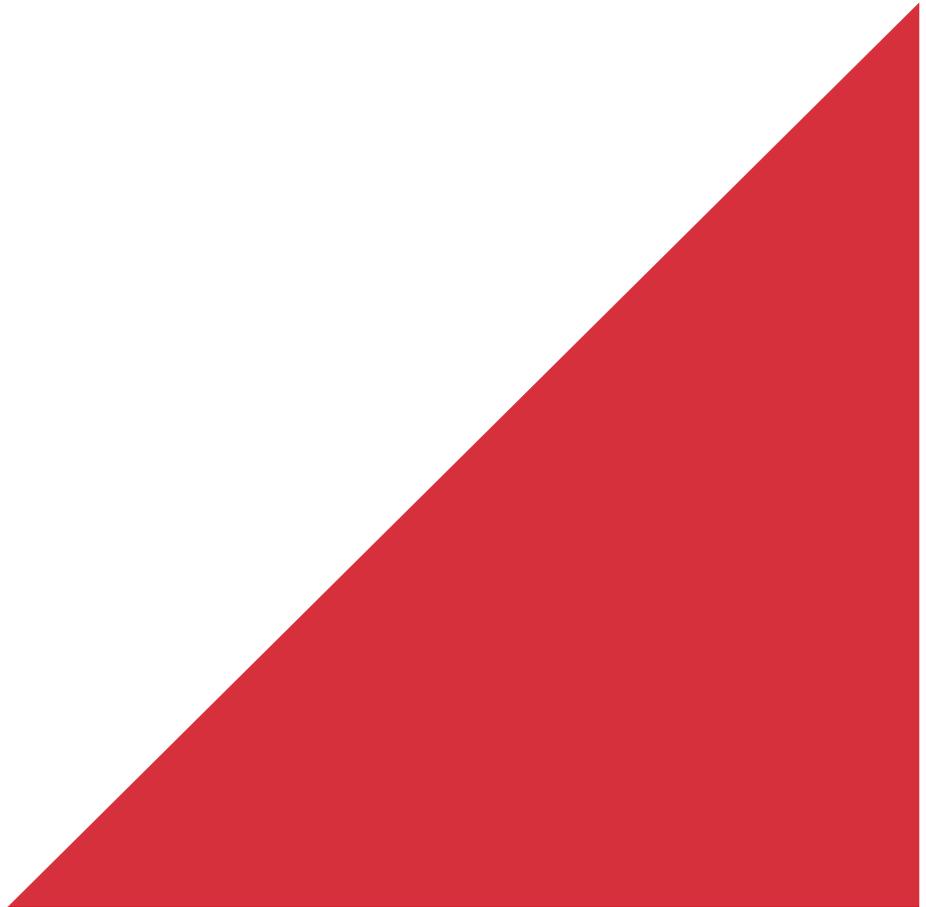




New Zealand Transport Agency

Petone to Grenada Assessment of Alternative Routes



New Zealand Transport Agency

Petone to Grenada

Assessment of Alternative Routes

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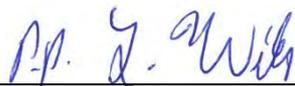
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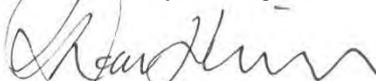
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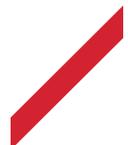
Petone to Grenada

Assessment of Alternative Routes

Approved for
Release By

Benjamin Holland.

Ben Holland, Project Director



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1 Executive Summary

The purpose of this report is to assist the NZ Transport Agency (Transport Agency) in determining a preferred new link road between Petone and Grenada. This report outlines and reports on numerous potential route options for a new road link in order to provide a robust suite of information to be factored into the Transport Agency decision as to route. This report does not select any option, but rather provides information to the Transport Agency to assist in its decision as to which route option to pursue. Also included in this report is the assessment of a series of potential fill sites that might be able to accommodate surplus material from earthworks associated with the new route.

Investigation into potential routes for this link road have been underway since 2013 building on historical assessments summarised in this report, with extensive assessment of routes and engagement with the community having been undertaken since that time.

The Transport Agency's objectives for the link road project are:

1. To enhance local, regional and national economic growth and productivity for people and freight;
2. To improve connectivity between the lower Hutt Valley and Johnsonville and Porirua;
3. To reduce journey times and improve journey time reliability between the lower Hutt Valley, Ngauranga and Porirua, and on the Wellington State highway network;
4. To enhance safety of travel on the Wellington State highway network;
5. To enhance resilience of the Wellington State highway network;
6. To manage the immediate and long term social, cultural, land use and other environmental impacts of the Project on the Wellington region and its communities by so far as practicable avoiding, remedying or mitigating any such effects through route and alignment selection, expressway design and conditions;

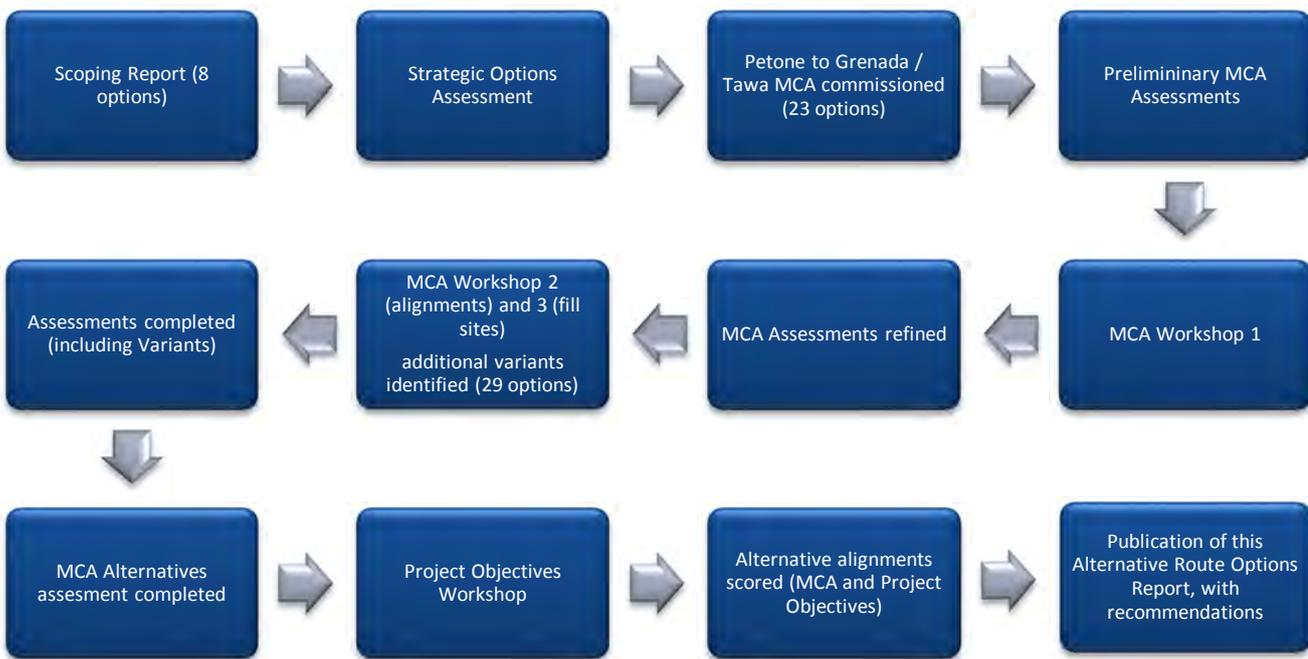
By developing and constructing a cost efficient new road alignment to expressway standards between SH2 in the lower Hutt Valley and SH1 north of Ngauranga.

