landscape treatments seek to maximise visibility to the wider landscape from the road and reinforce the potential of the bridge to act as a key landmark along the route and within Belmont Regional Park. ▪ Ensure a high level of amenity for park visitors under bridges connecting both sides of the park.
▪ The road alignment passes through predominantly box cuts in close proximity to existing residential areas and Cardiff Park at the southern end of Porirua East Basin.	▪ Ensure that negative visual effects resulting from fill batters and exposed sections of the carriageway are addressed through the introduction of intervening vegetation.
Visual Experience	
▪ The section of the road to the north of Cannons Creek will be visible to users of Belmont Regional Park.	▪ The majority of the road is located within box cut and the location of access tracks is largely on adjoining elevated land therefore views will be predominantly down to the road. Negative impacts of these views should be addressed through the location of access tracks and landscape treatments.
▪ The road will sidle across the southern hills of the Porirua East Basin and will include a series of box cuts and fill batters or bridges. ▪ This may result in sections of the road being visible from elevated locations within Porirua East and introducing a additional 'built edge' further up the hill face. ▪ In addition, it will also create a unique road user experience where views will alternate between open and enclosed and will provide a visual connection with urban Porirua.	▪ Landscape treatment will seek to 'bed' the road into the landscape but limiting the scale and final form of earthworks; re-establishing and enriching any existing vegetation that has been removed; and introducing new vegetation on exposed cut/ fill faces. ▪ Ensure that views to the wider landscape are maximised through the careful design and siting of landscape treatments and road furniture (e.g. safety barriers and screen planting).

DESIGN ISSUES	DESIGN OBJECTIVES
Biodiversity and ecology	
▪ Construction of bridges may result in vegetation removal and disturbance to areas adjacent to the stream.	▪ Minimise the removal of native vegetation. ▪ Locate piers as far back on the stream bank as practicable. ▪ Need for management of use of concrete in the stream corridors to avoid contamination. ▪ Adequate sediment / erosion control and stormwater treatment devices to minimise the input of sediment and contaminants into the streams.
▪ Sections of Canons Creek will need to be culverted.	▪ Design culverts to facilitate fish passage and retain as much in stream habitat as possible.
▪ The alignment requires some vegetation removal for road construction and operation.	▪ Minimise the removal of indigenous vegetation through sensitive route alignment and construction methodology, including the location of haul roads and construction tracks.
Local connectivity / severance	
▪ Alignment severs farm access through Belmont Regional Park	▪ Provide vehicular access under bridges to land east of the alignment.
▪ Alignment severs pedestrian connection from Cannons Creek to Belmont Regional Park (Takapu Track)	▪ Redirect and reconnect pedestrian path under proposed Cannons Creek bridge.
▪ Alignment severs pedestrian and horse riding connection from Takapu Road to Belmont Regional Park (Duck Creek Track)	▪ Redirect and reconnect pedestrian / horse riding path under alignment.
▪ Opportunity to accommodate tramping track within the designation corridor.	▪ Provide suitable crossing of the Main Alignment so that existing tracks can continue to provide a continuous walking route, possibly running under Cannons Creek bridge and connecting with Cannons Creek Lakes reserve.
Design Continuity	
▪ Given the regular alternation between box cuts and fill batters/ bridges there is the potential for regular changes to road elements to result in a messy and confusing road user experience.	▪ Ensure that the number and changes in road elements are kept to a minimum. Use elements that are of a consistent character (e.g. safety barriers – earth bunds vs structural barriers).
Noise	
▪ No issues	
Drainage	
▪ There may be an opportunity to connect part of the proposed alignment's stormwater treatment into Porirua City Council's existing stormwater systems.	▪ Ensure efficient and effective treatment of stormwater runoff occurs.

5.8.3 Design proposals

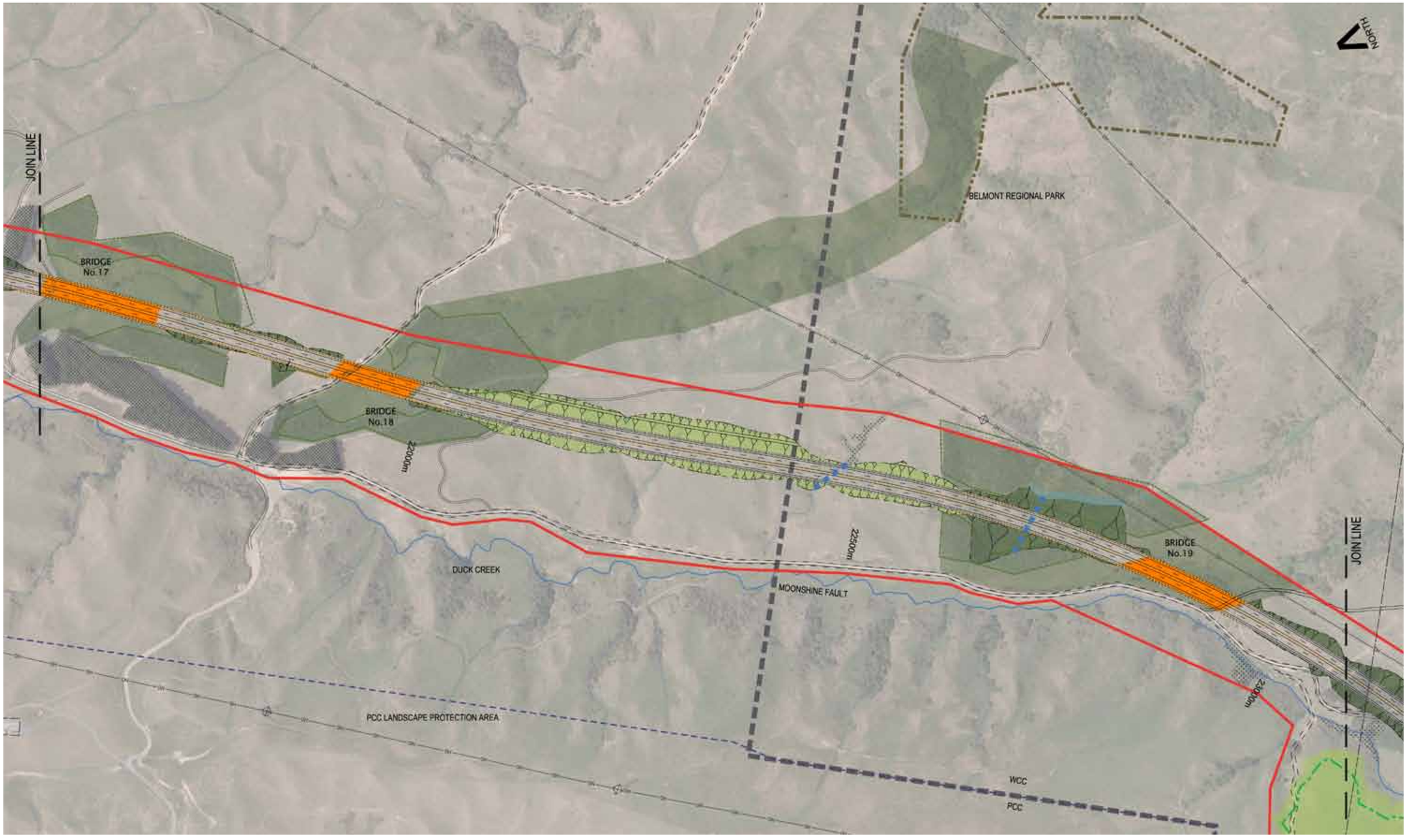
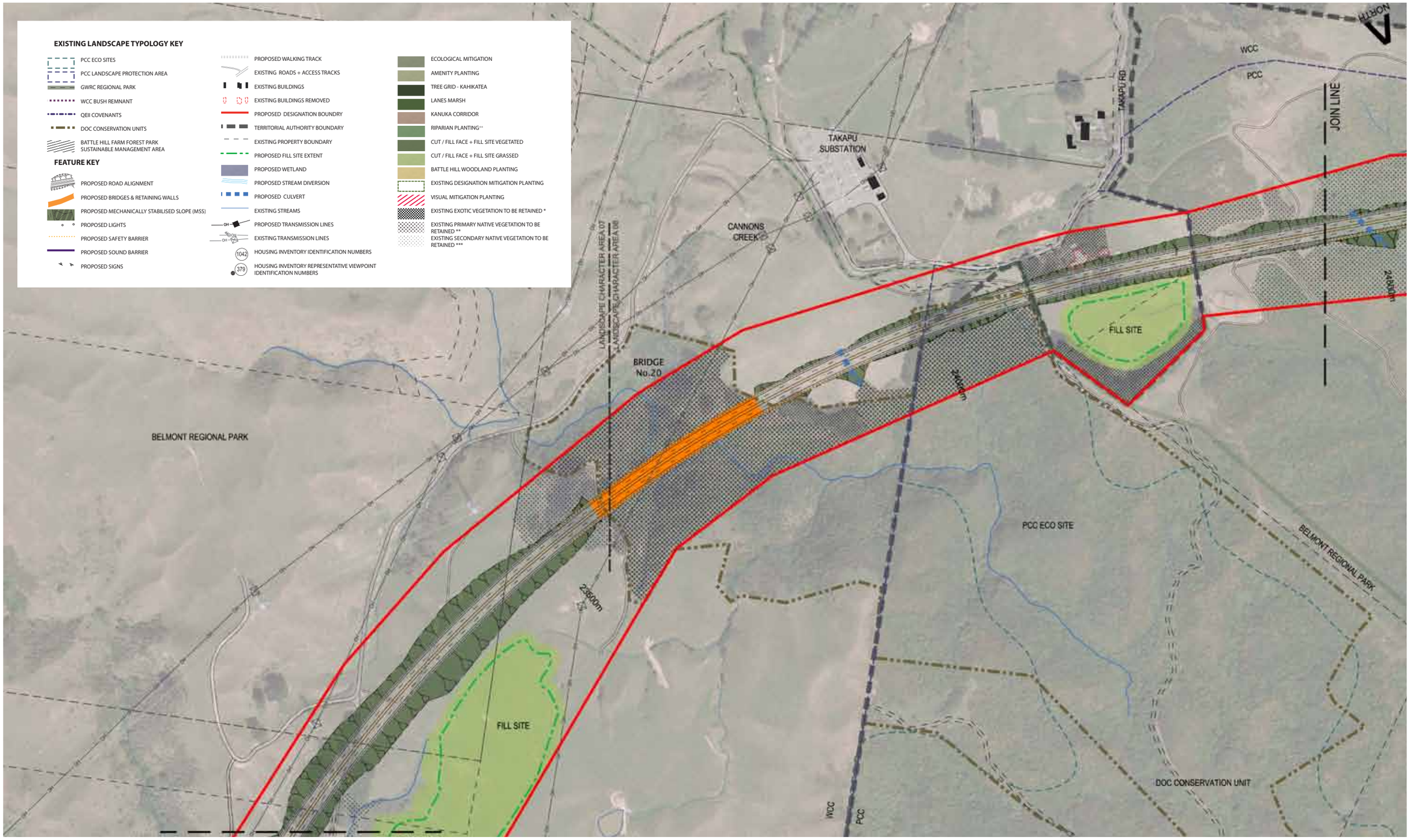


Figure 5.60: Section 8 Design proposals

0 50 100 200 m


EXISTING LANDSCAPE TYPOLOGY KEY
PCC ECO SITES
PCC LANDSCAPE PROTECTION AREA
GWRC REGIONAL PARK
WCC BUSH REMNANT
QEII COVENANTS
DOC CONSERVATION UNITS
BATTLE HILL FARM FOREST PARK SUSTAINABLE MANAGEMENT AREA
FEATURE KEY
PROPOSED ROAD ALIGNMENT
PROPOSED BRIDGES & RETAINING WALLS
PROPOSED MECHANICALLY STABILISED SLOPE (MSS)
PROPOSED LIGHTS
PROPOSED SAFETY BARRIER
PROPOSED SOUND BARRIER
PROPOSED SIGNS
PROPOSED WALKING TRACK
EXISTING ROADS + ACCESS TRACKS
EXISTING BUILDINGS
EXISTING BUILDINGS REMOVED
PROPOSED DESIGNATION BOUNDRY
TERRITORIAL AUTHORITY BOUNDARY
EXISTING PROPERTY BOUNDARY
PROPOSED FILL SITE EXTENT
PROPOSED WETLAND
PROPOSED STREAM DIVERSION
PROPOSED CULVERT
EXISTING STREAMS
PROPOSED TRANSMISSION LINES
EXISTING TRANSMISSION LINES
1042 HOUSING INVENTORY IDENTIFICATION NUMBERS
379 HOUSING INVENTORY REPRESENTATIVE VIEWPOINT IDENTIFICATION NUMBERS
ECOLOGICAL MITIGATION
AMENITY PLANTING
TREE GRID - KAHIKATEA
LANES MARSH
KANUKA CORRIDOR
RIPARIAN PLANTING**
CUT / FILL FACE + FILL SITE VEGETATED
CUT / FILL FACE + FILL SITE GRASSED
BATTLE HILL WOODLAND PLANTING
EXISTING DESIGNATION MITIGATION PLANTING
VISUAL MITIGATION PLANTING
EXISTING EXOTIC VEGETATION TO BE RETAINED *
EXISTING PRIMARY NATIVE VEGETATION TO BE RETAINED **
EXISTING SECONDARY NATIVE VEGETATION TO BE RETAINED ***
NORTH
WCC
PCC
TAKAPU RD
JOIN LINE
TAKAPU SUBSTATION
CANNONS CREEK
LANDSCAPE CHARACTER AREA 07
LANDSCAPE CHARACTER AREA 08
BRIDGE No.20
FILL SITE
24800m
23600m
BELMONT REGIONAL PARK
PCC ECO SITE
DOC CONSERVATION UNIT
WCC
PCC

