Te Ahu a Turanga; Manawatū Tararua Highway
Notices of Requirement for Designations
Volume Two: Assessment of Effects on the Environment and supporting material

NZ TRANSPORT AGENCY
WAKA KOTAHI

New Zealand Government

PART J: APPENDICES

APPENDIX THREE: ROAD DESIGN PHILOSOPHY STATEMENT

29 October 2018

NZ Transport Agency

Te Ahu a Turanga -Manawatu Gorge Replacement Route

Preliminary Design Philosophy Report

October 2018

Table of contents

Table index

1. Introduction

1.1 Purpose of this report

This Preliminary Design Philosophy Report (PDPR) outlines the key standards, philosophies, guidelines and assumptions that have been adopted to inform the development of the design of the Te Ahu a Turanga; Manawatū Tararua Highway project (Project) as is presented in this Notice of Requirement (NoR).

1.2 Scope

The scope of this PDPR covers all aspects of the State Highway design required to complete the scope set out in the Project Description contained in the AEE. Each design element is discussed within this PDPR.

This report also describes option development that has occurred post completion of the DBC in response to stakeholder feedback and more detailed assessment by technical specialists in the preparation of the AEE in support of the NOR application.

The design philosophy development is an ongoing process and therefore describes the standards, philosophies and assumptions at the time of writing. There is scope for these to change with the aggregation of data, information and knowledge as the project progresses and opportunities are realised.

The Long List and Short List Option Assessment Reports provide detail on the assessment of options leading to the selection of the preferred option.

1.3 Key Features of the Project

- Approximately 11.5 km of new highway commencing at the eastern abutment of the SH3 bridge over the Manawatū River at Ashhurst, travelling east and rejoining SH3 near Woodville at an upgraded intersection with SH3, Woodland Road/Troup Road. The route predominately passes north of the Manawatū Gorge, passing over the Ruahine Ranges through the Te Āpiti windfarm;
- Where grades exceed 6% crawler lanes have been added in both directions, resulting in four lanes;
- Where grades are less than 6% across the central plateau between steeper sections, the lanes extended to provide a consistent 4-lane corridor without multiple merge and diverge points. Thus the majority of the new highway, being the length from the SH3/SH57 intersection on the west of the Ruahine Ranges and the SH3/Woodlands Road/Troup Road intersection on east of the Ruahine Ranges, is 4 lanes to accommodate crawler lanes and cross-section consistency where required;
- Two lane single carriageway highway (1 lane in each direction) where crawler lanes or additional lanes are not required for consistency;
- Central median and wire rope barrier system between major intersections (roundabouts at SH57/SH3 and SH3/Woodlands Road/Troup Road) which effectively delineate and transition the new road from the existing;
- Multiple large cuts and embankments through challenging terrain;
- A new 300 metre plus bridge over the Manawatū River at the western mouth of the Gorge, including crossing of the existing rail corridor;

- Minimal disruption to local roads, with tie-ins at both ends and improvements to the SH57/SH3 intersection southeast of Ashhurst; and
- Traverses multiple watercourses and sub-catchments of the Manawatū River.

2. Design Development

2.1 General

A Detailed Business Case report (DBC) was completed in March 2018, which described the process of options (alternatives) development and assessments undertaken to select a preferred option. The options assessment process is summarised in Part E of the AEE.

Following completion of the DBC, the NZ Transport Agency engaged technical specialists to assess the impacts and required mitigations of the DBC preferred option. An iterative process of design development entailing design, assessment, and re-design has resulted in the refinement of the indicative alignment and the proposed designation corridor. The proposed designation corridor maintains sufficient width where this can be provided to accommodate design and construction innovation through the implementation phase of the Project.

The following section describes how the indicative alignment and designation design was developed, and the variations considered for specific sections of the corridor following the completion of the DBC.

2.2 SH3 western extent to start of incline after crossing the Manawatū River

2.2.1 General

The western extent of the Project is the eastern abutment of the existing SH3 Manawatū River bridge. The alignment traverses east to beyond the existing intersection with SH57 before turning north and across a new bridge over the Manawatū River at the mouth of the Manawatū Gorge. The alignment then rapidly increases in gradient as it begin its ascent of the Ruahine Ranges.

The western section requires property access to both sides of the new alignment. Existing access off SH57 is to remain, with property access east of the SH3/SH57 intersection to be provided from the old SH3.

The alignment crosses the existing Manawatū Gorge track carpark, with works required to maintain and/or offset any loss in carpark capacity.

The southern designation boundary from the Project start runs along the existing SH3 boundary to SH57 and then south along the SH57 boundary to the expected extent of works affecting SH57. The boundary then follows the alignment to the east and north around the extent of the likely reconfigured intersection and earthwork extents.

The northern designation boundary from the Project start is located to the north of the existing highway boundary to accommodate the provision of stormwater retention and construction access.

2.2.2 Lane configuration and intersection – DBC recommended option

The DBC phase recommended option comprised a two way single carriageway with one lane in each direction from the Project start (eastern abutment of the existing SH3 Manawatū River Bridge), traversing east to a priority tee intersection with SH57, comprising right hand and left hand turn lanes from SH3. The Project alignment then traversed east and north to cross a new bridge over the Manawatū River at the mouth of the Manawatū Gorge, after which crawler lanes in both directions are developed at the beginning of the western incline. The SH57/SH3 intersection would have flag lighting as a minimum, and potentially lighting for the extent of the turn lanes on SH3 and approach on SH57.

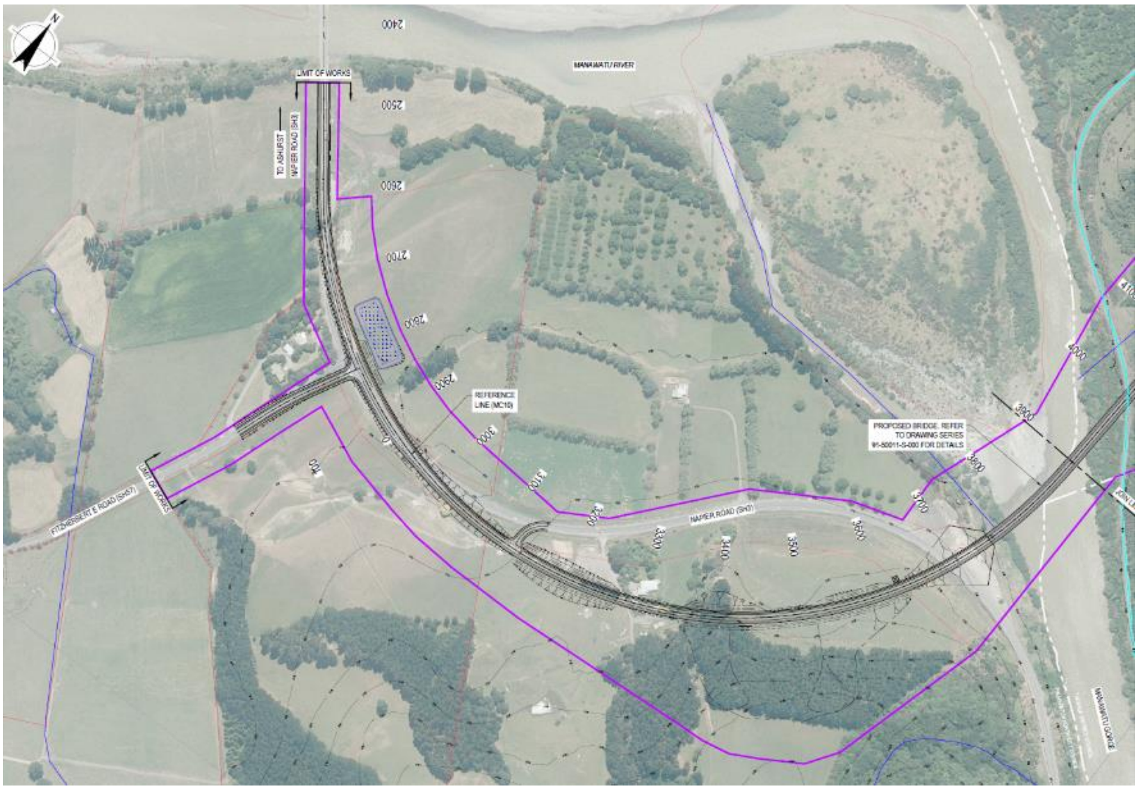


Figure 1 - SH3 western extent to start of incline after crossing the Manawatū River - DBC recommended option

The Road Safety Audit undertaken on the DBC recommended option raised concerns with respect to the combined impact on road safety that the location of the merge of the westbound crawler lane might have on the western slope decline and its interaction with the Manawatū River Bridge, the curve between the bridge and the SH3/SH57 intersection, and the form of the intersection itself.

Specific concerns included:

- Safe merging of slow vehicles immediately before the bridge with no run-off area;
- If merge occurred after the bridge, safe merge of slow vehicles on a sweeping right hand bend approaching a tee intersection;
- Safe access/egress to the Manawatū Gorge carpark on the inside of the bend with potentially compromised sight distances;
- Ability to make safe right hand turns from SH3 into SH57, 'climbing' up the super elevation on the bend being a slow manoeuver for Heavy Commercial Vehicles ("**HCVs**"); and
- Potential for uncontrolled U-turn movements occurring west of the crawler lane merge once westbound traffic was beyond the central median.

2.2.3 Lane Configuration and Intersection NOR indicative alignment

In response to the concerns identified through the Road Safety Audit (as set out above), the development of the NOR indicative alignment for this section of the proposed designation corridor focused on this section being an overall transport solution to address each of those matters identified.

The NOR indicative alignment provides a roundabout for the intersection of SH3/SH57, with dual lanes for the SH3 through movements and single lane for the turning movements to/from SH57. The crawler lanes and central median from the Western incline are extended to the roundabout, with the crawler lane westbound merged between the roundabout and the existing SH3 bridge. The eastbound crawler lane is developed at the roundabout to allow for heavy vehicles to increase speed from the roundabout without holding up light vehicles.

Access to the Manawatū Gorge carpark is provided via a 4th leg to the roundabout opposite SH57 and the old section of SH3. Access to properties either side of the new section of north and east of SH3 is provided from the 4th leg of the roundabout via the old SH3.

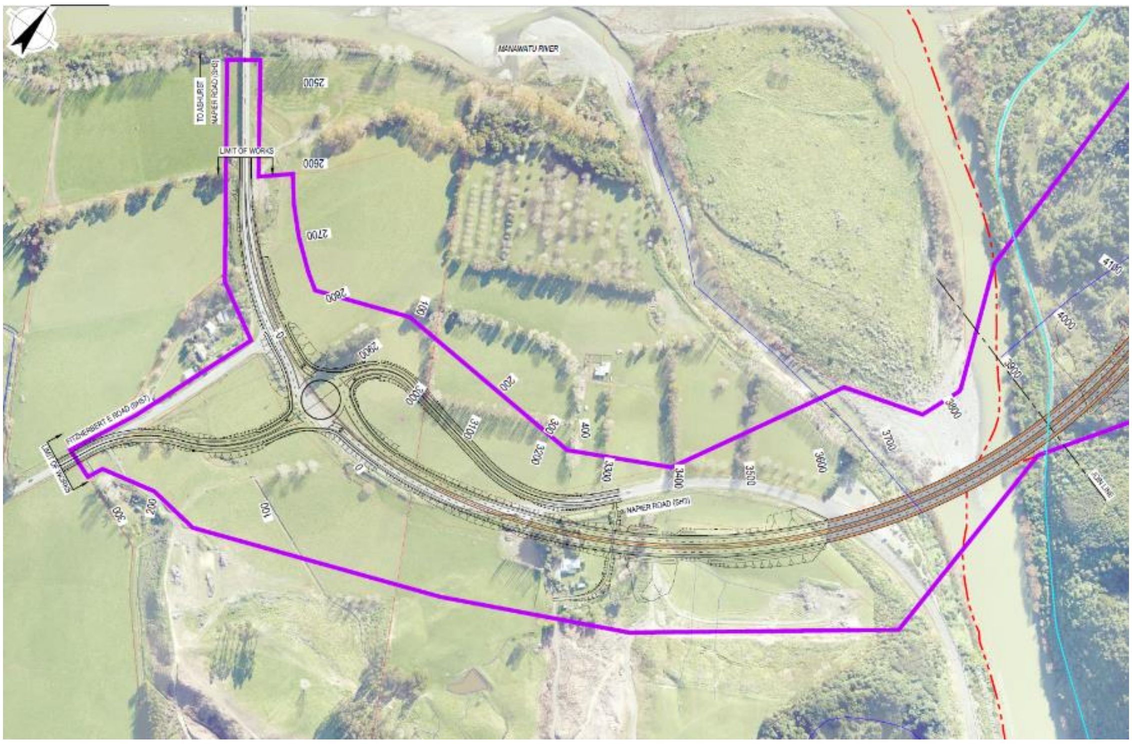


Figure 2 - SH3 western extent to start of incline after crossing the Manawatū River - NOR indicative alignment

This configuration provides the following benefits over that of the DBC option:

- Controlled merging of the crawler lane traffic after the speed controlling roundabout;
- Improved intersection safety for access/egress at SH57;
- Improved safety for access/egress to the Manawatū Gorge carpark;
- Improved safety for access/egress to the properties either side of SH3 in the Bridge to Bridge section, as well as access to the property to the east of SH3 via an overpass under SH3 or aservice road under new Manawatū River Bridge;
- Safe U-Turn provision via roundabout;
- Positive delineation of change of road environment from Gorge replacement to existing SH3 at roundabout; and
- Ability to provide a more direct (straighter) linkage from the Manawatū River Bridge to the SH3/SH57 intersection, through flexibility on approach angles at the roundabout, allowing

for greater potential to optimise the alignment and design of the new section of SH3 and Manawatū River Bridge.

2.2.4 Other options considered but not developed

The following options within this length were considered, however not developed further, for the reasons identified:

Option considered	Reason not developed
Merging crawler lanes immediately after the Manawatū Bridge	Required merging of crawler lane on sweeping right hand bend.
Merging crawler lanes after sweeping right hand bend	Would have merge within the proximity of the SH3/SH57 tee intersection and before existing SH3 Manawatū River Bridge.
Single lane roundabout for the intersection with SH3/SH57 with developed left turn lane for westbound (crawler lane extended to roundabout)	Would require all through traffic to merge into right hand lane, including HCVs, immediately prior to the roundabout. This would create both gap issues in the right hane land, and potentially conflicting weaving movements for vehicles in right hand lane wanting to turn left in to SH57.
Single lane SH3 eastbound from roundabout with crawler lane developing after new Manawatū River Bridge	SH3 has a gradual incline from the roundabout to over the bridge, with a central median. Slowly accelerating HCVs therefore potentially holding up and frustrating the majority of vehicles, including more powerful HCVs able to obtain a reasonable speed prior to the main incline. It should be noted that an option similar to this may be developed through the detailed design phase of the Project, although this would not affect the designation footprint.

2.3 New Manawatū River Bridge – South Abutment Position

One of the considerations for the Project is to maintain, or not negatively impact on, accessibility to the Gorge and Gorge carpark.

The new Manawatū River bridge is within the length described above in section 2.2. The new State highway alignment traverses the existing Manawatū Gorge carpark. The capacity of the carpark and accessibility to the Manawatū Gorge is affected by the location of the southern bridge abutment.

2.3.1 Manawatū River Bridge – South Abutment position DBC recommended option

The DBC phase concept design positioned the southern abutment of the Manawatū River Bridge immediately adjacent to the Gorge edge. This positioned the abutment on the existing Gorge carpark, with approach embankment filling over the existing SH3 and carpark. This abutment location provides for the shortest bridge (as affected by the southern approach).