29 possible routes have been the subject of detailed assessments summarised in this report, six between Petone and the Crest of the Wellington Escarpment (known as 'Section 1') and 23 from the Crest of the Wellington Escarpment westward to a connection with SH1 (known as 'Section 2'). All alignments in Section 1 are compatible with those in Section 2 and meet at a common point.

Presented in the report are the findings of:

- an extensive Multi-Criteria Analysis (MCA) whereby a range of assessments by diverse technical specialists has been used to assess route options against transportation-focused and other environmental criteria; and.
- An assessment of each route option for its 'fit' with the project objectives.

The report then presents the combined findings of the assessment against project objectives assessments, the MCA and other factors to the Transport Agency, in order to provide a robust basis for the Transport Agency's decision as to the route of the link road. The process is shown diagrammatically below.



The route options have been split in two sections as follows:

1. Section 1: Routes to the east of the crest of the Wellington escarpment (to Petone); and
2. Section 2: Routes to the west of the crest of the Wellington escarpment (to SH1 at Grenada or Tawa and Transmission Gully).

The assessment found that there are three strongest route options, one in Section 1, and two in Section 2. Option 4 (P4) scored consistently very strongly amongst all options in Section 1. In Section 2, two similar routes scored equally strongly, namely Options 10a and 11a (Option C (V1) Variant 1 Managed Motorway 1 and Option C (V1) Variant 1 Managed Motorway 2). Both these options are derivatives of an earlier Scoping stage option known as C. Both are essentially further developed options of C that respond to environmental effect identified, mitigation opportunities proposed, and other benefits that may have been identified.

Together this presents a strong connected route of either Options 4 – 10a, or 4 – 11a as a highest scoring route for consideration. This report however also contains the result for all other route and other background information to assist the Transport Agency in making its decision as to the route of the link road.

Information about potential fill sites, including the order in which they might optimally be used, and how effects might best be mitigated were also considered as part of the MCA process and are contained in this report.

2 Introduction

2.1 Purpose of Report

The purpose of this report is to assist the Transport Agency in determining a preferred new link road between Petone and Grenada. This report outlines and reports on numerous potential route options for a new road link in order to provide a robust suite of information to be factored into the Transport Agency decision as to route. Investigation into potential routes for this link road have been underway since 2013, with extensive assessment of routes and engagement with the community having been undertaken since that time.

This report follows earlier studies and assessments that have identified a route between Petone and Grenada/Tawa/Porirua as a preferred general route to connect the lower Hutt Valley with Johnsonville and Porirua. This assessment considers in more detail general routes along that actual route, together with potential connections and intersections for the new route.

The project objectives are:

1. To enhance local, regional and national economic growth and productivity for people and freight;
2. To improve connectivity between the lower Hutt Valley and Johnsonville and Porirua;
3. To reduce journey times and improve journey time reliability between the lower Hutt Valley, Ngauranga and Porirua, and on the Wellington State highway network;
4. To enhance safety of travel on the Wellington State highway network;
5. To enhance resilience of the Wellington State highway network;
6. To manage the immediate and long term social, cultural, land use and other environmental impacts of the Project on the Wellington region and its communities by so far as practicable avoiding, remedying or mitigating any such effects through route and alignment selection, expressway design and conditions;

By developing and constructing a cost efficient new road alignment to expressway standards between SH2 in the lower Hutt Valley and SH1 north of Ngauranga.

29 possible routes have been the subject of detailed assessments summarised in this report, six between Petone and the Crest of the Wellington Escarpment (known as 'Section 1') and 23 from the Crest of the Wellington Escarpment westward to a connection with SH1 (known as 'Section 2'). All alignments in Section 1 are compatible with those in Section 2 and meet at a common point.

Presented in the report are the findings of:

- an extensive Multi-Criteria Analysis (MCA) whereby a range of assessments by diverse technical specialists has been used to assess route options against transportation-focused and other environmental criteria; and
- An assessment of each route option for its 'fit' with the project objectives.

The report then presents the combined findings of the assessment against project objectives assessments, the MCA and other factors to the Transport Agency, in order to provide a robust basis for the Transport Agency's decision as to the route of the link road.

2.2 Structure of Report

This report is broken in 12 main parts. Section 3 provides a brief background to the processes preceding this report, referring to earlier community and stakeholder engagement undertaken, and the consideration of a wider range of alternatives that resulted in the selection of the current general route for further consideration through this present assessment.

Section 4 gives an overview of the 29 route options being evaluated in this report. This section also explains how the six routes east of the crest of the Wellington escarpment and 23 routes west of the crest of the Wellington escarpment meet at a common point at the crest. A brief summary is also given of a number of previous route options identified since 1975.

Section 5 documents the route option evaluation process throughout the various stages of the scoping phase of this project, with preliminary cost estimates provided in Section 6.

Section 7 provides a preliminary economic evaluation of the route options in accordance with the Transport Agency Economic Evaluation Manual (EEM) procedures to enable the Transport Agency to take that information into account when making its decision on a preferred route.

As several of the route options, particularly those east of the crest of the Wellington escarpment, have the potential to generate large quantities of surplus material, a number of sites that might be able to accommodate this material as fill have also been considered and assessed. The primary purpose of this assessment has been to form a preliminary view on whether such sites are likely to be appropriate to receive the volume of fill potentially generated by the different options (and in turn consider the extent to which the amount of fill generated by a particular route option might influence recommendations and decisions as to routes).

Further, if the material is able to be placed in close proximity to the new alignment this would have various advantages including avoiding any potential adverse environmental effects of transporting the material on the public roading network and disposing of it elsewhere. In some instances the placement of fill on-site may also be of benefit to the receiving sites or be able to be used for mitigation. This assessment extended to identifying how the environmental effects of placing such fill could be mitigated. It considered whether several sites should not be considered further or replaced with other sites. These and their extent are set out in Section 8.

The approach used to evaluate the various options is set out in Section 9. It describes how the options have been assessed against project objectives, and how the MCA assessment has been completed. With respect to the MCA section 9 describes the process of testing the relative merits of the options by specialists first ascribing 'raw' scores to the options, subsequent analysis of the raw scores using two 'unweighted' systems or scenarios, further analysis by applying a 'workshop weighting' system (based on relative weightings recommended by the specialists themselves), and additional sensitivity testing using a series of different weighting systems. The section also explains the rationale behind the selection of the 14 criteria used in the MCA process and the different weighting systems used to test the sensitivity of the other results. Those systems emphasised the effects of the various options in terms of business impacts, transport, built environment, land contamination, natural environment, and culture/heritage aspects (respectively).

These weighting systems along with a scenario based on relative weightings recommended by the groups of specialists themselves have been used to test and inform the findings of this report as to the relative merits of the route options.