0 50 100 200 m

EXISTING LANDSCAPE TYPOLOGY KEY

- PCC ECO SITES
- PCC LANDSCAPE PROTECTION AREA
- GWRC REGIONAL PARK
- WCC BUSH REMNANT
- QEII COVENANTS
- DOC CONSERVATION UNITS
- BATTLE HILL FARM FOREST PARK SUSTAINABLE MANAGEMENT AREA

FEATURE KEY

- PROPOSED ROAD ALIGNMENT
- PROPOSED BRIDGES & RETAINING WALLS
- PROPOSED MECHANICALLY STABILISED SLOPE (MSS)
- PROPOSED LIGHTS
- PROPOSED SAFETY BARRIER
- PROPOSED SOUND BARRIER
- PROPOSED SIGNS
- PROPOSED WALKING TRACK
- EXISTING ROADS + ACCESS TRACKS
- EXISTING BUILDINGS
- EXISTING BUILDINGS REMOVED
- PROPOSED DESIGNATION BOUNDRY
- TERRITORIAL AUTHORITY BOUNDARY
- EXISTING PROPERTY BOUNDARY
- PROPOSED FILL SITE EXTENT
- PROPOSED WETLAND
- PROPOSED STREAM DIVERSION
- PROPOSED CULVERT
- EXISTING STREAMS
- PROPOSED TRANSMISSION LINES
- EXISTING TRANSMISSION LINES
- (1042) HOUSING INVENTORY IDENTIFICATION NUMBERS
- (379) HOUSING INVENTORY REPRESENTATIVE VIEWPOINT IDENTIFICATION NUMBERS
- ECOLOGICAL MITIGATION
- AMENITY PLANTING
- TREE GRID - KAHIKATEA
- LANES MARSH
- KANUKA CORRIDOR
- RIPARIAN PLANTING**
- CUT / FILL FACE + FILL SITE VEGETATED
- CUT / FILL FACE + FILL SITE GRASSED
- BATTLE HILL WOODLAND PLANTING
- EXISTING DESIGNATION MITIGATION PLANTING
- VISUAL MITIGATION PLANTING
- EXISTING EXOTIC VEGETATION TO BE RETAINED *
- EXISTING PRIMARY NATIVE VEGETATION TO BE RETAINED **
- EXISTING SECONDARY NATIVE VEGETATION TO BE RETAINED ***

NORTH

JOIN LINE

ROUTE SECTION

PORIRUA GUN CLUB

24000m

23500m

23500m

CARDIFF PARK

PCC LANDSCAPE PROTECTION AREA

CARDIFF CRES

754

856

857

755

PCC ECO SITE

BRIDGE No:21

JOIN LINE

BELMONT REGIONAL PARK

SIEVERS GR

756

PORIRUA

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Earthworks

21500 to 23500m: Duck Creek

The alignment is elevated above the east bank of Duck Creek, and crosses tributary streams and spurs in a regular sequence of box cuts and embankments / bridges. The cuttings are typically 10m–15m deep, but the long cutting between 22000m and 22500m has batters on the eastern side up to 25m high which will require benching. There is one embankment at 22700m with a relatively wide footprint, but bridges will be used to span the three larger tributaries.

There is one proposed spoil disposal site near 23300m, on a plateau-like area between Duck Creek and Cannons Creek.

The following design principles apply

- Fine-tune the detail design of the batters on the east side of the long box cut at 22300m with a view to avoiding or reducing the extent of the bench required; and
- Adopt the general design principles for cut batters (steep topography) presented in chapter 4.

23500 to 24900: Cannons Creek

At the top of Duck Creek (i.e. at bridge No.19 22780m) the alignment changes direction by almost 90° and cuts through the watershed ridge into the Porirua basin to the west.

The alignment includes a long box cut through the watershed ridge, a 'viaduct' over the headwaters of Cannons Creek (bridge No.20), and a series of moderate box cuts and embankments across the hill face behind urban Porirua. All the cut batters are less than 15m, avoiding the need for benching.

A small spoil disposal site is located at 24100m within a small hilltop depression.

The general design principles for cut batters in steep topography presented in chapter 4 should be followed.

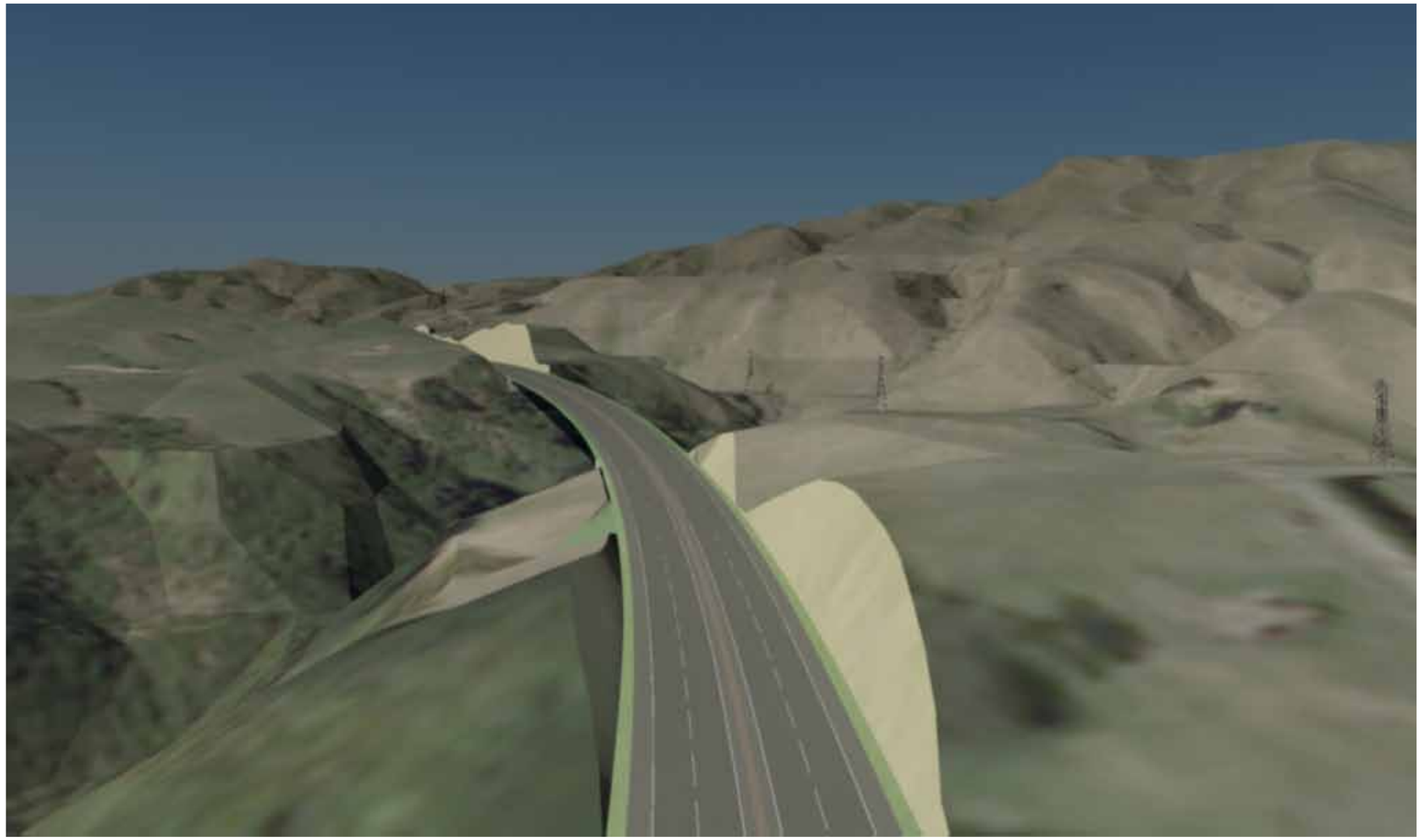

Figure 5.61: Section 8 Earthworks - View to North

Figure 5.62: Bridge 20 Cannons Creek Bridge - 4 lane highway + bridge
LS14 - Location 23600m

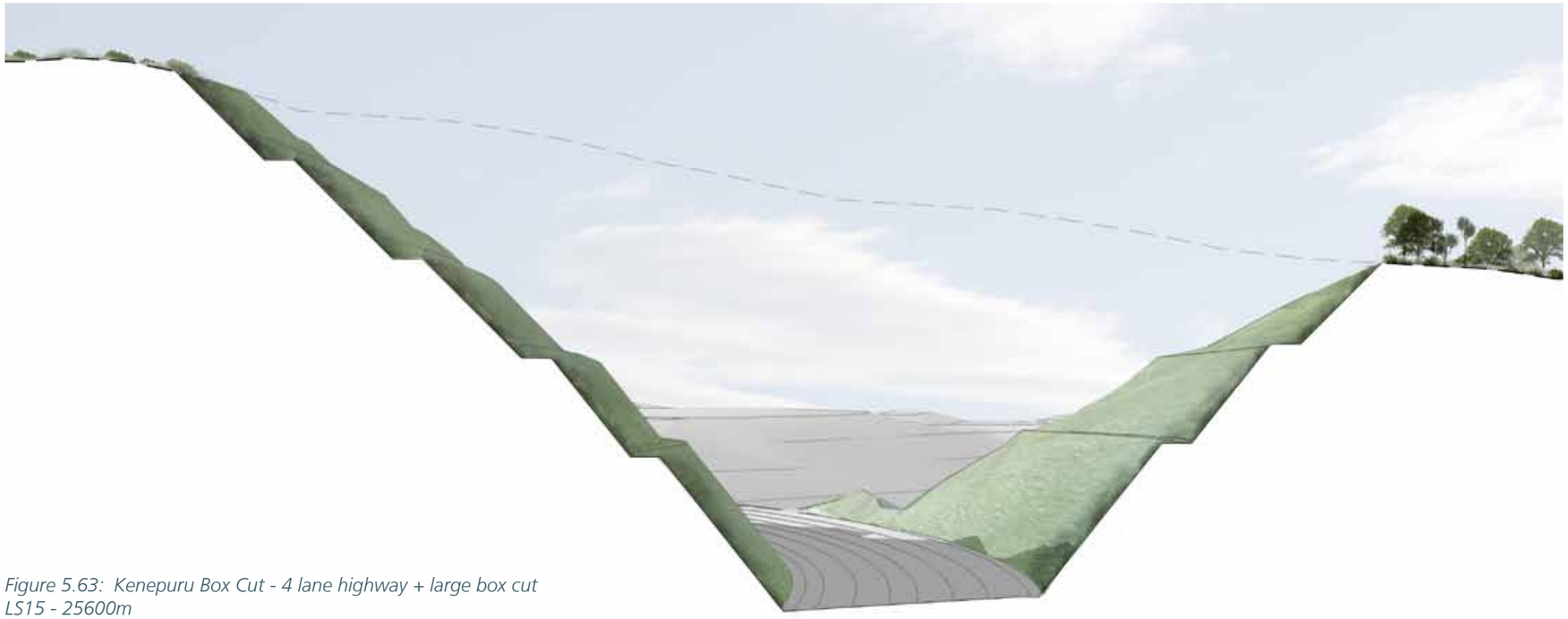

Figure 5.63: Kenepuru Box Cut - 4 lane highway + large box cut
LS15 - 25600m

Structures

Cannons Creek bridge - Bridge 20

This bridge will be visible at close range by visitors to Belmont Regional Park including pedestrians, cyclists and horse riders passing underneath it, and from a distance by residents of parts of Cannons Creek. The overall profile of the bridge, the slenderness of the superstructure relative to the piers and the selection of the structural system and resulting soffit and pier shapes are key considerations in the design of the bridge. In particular:

- The proposed structure consists of two parallel bridges, one for each carriageway. Each carriageway is supported by a three span single cell concrete box girder. Each girder is haunched towards the piers, with its depth varying from 3m-7.5m. The piers consist of 5m square box columns with each pair linked by a high level beam. This system is considered to provide an elegant solution both in terms of overall profile from a distance and of simple connections and neat underside which will be seen at closer range by Park visitors; and
- Drainage pipes should be contained within the girder box and pier. Extend barrier skirt to conceal pipe connection between the edge of the carriageway and the girder;
- Existing Regional Park paths and farm tracks will be rerouted under the bridge. These will run at the top of the gorge near both abutments. The detailing and finish of the abutment walls should be of high quality to respond to their visibility at close range; and
- The piers and bridge underside should have clean, smooth surfaces.