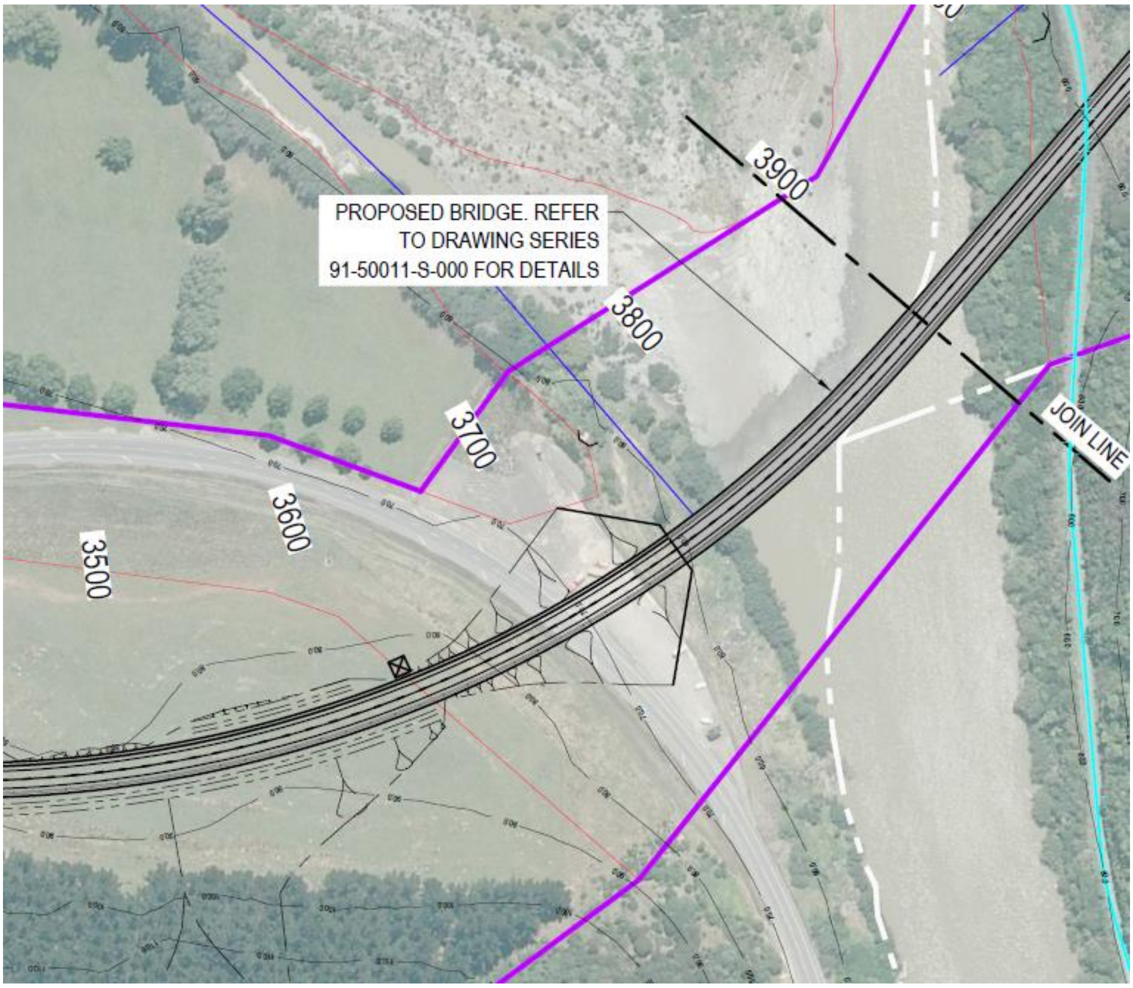


Figure 3 - Manawatū River Bridge – South Abutment position - DBC recommended option

With the southern bridge abutment in this location, to maintain existing Gorge access and levels of parking, it is necessary to provide replacement parking and reinstate Gorge access. Parking replacement could potentially utilise the existing SH3. Gorge access could be achieved either through the construction of access around the face of the abutment, or via an underpass through the approach embankment.

2.3.2 Manawatū River Bridge – South Abutment Position NOR indicative alignment

The NOR indicative alignment location for the southern abutment of the Manawatū River Bridge is from the terrace immediately south of the existing SH3, with the bridge going over SH3 and the carpark. This maintains the existing parking and Gorge connectivity, eliminating the requirement to provide additional parking at another location or to engineer Gorge access.

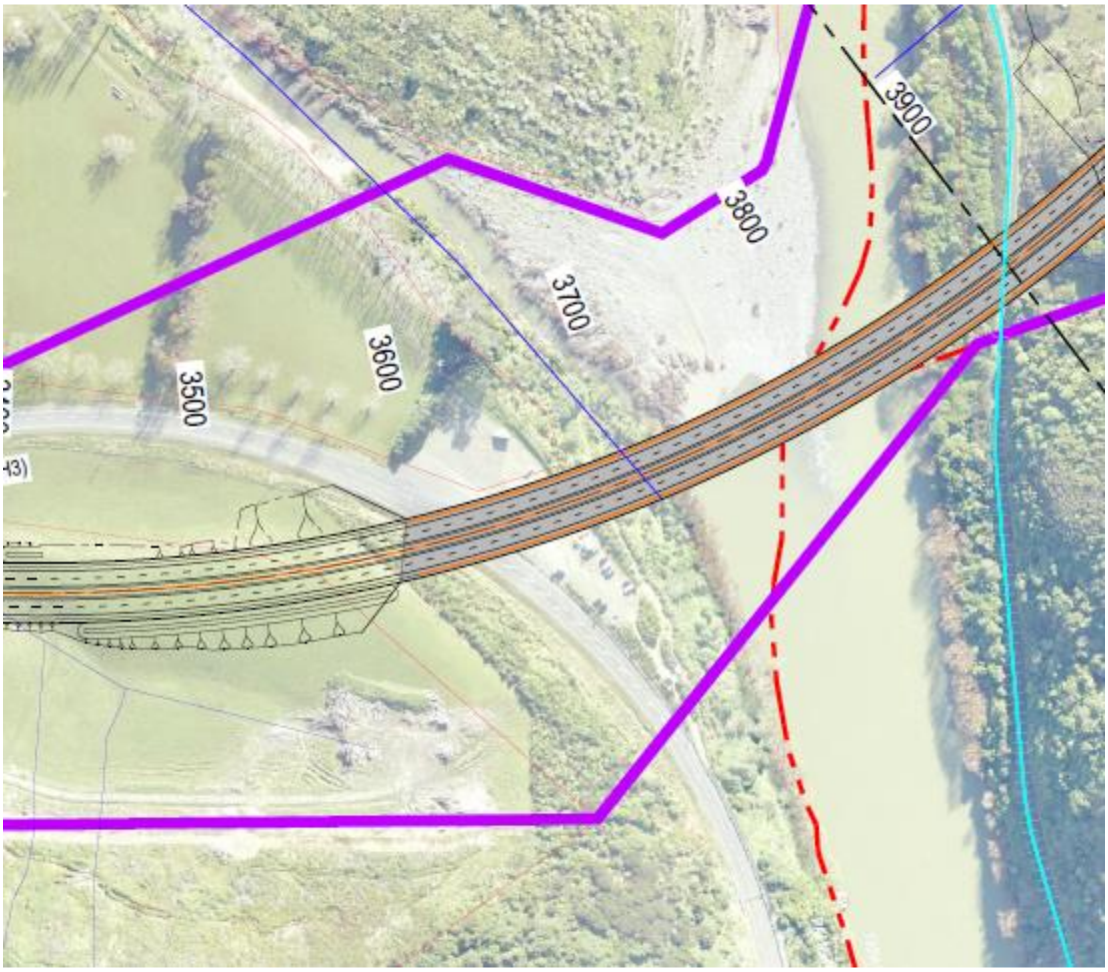


Figure 4 - Manawatū River Bridge – South Abutment Position NOR indicative alignment

2.3.3 Other Options Considered

Other options considered were subtle variations only on the above two options. These variations in the highway alignment arose through looking at options to address concerns associated with road safety described in section 2.2, and to minimise ecological, natural character and landscape impacts north of the new Manawatū River Bridge described in section 2.4. All considered alignments are able to accommodate the southern abutment options as presented in the DBC recommended option or in the NOR indicative alignment.

2.4 New Manawatū River Bridge – North Abutment to Beyond Forest and Wetland

2.4.1 General

The designation across the river, and flexibility thereof, has been limited so as to avoid encroachment into the existing legal property boundary of Parahaki Island (to the west of the proposed bridge alignment) and the Manawatū Gorge Scenic Reserve (to the east of the proposed bridge alignment). This has limited the flexibility of the northern bridge abutment location and corridor alignment for the western incline. The bridge, whatever its alignment, will cross the Manawatū Gorge ONL, which includes Parahaki island and down to the confluence with the Pohangina River.

The area immediately west of the Manawatū Gorge Scenic Reserve north of the River contains several different and clearly defined ecosystems. A wetland and stand of swamp maire are on the east side of the corridor, a stand of mature old-growth forest is to the west of the corridor, and a high value stream bisects them. Each of these ecosystems is of high value, with the various options developed in order to assess to what extent these can be efficiently avoided, if at all, and to inform the footprint to be assessed for its ecological impact.

All options assume the new Manawatū River Bridge spans the rail line which runs along the northern embankment of the Manawatū Gorge, with the abutment being positioned accordingly. It is probable there will be a bridge pier between the river and rail line requiring a temporary rail crossing to enable construction access.

2.4.2 New Manawatū River Bridge – North Abutment to Beyond Forest and Wetlands - DBC recommended option

The DBC phase recommended option traversed the approximate midpoint of the proposed corridor, with the northern bridge abutment immediately north of the rail line. This alignment contained a variable curve on the bridge, including development of superelevation therein.

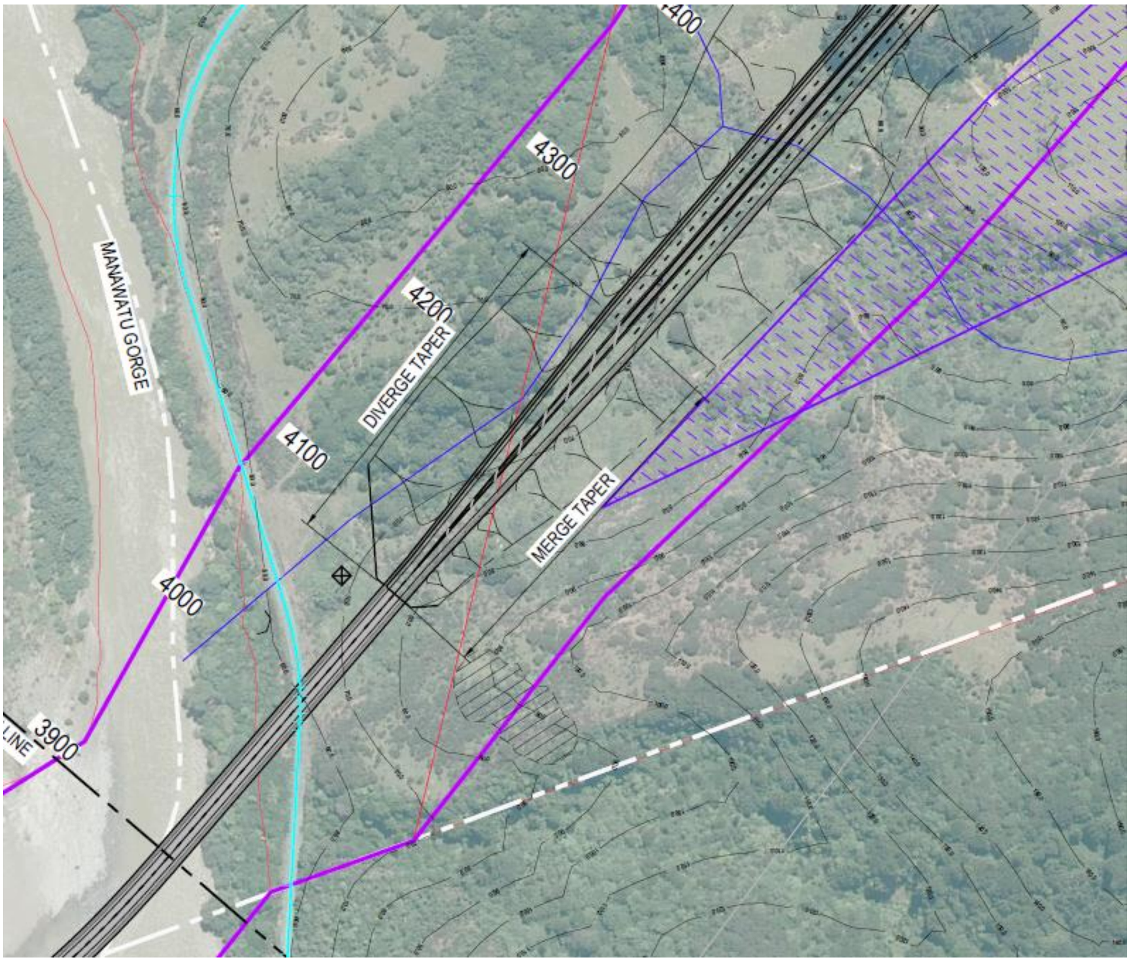


Figure 5 - New Manawatū River Bridge – North Abutment to Beyond Forest and Wetlands - DBC recommended option

Further investigation identified the following concerns or opportunities with this alignment:

- The variable curve on the bridge and developing superelevation, while able to be engineered, is not typically as efficient and cost effective as a structure with a continuous curve with continuous superelevation.

- The alignment does not differentiate between the differing ecological values of the multiple areas, and therefore may not represent an appropriate balance of effects.
- The alignment traverses the majority of the existing stream.

2.4.3 New Manawatū River Bridge – North Abutment to Beyond Forest and Wetland - NOR indicative alignment

The NOR indicative alignment positions the bridge and alignment as it crosses the northern river bank and rail line to the east of the proposed corridor, immediately west of the Manawatū Gorge Scenic Reserve. The northern abutment of the Manawatū River bridge is positioned on a knoll immediately north of the rail line and to the south of the swamp maire. The highway then crosses the wetland and swamp maire via a second bridge, then onto an engineered embankment north of the wetland. It then runs parallel to the stand of old growth native forest and stream before crossing the stream as the alignment leaves the high value ecological areas.

Each bridge has a continuous curve and superelevation.

The eastern extent of the proposed designation at this location coincides with the boundary of the Manawatū Gorge Scenic Reserve, and the indicative alignment is close to that boundary at one location.