Section 10 contains the main findings of the report. It identifies the findings of the evaluation of the option against the project objectives, setting out how consistent each of the 29 routes is with each of the 6 objectives respectively, before finding which option/s are most consistent overall. Also in Section 10 is the MCA assessment, encompassing all 29 options evaluated against the 14 criteria and sensitivity scenarios. These are set out as 'unmitigated'¹ and 'mitigated', the latter being mitigation that has been identified by various environmental specialists during the preparation of 14 assessments on each of the 14 criteria respectively. These assessments are also split into routes east of the crest of the Wellington escarpment and west of the Wellington escarpment consistent with the description of routes in Section 4. At the end of Section 10 is a summary of the highest scoring options both east and west of the crest of the Wellington escarpment as assessed against the project objectives and MCA respectively.

Drawing directly from the summary at the end of section 10, Section 11 presents the overall findings of this assessment of alternative routes. This section summarises key findings and makes a recommendation as to preferred link and route from Petone to Grenada as well as the SH1 corridor north of Tawa or an option linking to Transmission Gully, the fill sites available and the order in which they might be used (using sites with lowest effects first).

3 Background and Process Preceding this Report

3.1 Scoping Report and Pre-MCA Community Engagement

A Scoping Report² was released in 2014 summarising investigations into route development in respect of a Petone to Grenada and/or Tawa link road and widening of the SH1 corridor. This preliminary Scoping Report was followed by consultation seeking the views of the community in respect of the sub-options that were selected for further development in the Scoping Report. Of these options the consultation had an emphasis on the preferred options C, D and P4.

The following summary outlines some of the main findings from that consultation. A summary of consultation was also provided to the MCA technical specialists as the first MCA workshop.

This enabled the specialists, at an early stage, to consider public perceptions about the effects of the Scoping Report options.

The consultation process started at the end of January 2014 with individual meetings for directly affected property owners. Information days were then held in Petone and Tawa and the consultation was open to public comments from the 22nd of February until the 17th of April 2014. A total of 1415 written submissions were received, with a number submitted after the closing date. Of these, 60 were signatories to group submissions. All submissions were accepted and summarised in a consultation report document.

¹ Incorporating Base Position mitigation only, refer to Appendix C for details

² Petone to Grenada Transportation Link Scoping Report – April 2014 (<http://www.nzta.govt.nz/projects/petone-grenada-link-road/docs/p2g-scoping-report-final-2014-part1.pdf>)

3.1.1 Key outcomes from consultation with regard to design elements of the road

- A large proportion of the comments came from the Tawa Community.
- For the Petone to the crest of the Wellington escarpment many submitters expressed a preference for Option 4 (P4).
- Many submitters were supportive of using the excess fill for the Petone to Ngauranga Cycleway.
- There was a concern that the Link Road would increase traffic on Petone Esplanade.
- Horokiwi submitters requested that suitable access to the people living in Horokiwi should be provided. The people living in Horokiwi also clearly stated their desire to work closely with the Transport Agency to find the best workable access solution.
- Submitters were concerned about the capacity of the Tawa Interchange once the Link Road was built.
- Submitters were supportive of building the Petone interchange as soon as possible.
- A great number of submitters questioned the need for extra capacity north of Tawa.
- A significant number of submitters indicated that improving resilience of the roading network was important to them.
- There was support for the provision of cycling and pedestrian facilities along the route, with a suggestion to provide these facilities off-route at certain areas.
- There was overall support for the provision of a pedestrian/cycle connection between Belmont Regional Park and the Petone Foreshore to be included in the project.
- Submitters would like to see more of an emphasis on public transport on the Link Road and the Link Road should not undermine current use of Public Transport.
- There was a concern that the steep gradient between Petone and the crest of the Wellington escarpment, Option 4 (P4), will discourage heavy vehicles from using it.
- A similar number of people support tolling as oppose it.

3.1.2 Key comments with regard to environmental effects to be considered in the next stage of the project

- The most dominant environmental concerns related to social, pollution and ecological effects.
- The social effects related to loss of property and emotional connection to the property, distress in the community, uncertainty and anxiety. There were also concerns that the Link Road would impact on social facilities such as sports fields and schools.

- Pollution concerns related to air, water and light pollution.
- Concerns about ecological effects were centred predominantly around the areas of Belmont Regional Park, Horokiwi and Takapu Valley. Concerns centred on sedimentation of streams and local habitat of fauna and flora.

3.1.3 Other matters raised during consultation

- Many submitters expressed support for upgrading SH58 rather than developing P2G.
- Many submitters expressed the view that Cross-Valley Link (in Hutt City) should form part of the P2G Link road.
- Many submitters expressed support for greater investment in public transport in the region.

3.1.4 Overarching Feedback

There was support for the concept of the Petone to Grenada Link Road, along with the request that additional work should be done on a number of aspects of the proposal.

There was clear support for a new Petone Interchange, and numerous submitters commented that the replacement of the Petone Interchange should be the highest priority part of the project.

Option 4 (P4) is clearly supported as the preferred option for the section of the Link Road between Petone and the crest of the Wellington escarpment. Submitters generally welcomed the development of this option which avoids direct impact on the Belmont Regional Park, although concerns were raised about the potential visual impact of the road on settlements in Petone and Korokoro.

Submitters generally supported the concept of a route from the crest of the Wellington escarpment west to the SH1 corridor were also generally supported, though a number of submitters raised concerns around the impact on the Hunter's Hill development area.

Feedback on the proposals for additional capacity north of Tawa was mixed. There was support and opposition for both Option 7(C) and Option 8 (D). On the whole there was strong feedback requesting the need for additional capacity north of Tawa be reviewed with a view to:

- Re-evaluate the need for and time frame of additional capacity to be provided north of Tawa;
- Review potential for public transport upgrades to alleviate the need for additional capacity north of Tawa;
- Review potential for widening of SH1 (Option 7 (C)) to take place in the road reserve;
- Review the potential for an upgraded SH58 to alleviate the need for additional capacity north of Tawa;
- Review the potential for a redesigned Option 8 (D) to avoid the sports fields at Grenada North; and
- Review the proposed design of the Tawa interchange to ensure sufficient capacity will be provided if/when the Petone to Grenada Link Road is constructed.

It was concluded that east of the crest of the Wellington escarpment there is clear support for Option 4 (P4), but west of the crest of the Wellington escarpment there is no clear preference for either Option 7 (C) or Option 8 (D).

3.2 Strategic Options Assessment

Before undertaking further detailed investigations and assessments of potential route options between Petone to Grenada, the Transport Agency commissioned a further report to revisit and test the finding that this general route was preferred, by a further high level investigation of a series of other options between the lower Hutt Valley and SH1 identified in Figure 3.1 below. This was described as a

“high level review and analysis of the main broad route options considered in the historical reports and processes identified in the Chronology of Reports and Decision Making that covers various studies and decision making processes from 1975 to the present. The intention was to consider whether the decisions made through the Ngauranga Triangle Study and the Hutt Corridor Plan (and following previous studies) to prefer a Petone to Grenada and/or Tawa link remains appropriate in light of current circumstances, and what the Transport Agency is now seeking to achieve by pursuing the new east – west link..”³

A list of the potential route options that had been previously considered was compiled, followed by a workshop that undertook a comparative assessment of those options against the current Project Objectives. At the workshop the project team considered any other alternatives including a tunnel or PT only options.

The findings of this assessment were as follows:

“The northern options that connect to Transmission Gully and the SH58 option have been able to be discounted for a number of reasons primarily in that they do not score as well on the economic, connectivity nor travel time savings objectives. It is also the view of the Project team that Douse options can be ruled out on the basis of being fatally flawed environmentally.