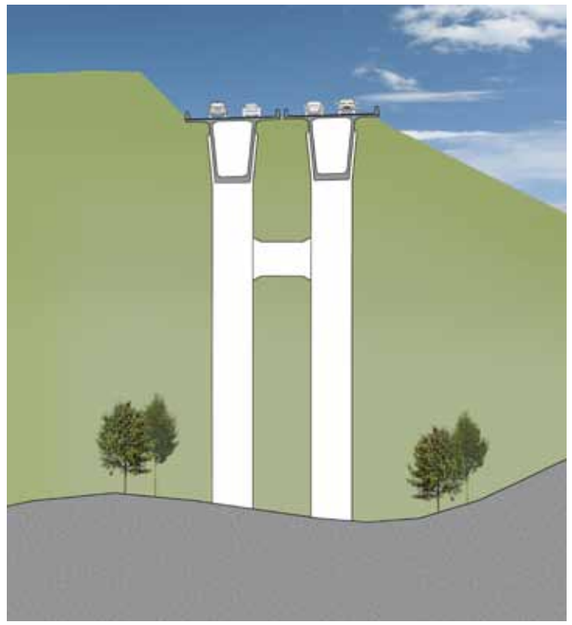

Figure 5.64: Bridge 20 Cannons Creek Bridge cross section

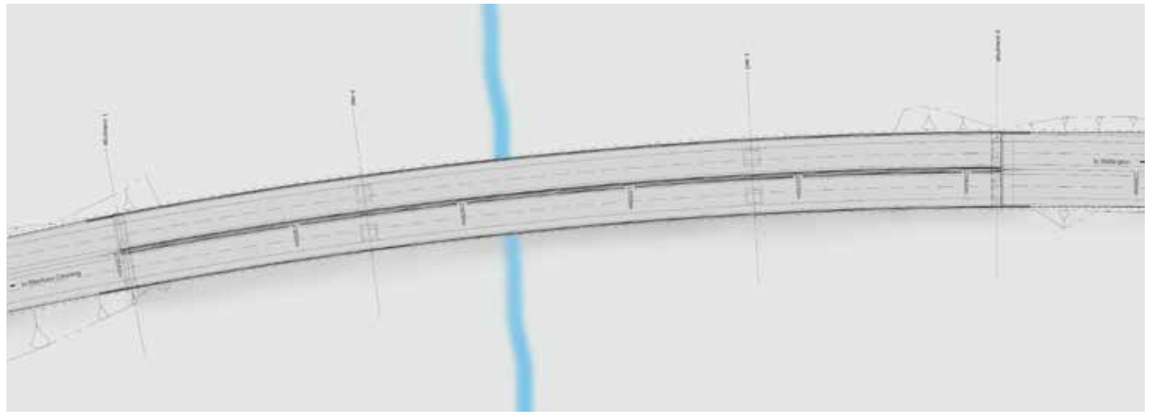

Figure 5.65: Bridge 20 Cannons Creek Bridge plan

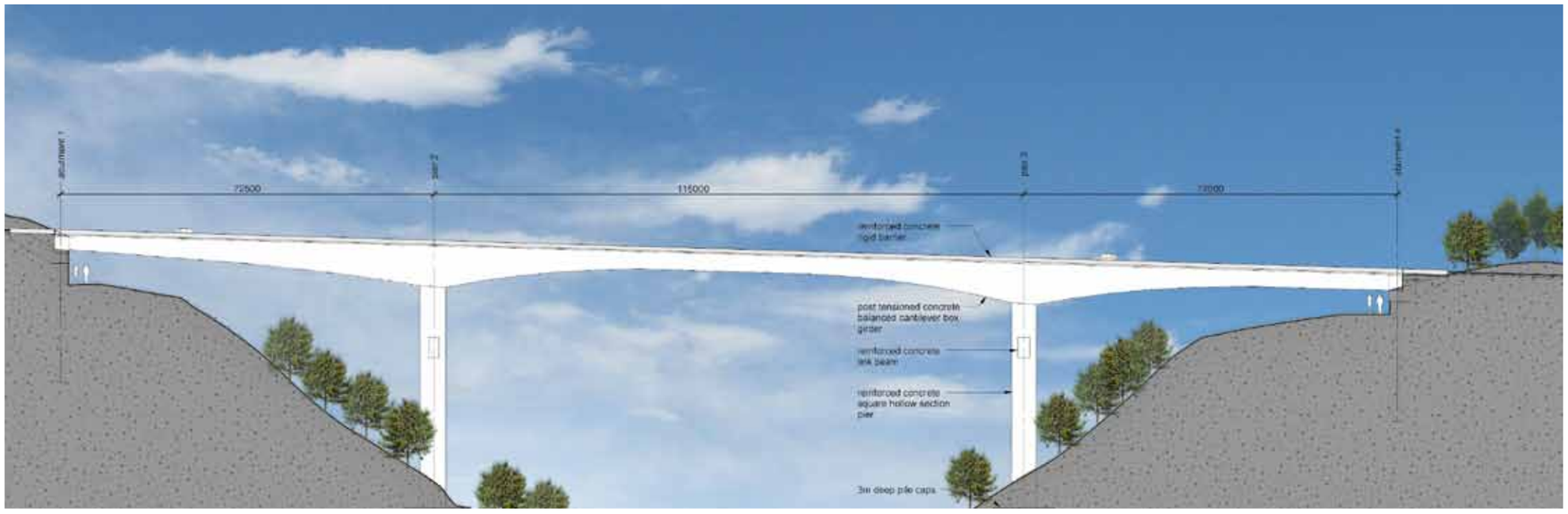

Figure 5.66: Bridge 20 Cannons Creek Bridge elevation

Pedestrian and cycle paths

Belmont Regional Park's Takapu Track (a pedestrian, cycle and horse riding track near the end of Takapu Road) will be severed by the alignment and is to be redirected under Cannons Creek bridge, on high grounds near the abutments (Figure 5.67). An existing farm track along Cannons Creek which crosses the alignment will also need to be re-aligned. These will involve the lowering of the farm track at the northern abutment and the creation of a new multi-purpose track at the southern abutment.

Belmont Regional Park's Duck Creek Track crosses the alignment in two locations and is to be redirected under bridges 19 and 18.

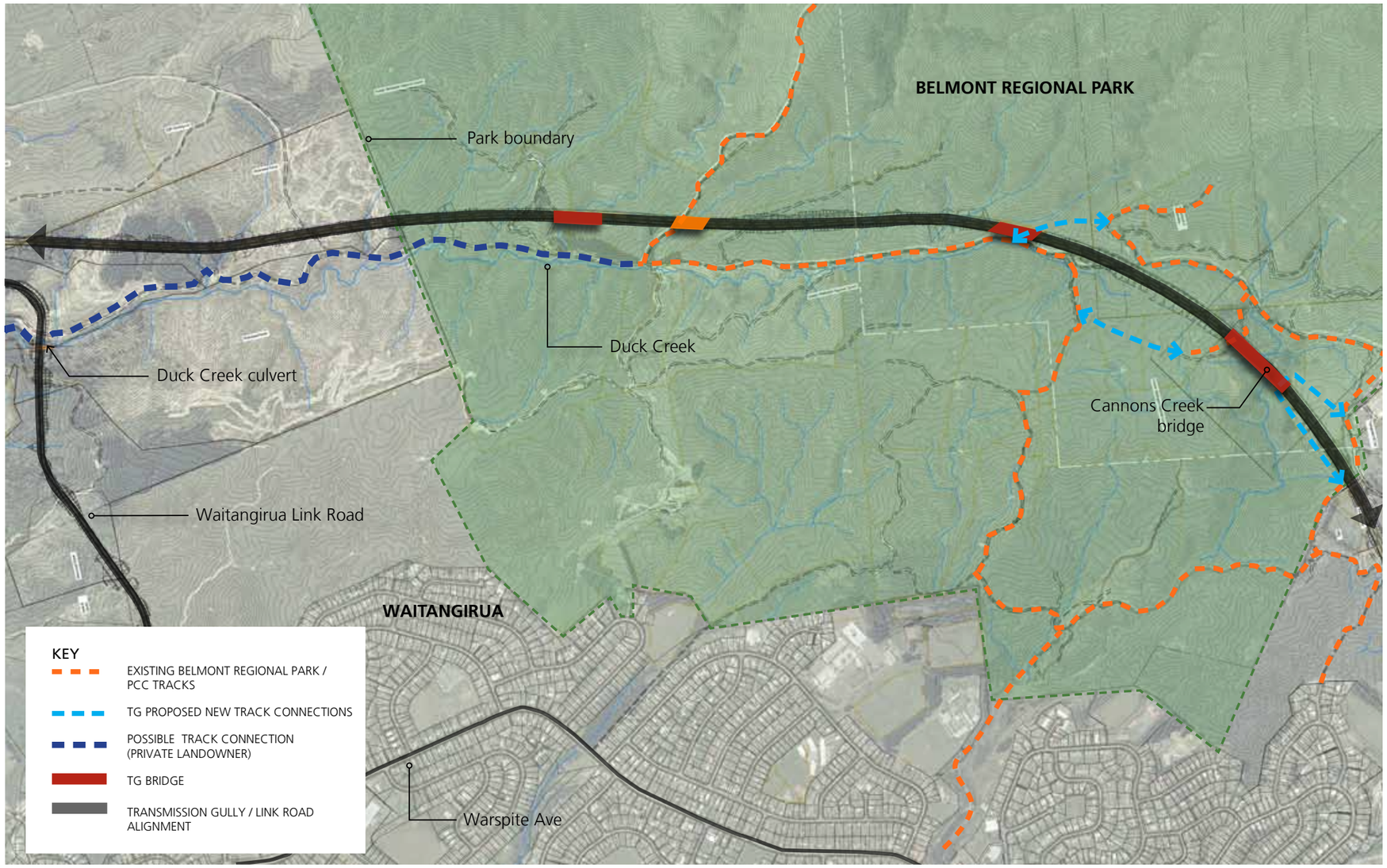

Figure 5.67: Realigned tracks in Belmont Regional Park

Landscape treatment

Table 5.16: Section 8 Cannons Creek - Landscape treatment

Landscape Character Area (Route Section)	Vegetation and Landform Character	Pattern of Enclosure/ Openness and Views	Design Response	Indicative plant species
Duck Creek (Section 7 & 8)	Duck Creek narrow stream valley oriented north-south with steep moonshine scarp to the west and steep/ rolling Belmont Hills to the east. Reverting plantation forest at northern end of Character Area with reverting native scrub across the moonshine fault scarp and pasture to the east. Several of the existing mitigation planting areas are located to the east of Duck Creek.	**Semi Enclosed** – Sequence of enclosed cuttings and open views along Duck Creek valley to Moonshine fault scarps.	Rehabilitate streams that run perpendicular to the corridor to reinforce natural landform patterns. Retain spurs in open pasture. Retire western fault scarp to promote natural succession.	**Canopy species:** - Kanuka *(Kunzea ericoides)* - Lowland ribbonwood *(Plagianthus regius)* - Rewarewa *(Knightia excelsa)* - Tawa *(Beilschmeidia tawa)* - Titoki *(Alectryon excelsus)* - Tree Ferns *(Cyathea medullaris & cunninghamii)* **Shrubs and understorey tree species:** - Cabbage tree *(Cordyline australis)* - Five Finger *(Pseudopanax arboreus)* - Karamu *(Coprosma robusta)* - Koromiko *(Hebe stricta)* - Kowhai *(Sophora chathamica)* - Mahoe *(Melicytus ramiflorus)* - Ngaio *(Myoporum laetum)* - Pittosporum sp. *(P. euginoides & tenufolium)* - Puka *(Griselinia littoralis)* **Low shrubs/ ground cover:** - Carex sp. *(C. secta, dissita & virgata)* - Coprosma sp. *(e.g. Coprosma propinqua)* - Flax *(Phormium cookianum)* - Olearia sp. *(Olearia solandri)* - Tauhinu *(Ozothamnus leptophyllus)* - Toe toe *(Cortaderia fulvida)*

Landscape Character Area (Route Section)	Vegetation and Landform Character	Pattern of Enclosure/ Openness and Views	Design Response	Indicative plant species
Porirua East (Section 8 & 9)	Steep sided Cannons Creek valley and moderately sloping, north-facing Porirua backdrop hills. Mixture of pine plantation; shelter belts; wildling pines; native remnant/ regeneration; and rough pasture.	**Semi Enclosed** – Sequence of enclosed cuttings and open views to the north across Porirua basin. Several large box cuttings and Cannons Creek valley establishing key nodes/ thresholds along the route.	Rehabilitate cut and fill batters with species that complement existing native vegetation patterns. Enrich existing areas of native remnant/ revegetation on the downhill side of highway to enhance ecological corridor . Mitigate for adverse visual effects resulting from cut faces through selection and placement of vegetation.	**Canopy species:** - Kanuka *(Kunzea ericoides)* - Kohekohe *(Dysoxolum spectabile)* - Nikau *(Rhopalostylis sapida)* - Northern rata *(Metrosideros robusta)* - Rimu *(Dacrydium cupressinum)* - Tawa *(Beilschmeidia tawa)* - Tree Ferns *(Cyathea medullaris & cunninghamii)* **Shrubs and understorey tree species:** - Cabbage tree *(Cordyline australis)* - Five Finger *(Pseudopanax arboreus)* - Karamu *(Coprosma robusta)* - Kawakawa *(Macropiper excelsum)* - Koromiko *(Hebe stricta)* - Mahoe *(Melicytus ramiflorus)* - Ngaio *(Myoporum laetum)* - Pittosporum sp. *(P. euginoides & tenufolium)* - Puka *(Griselinia littoralis)* - Wineberry *(Aristotelia serrata)* **Low shrubs/ ground cover:** - Asplenium species *(e.g. A. oblongifolium, bulbifernum & hookerianum)* - Astelia sp. *(A. fragrans)* - Blechnu m sp *(e.g. B. novae-zelandiae, fluviatale & filiforme)* - Carex sp. *(C. secta, dissita & virgata)* - Coprosma sp. *(e.g. Coprosma propinqua)* - Flax *(Phormium cookianum)* - Olearia sp. *(Olearia solandri)* - Tauhinu *(Ozothamnus leptophyllus)* - Toe toe *(Cortaderia fulvida)*

5.9 Section 9 – Linden

5.9.1 Local context

Topography, geology and hydrology

Section 9 is characterised by:

Moderately steep northeast- and then northwest-facing flanks of broad ridge top, crossing a number of deep gullies in rough pasture and scrub to plantation pine at the southern end, and culminating in the gentle slopes of the Porirua Stream valley at SH1 Linden.