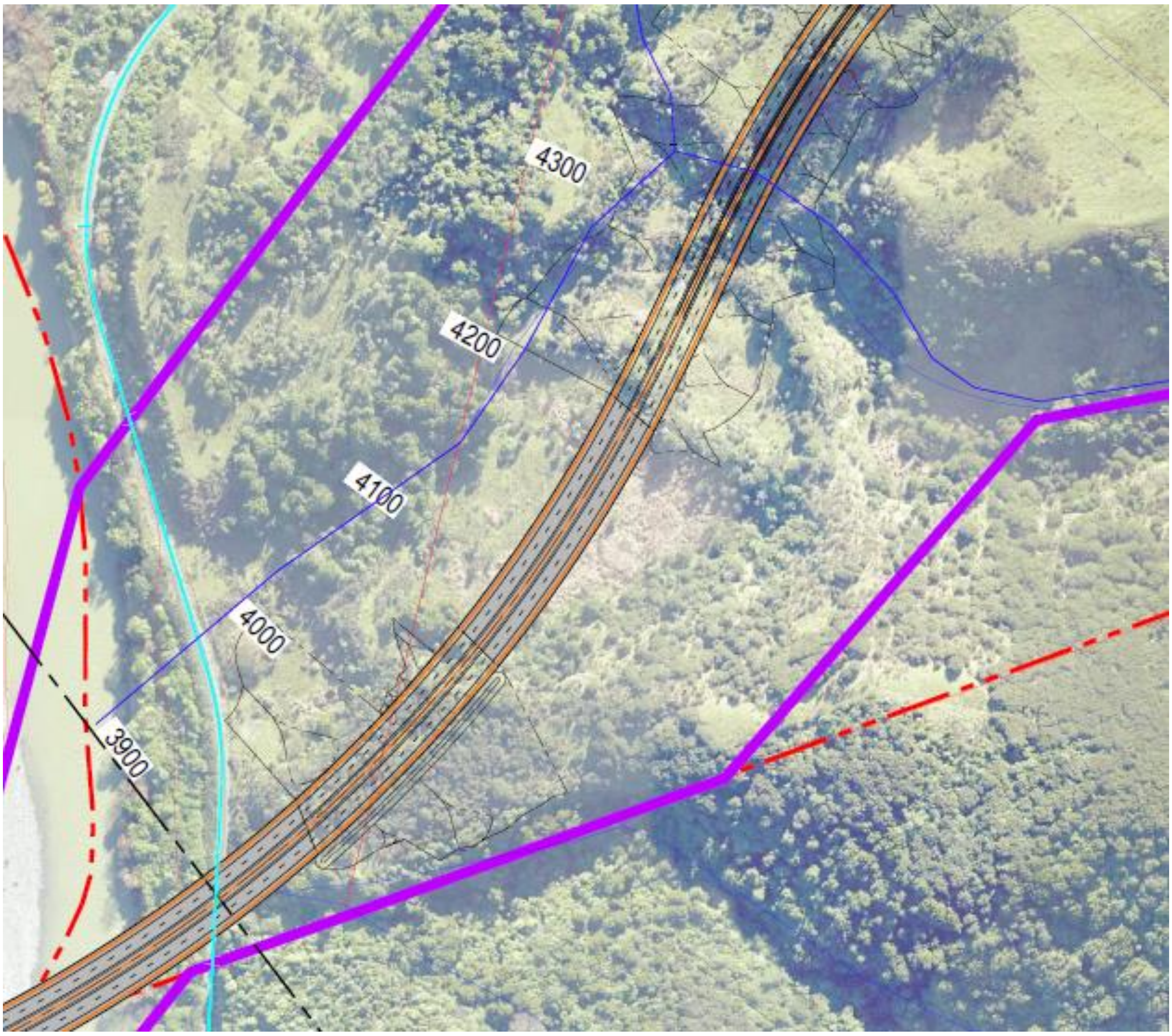


Figure 6 - New Manawatū River Bridge – North Abutment to Beyond Forest and Wetland - NOR indicative alignment

Key features of the NOR indicative alignment are:

- Twin bridge option, each with continuous curve and superelevation;
- Increased separation of alignment from Parahaki Island;
- Avoids the old-growth forest;
- Avoids significant length of the existing stream, with its eastern arm traversed at a large angle to the alignment (therefore shorter);
- Retains the majority of the existing wetland;
- Allows construction activity (access tracks and machinery) to be located on least sensitive eco-systems with effects on the raupō seepage wetland minimised;
- Retains the majority of the existing swamp maire;
- Avoids some of the stream and wetland, which reduces the effects on natural character of the waterbodies.

2.4.4 New Manawatū River Bridge – North Abutment to Beyond Forest and Wetland – Eastern alignment – Short Manawatū River bridge

Other design options were developed that will not be progressed due to adverse effects on ecological values and natural character. One such design, the Eastern alignment, short bridge option, positioned the Manawatū River bridge and alignment (as it crossed the northern river bank and rail line to the east of the proposed corridor) immediately west of the Manawatū Gorge Scenic Reserve. The northern abutment of the Manawatū River bridge was positioned on a knoll immediately north of the rail line and to the south of the swamp maire. The alignment then ran parallel to the stand of old growth native forest and stream on embankment, before crossing the stream as the alignment left the high value ecological areas. The alignment removes the wetland, a large section of stream and swamp maire through their location under a large embankment.

The bridge had a continuous curve and superelevation, with its northern bridge abutment immediately north of the rail line.

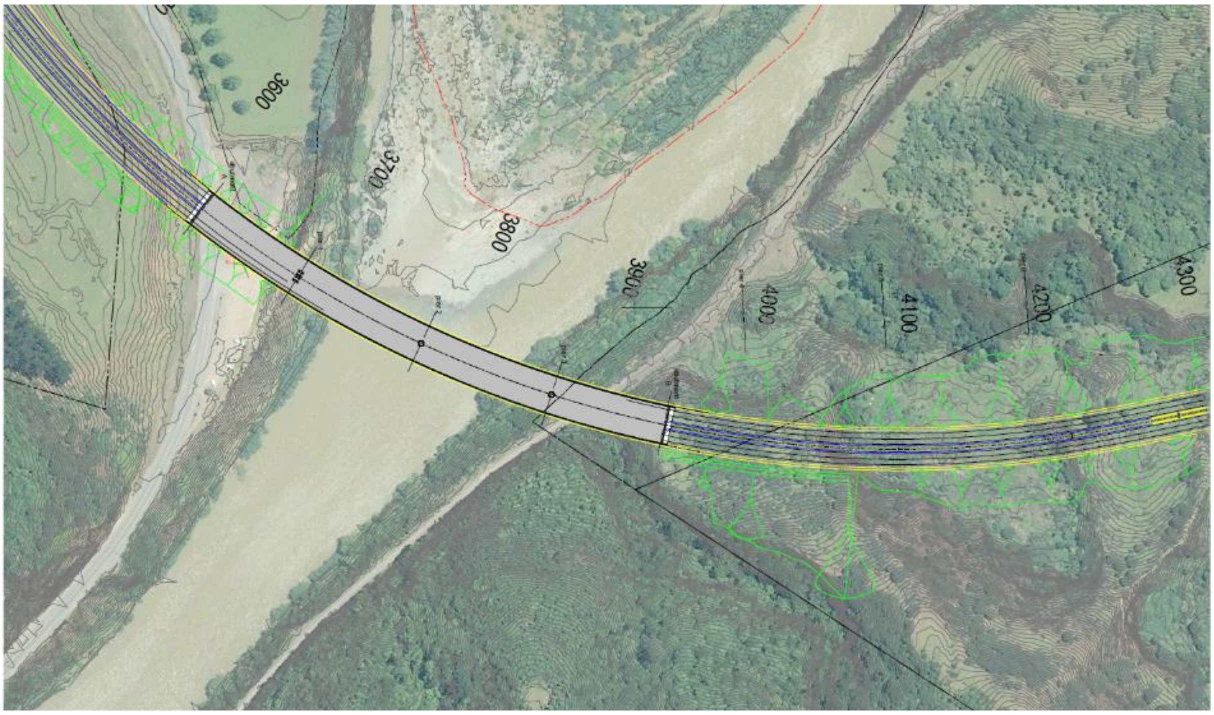


Figure 7 - New Manawatū River Bridge – North Abutment to Beyond Forest and Wetland – Eastern alignment – Short Manawatū River bridge

Key features of the Eastern alignment, short bridge option were:

- Short bridge option, with continuous curve and superelevation;
- Increased separation of alignment from Parahaki Island;
- Avoids the old-growth forest;
- Avoids significant length of the existing stream, with its eastern arm traversed at a large angle to the alignment (therefore making the bridge significantly shorter);
- Removes the existing wetland; and
- Removes the existing swamp maire.

2.4.5 New Manawatū River Bridge – North Abutment to Beyond Forest and Wetlands – Western Edge of Corridor – Short Bridge

Another design option assessed to have unacceptable ecological, landscape and natural character effects was an alignment pushed as far west as practicable (given the constraint of avoiding the Parahaki Island land parcel). The bridge had a continuous curve and superelevation, with its northern bridge abutment immediately north of the rail line.

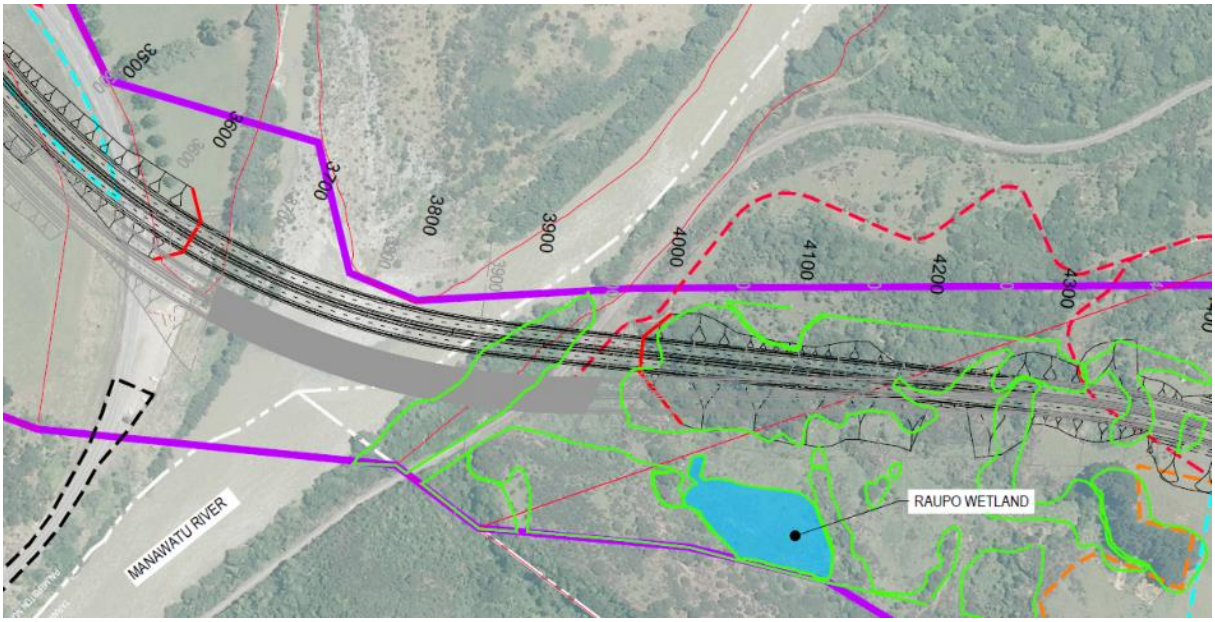


Figure 8 - New Manawatū River Bridge – North Abutment to Beyond Forest and Wetland - Western Alignment

Key features of the Western edge of corridor option were:

- Short bridge option, with continuous curve and superelevation;
- Limited separation of alignment from Parahaki Island;
- Retained the existing wetland;
- Retained the existing swamp maire;
- Loss of significant length of stream under footprint and diversionof a significant length of the existing stream;
- Removed a large area of the old growth native forest; and
- Significant effect on the natural character through loss of wetland and length of stream.

2.4.6 New Manawatū River Bridge – North Abutment to Beyond Forest and Wetlands – Long Bridge

A long bridge option was also developed on the alignment of the Western edge of corridor, to assess the viability of continuing the Manawatū River Bridge to beyond the majority of the old growth native forest, wetland and swamp maire. The bridge has a variable curve (it straightens north of the rail line) and superelevation, with its northern bridge abutment to the north of the rail line.

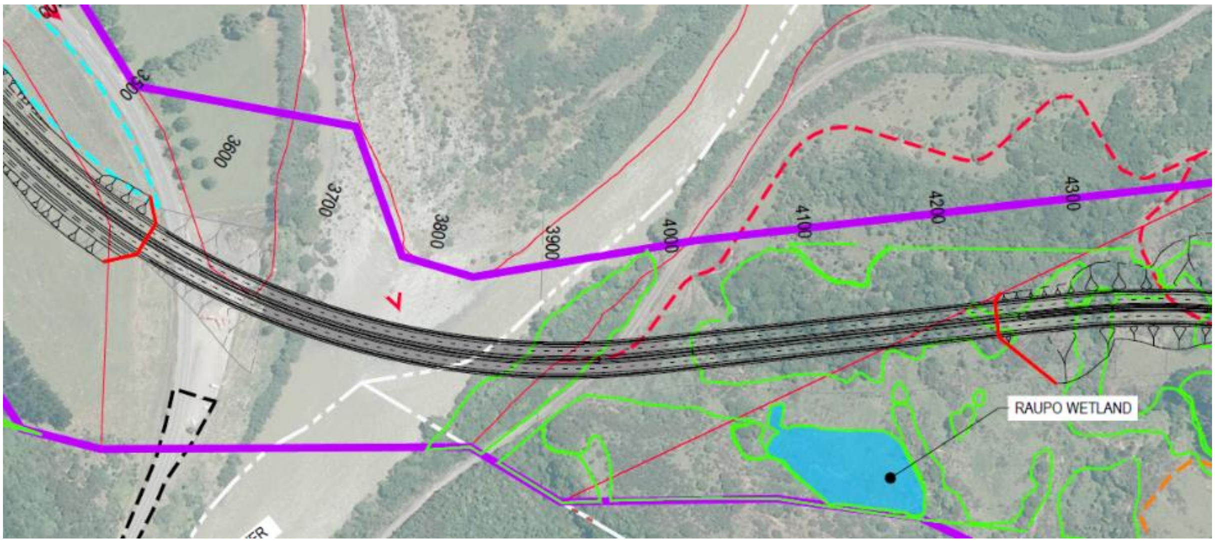


Figure 9 - New Manawatū River Bridge – North Abutment to Beyond Forest and Wetlands – Long Bridge

Key features of the Western edge of corridor option are:

- Long bridge, with variable curve and superelevation;
- Limited separation of alignment from Parahaki Island;
- Retains the existing wetland;
- Retains the existing swamp maire;
- Substantially avoids the existing stream, potentially a requirement for localised permanent diversion to avoid piers and temporary culverting for construction access; and
- Removes a variable portion, subject to pier spacing, of the old-growth forest to accommodate construction access and areas.

From an ecological perspective this option performs similarly to the twin bridge option discussed above (at 2.4.3). In terms of effects on natural character this option is preferred to the option at 2.4.3, as substantially less length of stream is lost/affected. Accordingly this option, and variations between this option and the twin bridge option, are able to be considered further during the following implementation phase.

2.4.7 New Manawatū River Bridge – Alternative alignments

In addition to the above alternative alignment options to avoid the raupō seepage wetland and old-growth forest were also considered.

Options to cross the Manawatū River so as to align the road to the west of the old-growth forest were quickly dismissed, as the curves and gradients would not meet minimum standards. Further, there was concern that such an alignment could cause negative cultural issues.

Options to cross the Manawatū River, to align the road to the east of the swamp maire and raupō seepage wetland, would traverse the Manawatū Gorge Scenic Reserve. Such an alignment would require a very significant cut (approximately 4-6 million cubic metres of cut), entailing a significant footprint and thus a significant effect on the ecological values of the Manawatū Gorge Scenic Reserve. This alignment would also traverse an area identified as an ONL, and adversely affect the natural landform and have significant visual effect. Accordingly, this option was abandoned.

2.5 Western Incline to Western QEII Covenant Area

2.5.1 General

The alignment in this section progresses north, from the new Manawatū River bridge, climbing north before turning east and across the western QEII covenant area as the alignment enters the western extent of the Te Āpiti wind farm.

Options considered through this section have been developed taking into account the position at its start (from the various alignments where it exits the forest and swamp areas to the south) and to assess potential extents of disturbance within the QEII covenant areas with alternative crossing points.

Where the alignment heads north, the eastern designation boundary has been positioned adjacent to the Manawatū Gorge Scenic Reserve and QEII covenant area, with the large area between the boundary and indicative alignment being a likely disposal area for unsuitable and surplus earthwork material. The western designation boundary has been positioned taking into account the likely extent required to accommodate an optimised alignment to be developed during detailed design.