Consideration was given to include the Horokiwi option going forward as based on the raw aggregate score it scores reasonably well. However the Project team consider that this should not be progressed further. The option does not provide an exclusively new route and still relies on a section of SH2 to be utilised and this would not be as resilient as options connecting at Petone. There are also significant matters about the scale of any reclamation, the precise effects on the residential population at Horokiwi and the likely very visible nature of the interchange that would need to be located in the coastal environment.

Based upon the above high level assessment that has been carried out it is recommended that only two of the strategic alignments should be carried through for a more detailed MCA assessment. These are Petone to Grenada and Petone to Tawa. At the same time it is also recommended that options for capacity improvements including do minimum be assessed for options north of Tawa. In coming to this conclusion the Project Team took into account the fact that there has been detailed work undertaken considering how to avoid / remedy / mitigate the effects of the Petone options, but nonetheless felt that

³ Incite (2015) P2G Strategic Options Assessment Workshop Report, 9 June 2015

the effects of the Petone options are inherently more amenable to be avoided / remedied / mitigated through detailed route selection than the other options considered.

This assessment is also in alignment with the intent of the Hutt Corridor Plan, the Western Corridor Plan and the outcomes of the Ngauranga Triangle Study.”⁴

The approach used in the Strategic Options Assessment, of considering options against the Project Objectives to consider that group of more geographically dispersed routes, was also used to assess the 29 route options considered in this study. This enabled a consistent approach to be applied.

⁴ Incite (2015) P2G Strategic Options Assessment Workshop Report, 9 June 2015

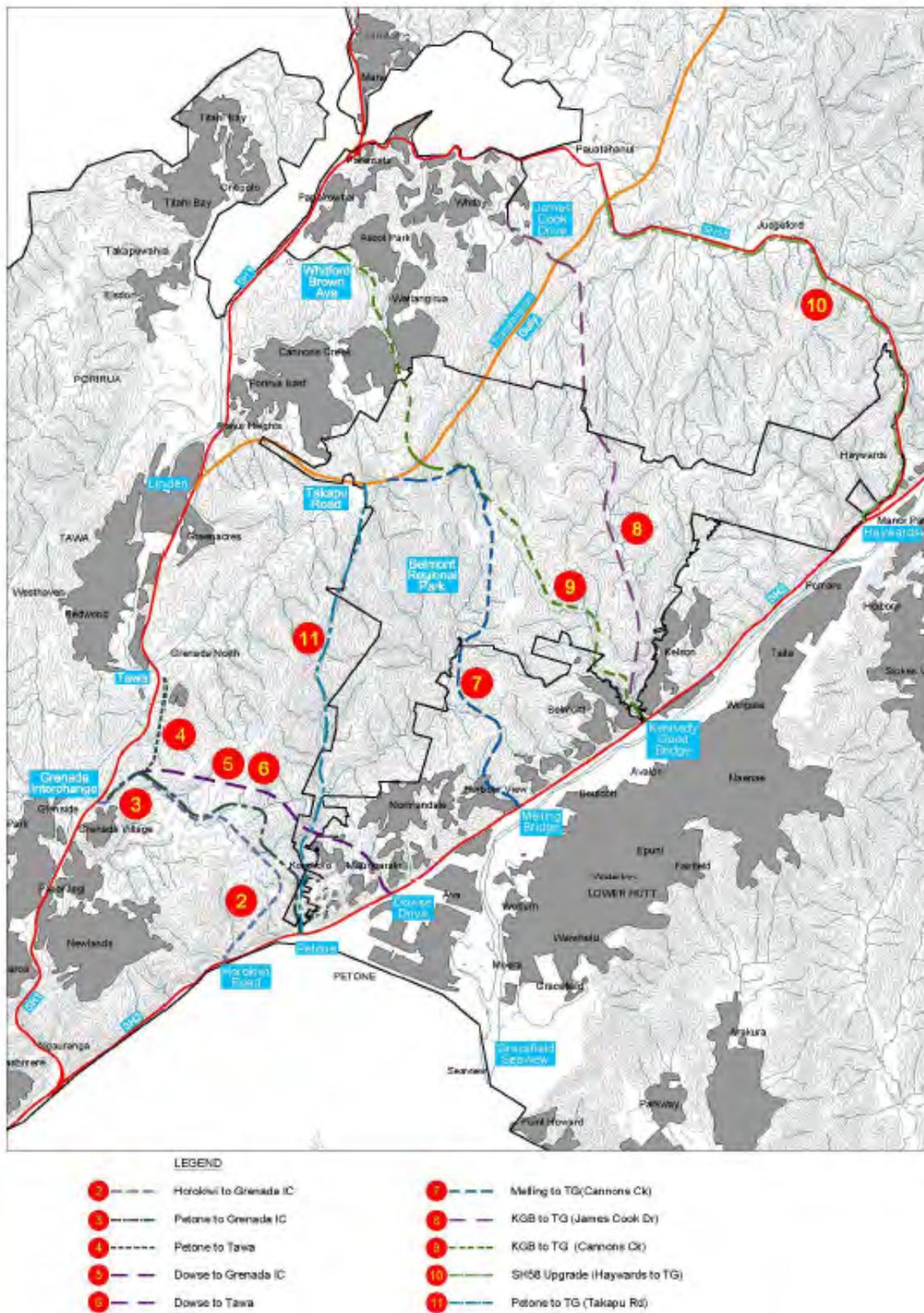


Figure 3.1: The options considered in the Strategic Options Assessment Workshop Report

4 Development and Description of Route Options - Overview

4.1 Introduction

The overall extent, or footprint, of the route options being considered for a link road between Petone and Grenada is shown in Figure 4.1 below. It should be noted that while there are 29 options identified, there are in effect 6 x 23 complete routes. There are 6 routes east of the crest of the Wellington escarpment, identified as Section 1, and the preferred one of these will ultimately connect to the preferred of 23 routes west of the crest of the Wellington escarpment, identified as Section 2.