Landscape features

The landscape features of note in this section are as follows:

- Cannons Creek – Ranui Heights: Southern perimeter of Porirua East basin. Rolling to steep hills, backdrop to suburban areas of Cannons Creek and Ranui Heights. Characterised by mosaic of remnant native bush (Gillies Bush Reserve), regenerating gorse and tauhinu scrub, rough pasture, small plantations and wilding pines. Structures include Porirua Gun Club shooting range, and two minor transmission lines (110kV, single circuit pole lines); and
- Linden: Existing SH1 motorway and North Island Main Trunk Railway corridor following north-south alignment along Porirua Stream valley. Tawa and Linden suburban areas aligned along the valley.

Significant views and landmarks

For Wellington bound (southbound) traffic, the Linden interchange and tie-in with the existing SH1 will provide the first contact with the urban areas of Porirua and Wellington after the remote country traversed by the highway.

For northbound traffic, the transition between the urban environment and the seemingly remote hill country will be dramatic.

The threshold between these two very different environments will form a natural gateway and should be celebrated through the design of structures, earthworks and landscape proposals.

Land uses

This section is bounded by the residential areas of Cannons Creek and Ranui Heights to the north, with forestry and rural land uses to the south and east.

West of the alignment is the suburb of Linden which is predominantly residential with associated uses such as schools and a limited number of commercial activities. Linden Primary School adjoins the existing SH1 and proposed Transmission Gully Project alignment. Tawa Intermediate and Tawa College also adjoin the existing motorway further south.

North-west of Linden is a commercial and light industrial area sandwiched between Kenepuru Drive and the railway line.

East of the alignment and south of Collins Avenue is the residential area of Greenacres.

District Plan Zones

This section of the alignment is split between Porirua City and Wellington City. The alignment crosses or is within proximity of a number of land use zones:

- The eastern part of the alignment sits within Porirua's 'Rural' zone;
- The alignment crosses a section of Porirua Park which is partly zoned for 'Recreation' and partly for 'Open Space' in Porirua's District Plan;
- The alignment runs south of the Cannons Creek and through the southern, undeveloped, part of Ranui Heights both of which are zoned 'Suburban' in Porirua's District Plan;
- The Kenepuru Interchange is located within land zoned 'Rural' in Porirua's District Plan;
- The Kenepuru Link Road traverses land zoned 'Rural', 'Suburban' and 'Industrial' in Porirua's District Plan. In the vicinity of the alignment, the land contained between the railway line and Kenepuru Drive is generally zoned 'Industrial' in Porirua's District Plan, except for a strip of open space zoned partly 'Recreation' and partly 'Open Space' located north of the junction of the link road with Kenepuru Drive;
- The southern end of the alignment is within Wellington City's jurisdiction. Under Wellington City District Plan the land east of the alignment is zoned 'Rural' to the north of Collins Avenue and 'Outer Residential' to the south; and
- West of the alignment, the land in Linden is predominantly zoned 'Outer Residential' under Wellington City District Plan.


Photo 5.26: Collins Avenue bridge (SH1 above)


Photo 5.27: Keneperu Drive, Linden


Photo 5.28: Linden Primary School

Figure 5.68: Section 9 Existing condition

Connections

Local roads

The Transmission Gully Project main alignment will connect with Kenepuru Drive via a grade separated interchange and link road. The link road will be designed to transition from the motorway environment to the local road network.

Pedestrian network

Along Kenepuru Drive, pedestrian footpaths are currently only provided along the eastern side of the road. The design of the Kenepuru Drive / link road junction will need to provide for the safe movement of pedestrians.

The existing SH1 bridge spanning over Collins Avenue will need to be replaced as part of the Project. This offers an opportunity to provide improved pedestrian and/ or cycle facilities under the new bridge. At present, a pedestrian footpath is provided under the bridge on the southern side of Collins Avenue only, adjacent to Linden Primary School.

There is an informal pedestrian path from the end of Raroa Terrace through to Collins Ave bridge on embankment above SH1 (east of alignment). This access feeds through to Mahoe Park area via formal pedestrian lane between Raroa Terrace and Mahoe Street. The Project offers the potential to formalise this link.

Cycle network

Kenepuru Drive is part of the Regional Cycling Network identified in the Regional Cycling Plan (GWRC 2008). As is the case for all other motorways, cyclists are not permitted along the existing SH1 south of Porirua. This makes Kenepuru Drive the only flat option for cyclists heading towards Linden, Tawa and Wellington (some 20km away) from Porirua city centre. There are currently no formal cycle lanes or paths along Kenepuru Drive and cyclists share the carriageway with vehicles or use the road shoulders. The design of the Kenepuru Drive / link road junction will need to provide for the safe movement of cyclists.

As stated above, the replacement of the Collins Avenue bridge opens up opportunities for improved pedestrian and cycle facilities. At present, there are no formal cycle lanes under this bridge.

5.9.2 Design issues and objectives

Table 5.17: Section 9 Linden – Design issues and objectives

DESIGN ISSUES	DESIGN OBJECTIVES
Integration in the landscape & response to Landscape Character	
There are two distinct character areas within Section 9: ■ North of the Linden Interchange the Section is characterised by steep to rolling hills that form the backdrop to the Eastern Porirua Basin, including Ranui Heights. ■ Vegetation consists of a mosaic of regenerating native bush and shrubland (mainly in the Cannons Creek valley), regenerating scrub, rough pasture, and exotic shelter belts. ■ The area to the south of the Linden Interchange is characterised by mainly residential, with light industrial and commercial activities along the rail corridor and Kenepuru Drive. There are also several schools in the vicinity of the interchange and adjacent to the existing highway.	■ Ensure that existing well-established native vegetation is retained wherever possible and seek to reinforce existing vegetation patterns following construction. ■ Seek to limit the overall footprint and prominence of the road to ensure that the largely undeveloped 'green' matrix of the backdrop hills is maintained. ■ Ensure that the overall footprint and character of the proposed road and associated bridges merge with the existing environment and seek to limit encroachment into adjoining land.
Adjoining land use and amenity	
■ The project requires the widening of the existing motorway on the approach to TG at Linden. The road reserve is contiguous with Linden Primary School in this location	■ Widen road on the eastern side only and retain current road position in relation to Linden Primary School. ■ Introduce landscape treatment along the edge of Linden School in a manner that is consistent with noise barrier and property edge treatments along this section of the route.
■ Amenity of properties in Linden: Residential properties along Tremewan Street west of SH1 will be impacted by road widening.	■ Where properties are removed to accommodate road widening, a suitable landscaped buffer (e.g. vegetation, bunds, fences or a combination) should be provided to ensure amenity levels are maintained or enhanced for those properties that are retained. ■ Consider the effects that the construction and ongoing presence to Linden Interchange and Kenepuru Link road may have on existing amenity levels and seek to mitigate through the use of appropriate structural or planting measures.
■ The widening of the existing motorway has the potential to impact the amenity of Arthur Carman Park.	■ The introduction of a landscape buffer along the boundary of the Park shall be undertaken if the widening affects the amenity values of the Park.

DESIGN ISSUES	DESIGN OBJECTIVES
▪ Amenity of properties in Greenacres: Existing properties on Little Collins Ave and Rangatira Road will be impacted by road widening and the Linden Interchange in general.	▪ Where properties are removed to accommodate road widening, a suitable landscaped buffer (e.g. vegetation, bunds, fences or a combination) should be provided to ensure amenity levels are maintained or enhanced for those properties that are retained. ▪ Consider the effects that the construction and ongoing presence to Linden Interchange and Kenepuru Link road may have on existing amenity levels and seek to mitigate through the use of appropriate structural or planting measures. ▪ Ensure views from elevated properties are considered in developing future detailed landscape design responses and mitigate where required.
▪ Amenity of properties in Ranui Heights: Existing properties on Ernest Street; Gillies Place; Ash Grove; Japonica Crescent; and Apple Crescent may be impacted by the new Alignment and Kenepuru Link Road.	▪ Ensure that a buffer of existing vegetation (predominantly pine trees) is retained during construction and additional planting carried out post-construction to ensure existing amenity levels are retained to the highest degree possible.
▪ The widening of the existing motorway has the potential to impact the amenity of Mahoe Park.	▪ Provide landscaped buffer along park boundary or within road reserve where required to maintain existing amenity levels.
▪ Design and placement of Kenepuru Link Road bridge to fit with existing buildings.	▪ The location of the bridge piers should not compromise the usability of the building below.
Visual Experience	
▪ The Linden Interchange and the sections to the north and south will be located on the hill slopes that provide the backdrop to views from Porirua East and Tawa respectively.	▪ Consider the timing and physical extent of construction associated with these areas with the view to limiting the potential adverse effects on existing outlooks. ▪ Design landscape treatments to reflect and reinforce existing landscape patterns whilst considering the mitigation of potential adverse effects on existing outlooks. ▪ Where possible retain a buffer of existing vegetation to avoid and/ or mitigate potential adverse visual effects on properties in Ranui Heights. ▪ Ensure design development and subsequent design responses consider the high visibility of this area and the potential to increase the overall amenity through high quality design resolution.
▪ The proposed fly-over above part of SH1 will be highly visible to southbound road users.	▪ Design fly-over to respond to its high visibility location. ▪ In particular, design substructure to be simple and neat. Avoid fussy details which may not be visible at speed or could distract drivers.

DESIGN ISSUES	DESIGN OBJECTIVES
▪ The visual experience for south bound travellers will be one of relatively confined (box cuts) decent across the Porirua Backdrop Hills with fleeting glimpses to the north across from fill embankments. The large box cuts at 25000m and 25600m will be visible from south Cannons Creek and will be landmarks along the route. Views above Ranui Heights will be across Porirua CBD and harbour and the Linden box cut will also be a landmark feature.	▪ Ensure that views to the wider landscape for south bound travellers are retained through the careful selection and placement of adjoining vegetation. ▪ Ensure the design and placement of road furniture does not detract from the visual experience of road uses.
▪ The visual experience for north bound travellers will be one of unfolding views that ascend from existing SH1 through the Linden box cut to the Porirua Backdrop Hills and on up to Cannons Creek. Travellers will be on the 'outside' lane so views across the Porirua Basin will be relatively unobscured by other traffic and street furniture such as central median barriers.	▪ Ensure that views to the wider landscape for north bound travellers are retained through the careful selection and placement of adjoining vegetation. ▪ Ensure the design and placement of road furniture does not detract from the visual experience.
Biodiversity and ecology	
▪ The alignment requires some vegetation removal for road construction and operation.	▪ Minimise the removal of indigenous vegetation through sensitive route alignment and construction methodology, including the location of haul roads and construction tracks.
Local connectivity / severance	
▪ Kenepuru Drive is part of regional cycle network and an important access route for pedestrians travelling north - south. The design of the new Keneperu Drive intersection with link road has the potential to impact on these users.	▪ Provide safe pedestrian and cycle facilities at the intersection of the Link Road and Kenepuru Drive.
▪ Access under Collins Ave bridge is a key pedestrian and cycle connection point under SH1 for those residents east of motorway.	▪ Provide adequate and safe access for pedestrians and cyclists under new Collins Ave Bridge, including: - Pedestrian path on southern side of Avenue. - Sufficient distance between bridge supports for future pedestrian path on northern side of Avenue. - Sufficient road space in road shoulders for cyclists. ▪ Design bridge underside to provide high level of amenity for pedestrians and adequate levels of visibility and lighting for personal safety.
▪ Existing informal pedestrian access from end of Raroa Terrace through to Collins Ave bridge on embankment above SH1 (east of alignment). This access feeds through to Mahoe Park area via formal pedestrian lane between Raroa Terrace and Mahoe Street.	▪ Formalise access path and integrate new safety fence with bank steepening and noise barriers.