Where the alignment turns and heads east into the Te Āpiti wind farm, the southern designation is on the Manawatū Gorge Scenic Reserve boundary. The northern designation boundary has been positioned taking into account the likely extent required to accommodate an optimised alignment to be developed during detailed design, taking into account the need to balance impact on the QEII covenant area versus earthworks extent, and impact of the alignment on the existing Te Āpiti wind farm.

2.5.2 Western QEII covenant area - DBC recommended option

The DBC phase concept design traversed the western QEII covenant area immediately north of the confluence of the western and eastern branches, with embankments constructed through both branches of the stream. It was acknowledged there was potential for a bridge to be constructed over the western branch to minimise the extent of vegetation clearance and associated affects.

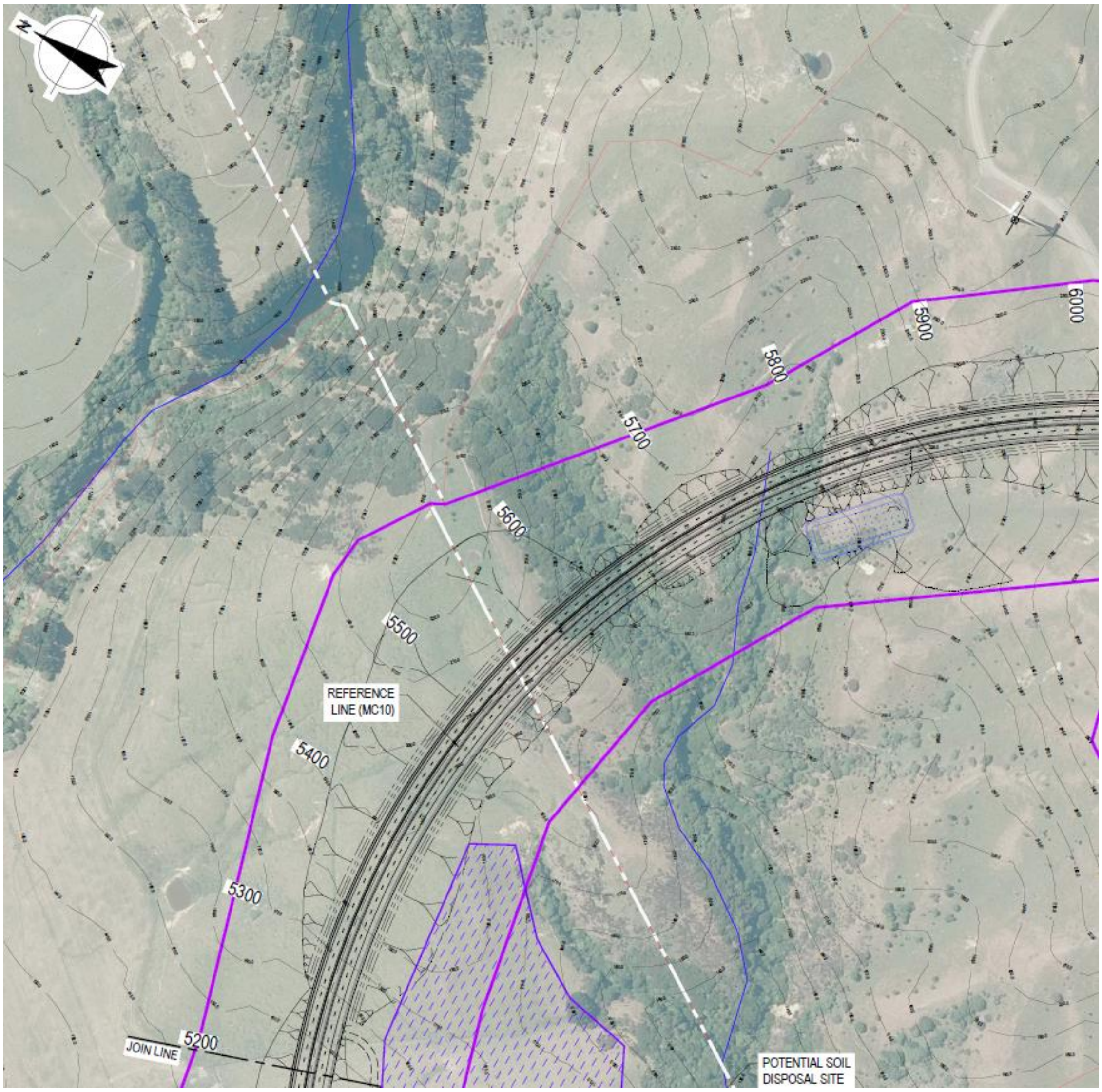


Figure 10 - Western QEII covenant area - DBC recommended option

Further investigation identified the following concerns or opportunities with this alignment:

- Updated survey information (LiDAR) available after completion of the DBC confirmed the gullies for each branch to be deeper, with steeper sides than previous topographical information indicated; and
- Subtle modification of alignment where it traverses the QEII covenant area significantly affected the extent of vegetation clearance required.

2.5.3 Western QEII covenant area - NOR indicative alignment

The NOR indicative alignment traverses the western QEII covenant area to the north of the DBC recommended option, in order to affect less of the QEII area on both branches. This alignment also proposes a bridge over the western branch, noting the western branch is ephemeral and the eastern branch has a permanent flow.

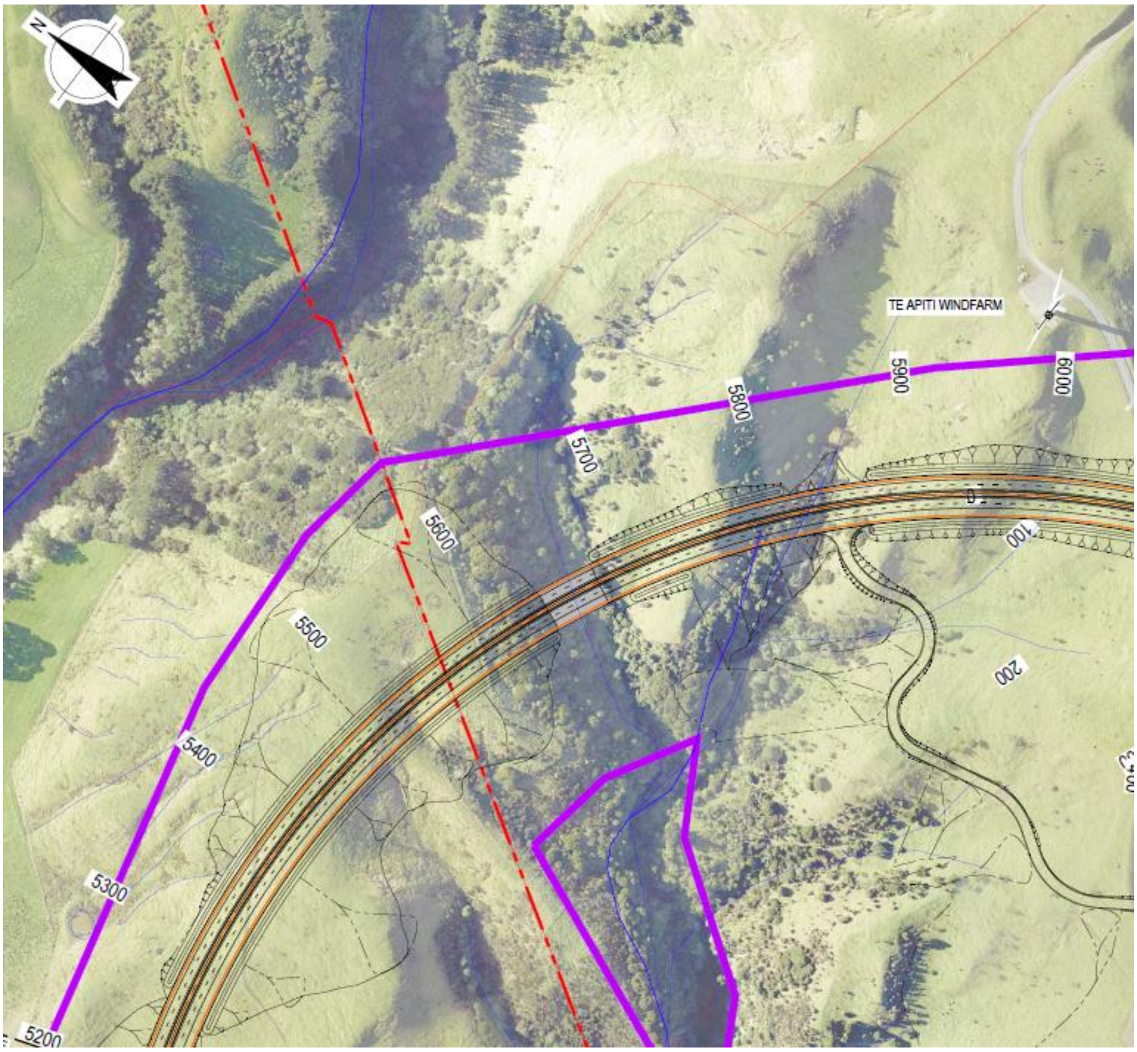


Figure 11 - Western QEII covenant area - NOR indicative alignment

Key features of the NOR indicative alignment are:

- The vertical alignment (elevation) of the highway where it traverses the western QEII area brings the highway into and across the western branch, slightly below the mid height of the gully. This results in a cut on the upper western face, with lesser cuts on the eastern face and the eastern branch;
- Avoids the confluence of the two branches; and
- Results in the shortest length of eastern branch requiring culverting, particularly if fill is reduced through the use of retaining structures.

2.5.4 Western QEII covenant area - Southern option

The southern option traverses the western QEII covenant area to the south of the DBC alignment where the highway enters the gullies at a higher level (relative to their crest). The southern side of this alignment constructs a fill across the confluence of the two branches, with the northern side being contained within the branches.

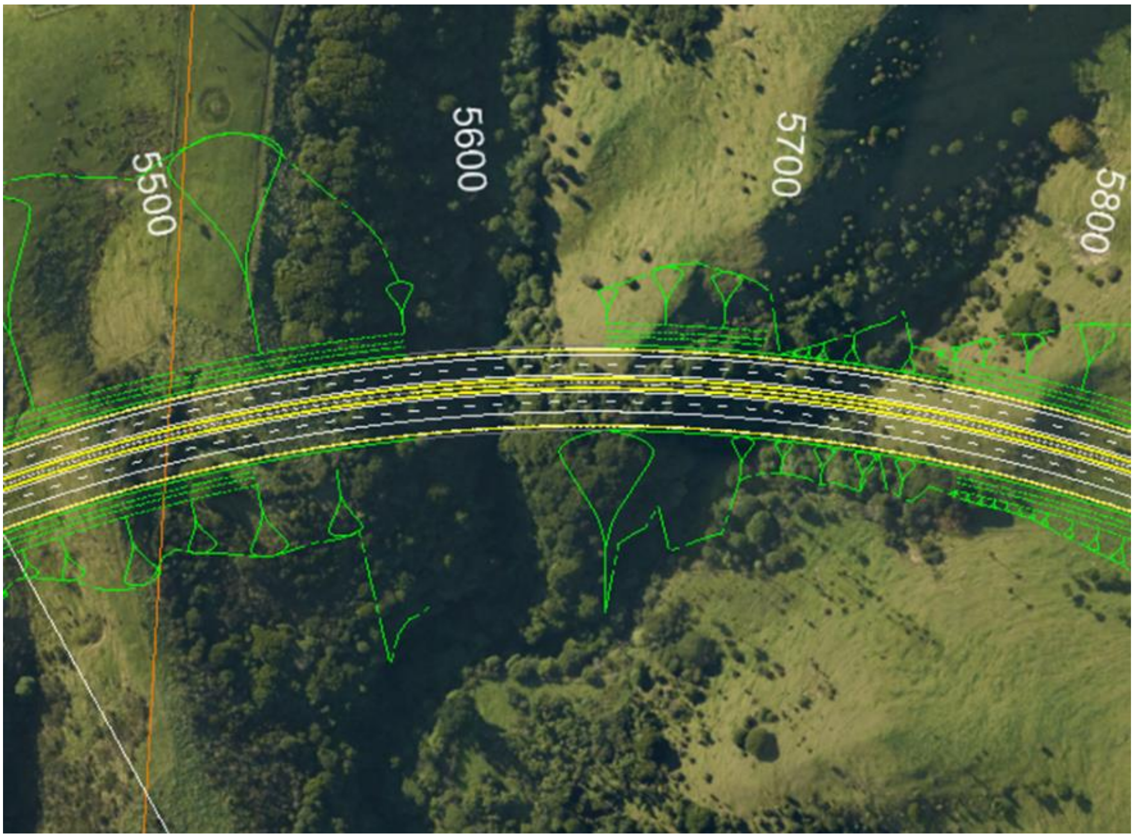


Figure 12 - Western QEII covenant area - Southern option

Key features of the southern option are:

- With the southern edge being an embankment fill, this reduces the ability to bridge the covenant area without the provision of a long bridge;
- The covenant area invert has a steep gradient resulting in an embankment footprint of significant length on the downstream side (large footprint); and
- Results in the shortest length of culverting required for the eastern branch.

2.5.5 Other Options Considered but Not Developed

Various options within the western QEII covenant area were considered, however not developed further, including:

Option considered	Reason not developed
Bridging both the western and eastern branch (as could be applied to both the DBC or NOR indicative alignment).	The option has not been developed further for the purposes of the NOR development, however it is not discounted as a potential future option. It is considered the highest cost option. This option would have least vegetation clearance within the covenant area and least impact on the eastern branch permanently flowing watercourse.
Alignment midway (approximately) between the current location and the	The option has not been developed further as it shortens the length between the Manawatū Gorge Bridge, the point it

Manawatū Gorge Scenic Reserve where there is less high value vegetation.	traverses the covenant area requiring either a cut through the covenant area, diverting its water course, or significantly increased gradient to the highway.

2.6 Eastern QEII covenant area to midway through the Te Āpiti wind farm (adjacent to Cook Road)

2.6.1 General

The alignment progresses east through the Te Āpiti wind farm, following a meandering route typically through the lowest terrain, positioned to minimise impact on the wind farm itself. This includes crossing lines of turbines as close as possible to the end of turbine strings to minimise the likely impact on re-cabling or other associated accommodation works.

Where possible, the alignment has been positioned equidistant between pairs of turbine towers in order to reduce the likelihood of affecting the towers themselves. Where this has not been achieved, this is a result of other design considerations, such as QEII covenant areas or significant earthwork implications.

The southern designation boundary runs along the edge of the Manawatū Gorge Scenic Reserve with the area between the southern boundary and the highway representing areas for potential disposal sites for surplus and unsuitable fill, and potential mitigation planting areas.

The northern designation boundary is positioned to accommodate the northern-most alignment considered potentially feasible, and offers flexibility to develop alternative alignment options to optimize the future operation of and/or to minimise effects on the Te Āpiti wind farm.

2.6.2 Eastern QEII Covenant Area to midway through the Te Āpiti wind farm - DBC recommended option

The DBC recommended option enters the Te Āpiti wind farm immediately west of the eastern QEII covenant area, bisecting the western-most turbine towers before crossing the eastern covenant area.

The southern cut face between the turbine towers daylights in the vicinity of a tower base, requiring either protection of the tower's foundation or removal of the tower.

The alignment then crosses the eastern covenant area across the confluence of the three stream branches in the covenant area before swinging south-east, then east so as to follow the terrain as much as practicable. The earthworks extend to encapsulate the last turbine tower on the turbine string east of the covenant area, which would require the removal of the turbine, tower and base.

Progressing east, the alignment crosses several waterways and bisects two more turbine strings, without impacting towers, as well as bisecting areas of significant vegetation without major impact. The alignment approaches the point adjacent Cook Road to the north, (a further QEII covenant area), where a crossing (overpass with access road under) is proposed to reconnect wind farm access roads either side of the highway. A new wind farm access road is proposed adjacent to the highway alignment connecting severed infrastructure.