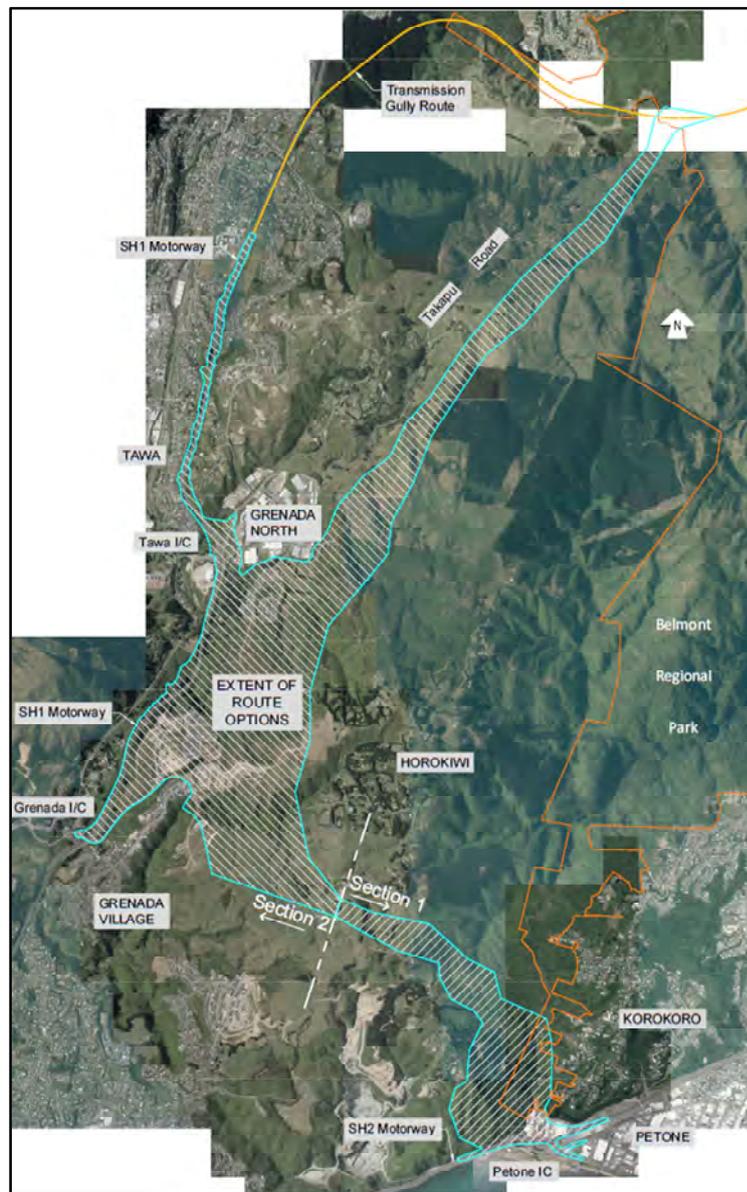


Figure 4.1: Overall Extent of Route Options

The purpose of this section is to provide a brief summary of the route options developed for a link road between Petone and Grenada from previous proposals over the last decades to the current range of

options evaluated in this report. The development of the route options evaluated in this report and summarised in this section are closely linked to the evaluation of options process which is described in the next section.

4.2 Early Options

A Petone and Grenada link road was first identified in 1975 in the Wellington Region Land Use and Transport Study (WRLUTS). Between this time and 2003 various routes were considered between Petone and Grenada, commissioned by either the Transport Agency (or its predecessors) or Greater Wellington Regional Council and documented in a number of reports. In 2003 the Final Hutt Corridor Plan recommended investigating a link road between Petone and Grenada to begin between 2003 and 2008 with construction to commence before 2013.

The final Western Corridor Plan in 2006 also recommended investigating a link road between Petone and Grenada to begin in 2006 and 2007 with construction to be completed by 2015. Following the completion of these plans the Ngauranga Triangle Strategy Study was carried out in 2009 and identified a Petone to Grenada link road as a significant component of the preferred Ngauranga Triangle Strategy. This was followed in 2010 by a detailed Project Feasibility Report (PFR) of Petone to Grenada link road which recommended a preferred route, comprising a four lane expressway, between SH2 at Petone to SH1 just south of Tawa. This route, identified as the PFR route, is illustrated in Figure 4.2 below.

Further information on these early options and the decision making process to reach the PFR is detailed in the 2015 Chronology of Reports and Decisions by Incite⁵.

⁵ Incite (2015) Petone to Grenada Project - Chronology of Reports and Decisions

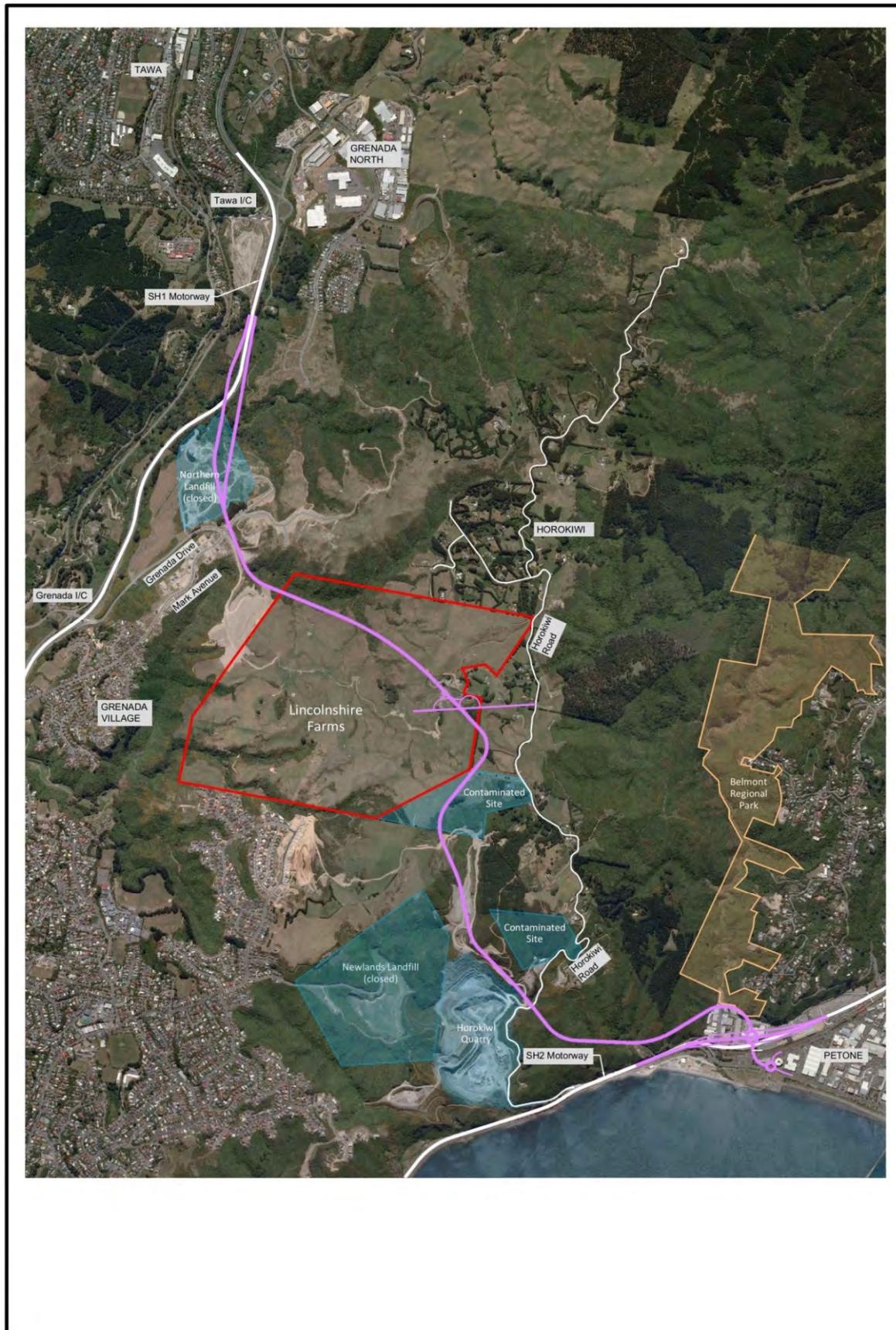


Figure 4.2: PFR Petone to Grenada Link (2010)

4.3 Initial Scoping Phase Options

At the initial scoping phase, prior to public engagement, a range of options were developed which built on the preferred option identified in the PFR described above. These options are described in the 2014 Petone to Grenada Transportation Link Scoping Report prepared by Opus⁶ (referred to as the Scoping Report). The options were divided into 2 sections as follows:

1. Section 1 – Petone to The crest of the Wellington escarpment; and
2. Section 2 – The crest of the Wellington escarpment to Transmission Gully (some utilising existing SH1 from Tawa/Grenada).