DESIGN ISSUES	DESIGN OBJECTIVES
Noise	
■ Noise barriers required along existing SH1 to reduce road-traffic noise to appropriate levels.	■ Two to three metre high noise walls required as shown on Figure 5.73.
Drainage	
■ There may be an opportunity to connect part of the proposed alignment's stormwater treatment into Wellington City Council's existing stormwater systems.	■ Ensure efficient and effective treatment of stormwater runoff occurs.

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5.9.3 Design proposals

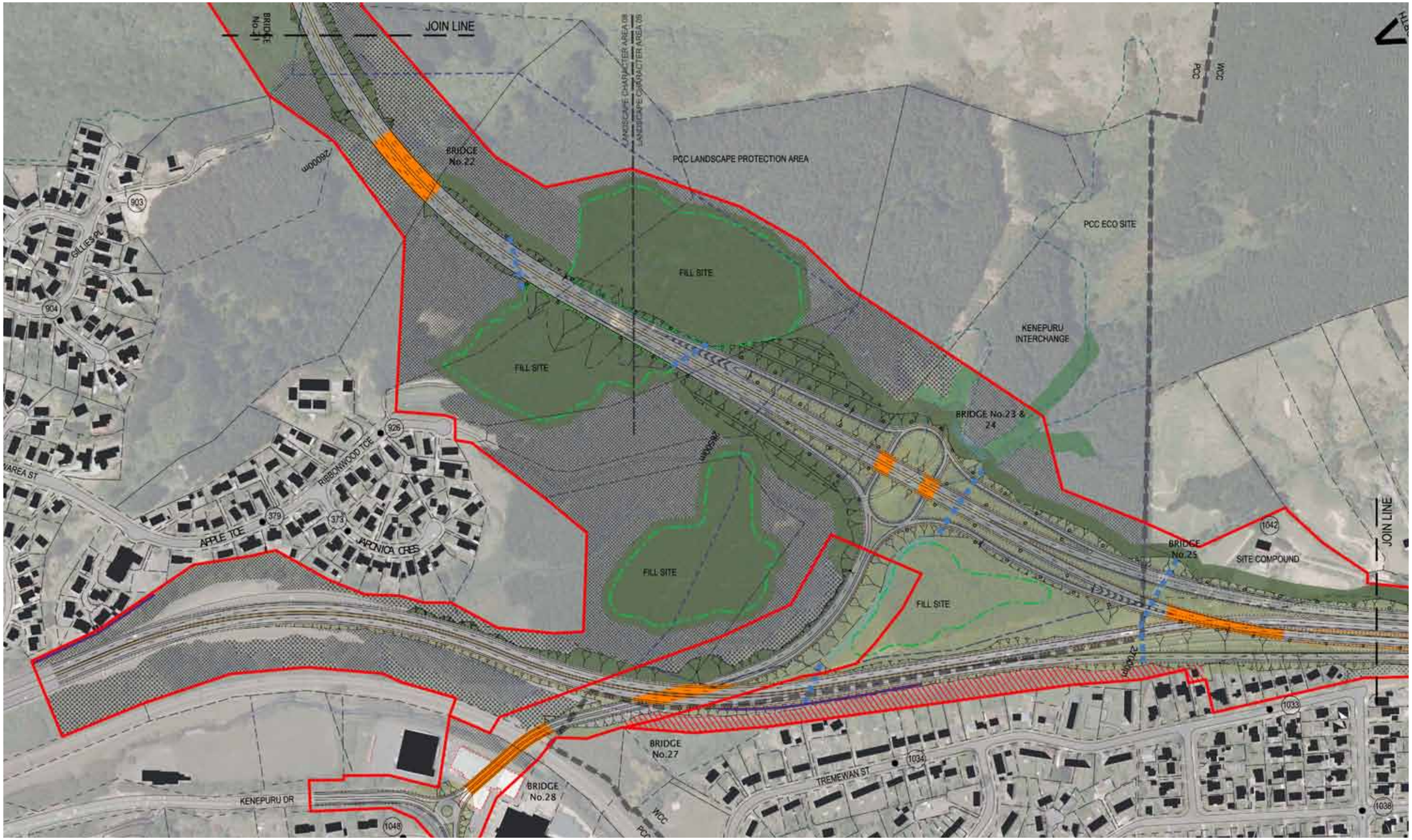

Figure 5.69: Section 9 Design proposals

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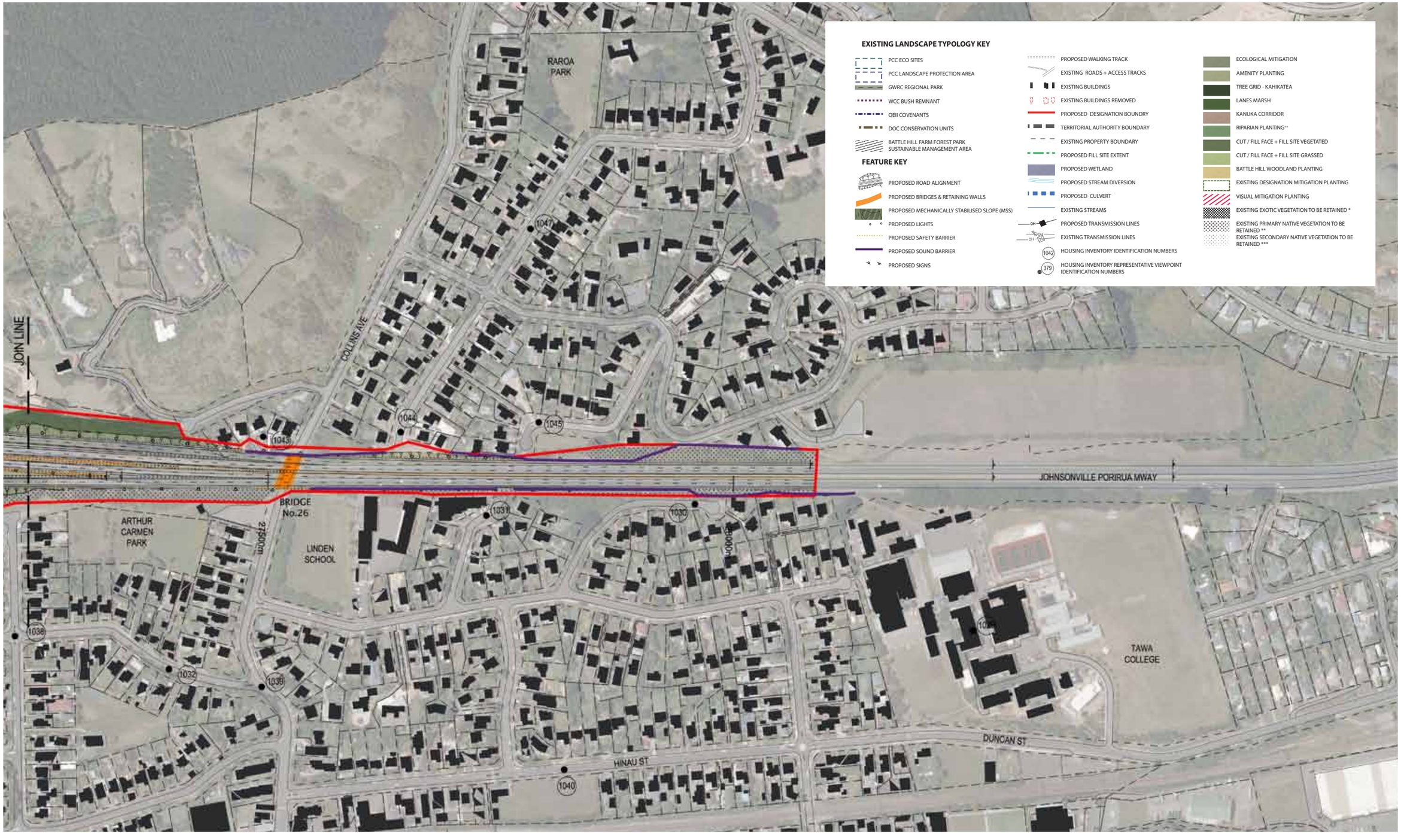

EXISTING LANDSCAPE TYPOLOGY KEY

- PCC ECO SITES
- PCC LANDSCAPE PROTECTION AREA
- GWRC REGIONAL PARK
- WCC BUSH REMNANT
- QEII COVENANTS
- DOC CONSERVATION UNITS
- BATTLE HILL FARM FOREST PARK SUSTAINABLE MANAGEMENT AREA

FEATURE KEY

- PROPOSED ROAD ALIGNMENT
- PROPOSED BRIDGES & RETAINING WALLS
- PROPOSED MECHANICALLY STABILISED SLOPE (MSS)
- PROPOSED LIGHTS
- PROPOSED SAFETY BARRIER
- PROPOSED SOUND BARRIER
- PROPOSED SIGNS
- PROPOSED WALKING TRACK
- EXISTING ROADS + ACCESS TRACKS
- EXISTING BUILDINGS
- EXISTING BUILDINGS REMOVED
- PROPOSED DESIGNATION BOUNDRY
- TERRITORIAL AUTHORITY BOUNDARY
- EXISTING PROPERTY BOUNDARY
- PROPOSED FILL SITE EXTENT
- PROPOSED WETLAND
- PROPOSED STREAM DIVERSION
- PROPOSED CULVERT
- EXISTING STREAMS
- PROPOSED TRANSMISSION LINES
- EXISTING TRANSMISSION LINES
- HOUSING INVENTORY IDENTIFICATION NUMBERS (1042)
- HOUSING INVENTORY REPRESENTATIVE VIEWPOINT IDENTIFICATION NUMBERS (379)
- ECOLOGICAL MITIGATION
- AMENITY PLANTING
- TREE GRID - KAHIKATEA
- LANES MARSH
- KANUKA CORRIDOR
- RIPARIAN PLANTING**
- CUT / FILL FACE + FILL SITE VEGETATED
- CUT / FILL FACE + FILL SITE GRASSED
- BATTLE HILL WOODLAND PLANTING
- EXISTING DESIGNATION MITIGATION PLANTING
- VISUAL MITIGATION PLANTING
- EXISTING EXOTIC VEGETATION TO BE RETAINED *
- EXISTING PRIMARY NATIVE VEGETATION TO BE RETAINED **
- EXISTING SECONDARY NATIVE VEGETATION TO BE RETAINED ***

Earthworks

24900 – 26200m 'Porirua East'

This stretch of the alignment comprises a series of cuttings and embankments across the backdrop hills of urbanised Cannons Creek and Porirua East.

The road is mostly in cutting; two of which are large: The cutting at 25000m has batters up to approximately 25m / 35m high, and the very large cutting at 25600m has batters up to 30m / 55m. By contrast the embankments are short and located across steep gullies. There are two bridges across short valleys.

The following design principles apply:

- Refine the detail design of the large cut batters with a view to avoiding the top benches by easing the slopes of the top batters; and
- Apply the general design principles for cut batters in steep topography presented in chapter 4.

Figure 5.70: Section 9 Kenepuru Interchange Earthworks - View to North-east

26200-27700m 'Kenepuru Interchange and Connection with SH1 at Linden'

South of the ridge at 26200m, the alignment will be within a deep cutting through the ridge with batters up to 20m / 40m high. This part of the route comprises the Kenepuru Interchange connecting with the Kenepuru Link Road to western Porirua, and the connection with the existing SH1 at Linden.

The Kenepuru Interchange is located on the hill above Linden at 26700m. The Interchange is located in a small valley so that the Main Alignment will pass over the roundabout connecting with the Kenepuru Link Road.

The Main Alignment will descend the hill between the Kenepuru Interchange and the connection with the existing SH1 by means of relatively shallow cuttings and embankments.

The Main Alignment will merge with the existing SH1 along the Tawa Straight. The southbound Main Alignment lanes will merge from the left with existing SH1. Traffic joining the Main Alignment in a northbound direction will be elevated on a curving flyover bridge over the existing southbound SH1 carriageway. Traffic continuing to Porirua will take a left lane exit from the existing SH1.

The connection with the existing SH1 at Linden will require widening of the existing corridor along the Tawa straight, mostly on the eastern side and including doubling the width of the bridge over Collins Avenue.

Potential spoil disposal sites are located as follows:

- The gully up and downhill of the embankment at 26300m.
- The valley and spur to the NW of the box cut at 26500m, between the Kenepuru Interchange and Ranui Heights.
- The triangle of land on the hillside between the Kenepuru Link Road and existing SH1.