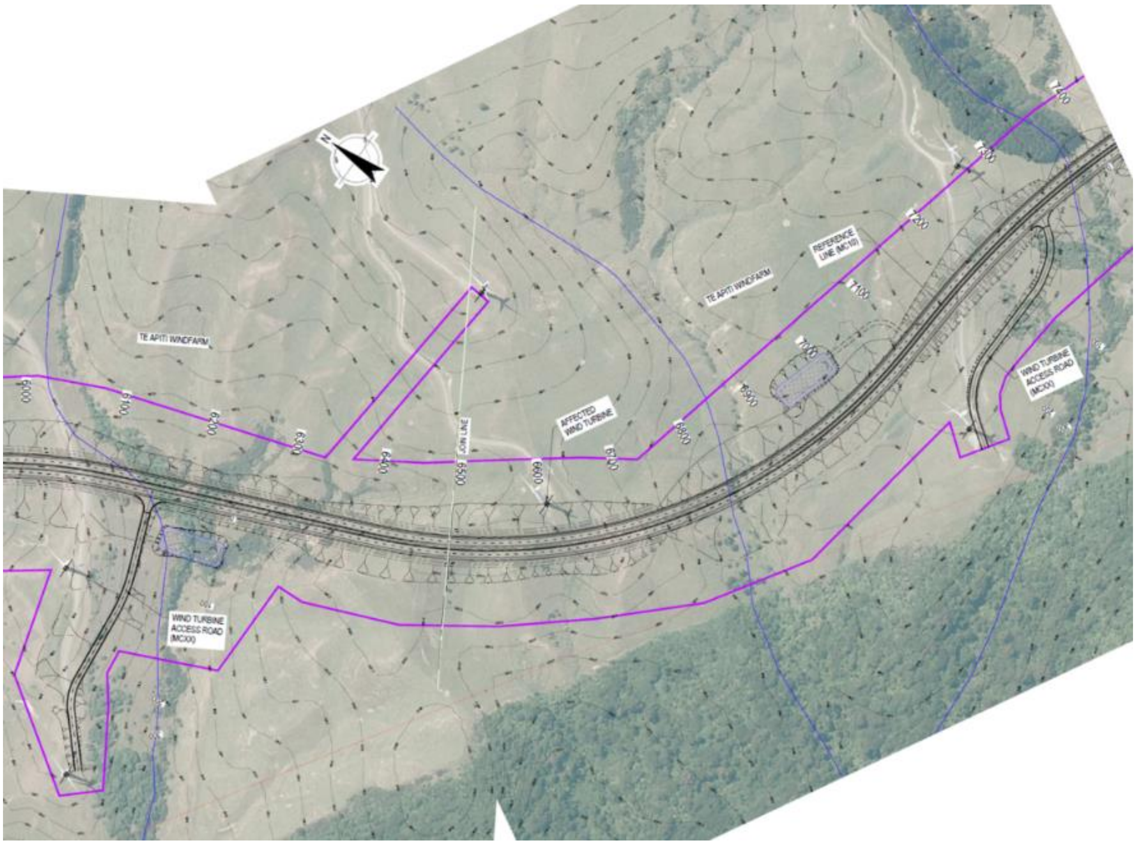


Figure 13 - Eastern QEII Covenant Area to midway through the Te Āpiti wind farm - DBC recommended option

Key features of the DBC recommended option are:

- Minimum earthworks (albeit with potential for further optimization);
- Requires removal of one and potentially two wind farm turbines;
- Requires reconfiguration of access tracks and wind farm cabling; and
- Impacts high value vegetation and natural character at the confluence of the eastern QEII covenant area branches.

2.6.3 Eastern QEII Covenant Area to midway through the Te Āpiti wind farm - NOR indicative alignment

The NOR indicative alignment design enters the Te Āpiti wind farm immediately west of the eastern covenant area, bisecting the western most turbine towers before crossing the eastern covenant area.

The alignment bisects the turbines at a point where the earthworks daylight equidistant between the turbine towers, resulting in increased likelihood the southern tower will be unaffected.

The alignment then crosses the eastern covenant area upstream of the confluence of the three stream branches before swinging south and largely following the alignment of the DBC recommended option. Earthworks extend to encapsulate the last turbine tower on the turbine string, east of the covenant area, requiring the removal of the turbine, tower and base.

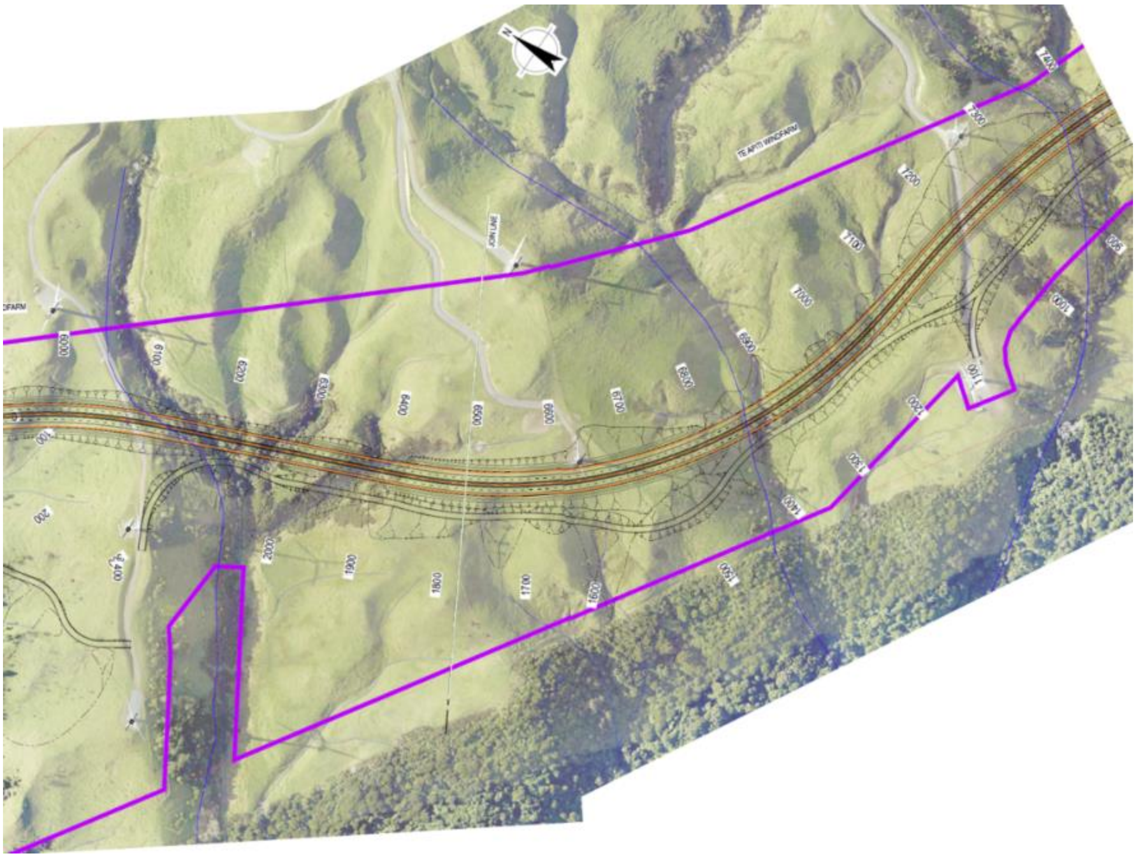


Figure 14 - Eastern QEII Covenant Area to midway through the Te Āpiti wind farm - NOR indicative alignment

Key features of the NOR indicative alignment are:

- Slight increase in earthwork volumes to miss the marginal turbine tower;
- Reduces impact on the high value vegetation at the confluence of the eastern QEII covenant area branches, instead traverses each branch to the north where the vegetation is not considered as having the same value. However, the earthworks footprint has a significant effect on the natural character of the stream;
- Requires removal of one wind farm turbine; and
- Requires reconfiguration of access tracks and wind farm cabling.

2.6.4 Eastern QEII covenant area to midway through the Te Āpiti wind farm - Northern Option

The Northern option is similar to the NOR indicative alignment, except that is has a straighter alignment, which bisects all pairs of close wind farm turbine towers equidistant from each other, avoiding the need for turbine removal.

The alignment traverses the section where the terrain is higher than the NOR indicative alignment, resulting in a substantial increase in earthwork volumes (cut increase of more than 400,000m^3).

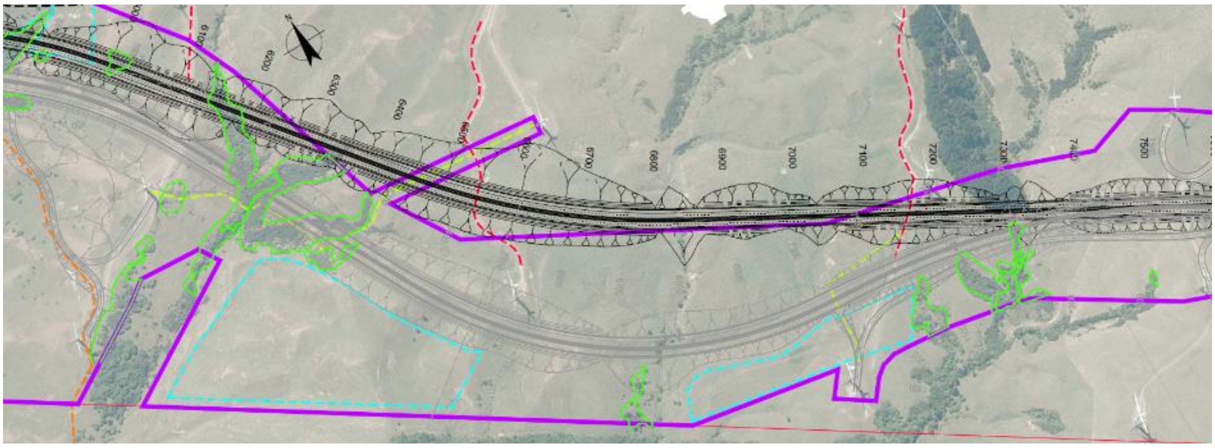


Figure 15 - Eastern QEII covenant area to midway through the Te Āpiti wind farm - Northern Option

Key features of the Northern option are:

- Significant increase in earthwork volumes arising from an alignment with minimal wind farm effects;
- Avoids impact on the high value vegetation at the confluence of the eastern QEII covenant area branches, instead traverses each branch to the north where the vegetation is considered to have lower value;
- Avoids all wind farm turbines; and
- Requires reconfiguration of access tracks and wind farm cabling.

2.7 Midway through Te Āpiti wind farm (adjacent to Cook Road) across the Ruahine Ridgeline and on to the AgResearch Property

2.7.1 General

The indicative alignment tracks through the eastern extent of the Te Āpiti wind farm, across the Ruahine ridgeline and into the AgResearch property. From the western end it traverses northeast, passing north of a string of turbines before swinging southeast as it crosses the Ruahine ridgeline, which is identified as an ONL, and over the adjacent AgReseach property.

Options developed since completion of the DBC have focused on assessing the Project implications of options that avoid, to the extent possible, areas understood to be particularly valuable within the AgResearch property. The northern designation boundary is positioned to accommodate the northern-most alignment that is considered potentially feasible, which is also the NOR indicative alignment.

The southern designation boundary has been positioned to constrain works that would otherwise affect the AgResearch property.

2.7.2 Midway through Te Āpiti wind farm (adjacent to Cook Road) across the Ruahine Ridgeline and on to the AgResearch Property – DBC recommended option and NOR indicative alignment.

Both the DBC recommended option and NOR indicative alignments traverse t the eastern end of the Te Āpiti wind farm to its eastern extent, which allows for the mimimising of earthworks while avoiding turbine towers. As set out above, the alignment then tracks northeast, passing north of a string of turbines before swinging to the southeast as it crosses the Ruahine ridgeline in a large cutting where it bisects the top of the AgResearch property, before heading off in a southeasterly direction.

Figure 16 - Midway Te Āpiti wind farm to the AgResearch Property – DBC recommended option

Figure 17 - 2.7.2 Midway Te Āpiti wind farm to the AgResearch Property – NOR indicative alignment

Key features of the NOR indicative alignment are:

- Avoids wind farm turbines;
- Minimises earthworks;
- Large cut through Ruahine Ridgeline ONL;
- Requires reconfiguration of access tracks and wind farm cabling;
- Bisects the top of the AgResearch Property; and
- Requires formalized access, potentially from an overpass between an isolated section of the AgResearch property and the balance of the property.

2.7.3 Midway through Te Āpiti wind farm (adjacent to Cook Road) across the Ruahine Ridgeline and on to the AgResearch Property – Southern AgResearch alignment

The alignment from its western end of this section follows the NOR indicative alignment to a point immediately east of the turbines west of the Ruahine Ridgeline. The alignment then turns east across the ridgeline, and southeast across the southern edge of the AgResearch Property.

The cut depth at the ridgeline is deeper than the NOR indicative alignment due to gradient constraints of the eastern incline. With the alignment moved south where it crosses the ridgeline, the available road length from the ridgeline to the Woodville plain is reduced. As such, in order to not significantly increase the incline gradient, the point at which the alignment crosses the ridgeline is at a lower elevation (with the incline crest further west of the ridgeline) than the NOR indicative alignment. This results in a net increase in earthworks, plus the alignment traversing through or close to a windfarm turbine.

This is the alignment used to determine the southern designation position.

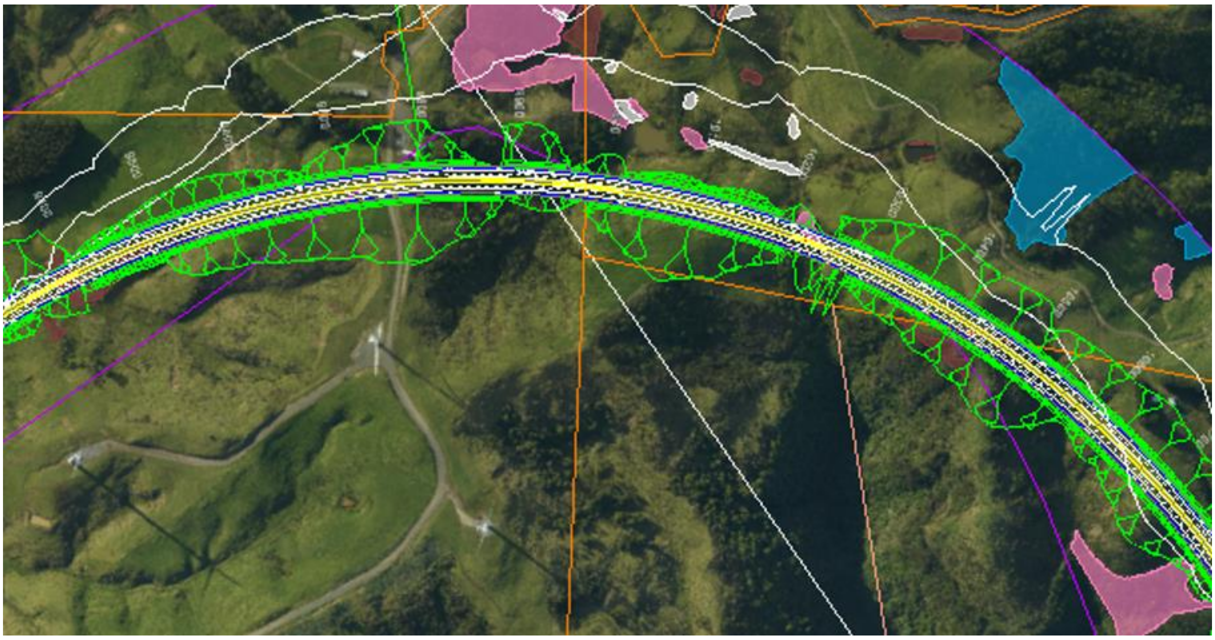


Figure 18 - Te Āpiti wind farm across Ruahine Ridgeline to the AgResearch Property – Southern AgResearch alignment

Key features of the southern AgResearch alignment are:

- Increased earthworks (when compared with the NOR indicative alignment);
- Requires the removal of 1 turbine tower and potentially a second;
- Requires reconfiguration of access tracks and wind farm cabling;
- Cuts the southern side of AgResearch Property;
- Eliminates the need to provide cross highway access for AgResearch; and
- Traverses Ruahine Ridgeline ONL.