Section 1 comprised 4 options identified as Options 1 to 4 (P1, P2, P3 and P4) which share a common interchange at Petone, and a common western connection to Options 5 to 8 (A, B, C, or D) at the crest of the Wellington escarpment

Section 2 comprised 4 options identified as Options 5 to 8 (A, B, C and D). These options commenced from a common point from the crest of the Wellington escarpment and continued to Transmission Gully (some utilising existing SH1 from Tawa/Grenada).

Given the complex terrain between Petone and Grenada, a software route alignment planning tool, known as Quantm, was used to assist the design team select route alignments which generated the least earthworks. Quantm generated multiple alternative 3D route alignments between points using complex route optimisation technology to return a range of the most earthwork efficient options. The design team utilised these route alignments to develop Options 1 to 4 (P1 to P4) and Options 5 to 8 (A to D).

These options are shown schematically in Figure 4.3 below. It is important to note that Options 5, 6 and 7 (A, B and C) in this figure also includes upgrading SH1 between each route's connection to SH1 and the intersection of SH1 with Transmission Gully at Linden. For simplicity this is not shown in Figure 4.3 below.

⁶ <http://www.nzta.govt.nz/projects/petone-grenada-link-road/docs/p2g-scoping-report-final-2014-part1.pdf>

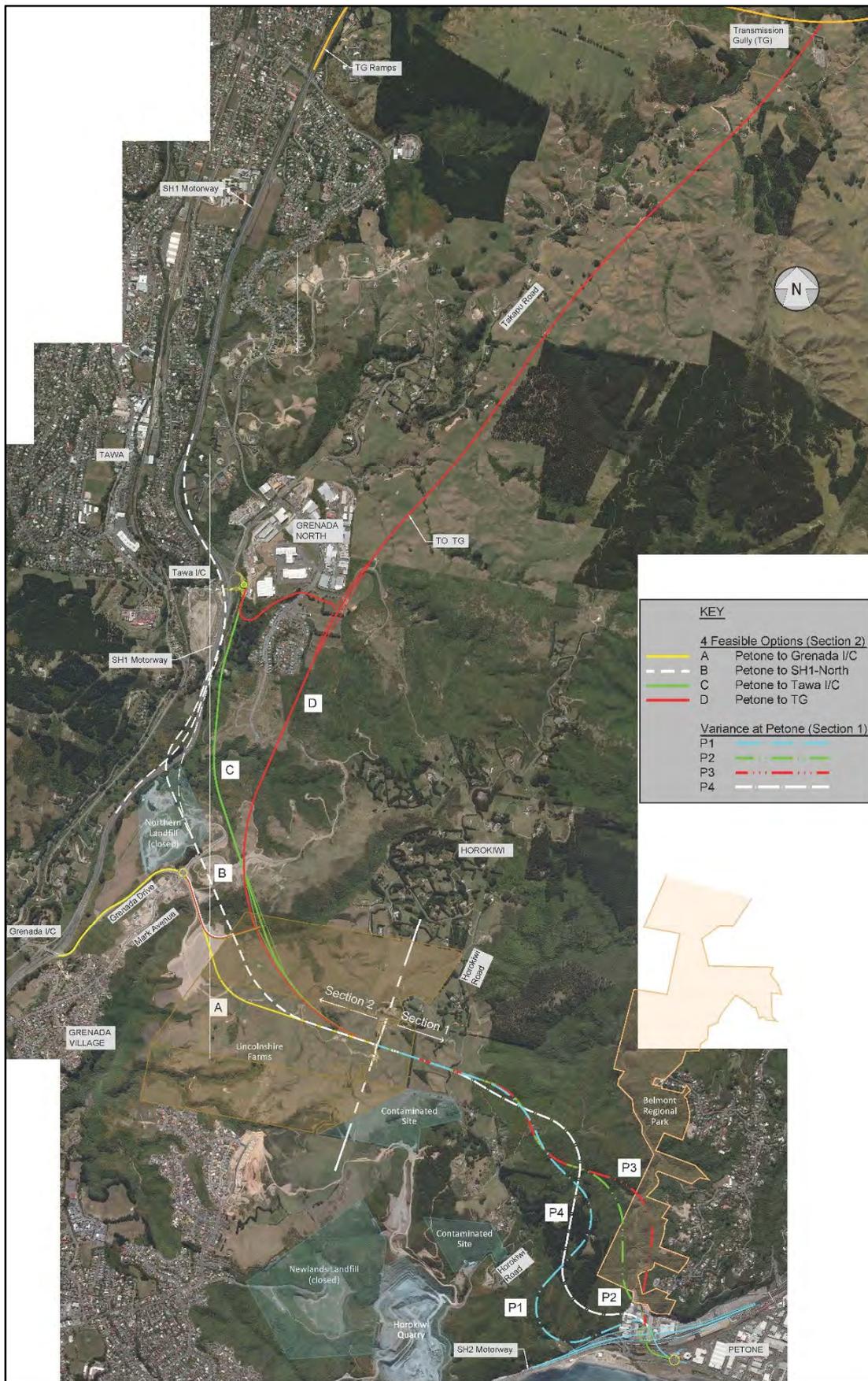


Figure 4.3: – Initial Scoping Options

Options 1 to 4 (P1 to P4) are described in detail in Sections 19 to 22 of the Scoping Report. Plan layouts of each option are also provided in Appendix A. A brief description of each option is provided below.

Option 1 (P1)- Comprises 6 lanes from the new interchange at Petone to the crest of the Wellington escarpment. From the proposed interchange at Petone, Option P1 climbs to the west in a sidling cut and retaining structure along the face of the coastal escarpment at a gradient of approximately 6%. Beyond the coastal escarpment this option curves to the northeast at a gradient of approximately 9% just to the west of the ridgeline which forms the eastern side of Korokoro Valley. From here this option curves again to the northwest and continues to climb at a gradient of approximately 9% to the crest of the Wellington escarpment.

Option 2 (P2)- Comprises 6 lanes from the new interchange at Petone to the crest of the Wellington escarpment. From the proposed interchange at Petone, Option P2 climbs to the north in an embankment fill along a section of the Korokoro Stream to the base of the western flank of the Korokoro Valley. The gradient along this section is approximately 6%. From this point Option P2 continues to ascend the western flank of Korokoro Valley in sidling cut at a gradient of approximately 9% until it reaches a tributary of the Korokoro Stream approximately 1000m north of the proposed interchange at Petone. At this point Option P2 curves to the northwest and crosses the upper reaches of the Korokoro Stream tributary in box cut. From here this option continues to climb at a gradient of approximately 9% in a deep box cut to the crest of the Wellington escarpment.

Option 3 (P3)- Comprises 6 lanes from the new interchange at Petone to the crest of the Wellington escarpment. From the proposed interchange at Petone, Option P3 climbs to the north in an embankment fill parallel to, but east of, the culverted section of the Korokoro Stream. The gradient along this section is approximately 6%. From this point Option P3 continues to ascend the eastern flank of Korokoro Valley in either sidling cuts, embankment fills or a combination of both at a gradient of approximately 9% for approximately 400m. At the end of this section, which is approximately 600m from the interchange at Petone, Option P3 deviates to the northwest in a deep embankment fill across the Korokoro Stream while maintaining a gradient of approximately 9%. Beyond the embankment fill this option climbs a tributary of Korokoro Stream in a box cut at a gradient of approximately 9% to the crest of the Wellington escarpment.