Figure 5.71: Bridges 23 and 24 Kenepuru Interchange - 4 lane highway + on & off ramps LS16 - Location 26680m

The Kenepuru Link Road will descend across the hillside north-west of the Kenepuru Interchange with large side batters on the downhill and uphill sides respectively. An underpass will carry the Link Road under the existing SH1. A curved bridge will carry the Link Road over Kenepuru Stream and NIMT Railway, to an intersection with Kenepuru Drive in western Porirua. The existing SH1 will be raised by approximately 3m in order to provide sufficient clearance under the SH1 underpass. The existing SH1 alignment will also be fine-tuned in order to ease the curve opposite Ranui Heights resulting in the road being moved a little further away from adjacent properties in Apple Terrace and Japonica Crescent.

The following design principles apply:

- Refine the detail design of the large cut batters east of the Kenepuru Interchange with a view to avoiding the top benches by easing the slopes of the top batters;
- Apply the general design principles for cut batters in steep topography presented in chapter 4; and
- Implement a sculptured earth form in the triangular area between the Kenepuru Link Road, Main Alignment and the existing SH1 motorway to provide a landmark feature.

Spoil disposal site

While gully sites are avoided where there are alternatives, two of the spoil disposal sites near Linden are located in valleys adjacent to the alignment. In these instances the watercourses are short and catchments small and the land already modified by the existing forestry. It is considered these sites are the most sensible option in the vicinity.

In addition, the disposal site in the triangle between the new alignment, the Kenepuru Link Road and the existing SH1 motorway has been identified as a potential large scale earth sculpture which would help create a landmark feature near the interchange.

Collins Avenue bridge - Bridge 26

This bridge will be visible at close range by pedestrians, cyclists and road users passing underneath it. It will also be visible from Arthur Carman Park and the surrounding community. Natural light, pedestrian amenity and personal safety are key considerations in the design of the bridge. For these reasons, special consideration must be given to the design and detailing of the bridge soffit, internal walls, retaining walls and side barriers. In particular:

- In order to achieve an elegant and simple bridge elevation, extend side barrier skirt down to cover full depth of bridge deck (both hollowcore units and reinforced concrete topping slab);
- The detailed design of the side barriers (to be developed during the Outline Plan of Works phase) could include architectural lines or three dimensional treatment but should avoid applied surface motifs. The design of side barriers must be consistent with the corridor-wide landscape concept, in particular, the emphasis on horizontal lines, sharp edges and avoidance of ornamentation;
- The gap between the bridge elevation and MSE retaining wall must be minimised, subject to constructability and cost considerations;
- Corbels should not be located on the visible side of the abutment wall in order to achieve a neat internal corner and to facilitate the installation of light fittings and wall / soffit treatments;
- The surface of the abutment walls should have good design, detailing and finish, and present a high quality aspect to the road and footpath. Opportunities for involving the school children and a local artist in the design of the abutment walls should be explored in consultation with the school. The design could include precast concrete fascia panels, extruded metal panels or mosaic. Feature lighting should be considered as part of the design of the abutment walls;
- Lighting fittings should be carefully located on the soffit or abutment walls to achieve a neat arrangement, and the cabling concealed from view; and
- The noise walls running along the eastern side of SH1 must be integrated with the design of the bridge and side barrier. This could be achieved by using an 'F' shape concrete barrier with extended top to required height to provide acoustic mitigation.

Figure 5.72: Bridge 26 Collins Avenue Bridge Elevation

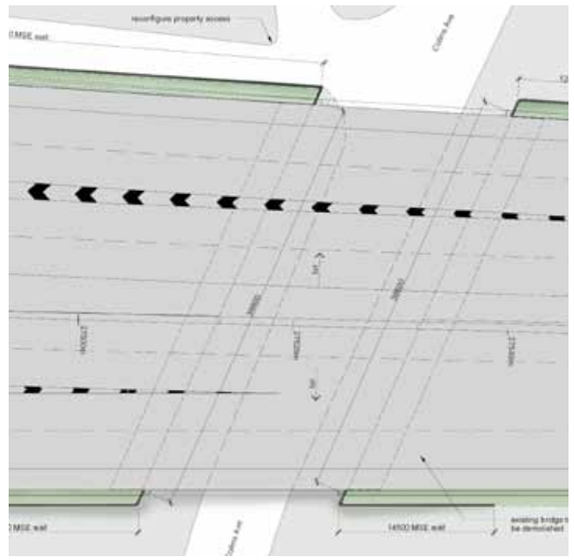

Figure 5.73: Collins Avenue Bridge Plan View

Kenepuru Link Road bridge - Bridge 28

This bridge will be most visible to rail users and pedestrians walking along the proposed pedestrian path along Kenepuru Stream. For these reasons, consideration must be given to the overall form of the bridge, the selection of the structural system, the design of the bridge underside, the shape of the piers, the design of bridge barriers and the layout of lighting columns.

More specifically:

- The proposed structural system is a super-T concrete girders with reinforced concrete deck slab. A single pier design is preferred over twin piers;
- Seek to achieve simple, slick and uncluttered underside;
- Drainage pipes are to be concealed from view;
- Balance bridge spans as much as practicable;
- Lighting columns are to line up with the piers or otherwise be laid out in a logical way in relation to the geometry of the bridge;

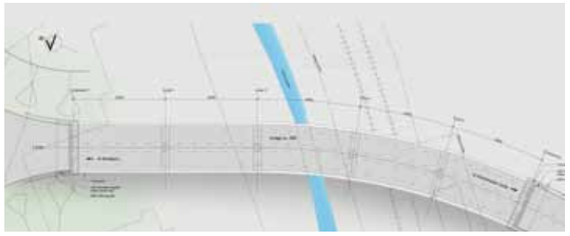

Figure 5.74: Kenepuru Link Road bridge plan

- A shared pedestrian and cycle path will run under the northern end of the bridge, alongside the abutment wall. The abutment should feature vertical MSE walls with good detailing and high quality finishes as this will be viewed at close range and low speed by the users of the shared path. If needed, lighting of the shared path should be integrated with the design of the bridge and abutment.

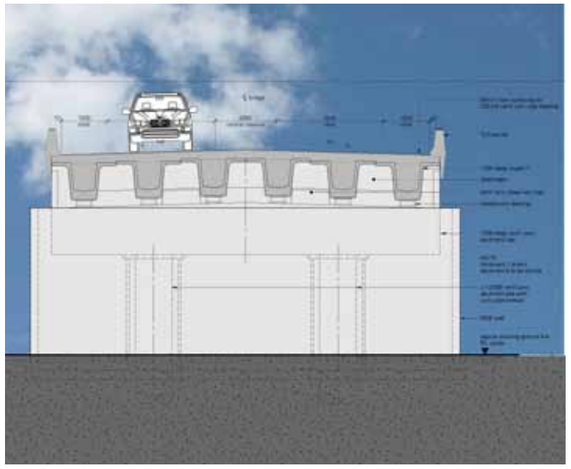

Figure 5.75: Bridge 28 Single pier cross-section

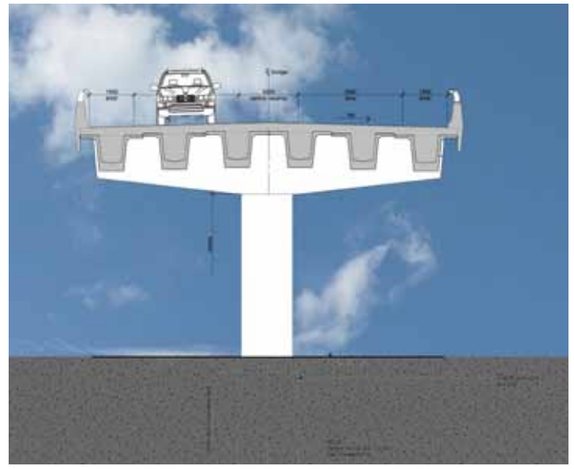

Figure 5.76: Bridge 28 Twin pier cross-section

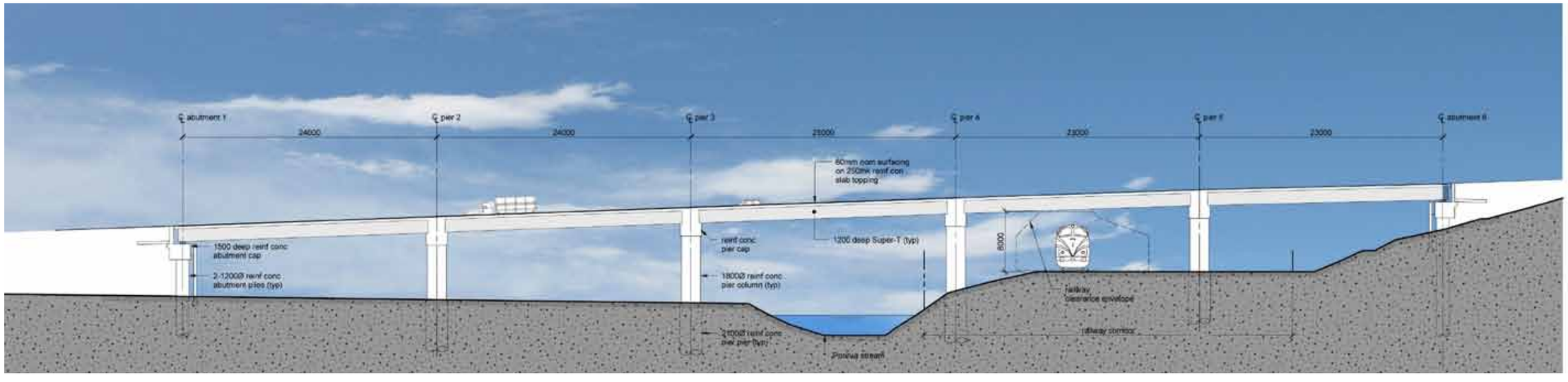

Figure 5.77: Bridge 28 Kenepuru Link Road bridge elevation

Kenepuru Link Road underpass - Bridge 27

This underpass will be most visible to road users entering or exiting the new highway at Linden. As such, the structure will form an important gateway into Porirua City. For this reason, consideration must be given to natural light penetration, minimising any 'tunnel effect' and the treatment of internal walls and ceiling.

The proposed structural system consists of precast concrete walls supporting a prestressed beam and concrete slab deck. The deck slab is proposed to only cover the area directly below the old SH1 above, leaving parts of the beams 'free-standing' above the new road at either end of the underpass (see figure 7.78). Where the structure extends beyond the road above, concrete walls will be substituted with discrete columns. This pergola-like arrangement will bring daylight in from either portals. This has the following advantages:

- It will increased natural lighting when compared with a fully roofed system;
- It will help minimise the perceived length of the underpass and associated 'tunnel effect';
- It will reduce the contrast between the level of lighting outside and inside the underpass, thus reducing glare and improving driver safety; and
- It will enhance diver experience and route legibility by creating a memorable 'event' along the journey.

The following design considerations apply:

- The internal surfaces of the underpass (walls and ceiling) should have simple uncluttered design and clean smooth finishes;
- Lighting (if needed) should be integrated in the internal design of the underpass and wiring ducts concealed;
- The exposed beams and columns should have good detailing and clean smooth finishes; and
- The use of a feature lighting to highlight the "pergola" feature should be considered.

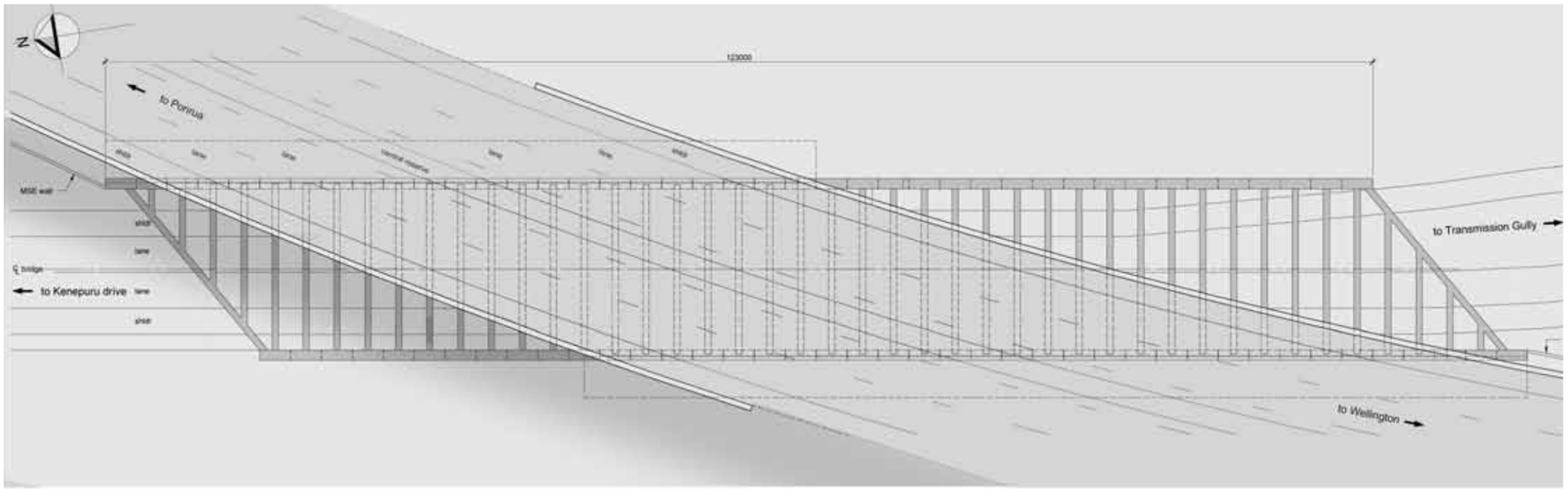

Figure 5.78: Bridge 27 Kenepuru Link Road underpass - Plan view

Figure 5.79: Grafton Gully structure similar to Bridge 27

Linden Fly-over - Bridge 25

This bridge will be highly visible to traffic travelling south along the old SH1 as the bridge crosses the highway at a skewed angle and rises towards incoming traffic. Special consideration must be given to the selection of the structural system given the highly visible underside of the bridge and to the shape of the piers. In particular:

- The proposed structural system is a single steel box girder with reinforced concrete deck slab. This structural system provides a simple, slick underside and simplified pier / girder connections;
- The piers should have good detailing and clean, smooth finish;
- In order to achieve an elegant and well proportioned bridge elevation, extend side barrier skirt down, consistent with the other proposed bridges at Linden;
- The surface of the abutment walls should have good design, detailing and finish, and present a high quality aspect to the road.