2.7.4 Other option considered but not developed

The following option was considered where the alignment crossed the ridgeline, however it was not developed further:

Option considered	Reason not developed
Crossing the ridgeline to the south of the AgResearch property, bisecting equidistant the two turbine towers.	The depth of the cut midway between the towers resulted in the earthworks extents daylighting near the base of the towers, resulting in both being at risk of removal. The alignment also resulted in a reduction in cut on the eastern incline resulting in a net shortfall in earthworks balance at this end of the Project. The alignment also shortened the incline length requiring deepening of the ridgeline cut to a greater extent than both the NOR indicative alignment and the Southern AgResearch Option, or increased incline gradients, or increasing the height and length of fill towards Woodville

2.8 Eastern incline to Woodville

2.8.1 General

The incline traverses typically in a southeast direction, from where it leaves the AgResearch property down the eastern slopes of the Ruahine ranges before swinging east towards Woodville.

The highway ties back in to the existing highway network at a new 5 leg roundabout, being a realigned intersection with Woodlands Road, Troup Road and a reconnection of the existing SH3 towards the eastern end of the Manawatū Gorge.

The southern designation boundary runs south of the southernmost option considered post completion of the DBC. The northern designation boundary is positioned to accommodate the NOR indicative alignment, which is south of the DBC recommended option.

2.8.2 Eastern Incline to Woodville – DBC recommended option

The DBC phase recommended option descends the Ruahine Range eastern slopes in a long cutting in a southeasterly direction following a ridge before heading south and then southeast again. There it exits cut and descends the final extent of the incline on an embankment across a large valley and out onto the plain towards Woodville. The large embankment covers an area of regenerating broadleaf forest and high value stream in a meandering incised gully, before extending across the plain to beyond a major stream (bridged) running parallel to the ranges. Opportunity exists to flatten the embankment slopes over the plain to soften its visual impact and to better integrate the embankment with the adjoining landform, and to enable slopes that can retain an agricultural use.

Once at grade, the crawler lanes merge to a single lane two way road with the wire rope and median terminating at the end of the merge/diverge.

The existing SH3 joins the alignment to form a new ‘T’ intersection, with the new highway joining at the existing intersection of SH3, Woodlands Road and Troup Road.

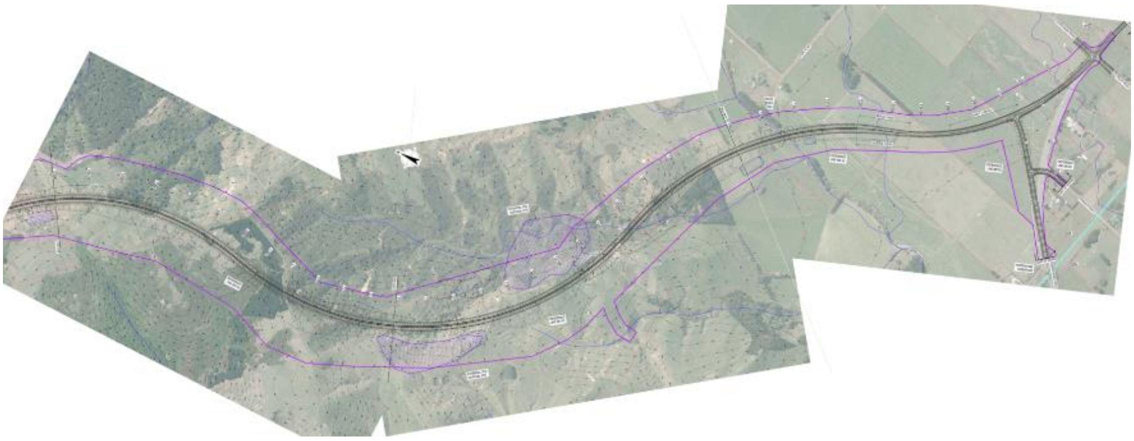


Figure 19 - Eastern Incline to Woodville – DBC recommended option

Key issues associated with DBC Design are:

- Road safety concerns associated with the change of environment from a four lane carriageway (two lane with crawler lanes) to the two lane carriageway without appropriate threshold or environment change;
- Potential for unsafe U-turn movements beyond the end of the wire roped median;
- Insufficient separation between the crawler lane merge and the development of right turn lanes to new SH3 T Intersection;
- Potential safety issues with the low volume side road (tee intersection) and the high volume SH3;
- Potential safety issues with the low volume side roads (Woodlands Road and Troup Road) and the high volume SH3;
- Lack of threshold type change of environment from rural State highway to peri-urban and urban SH3 within Woodville;
- Requires removal of large area of regenerating broadleaf forest; and
- Requires culverting or similar of large length of existing high value stream within broadleaf forest.

Specialist assessment and design development since the DBC completion has eliminated the DBC design without amendment as an acceptable alignment to be taken forward. It has therefore not been considered as an influencer on the proposed designation boundary.

2.8.3 Eastern incline to Woodville – NOR indicative alignment

As with the DBC recommended option, the NOR indicative alignment descends the Ruahine Range eastern slopes in a long cutting in a southeasterly direction, following a ridgeline before heading south and then southeast again. It exits cut (substantially as per the DBC design) and descends the final extent on an embankment adjacent to and partially over a large valley and out on to the plain towards Woodville. The embankment is located to the south of, and thus substantially avoids, the area of regenerating broadleaf forest and gully, containing the high value stream, before extending across the plain to beyond a major stream (bridged) running parallel to the ranges. The downstream end of the stream coming out of the ranges traverses pasture and will require diversion.

Opportunity exists, as with the DBC design, to flatten the embankment slopes over the plain to soften its visual impact and to enable slopes that can retain an agricultural use.

Once at grade, the crawler lanes merge to a single lane two-way road with the wire rope and median extending through to a new five leg roundabout, being the new highway, a realigned intersection with Woodlands Road, Troup Road and a reconnection of the existing SH3 towards the eastern end of the Manawatū Gorge.

Figure 20 - Eastern incline to Woodville – NOR indicative alignment

Key features of the NOR indicative alignment are:

- The new roundabout provides for a distinctive interface between the high standard rural highway and the existing SH3 approach in to Woodville;
- U-turn movements beyond the end of the wire roped median able to be safely completed at the roundabout;
- Sufficient separation between the crawler lane merge and the new roundabout;
- New roundabout providing improved safety for access to/from lower volume side roads;
- Removes less area of the regenerating broadleaf forest; and
- Requires stream diversion where affected across the plain.

This option has been used for determining the northern extent of the designation boundary

2.8.4 Eastern incline to Woodville – Southern Option

The Southern option descends the Ruahine Range eastern slopes in the same way as set out above for both the DBC and NOR indicative designs, where it exits cut (substantially as per the DBC recommended option). It descends the final extent on an embankment on a straight alignment south of the regenerating broadleaf forest and out on to the plain towards Woodville. The embankment substantially avoids the area of regenerating broadleaf forest and gully containing the high value stream before extending across the plain to beyond a major stream (bridged) running parallel to the ranges. The embankment across the plain avoids the downstream end of the stream coming off the ranges where it traverses pasture.

Opportunity exists, as with the NOR indicative alignment, to flatten the embankment slopes over the plain to soften its visual impact and to better integrate the embankment with adjoining landform and to enable slopes that can retain an agricultural use.

As per the NOR indicative alignment, once at grade, the crawler lanes merge to a single lane two-way road with the wire rope and median extending through to a new five 5 leg roundabout, being the new highway, a realigned intersection with Woodlands Road and, Troup Road and a connection of the existing SH3 towards the eastern end of the Manawatū Gorge.

Figure 21 - Eastern incline to Woodville – Southern Option

Key features of the Southern option are:

- The new roundabout provides for a distinctive interface between the high standard rural highway and the existing SH3 approach in to Woodville;
- U-turn movements beyond the end of the wire roped median able to be safely completed at the roundabout;
- Sufficient separation between the crawler lane merge and the new roundabout;
- New roundabout providing improved safety for access to/from lower volume side roads;
- Avoids the majority of the regenerating broadleaf forest; and
- Eliminates the requirement for the stream diversion where affected across the plain

This option has been used for determining the southern extent of the designation boundary.

3. GENERAL DESIGN PHILOSOPHY

3.1 Design Life

The design life for key civil and structural design elements of the Project are provided in Table 1.

Table 1: Design Life

Asset	Design Life
Bridge structures	100 years
Pavements	25 years (state highway and arterial corridors) 25 years (local roads)
Retaining walls	100 years
Embankments	100 years (state highway and arterial corridors) 50 years (local roads)
Stormwater pipe system	Pipe System = 100 years Detention System = 100 years Treatment Devices = 100 years

3.2 Safe System Approach

Embracing the introduction of the international initiative of a Safe System Approach, the NZ Transport Agency has developed the Safer Journeys strategy. This strategy aligns the NZ Transport Agency with the principles of the Safe System Approach and has the vision of "a safe road system increasingly free of death and serious injury"[1].

Since 2011, three actions plans have been developed to address the safety concerns recognised within the State Highway network. These are the:

- 2011 – 2012 Action Plan;
- 2013 – 2015 Action Plan; and
- 2016 – 2020 Action Plan.

The design of this Project is to include the actions implemented to date as well as incorporate the new actions to be implemented in the latest plan.

The NZ Transport Agency Technical Memorandum TM-2503 *Guidelines for Edge Protection and Medians on Dual Carriageway Roads, incorporating a Safe System Philosophy,* issued March 2013, provides the Safe System philosophy guidelines that are intended for use on all dual carriageway roads. The guidelines contained within this technical memorandum are to be adopted into the design.

[1] http://www.saferjourneys.govt.nz/

3.3 Environmental and Sustainable Outcomes

3.3.1 General

The design philosophy is to be consistent with *Z/19 – State Highway Environmental & Social Responsibility Standard* and ensure the design meets the objectives of the *SH Environmental Plan*.

This has been captured and expanded upon in the AEE.

3.3.2 Sustainability

The Greenroads Certification has been adopted by the NZ Transport Agency for the management and reporting of sustainability on major projects. A minimum Greenroads rating of Silver shall be achieved for the Project.

3.3.3 Water Quality

Potential water quality impacts from the operation of the new road primarily relate to contaminants entrained in stormwater runoff from the road.

Effective stormwater treatment measures are to be implemented as part of best practice stormwater design.

3.3.4 Fish Passage

Where required, provisions for the safe passage of fish are to be made in accordance with NZ Transport Agency publication - Fish Passage Guidance for State Highways 2013.

3.3.5 Rest/Look-out Areas

Rest and look-out areas are to be provided as required. It is anticipated that there will be two such areas provided at either end of the plateau to provide rest and view points.

4. Geometric Design

4.1 General

The design philosophy adopted during the development of the geometry is to deliver a national route (as classified under the One Network Road Classification).

4.2 Design Publications

- NZ Transport Agency Technical Memorandum TM-2501 Superelevation calculations (Ratified September, 2013)
- NZ Transport Agency Technical Memorandum TM-2503
- NZ Transport Agency Traffic Control Devices Manual (TCDM) – Part 10 Motorways and Expressways
- NZ Transport Agency Bridge Manual (SP/M/022)
- RTS 18 – New Zealand On-road Tracking Curves for Heavy Motor Vehicles (2007)
- Austroads Guide to Road Design – Part 3: Geometric Design
- Austroads Guide to Road Design – Part 4: Intersections and Crossings
- Austroads Guide to Road Design – Part 4A: Unsignalised and Signalised Intersections
- Austroads Guide to Road Design – Part 4B: Roundabouts

4.3 Site Information

4.3.1 Topographical Survey and Imagery

The design is based on 2018 LIDAR survey undertaken by Aerial Surveys Limited, supplied in terms of Whanganui 2000 Meridional Local Circut map projection and Moturiki 1953 height datum. The data is converted from the NZGD2000 ellipsoidal heights into the local height system using the LINZ NZGeogrid16 and offset model.

4.3.2 Geotechnical Information

A range of geotechnical reporting has been completed for this Project. The following reports can be found within the DBC Report:

- Preliminary drilling scope;
- Scope for detailed engineering geological mapping; and
- Preliminary Geotechnical Appraisal Report.

Subsequent to the completion of the DBC report, Stage 1 Site Investigation has been undertaken with the outputs contained in the following:

- Stage 1 Geotechnical Investigation Factual Report, Rev. 0, July 2018.

4.3.3 Traffic Data

Current and predicted traffic volumes on the network including the new road (once completed) are provided in Technical Assessment Report 1 (Volume 3 of the application).

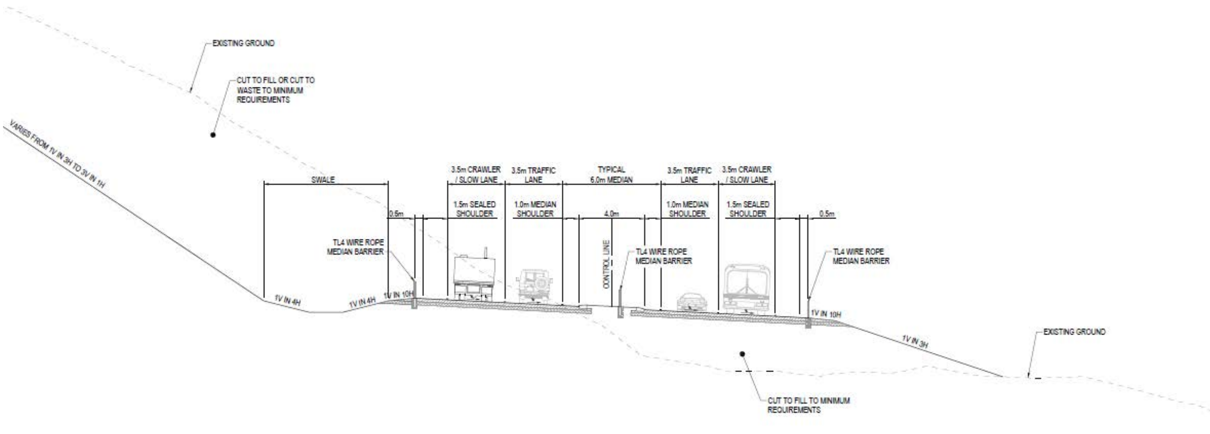
4.4 Mainline Road Layout

The road layout is to reflect an appropriate standard for the highway class, as follows:

- Two lane single carriageway highway (1 lane in each direction) between:
  - the eastern abutment of the SH3 bridge over the Manawatū River at Ashhurst and the new SH3/SH57 intersection; and
  - the new SH3/Woodlands Road/Troup Road roundabout and the eastern tie-in to the existing SH3 approaching Woodville;
- Addition of crawler lanes (2 lane in each direction) where required due to grades being >6%; with median and central wire rope barrier;
- Dual carriageway across the ridge/plateau between the crawler lanes with median and central wire rope barrier;
- Two lane single carriageway (1 lane in each direction) with median and central wire rope between the new SH3/Woodlands Road/Troup Road roundabout and the crawler lanes;
- 3.5 m wide traffic lanes;
- 2.0 m wide outside shoulders on single carriageway, or 1.5 m outside shoulders where there is a dual carriageway (outside crawler lanes);
- 4.0 m crowned or 6.0 m dished median width including 1.0 m wide nearside shoulders where there is a dual carriageway;
- Median barriers will need to be offset to allow for the appropriate sight distance;
- 0.5m offset to barrier face from outside shoulder edge; and
- 1.5 m offset to road furniture behind road side barrier.