Option 4 (P4)- Comprises 6 lanes from the new interchange at Petone to the crest of the Wellington escarpment. From the proposed interchange at Petone Option P4 climbs to the west, at a gradient of approximately 6% in a structure to the face of the steep hill slope at the intersection of the coastal escarpment and western flank of the Korokoro Valley. From this point Option P4 runs through the steep sided hill slope in a large box cut, at a gradient of approximately 9%, before curving to the north to cross the upper reaches of a tributary of the Korokoro Stream. After crossing this tributary in a small embankment fill, it curves to the northwest, at a gradient of approximately 9%, to reach the crest of the Wellington escarpment.

Details on the Section 2 Options A to D are provided in Sections 14 to 17 the Scoping Report. Plan layouts of these options are also provided in Appendix A. Each option is briefly described below.

Option 5 (A)- Comprises 4 lanes from the crest of the Wellington escarpment to Grenada Interchange, a new interchange at Grenada and upgrading SH1 between Grenada and Transmission Gully from 4 lanes to 6 lanes. This option descends from the crest of the Wellington escarpment to SH1 at gradients which range between 5% and 8%.

This option also involves improving the horizontal and vertical alignment of the "Tawa Curves". The "Tawa Curves" comprise the three curves on SH1 immediately north and south of the Tawa interchange and at the interchange itself.

Option 6 (B)- Comprises 6 lanes from the crest of the Wellington escarpment to SH1 just south of the Tawa Interchange, a new interchange just south of the Tawa Interchange, a new interchange with a link to Grenada Drive and upgrading SH1 between Tawa and Transmission Gully from 4 lanes to 6 lanes. This option also involves removing the north facing ramps of the existing Tawa interchange because of the close proximity of the new interchange to SH1. This option also improves all three "Tawa Curves" described above. Option B cuts through the Northern Landfill. This option descends from the crest of the Wellington escarpment to SH1 at gradients which range between 4% and 9%.

Option 7 (C)- Comprises 6 lanes from the crest of the Wellington escarpment to SH1 at Tawa, a new interchange at Tawa, a new interchange with a link to Grenada Drive and upgrading SH1 between Tawa and Transmission Gully from 4 lanes to 6 lanes. This option involves improving two of the "Tawa Curves", namely the curve at the interchange itself and the curve immediately north. This option descends from the crest of the Wellington escarpment to SH1 at gradients which range between 4% and 9%.

Option 8 (D)- Comprises 6 lanes from the crest of the Wellington escarpment to a new interchange to Grenada, 4 lanes from this interchange to a new interchange to Tawa and 2 lanes from this second interchange to Transmission Gully. This route comprises 4 new interchanges, namely a new interchange to Grenada, a new interchange to Tawa, a new interchange at Tawa and a new interchange at Transmission Gully. No upgrading of SH1 is proposed with this option. While Option D does not include upgrading SH1 it involves a new interchange at Tawa. The new interchange at Tawa includes improving the curve on SH1 at the interchange. This option descends from the crest of the Wellington escarpment to North Grenada at gradients which range between 4% and 9%. From North Grenada to Transmission Gully this option ascends at a gradient of approximately 2%.

4.4 Further Development of Initial Scoping Phase Options

Following an evaluation of the initial scoping phase options, described above, and engagement with the public, key stakeholders and directly affected landowners the options were further developed, modified and refined. This resulted in a number of additional scoping phase options which are summarised below. Options 1 to 8 (P1 to P4 and A to D) were developed at the initial scoping phase prior to public engagement while Options 9 to 23 were developed at the further scoping stage following public engagement. A layout of each option is provided in Appendix A.

A brief description of Options 9 to 23 is provided below.

Option 9 (C (V1) Full SH1 Widening)- This option is similar to Option 7 (C) described above but deviates to the east at Havana Rise to avoid the ongoing residential development in this area. This option also avoids a water reservoir recently constructed to service the development in this area. Like Option 7 (C) this option involves increasing SH1 from 4 lanes to 6 lanes between Tawa and Transmission Gully by widening SH1 outside the existing carriageway. This is achieved by retaining the existing carriageway formation (of 4 lanes) including the existing wire rope median and providing an additional outer northbound and southbound lane including full shoulders. Increasing the overall width of the carriageway formation resulted in directly impacting on several adjacent properties along SH1 between Tawa and Transmission Gully. This option also replaces the interchange at Tawa, developed at the

Scoping Stage for Option 7 (C) (and described in the Scoping Report), with an updated version which includes improving the SH1 curve at Tawa interchange.

Option 10 (C (V1) Managed Motorway 1) – This option is the same as Option 9 described above, but involves increasing SH1 from 4 lanes to 6 lanes between Tawa and Transmission Gully using a different approach to reduce the impact on adjacent properties. This approach is known as a managed motorway solution and involves providing 6 lanes within a smaller footprint. This involves extending the new carriageway into the existing median, replacing the wire rope median barrier with a solid median barrier and reducing the width of the shoulders. The managed motorway option includes overhead gantries with electronic signs that are programmed to respond automatically to manage the flow of traffic. While this option has a smaller footprint along SH1 between Tawa and Transmission Gully, it requires the construction of 6 new lanes (reconstructing the existing 4 lanes and constructing 2 additional lanes) which will result in a greater disruption to road users during construction. This option also impacts directly on adjacent properties along SH1 between Tawa and Transmission Gully but not to the same extent as Option 9. This option also replaces the interchange at Tawa, developed at the Scoping Stage for Option 7 (C) (and described in the Scoping Report), with an updated version which includes improving the SH1 curve at Tawa interchange.

Option 11 (C (V1) Managed Motorway 2) – This option is the same as Option 10 described above but retains all widening on SH1 between Tawa and Transmission Gully within the SH1 corridor. In order to retain all widening within the SH1 corridor and avoid impacting on adjacent properties, some cut slopes and fill batters have been steepened. The steeper cut slopes and fill batters will be engineered to ensure slope stability. However, by retaining all widening within SH1 corridor, one of the “Tawa Curves” just north of the Tawa interchange will not be improved (i.e. realigned to ease the horizontal curvature). This option also replaces the interchange at Tawa, developed at the Scoping Stage for Option 7 (C) (and described in the Scoping Report), with an updated version which includes improving the SH1 curve at Tawa interchange.

Option 12 (C (V1) No SH1 Widening) - This option is the same as Option 10 described above but terminates at Tawa. This option also replaces the interchange at Tawa, developed at the Scoping Stage for Option 7 (C) (and described in the Scoping Report), with an updated version which includes improving the SH1 curve at Tawa interchange.

Option 13 (C (V2) Full SH1 Widening) - This option is similar to Option 9 described above but deviates to the west at Havana Rise to avoid the ongoing residential development in this area rather than the east. Like Option 6 (B) this option cuts through the Northern Landfill. This option also replaces the interchange at Tawa, developed at the Scoping Stage for Option 7 (C) (and described in the Scoping Report), with an updated version which includes improving the SH1 curve at Tawa interchange.