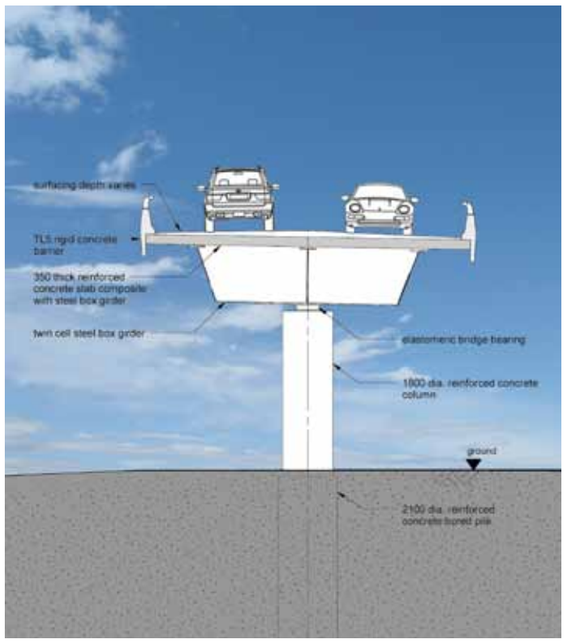

Figure 5.80: Bridge 25 Linden Fly-over cross-section

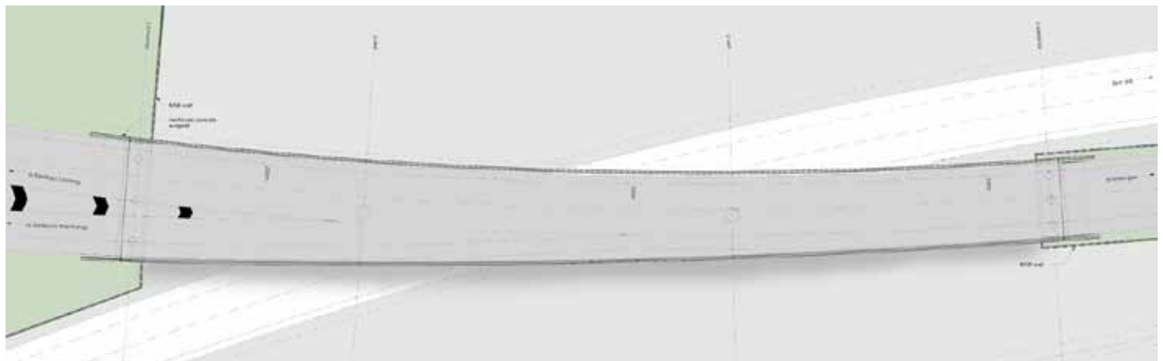

Figure 5.81: Bridge 25 Linden Fly-over plan

Kenepuru Interchange - Bridges 23 and 24

These two bridges will be most visible to road users approaching the motorway from the Kenepuru Link Road. The design of MSE walls, bridge barriers and landscape treatment of the roundabout will be the most noticeable features of the interchange.

- In order to achieve an elegant and simple bridge elevation, extend side barrier skirt down to cover full depth of bridge deck (both hollowcore units and reinforced concrete topping slab);
- The detailed design of the side barriers (to be developed during the Outline Plan of Works stage) could include three dimensional or textural treatment but should avoid applied surface motifs. The design of side barriers must be consistent with the corridor-wide landscape concept, in particular, the emphasis on horizontal lines, sharp edges and avoidance of ornamentation; and
- The gap between the bridge elevation and MSE retaining wall must be minimised, subject to constructability and cost considerations.

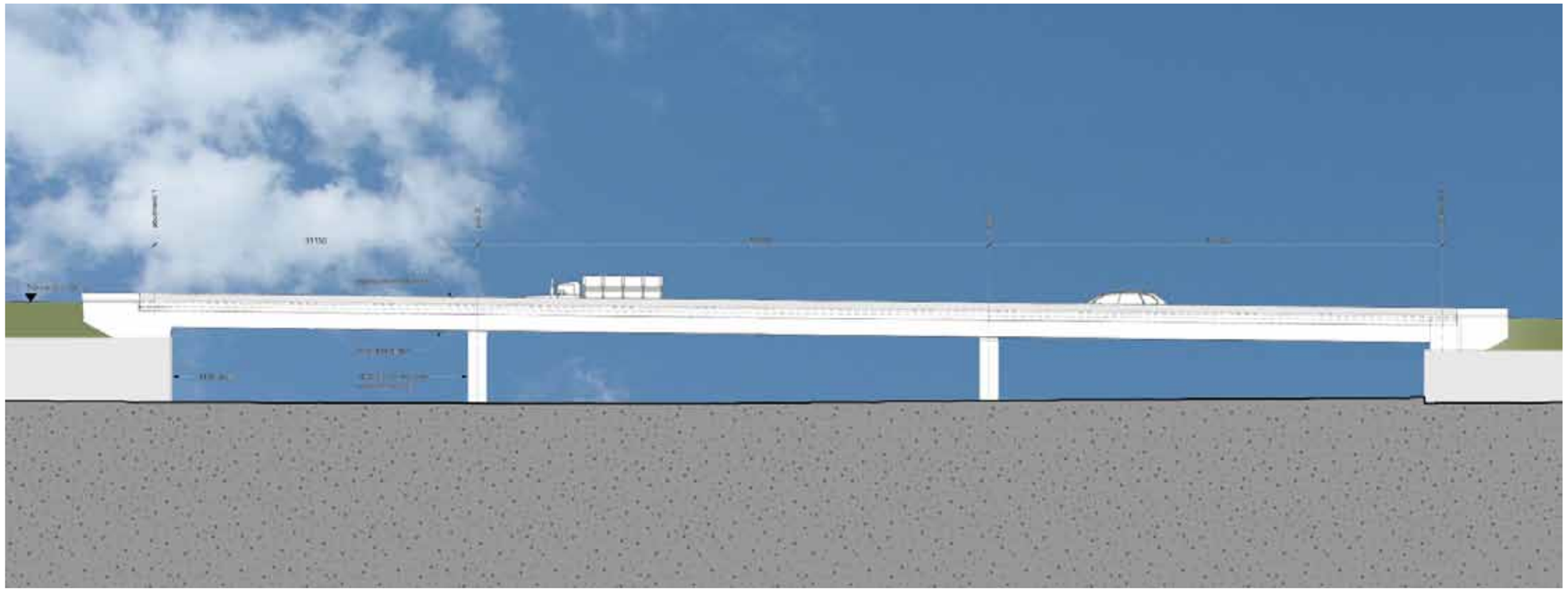

Figure 5.82: Bridge 25 Linden Fly-over elevation

Noise barriers

A number of properties require noise mitigation measures along the altered parts of the existing SH1, as shown on Figure 5.83:

Ranui Heights

- A noise wall is recommended to shield four residential properties off Apple Terrace in Ranui Heights;
- Given the elevation of the properties above the existing highway, a noise wall sitting on the property boundary is the most appropriate solution;
- The noise wall will be 2m high at its southern end and 3m at its northern end (as per acoustic assessment and subsequent consultation with property owners). The transition between the two different heights should be designed to be gradual and take advantage of topographical variations to present a coherent overall aspect to road users;
- The noise wall should take the form of a timber fence, in keeping with the local suburban character. The finish of each side of the wall should respond to the highway or suburban garden context; and
- The road side of the wall should be planted to partly screen the wall from the road, integrate with the surrounding vegetation and deter graffiti.

Tremewan Street

- A 2m high noise bund is recommended to shield three residential properties at the northern end of Tremewan Street; and
- The noise bund should be profiled and landscaped to integrate with the adjoining landform and planting.

Greenacres

- Noise walls are recommended to shield a number of residential properties on Little Collins Street, Raroa Terrace, Mahoe Street and Allen Terrace;
- Given the varied topography, the walls will either follow the property boundaries when properties sit high above the road, or follow the road edge where properties are level with or below the road. The transitions from property boundary to roadside should be gradual to avoid visually jarring changes of direction;
- The walls will generally be 2m high but the southern end will be 2.5m high (as per acoustic assessment and subsequent consultation with property owners). The vertical transition between walls of different heights is to be gradual and take advantage of the topography. This may involve tapering or separation and overlapping the different height walls but should avoid abrupt change;
- The alignment of the noise wall between Raroa Terrace and Collins Avenue will allow space for the existing informal walkway to be formalised and realigned, as per agreement with WCC;
- The Greenacres and Linden noise walls on either side of SH1 will be seen together by road users and should therefore be designed as a whole composition in terms of materials, architectural design and landscape treatment;
- The road side of the wall should be planted to partly screen the wall from the road, integrate with the surrounding vegetation and deter graffiti;
- A 2m high noise wall is recommended along the eastern edge of Collins Ave bridge. The noise wall should be architecturally designed to integrate with the design of the bridge and side barriers and to minimise its visual impact when seen from Collins Avenue below and from SH1 itself. To maintain the legibility of the bridge, the use of a transparent noise wall above the bridge barrier should be considered. As a minimum, the noise wall should be integrated with the bridge side barrier by extending the top of the concrete barrier to 2m with appropriate architectural treatment; and
- The transition between the bridge noise wall and the adjoining sections of noise wall should be architecturally designed and avoid simply butting one type of wall against another. The bridge noise wall could be extended north and south of Collins Avenue bridge to overlap with the adjoining noise walls, if these are to be different in design.

Linden

- A continuous noise wall is recommended to shield Linden Primary School and a number of residential properties on South Street and Ranui Terrace;
- The height of the noise wall will vary from 3m along Linden Primary School, to 2m between Matai Street and the end of South Street , to 2.5m and 3m at the southern end of Ranui Terrace (as per acoustic assessment and subsequent consultation with property owners). The vertical transition between walls of different heights is to be gradual and take advantage of the topography. This may involve tapering or separation and overlapping the different height walls but should avoid abrupt change;
- The wall will generally be located along the road edge except for a gradual transition to the property boundaries south of South Street;
- The Greenacres and Linden noise barriers on either side of SH1 will be seen together by road users and should therefore be designed as a whole composition in terms of materials, architectural design and landscape treatment;
- The road side of the wall should be planted to partly screen the wall from the road, integrate with the surrounding vegetation and deter graffiti; and
- The school face of the wall should have good design, detailing and finish, and present a high quality aspect to the school grounds. Opportunities for involving the school children and a local artist in the design of that face should be explored in consultation with the school. Landscape planting should be provided on the school side of the wall, to be agreed with the school at the Outline Plan of Works stage.