4.4.1 Typical Cross Section

The typical design cross sections for the route are shown below in Figure 22.



TYPICAL SECTION - DUAL CARRIAGEWAY WITH MEDIAN AND SAFETY BARRIER
SCALE 1:200H-A1, 1:200V-A1, 1:400H-A3, 1;400V-A3

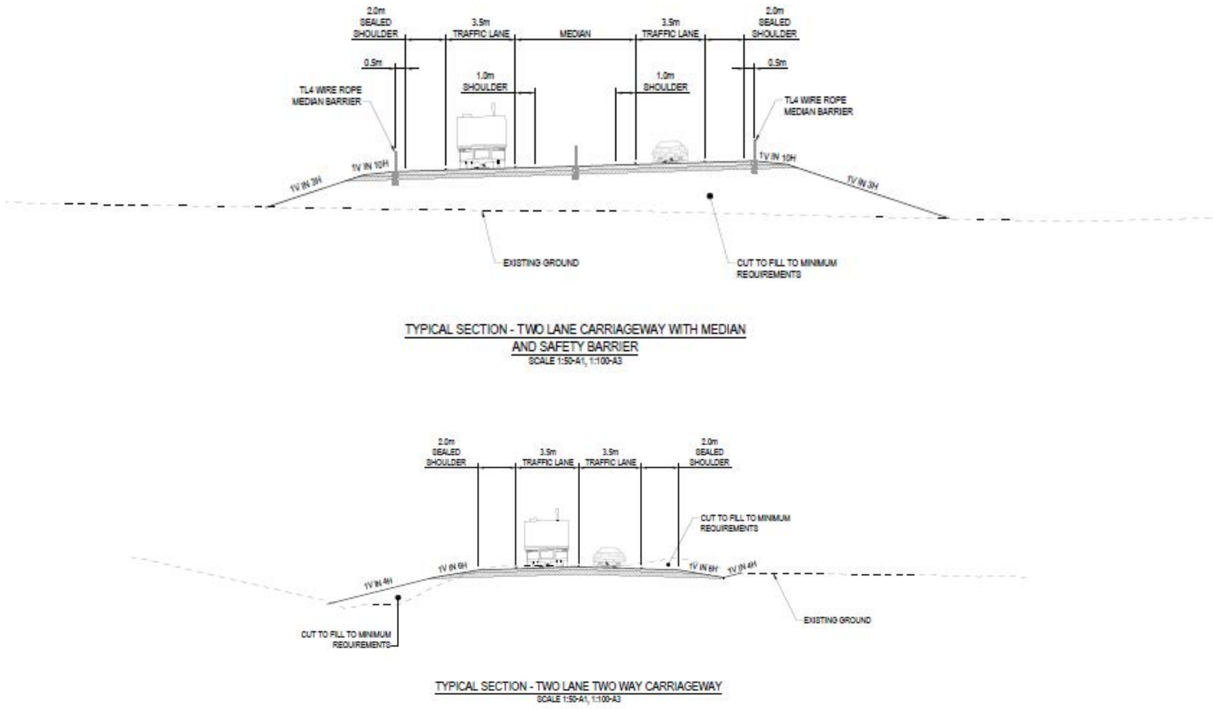


Figure 22: Typical Cross Sections

4.5 Road Classification

4.5.1 Main Alignment

SH3 is not currently classified as a national route under the One Network Road Classification. Once constructed, it is intended to gazette the new section of SH3 as a Limited Access Road under the Government Roading Powers Act 1989.

The new alignment will be labelled SH3, replacing the existing route.

4.5.2 Local Roads (where work is proposed as part of this Project)

All local roads are to retain their existing classification and route number where applicable.

4.6 Design Speed

4.6.1 Main Alignment

The operating speed expected for the main alignment is 100 km/h. However, to improve safety performance, where practicable the road will meet 110km/h design speed requirements. Where the desirable values given in the Austroads Guide to Road Design cannot be practicably achieved, the implication of a lower parameter value for drivers travelling at 100km/h must be assessed.

4.6.2 Local Roads (where work is proposed as part of this Project)

The adopted design speed for the local roads depends on the existing speed environment, and will be determined on a case-by-case basis.

4.7 Design Vehicles

The design vehicle for the SH3 alignment will be a RTS 18 m long quad rear axle semi-trailer. This section of the State Highway is also an Over-Dimension route, and a clearance envelope of 10m x 6m will be provided in accordance with the 3rd Edition of the Bridge Manual.

4.8 Mainline Horizontal Geometry

A typical crossfall of 3% is to be used for straight sections of the carriageway with the crown located within the median.

The minimum design curve radius is 600 m.

The maximum grade-corrected superelevation to be used is 8%.

4.9 Mainline Vertical Geometry

Vertical geometry is to be designed to minimise the amount of cut and fill required, with an aim to equalise the cut and fill volumes as much as practicable. The maximum uphill grade is to be 8%.

Vertical curves shall meet both appearance and head light sight distance requirements as follows:

- Sag curve minimum K = 31
- Crest curves minimum K = 97.3 (plus any allowance for grade correction)

Where the vertical grade exceeds 6%, crawler lanes have been provided in both uphill and downhill directions of travel in accordance with Austroads Part 3.

Uphill crawler lanes are provided in anticipation of heavy vehicles needing to travel slowly up the steep grades, and will allow safe passing opportunities for smaller vehicles who will generally be travelling significantly faster.

Downhill crawler lanes are provided to allow heavy vehicles to traverse the steep downhill grades slowly, thereby assisting in avoiding loss of control accidents for heavy vehicles due to excessive speed. The crawler lane again allows safe passing opportunities for smaller vehicles who will generally be travelling significantly faster.

The crawler lanes have been extended over the summit plateau to provide for the very slow moving HCVs over this section of the Project.

4.10 Local Road Geometry (where work is proposed as part of this Project)

The existing alignment and horizontal geometry is to be maintained where possible to minimise designation required and retain existing connectivity.

Vertical geometry is to be retained where possible, noting that adjustments are to be made where grade separation is to occur i.e. the vertical alignment will change to traverse over or under the mainline alignment.

4.11 Sight Distances

Car stopping sight distance shall be available along all traffic lanes on all roads. When determining the required car stopping sight distances listed in Austroads Part 3, Table 5.5, the design shall include the grade correction factors where necessary to account for the additional distance that vehicles travel when braking on a downhill grade, or reductions for an uphill grade. Sight distances are to be calculated using the following parameters:

- Design speed as per Section 4.6 above
- Coefficient of deceleration d = 0.36
- Reaction time = 2.5 seconds

Resulting in a minimum Stopping Sight Distance (SSD) = 209m

There is potential that, in some instances, verge or median widening to achieve grade corrected SSD may be prohibitive. Where this is the case any reduction in SSD is to be discussed and agreed with the NZ Transport Agency prior to completion of developed design.

4.12 Clearances

4.12.1 Horizontal Clearances

The design is to account for the envelope of the design vehicle and ensure adequate clearance from lateral objects.

4.12.2 Vertical Clearances

Vertical clearances are to meet the minimum clearances as set out in Figure A4 of the NZ Transport Agency's Bridge Manual (SP/M/022) with a 6.0 m clearance over traffic lanes.

Vertical clearances for private access underpasses (SH over) are to be agreed with the individual landowners. A maximum of 4.8m is anticipated, with a lesser clearance anticipated where alternative access/egress is possible for low demand HCVs.

4.12.3 Over Dimensional Route

The 10.0 m wide x 6.0 m high over dimensional envelope is to be allowed for in the SH design. The concept of operations for OD loads is to be agreed with the Heavy Haulage Association.

4.13 Safety Audit

A safety audit of the DBC design was undertaken, which identified several issues requiring addressing at later design stages.

The design developed in order to confirm the corridor for the Notice of Requirement has been amended to incorporate the agreed recommendation from the Road Safety Audit. The design has not been subjected to further Road Safety Audit. This will be completed as part of future design phases.

5. Traffic Services

5.1 Travel Demand Management

The application of specific travel demand management measures are not applicable to this project.

5.2 Signs

Sign design is not required for this stage of the project to support the Notice of Requirement process. The following design publications will apply to subsequent design stages.

In particular it is expected that the signage design will focus on:

- Advance directional signage at either end of the route;
- Signage associated with the Manawatū Gorge car park at the northern end of the site; and
- The crawler lanes.

5.2.1 Design Publications

- Manual of Traffic Signs and Markings (MOTSAM) - Parts I and III
- Traffic Control Devices Manual (TCDM)

5.3 Road Markings

Road marking design is not required for this stage of the project to support the Notice of Requirement process. The following design publications will apply to subsequent design stages.

5.3.1 Design Publications

- Manual of Traffic Signs and Markings (MOTSAM) – Parts II and III
- NZ Transport Agency's *Guidelines for Audio Tactile Profiled Roadmarkings*

5.4 Walking & Cycling

Walking or cycling facilities are not specifically included along the mainline alignment, however the sealed shoulder space provides an option for cyclists to use the route and remain clear of the live traffic lanes.

Provisions to replicate existing local road crossings will be considered and the Eastern tie-in with SH3 (Woodville side of the Gorge).

5.4.1 Design Publications

- RTS 14 – Guidelines for facilities for blind and vision impaired pedestrians

5.5 Traffic Signals

Traffic signals are not required for this project.

5.6 Intelligent Traffic Systems

The design of Intelligent Traffic Systems (ITS) such as VMS, CCTV etc. is not required for this stage of the Project. The following design publications will apply to subsequent design stages if applicable.

5.6.1 Design Publications

- ITS-01-01: General requirements
- ITS-01-02: Environmental requirements
- ITS-01-31: General electrical requirements
- ITS-01-04: Civil and motorway site works
- ITS-01-05: Support structures and foundations
- ITS-06-01: Variable message sign civil and structural works
- ITS-06-02: Variable message sign supply and installation
- ITS-06-03: National transportation communications for ITS protocol
- ITS-07-01: Closed circuit television civil and structural works
- ITS-07-02: Closed circuit television supply and installation
- ITS-08-01: Automatic video incident detection
- ITS-08-02: Over-height vehicle detection

5.7 Concept of Operations

In the event of a significant incident that causes an unscheduled closure of SH3, or for scheduled closures of SH3, re-routing of traffic is available via either Saddle Road to the north, or the Pahīatua Track to the south.

6. Civil Design

6.1 Kerb and Channel

Kerb and Channel design will be provided where required for the management of stormwater. Refer to the stormwater section below for further information.

Kerb and Channel will be provided at intersections where required, including full provision at proposed roundabouts and approaches.

6.2 Safety Barriers

6.2.1 Mainline

Barrier Type

Continuous TL-4 wire rope barrier is proposed as the preferred barrier type for edge and median protection in alignment with TM-2503.

Where roadside hazards fall within the deflection and rollover envelopes of the wire rope system, more rigid systems shall be introduced.

Protection on bridges is to follow the requirements set out in the NZ Transport Agency Bridge Manual and is expected to generally be TL-5 F-shaped concrete barrier with HT rail.

Transitions

Transitions between barrier types are to comply with the NZ Transport Agency's standard details in TM2013.

Emergency Crossover Points

Emergency crossover points in the central barrier are to be considered at appropriate locations to allow emergency vehicles to undertake a U-turn movement. This will improve emergency service access to incidents on both sides of the road, from both directions.

The final provision, detail and spacing for the emergency crossover points will be confirmed at a later design stage.

Maintenance Access

Maintenance access is required to allow maintenance vehicles to access infrastructure within the road reserve but behind the barrier (such as swales and culverts). Widened sealed areas behind the barrier are likely to be required to allow maintenance vehicles to safely access and park their vehicles outside of the carriageway.

The final detail and spacing for the maintenance access points will be confirmed at a later design stage.

6.2.2 Design Publications

- Guide to Road Design – Part 6: Roadside Design, Safety and Barriers
- NZ Transport Agency Bridge Manual NZ TRANSPORT AGENCY SP/M/022 (3rd Edition)
- NZTA M23 and M23 Appendix A
- NZTA RSB series of standard drawings

- NZTA Technical Memorandum TM-2503

6.2.3 Local Roads

No barriers are proposed on local roads unless required to protect a hazard.

6.3 Utility Services

The indicative alignment has considered the location of nearby utility services. Continued investigation as to the location of existing utility services and consultation with the respective providers is to be undertaken during future stages of the design.

Impact on the existing utility is to be avoided where possible. Where conflicts are unavoidable, relocation or protection of the utility is to be progressed through design and engagement with the affected utility provider.

Future proofing of the alignment will be considered through future design stages, and may include the provision of an ITS duct for future NZ Transport Agency use if required.

6.3.1 Known Utility Services

Based on the provided existing utility mapping, the known utility services in the area are:

- Chorus – there are existing Chorus services at the western end of the project, between the existing and proposed brides over the Manawatū River, and immediately north of the proposed bridge over the Manawatū River.

  There is also an existing Chorus service at the eastern tie in point to the existing SH3.

  It is not anticipated that there will be significant works required to the existing Chorus infrastructure to accommodate the proposed project.

- Gas – there is an existing gas distribution main at the eastern end of the project in the vicinity of the SH57 intersection.

  The proposed alignment includes an additional road crossing over the existing gas distribution main that will need to be communicated and resolved with the gas company at future stages of the design.

- Lighting – there is existing flag lighting at the SH3 / SH57 intersection that will need to be replaced, along with the associated low voltage power circuit, to suit the revised SH3 / SH57 intersection and approaches.

  There is an existing flag light on the LV pole on the corner of Woodville Road and SH3. This will be replaced with new lighting on the proposed SH3, Troup Road, Woodville Road roundabout and approaches.

- Wind farm utilities – there are existing Meridian power and fibre optic services that link up to each wind turbine and generally run alongside the access roads within the area of the wind farm. These services will need to be modified in conjunction with other adjustments to the wind farm as a result of the project, and high level discussions have been held with Meridian to arrive at a concept design for this area.

- Electricity – Powerco – existing overhead wires run along the SH3 at the western end, and these will need to be modified to suit the new SH3 alignment as it ties into the existing road network at the western end.

Electricity – Transpower - existing overhead line runs along Troup Road / Woodlands Road, crossing SH3. Replacement and/or additional poles will be required to ensure the overhead lines maintain sufficient clearance beneath for SH purposes.

- Water – there is an existing underground water line that follows the existing SH3 alignment at the western end. The detailed design will need to be cognisant of this service, however depending on the levels of the final alignment there is potential no works will be required to this service.

7. Geotechnical

Geotechnical information provides important guidance to the design, such as appropriate cut and fill batter slopes, the use of benching in cut slopes, the appropriateness of cut material to be used as cut to fill, information regarding the existing subgrade, and structural foundation parameters.

A series of geotechnical reports were completed as part of the DBC process, and can be found appended to the DBC Report. These include:

- Preliminary drilling scope;
- Scope for detailed engineering geological mapping; and
- Preliminary Geotechnical Appraisal Report.

Subsequent to the completion of the DBC, the first phase of proposed geotechnical investigations has been completed with the results contained in the following:

- Stage 1 Geotechnical Investigation Factual Report – Rev 0
- Stage 1 Geotechnical Interpretive Report – Rev 0

The Indicative Alignment design has utilised the suggested cut and embankment slopes recommended therein. The will be refined further with additional geotechnical investigation and detailed design is subsequent phases of the project.

8. Lighting

8.1 Lighting Requirements

8.1.1 Areas to be Lit

The general philosophy is as follows, with reference to Section 12:

- Full lighting of the mainline is not proposed, due to its rural location.
- Lighting of the primary intersections being the roundabouts at the SH3/SH57 intersection and the SH3/Woodlands Road/Troup Road intersection.
- Lighting at specific, as yet unconfirmed, locations may be considered as part of any Crime Prevention Through Environmental Design (CPTED) assessment undertaken.

Where required lighting levels shall be to V3 standard and meet the requirements set out in NZ Transport Agency M30 and AS / NZS 1158.

8.1.2 Luminaires

LED luminaires are to be used.

8.1.3 Frangibility

8.1.4 Where light masts are not protected by a safety barrier or otherwise are at risk of being impacted by a vehicle at a speed greater than 80km/h, frangible bases will be specified. OD Envelope

Light columns should be set back to ensure that they are outside the tested deflection of the barrier system (minimum 1.5m) and that the OD envelope is maintained

9. Pavement and Surfacing

9.1 Design Publications

- AUSTROADS, Pavement Design - A Guide to Structural Design of Road Pavements, 2004
- New Zealand Supplement to the Document, Pavement Design - A Guide to Structural Design of Road Pavements (AUSTROADS 2004), February 2007

9.2 State highways (SH3 and SH57)

9.2.1 Pavement Design

It is expected that indicative pavement designs will be produced at future design stages based on an unbound granular pavement with chipseal surface.

At high stress locations, such as the proposed roundabouts, structural asphaltic concrete pavements will be considered.

9.2.2 Surfacing

The predominant surfacing type is likely to be a two coat grade 3/5 chipseal with a single coat grade 4 reseal within 12 months for the mainline carriageway.

Open graded porous asphalt (OGPA) provides superior noise reduction properties as well as a reduction in surface water and hence improved visibility of pavement markings. This will be considered where it is the most appropriate noise mitigation, if and where required as part of the Project.

Asphaltic Concrete (AC) or Stone Mastic Asphalt (SMA) is to be used in areas of high braking or stress (e.g., proposed roundabouts).

9.3 Local Roads

9.3.1 Pavement Design

The pavement design for local roads is to be based on AUSTROADS, Pavement Design - A Guide to Structural Design of Road Pavements, 2004.

The design of the pavements for local roads will also make reference to the existing pavement structure for the local road, with a philosophy to replicate the existing structure where practical in order for the future maintenance for the applicable Council to be made as easy as possible.

9.3.2 Surfacing

A two coat Grade 3/5 chipseal is to be used on local roads.

Where the local road is an area of high braking or stress (e,g, proposed roundabout approaches) AC or SMA is to be used.

10. Construction Stormwater Management

The following section describes the design philosophy for the management of stormwater flows for the construction of the Project. This philosophy will be developed further and implemented in the detailed design of the Project, and will be reflected in the resource consents sought for the Project.

10.1 Construction Stormwater management

The construction stormwater management philosophy adopted for the Project has been selected to manage erosion of disturbed earth and the collection and treatment of sediment laden runoff from the various construction zones. The following philosophy will be used to design the most appropriate erosion and sediment control measures for the Project:

- Minimise Disturbance;
- Stage Construction;
- Protect slopes;
- Protect watercourses;
- Rapidly stabilise exposed areas;
- Install perimeter controls and diversions;
- Establish sediment retention devices;
- Use trained and experienced staff;
- Adjust and amend the Erosion and Sediment Control Plan as required; and
- Assess and adjust erosion and sediment control measures as required on site.

10.1.1 Standards

The design standards to be used in the design of the appropriate erosion and sediment control measures are as follows:

- Greater Wellington Regional Council - Erosion and Sediment Control Guidelines for the Wellington Region; 2002.NZ Transport Agency – Erosion and Sediment Control Guideline for State Highway infrastructure; 2014.

11. Operational Stormwater Management

11.1 Operational Stormwater Management

The stormwater management philosophy adopted for the Project has been selected to manage stormwater runoff from flow, volume and contaminant perspectives as follows:

- The design will provide a best practicable option to avoid, remedy or mitigate adverse environmental effects, determined through a robust evaluation of the proposals in line with the NZ Transport Agency's and Horizons Regional Council's requirements relating to the design and construction of stormwater conveyance and treatment systems.
- The design will integrate the stormwater system collection and conveyance network, treatment systems and devices, culverts and watercourse diversions, and consideration of the floodplain.
- The design will include full consideration of, and will respond to, the implications of stormwater management throughout the design life of the asset.
- The design will take cognisance of any existing hydrologic regimes to deliver outcomes that avoid, remedy or mitigate any adverse environmental effects.
- The design will avoid or mitigate changes that may make any current flood issues in the catchment worse.
- The design will, through best endeavours and as far as is reasonably practical, provide for habitats in stream diversions where they existed prior to the Project, which may include restoring streams and natural habitats.
- The carriageway level will be set at a freeboard above the predicted 1 in 100 year flood levels. Carriageway stormwater runoff flows and volumes will be managed to provide safe serviceability of the road in the required design rainfall events.
- Outfalls will be assessed and where required will incorporate erosion control measures that do not impede fish passage.
- Where required and opportunities exist, the design will provide fish passage in culverts for all permanent streams with upstream habitats, and for intermittent streams where there is potential for fish habitat upstream.
- The works shall not cause significantly increased flood risk at existing properties.
- Overland flow paths are to be provided and maintained for flows in excess of the primary drainage network capacity up to and including the 100 year ARI storm flows.
- The design will include a range of water sensitive design solutions including treatment swales and treatment wetlands to deliver stormwater hydrology (flows and volumes) and stormwater quality (treatment) mitigation.

  Note: vegetated stormwater treatment systems typically take up more land area than a traditional “channel and pipe” approach, and a balanced approach will be needed recognising the range of activities and issues, and the constraints of the environment and existing land use.

11.1.1 Standards

The standards listed below shall be used in full or in part during the development of the design of the operational stormwater design. The particular standards used will be detailed in the Stormwater Design Report, which will form part of the Final Design Report for the Project.

- AS/NZS 2566 Buried Flexible Pipelines, 1998;
- AS/NZS 3500.3, Plumbing and Drainage Part 3: Stormwater, 2003;
- AS/NZS 3725, Design for Installation of Buried Concrete Pipes, 2007;
- NZ Transport Agency Stormwater Treatment Standard for State Highway Infrastructure, 2010;
- NZ Transport Agency's Bridge Manual (Bridge Manual) 3rd edition (SP/M/022-2013);
- NZ Transport Agency P46 Stormwater Specification; April 2016;
- NZ Transport Agency TNZ Highway Surface Drainage: A Design Guide for Highways with a Positive Collection, 1977;
- Austroads - Guide to Road Design: Drainage Part 5: Drainage – General and Hydrology Considerations; 2013
- Austroads - Guide to Road Design: Drainage Part 5A: Drainage – Road Surface, Networks, Basins and Subsurface; 2013
- Austroads - Guide to Road Design: Drainage Part 5B: Drainage – Open Channels, Culverts and Floodways; 2013; and
- Australian Rainfall & Runoff (2015), Blockage of Hydraulic Structures – Blockage Guidelines or approved alternative methodology.

11.2 Cross Drainage and Overland Flow Paths

Cross drainage structures, including culverts and bridges, are to be designed to allow the continued flow of existing watercourses and overland flow paths with minimal effect on the surrounding environment, and will generally be in the form of bridges or culverts (either pipes or box culverts).

The philosophy for passing flows from natural catchments upstream of the alignment shall be to maintain the existing hydrological regime, and not divert flows from one sub-catchment into another where possible, so as not to exacerbate existing, or create new, flooding issues.

11.2.1 Viaducts and Bridges

All viaducts and bridges are to be designed to cater for the 1 in 100 year ARI storm and checked for erosion in accordance with the NZ Transport Agency Bridge Manual against the 1 in 2500 year ARI storm. If required, additional protection measures are also to be incorporated as required by the NZ Transport Agency Bridge Manual. All structures must have a minimum freeboard of 600 mm in non-forested areas and a freeboard of 1200 mm in forested areas.

11.2.2 Culverts (Pipe or Box)

All culverts and pipe crossings (existing and new) that cross the State highway shall satisfy the following hydraulic conditions:

- Convey the 10 year ARI storm event flow without surcharge of the pipe for the Maximum Permitted Development (MPD) scenario; and

- Convey the 100 year ARI storm event flow without surcharge of the pipe more than 2 m above the pipe soffit, whilst ensuring a minimum 500 mm freeboard is provided from the peak water level to the outer edge line level for the MPD scenario.

Where an existing culvert does not meet the existing criteria, consideration shall be given to its replacement, and additional hydrological analysis will be undertaken to ensure that an increase in culvert size does not impact on flooding downstream.

All new culvert structures and pipe crossings under local roads shall be designed taking cognisance of the NZ Transport Agency's Stormwater Specification (P46).

In addition, secondary inlets shall be provided where it is necessary to maintain the culvert headwater requirements. Where a risk of blockage remains and/or the consequences are high, works shall be included to divert overflows that might occur so they are collected within the road stormwater infrastructure until entering another watercourse.

The design must include consideration of storm event scour, overtopping, embankment stability (including rapid drawdown conditions) and the potential for piping failure.

11.2.3 Fish Passage

Fish passage provisions will where practicable be in accordance with the NZ Transport Agency publication - Fish Passage Guidance for State Highways 2013.

11.2.4 Overland Flow Paths

Overland flow paths will be designed to cater for a 100 year ARI event. However, where no secondary flow route is available the capacity of the primary system will be designed to cater for the 100 year ARI rainfall event. Overland flow paths will be identified using Horizons Regional Council's GIS website.

11.3 Edge Collection Systems

11.3.1 Bridges

All bridges and viaducts are to be designed to have a positive drainage system and will be discharged to an appropriate stormwater treatment system.

11.3.2 Cut Batters

Grass or rock lined channels are to be provided at the base of all cut batters to convey flows in excess of the pavement collection system.

11.3.3 Large Fills

Pavement collection at the outer edge of the pavement in large fill embankments shall prevent stormwater from spilling over and down the face of the fill embankment.

11.3.4 Medians

On superelevated sections of carriageway, surface water runoff from the pavement will be captured in the median to prevent water flowing from one carriageway to another. Stormwater will be discharged to an appropriate stormwater treatment system.

11.4 Longitudinal Drainage Systems

Longitudinal drainage is designed to cater for the 1 in 10 year ARI event flow (Q_{10}) without surcharge, and where no overland flow path is available, the primary system shall be designed to cater for the 1 in 100 year rainfall event.

11.5 Clean Water Diversions

Clean water diversions are to be included at the top of all cut slopes. These diversions prevent stormwater runoff above cut slopes from flowing down the cuts and divert them to an existing stream or watercourse.

Clean water diversions shall be sized to convey the 1 in 100 year ARI storm event from the upstream catchment.

11.6 Water Quality and Water Quantity

Stormwater management and treatment devices shall be provided to treat stormwater runoff from roads to provide the outcomes required by the Horizons Regional Council's One Plan and will be designed to attenuate stormwater flows to predevelopment discharge rates for events up to and including the 1 in 100 year ARI rainfall event.

11.6.1 Water Quality

With respect to the treatment of stormwater, there is a preference for the provision of vegetated treatment systems such as swales and constructed wetlands. Stormwater runoff from new or modified impervious areas will be treated by stormwater management devices which meet the following criteria:

- Stormwater treatment shall be provided as part of a treatment train approach and the system as a whole shall provide for the removal of 75% total suspended solids (TSS) on a long-term average annual basis.
- Vegetated treatment devices shall be designed in accordance with the NZ Transport Agency's Stormwater Treatment Standard.

11.6.2 Water Quantity

The introduction of new paved surfaces will result in increased flows and volumes of stormwater being discharged into the receiving environment, which can cause both increased flooding and erosion.

To mitigate this effect, flow attenuation measures will be provided to limit flows to the pre-development discharge rates for events up to and including the 1 in 100 year ARI rainfall event.

12. Environmental and Cultural Design

As part of the design development up to the NoR, Boffa Miskell, on behalf of the NZ Transport Agency has prepared a Preliminary Environmental and Cultural Design Framework (ECDF) (provided as Appendix Two to Volume 2: Assessment of Effects and Supporting Material). The ECDF provides a design framework within which the design of the proposed Project will be developed. It identifies design principle constraints and opportunities that form the framework that will guide design.

The ECDF outlines the key environmental and cultural issues that need to be considered during detailed design and construction phases of the Project. It describes the environmental and cultural context, introduces design principles and outcomes, and identifies opportunities for NZ Transport Agency and partners that can be considered alongside the construction of the Project, and may require input from other parties.

13. Structures

Refer to the Bridge and Retaining Wall Design Philosophy Report (provided as Appendix Four to Volume 2: Assessment of Effects and Supporting Material) for information on the structural design philosophy for the Project.

14. Property Considerations

14.1 Property Access

The design approach for private property access is to be as follows:

- Access is required to be maintained from and to all properties (regardless of the presence of a habitable dwelling);
- Where access to existing dwellings has been severed, the proposed access must provide sufficient clearances for a vehicle deemed appropriate for the land use; and
- Rationalisation of the Te Āpiti Windfarm tracks is to be undertaken, with further discussions to be held with the land owners / operators to confirm the final requirements.

The final requirements for private property access will be subject to discussion with individual landowners, led by the NZ Transport Agency and its property agent. An assessment of property accesses is provided in Technical Assessment 1: Transport.

14.2 Severance

Severance of existing properties will be avoided or minimised where possible.

Where severance of existing land parcels occurs, it is expected that the NZ Transport Agency and its property agent will engage with the affected landowner to determine the required approach to be taken. This process will be undertaken in accordance with the Public Works Act 1981.

14.3 Designation

The proposed designation has informed the Land Requirement Plans, and these will be utilised by the NZ Transport Agency and its property agent in their liaison with affected landowners.

The proposed designation boundary has been set taking into consideration factors including:

- The geometric and carriageway specification requirements;
- Achievement of the required geometric sight lines;
- Provision of the required stormwater infrastructure, including swales, stream diversions, and wetland areas;
- Earthworks extents including assessments of safe cut and fill slopes;
- Utility requirements for clearances along and across the route;
- Footprints for structures, including embankments;
- Environmental considerations including landscaping and mitigation areas and the requirement to minimise environmental effects;
- Temporary site access (to be returned to the landowner following construction); and
- Temporary construction areas (to be returned to the landowner following construction).

The designation will be rationalised as far as practicable to minimise the overall land requirement.

15. Maintenance

15.1 Safety in Design

A Safety in Design assessment for the Project has been completed, and is included as an appendix to the DBC. It is intended that this assessment will be provided to the Contractor so that the identified risks can be managed accordingly throughout the further stages of the design, construction, and maintenance of the Project.

15.2 Maintenance

Maintenance of the proposed highway is not expected to include any specific ongoing requirements that are uncommon to normal highway maintenance practices.

It is expected that the ongoing maintenance costs associated with the proposed SH3 route will be higher than those associated with the old SH3 route as:

- the addition of barriers along the length of the Project (including central median barriers in some locations) will require additional maintenance to repair barrier strikes and to maintain the barriers;
- the increased sealed carriageway area will lead to increased maintenance costs;
- the proposed route is longer than the old route, including sections with steep grades; and
- the proposed Project includes a number of stormwater detention basins and swales that will require regular maintenance.

However, these increased maintenance costs are expected to be partially offset by:

- the asset being newer and constructed to higher standards than the old SH3 route;
- the new route being more resilient to weather events with shallower cut slopes decreasing the risk of slips;
- the wider carriageway and improved geometric alignment decreasing the risk of crashes; and
- the wider carriageway making traffic management easier to manage for maintenance activities, reducing the time and cost associated with maintenance activities.

The requirement for ongoing maintenance will be minimised where possible throughout the future design stages.

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Document Status

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