Photo 5.30: Concrete side barrier extended to act as noise wall

Photo 5.31: Concrete noise wall combined with side barrier

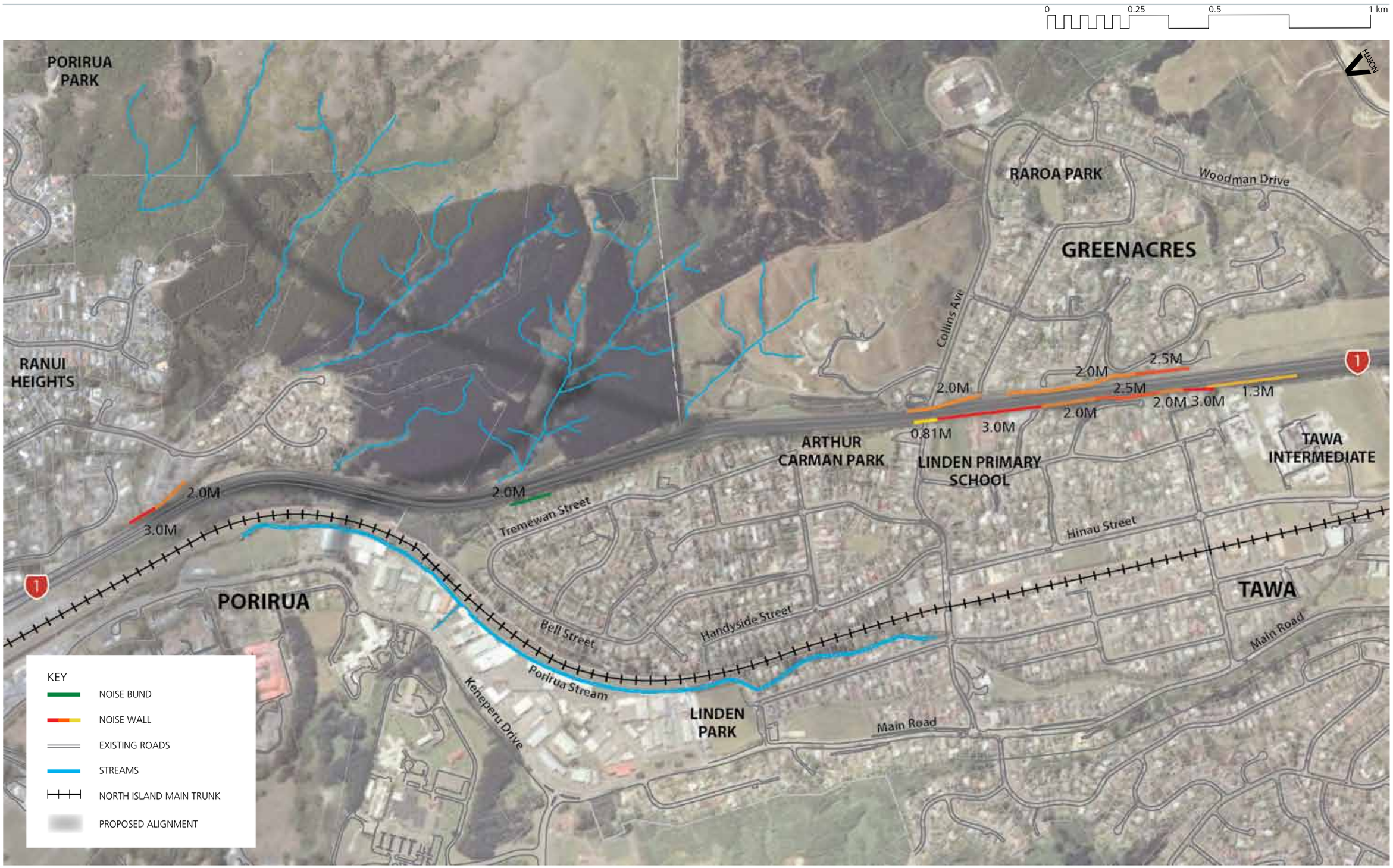

Figure 5.83: Proposed location and height of noise barriers

Pedestrian and cycle paths

Collins Avenue Bridge

- The footpath on the southern side of Collins Avenue should be maintained under the replacement bridge. Sufficient space should be allowed in the bridge span to enable WCC to construct an additional footpath on the northern side of Collins Avenue if needed in the future; and
- A pedestrian path should be formed between the end of Raroa Terrace and Collins Avenue to formalise the existing informal route in this location. This path is to be adopted by WCC.

Kenepuru link road junction

Safe pedestrian and cycle facilities should be provided at intersection of the Kenepuru Link Road with Kenepuru Drive. This should include:

Grade separated shared path (including southbound cycle link):

- Provide grade separated shared pedestrian and cycle path on eastern side of Kenepuru Drive. This shared path will veer off the roadside north of the roundabout, run under the Kenepuru link road bridge (Bridge 28) and then follow the side of the access drive (the road providing access to the bowling alley and other buildings below Kenepuru Drive in this location) to rejoin the existing roadside pedestrian path and cycle lane south of the junction, thus bypassing the roundabout (Figure 5.84)
- The treatment of the MSE wall and underside of the Kenepuru Link road bridge should have high quality detailing and finishes;
- Lighting should be integrated in the design of the bridge underside or abutment to provide a safe environment at all times;
- The gradient of the shared path should not exceed 10%;
- The alignment of the shared path should provide clear sightlines to minimise pedestrian / cycle conflict;
- The shared path should be minimum 3m wide; and
- Subject to consultation with PCC, a spur off the shared path could link to the adjacent sports field.

Roadside pedestrian path:

- In addition to the grade separated shared path, a continuous pedestrian path should be provided at grade on the eastern side of Kenepuru Drive to provide an alternative route with passive surveillance, especially at night time. This should connect to dropped kerbs at the link road roundabout.

Northbound cycle link:

- A dedicated cycle lane or path should be provided along Kenepuru Drive on the western side of the roundabout and some 50m upstream and downstream of the roundabout to provide safe movement for cyclists around the junction. If space allows, this should be physically separated from the carriageway to prevent vehicle encroachment.

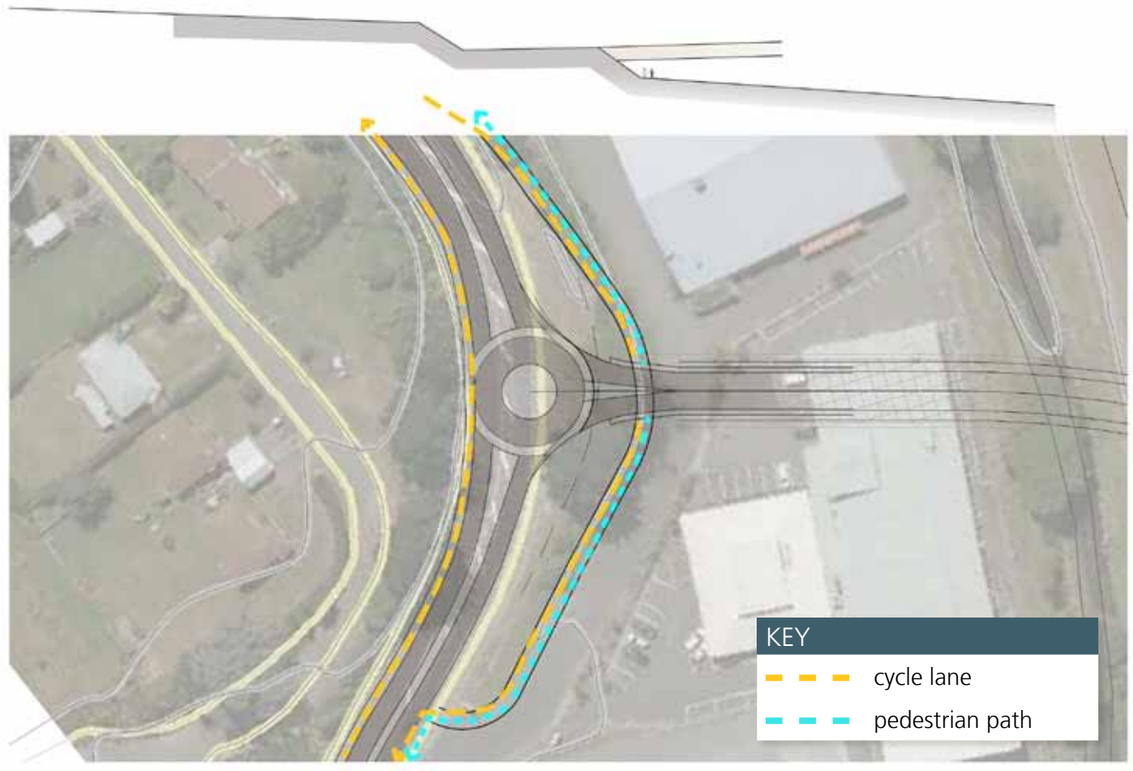

Figure 5.84: Kenepuru link road junction - Indicative alignment of proposed pedestrian and cycle facilities

Landscape treatment

Arthur Carman and Mahoe Parks

The widening of the existing SH1 may require the removal of existing vegetation on the roadside along Arthur Carman Park and Mahoe Park. This vegetation currently provides some visual screening of the passing traffic on the motorway from the parks and is of some amenity value to the park users. Any vegetation along these parks removed during the construction process should be replaced with amenity planting of sufficient height and density to provide an equivalent or better screening of the motorway post construction.

Table 5.18: Section 9 Linden - Landscape treatment

Landscape Character Area (Route Section)	Vegetation and Landform Character	Pattern of Enclosure/ Openness and Views	Design Response	Indicative plant species
Porirua East (Section 8 & 9)	Steep sided Cannons Creek valley and moderately sloping, north-facing Porirua backdrop hills. Mixture of pine plantation; shelter belts; wildling pines; native remnant/ regeneration; and rough pasture.	**Semi Enclosed** – Sequence of enclosed cuttings and open views to the north across Porirua basin. Several large box cuttings and Cannons Creek valley establishing key nodes/ thresholds along the route.	Rehabilitate cut and fill batters with species that complement existing native vegetation patterns. Enrich existing areas of native remnant/ revegetation on the downhill side of highway to enhance ecological corridor . Mitigate for adverse visual effects resulting from cut faces through selection and placement of vegetation.	**Canopy species:** - Kanuka *(Kunzea ericoides)* - Kohekohe *(Dysoxolum spectabile)* - Nikau *(Rhopalostylis sapida)* - Northern rata *(Metrosideros robusta)* - Rimu *(Dacrydium cupressinum)* - Tawa *(Beilschmeidia tawa)* - Tree Ferns *(Cyathea medullaris & cunninghamii)* **Shrubs and understorey tree species:** - Cabbage tree *(Cordyline australis)* - Five Finger *(Pseudopanax arboreus)* - Karamu *(Coprosma robusta)* - Kawakawa *(Macropiper excelsum)* - Koromiko *(Hebe stricta)* - Mahoe *(Melicytus ramiflorus)* - Ngaio *(Myoporum laetum)* - Pittosporum sp. *(P. euginoides & tenufolium)* - Puka *(Griselinia littoralis)* - Wineberry *(Aristotelia serrata)* **Low shrubs/ ground cover:** - Asplenium species *(e.g. A. oblongifolium, bulbifernum & hookerianum)* - Astelia sp. *(A. fragrans)* - Blechnu m sp *(e.g. B. novae-zelandiae, fluviatale & filiforme)* - Carex sp. *(C. secta, dissita & virgata)* - Coprosma sp. *(e.g. Coprosma propinqua)* - Flax *(Phormium cookianum)* - Olearia sp. *(Olearia solandri)* - Tauhinu *(Ozothamnus leptophyllus)* - Toe toe *(Cortaderia fulvida)*

Landscape Character Area (Route Section)	Vegetation and Landform Character	Pattern of Enclosure/ Openness and Views	Design Response	Indicative plant species
Linden (Section 9)	Steep – moderately sloping NW facing Tawa backdrop hills. Dominated by pine plantation and rough pasture on upper slopes. Existing SH1 passes along toe of hill slopes.	**Open** – large box cutting immediately to north of Interchange will provide only enclosure and will be landmark location along route. Views to wider Porirua and Tawa will be obtainable from corridor, particularly for southbound vehicles.	Plant central areas and road margins with species selected to create a clear identity for this key node. Rehabilitate stream margins and restore fill areas and cut batters with pasture or native vegetation to complement future land cover and land use (i.e. future subdivision)	**Canopy species:** - Kanuka *(Kunzea ericoides)* - Kohekohe *(Dysoxolum spectabile)* - Nikau *(Rhopalostylis sapida)* - Northern rata *(Metrosideros robusta)* - Rewarewa *(Knightia excelsa)* - Tawa *(Beilschmeidia tawa)* - Tree Ferns *(Cyathea medullaris & cunninghamii)* **Shrubs and understorey tree species:** - Cabbage tree *(Cordyline australis)* - Five Finger *(Pseudopanax arboreus)* - Karamu *(Coprosma robusta)* - Kawakawa *(Macropiper excelsum)* - Koromiko *(Hebe stricta)* - Mahoe *(Melicytus ramiflorus)* - Ngaio *(Myoporum laetum)* - Pittosporum sp. *(P. euginoides)* - Puka *(Griselinia littoralis)* - Wineberry *(Aristotelia serrata)* **Low shrubs/ ground cover:** - Asplenium species *(e.g. A. oblongifolium, bulbifernum & hookerianum)* - Astelia sp *(Astelia fragrans)* - Blechnum sp *(e.g. B. novae-zelandiae, fluviatale & filiforme)* - Carex sp. *(C. secta, dissita & virgata)* - Coprosma sp. *(e.g. Coprosma propinqua)* - Flax *(Phormium cookianum)* - Olearia sp. *(Olearia solandri)* - Tauhinu *(Ozothamnus leptophyllus)* - Toe toe *(Cortaderia fulvida)*