Option 14 (C (V2) Managed Motorway 1) – This option is similar to Option 10 described above but deviates to the west at Havana Rise to avoid the ongoing residential development in this area rather than the east. Like Option 6 (B) this option cuts through the Northern Landfill. This option also replaces the interchange at Tawa, developed at the Scoping Stage for Option 7 (C) (and described in the Scoping Report), with an updated version which includes improving the SH1 curve at Tawa interchange.

Option 15 (C (V2) Managed Motorway 2) – This option is similar to Option 11 described above but deviates to the west at Havana Rise to avoid the ongoing residential development in this area rather than the east. Like Option 6 (B) this option cuts through the Northern Landfill. This option also replaces the interchange at Tawa, developed at the Scoping Stage for Option 7 (C) (and described in the Scoping Report), with an updated version which includes improving the SH1 curve at Tawa interchange.

Option 16 (C (V2) No SH1 Widening) - This option is similar to Option 12 described above but deviates to the west at Havana Rise to avoid the ongoing residential development in this area rather than the east. Like Option 6 (B) this option cuts through the Northern Landfill. This option also replaces the interchange at Tawa, developed at the Scoping Stage for Option 7 (C) (and described in the Scoping Report), with an updated version which includes improving the SH1 curve at Tawa interchange.

Option 17 (C Full SH1 Widening (Update Tawa IC)) - This option is similar to Option 7 (C) but replaces the interchange at Tawa, developed at the Scoping Stage for Option 7 (C) (and described in the Scoping Report), with an updated version which includes improving the SH1 curve at Tawa interchange.

Option 18 (C Managed Motorway 1 (Update Tawa IC)) - This option is similar to Option 17 described above but involves increasing SH1 from 4 lanes to 6 lanes between Tawa and Transmission Gully using the “Managed Motorway 1” approach described in Option 10. This option also replaces the interchange at Tawa, developed at the Scoping Stage for Option 7 (C) (and described in the Scoping Report), with an updated version which includes improving the SH1 curve at Tawa interchange.

Option 19 (C Managed Motorway 2 (Update Tawa IC)) - This option is similar to Option 17 described above but involves increasing SH1 from 4 lanes to 6 lanes between Tawa and Transmission Gully using the “Managed Motorway 2” approach described in Option 11. This option also replaces the interchange at Tawa, developed at the Scoping Stage for Option 7 (C) (and described in the Scoping Report), with an updated version which includes improving the SH1 curve at Tawa interchange.

Option 20 (C No SH1 Widening (Update Tawa IC)) - This option is similar to Option 17 described above terminates at Tawa. This option also replaces the interchange at Tawa, developed at the Scoping Stage for Option 7 (C) (and described in the Scoping Report), with an updated version which includes improving the SH1 curve at Tawa interchange.

Option 21 (D (Update Tawa IC)) - This option is similar to Option 8 (D) described above but replaces the interchange at Tawa, developed at the Scoping Stage for Option 8 (D) (and described in the Scoping Report), with an updated version which includes improving the SH1 curve at Tawa interchange.

Option 22 (D (V1)) - This option is similar to Option 8 (D) above but deviates to the east at Havana Rise to avoid the ongoing residential development in this area. This option also continues to the east of the Option 8 route between Havana Rise and North Grenada to avoid the North Grenada Sports Fields. Between North Grenada and Transmission Gully this option follows a similar route to Option 8 (D). This option also replaces the interchange at Tawa, developed at the Scoping Stage for Option 8 (D) (and described in the Scoping Report), with an updated version which includes improving the SH1 curve at Tawa interchange.

Option 23 (D (V2)) - This option is also similar to Option 8 (D) described above but deviates even more to the east at Havana Rise than Option 22 described above. This option also avoids the North Grenada Sports Fields. Between North Grenada and Transmission Gully this option runs to the east of both Option 8 (D) and Option 22 described above but links to Transmission Gully at the same location. This option also replaces the interchange at Tawa, developed at the Scoping Stage for Option 8 (D) (and described in the Scoping Report), with an updated version which includes improving the SH1 curve at Tawa interchange.

4.5 Development of Further Options During the MCA Assessment Phase

The technical specialists briefed to undertake assessment of the options for the MCA process (refer to Section 8) were asked to assess the potential effects of the options.

Part of this assessment was to include identifying where, and as appropriate suggesting, means to mitigate potential effects they had identified. The mitigation identified by the specialists was incorporated into the assessments (and overall MCA scoring process) as discussed in section 8 of this report.

4.5.1 Development of the Variant Options

In some cases specialists suggested mitigation during the MCA process that involved realigning or altering part of the route itself. In responding to those suggestions, realigned or otherwise fundamentally altered routes were duly developed and considered as new options alongside all other options. They are identified as follows:

- Option 1a (P1 Variant 1);
- Option 1b (P1 Variant 2); and
- Options 9a, 10a, 11a and 12a (C (V1) – Variant 1 options)

A brief description of each is provided below.

Option 1a (P1 (Variant 1)): - This option is a variation of Option P1. This option involves realigning the southern section of the route to the south of the coastal escarpment, closer towards the foreshore. Details of this option are provided in Appendix A.

Option 1b (P1 (Variant 2)) - This option is also a variation of Option P1. This option involves maintaining the southern section of this option on a similar route but pulling it just south enough to avoid cutting into the coastal escarpment. This option also involves realigning SH1 closer to the foreshore than Option P1 and shifting the location of the interchange at Petone closer to the foreshore. Details of this option are provided in Appendix A.

Option 9a (C (V1) – Variant 1 Full SH1 Widening) – This option is a variation of Option 9 (C (V1)). This option is similar to Option 9 in all respects but involves a slight deviation north of Havana Rise to avoid impacting on the upper section of an area identified as “Car Haul Stream”. This option is provided in Appendix A but only shows the realigned section between the crest of the Wellington escarpment and Tawa

Option 10a (C (V1) – Variant 1 – Managed Motorway 1) - This option is a variation of Option 10. This option is similar to Option 10 in all respects but involves a slight deviation north of Havana Rise to avoid impacting on the upper section of an area identified as “Car Haul Stream”. This option is provided in Appendix A but only shows the realigned section between the crest of the Wellington escarpment and Tawa.

Option 11a (C (V1) – Variant 1 – Managed Motorway 2) - This option is a variation of Option 11. This option is similar to Option 11 in all respects but involves a slight deviation north of Havana Rise to avoid impacting on the upper section of an area identified as “Car Haul Stream”. This option is provided

in Appendix A but only shows the realigned section between the crest of the Wellington escarpment and Tawa.

Option 12a (C (V1) – Variant 1 –No SH1 Widening) - This option is a variation of Option 12. This option is similar to Option 12 in all respects but involves a slight deviation north of Havana Rise to avoid impacting on the upper section of an area identified as “Car Haul Stream”. This option is provided in Appendix A but only shows the realigned section between the crest of the Wellington escarpment and Tawa.

4.6 Summary of Options

Table 4.1 below provides a summary of all the options assessed in this report in relation to the various phases described above. Note that the initial scoping phase options, described in the previous section, are identified as Options 1 to 8 and the additional scoping phase options as Options 9 to 23. The options that were developed during the MCA process, namely Option 1a (P1-Variant 1), Option 1b (P1-Variant 2) and Options 9a, 10a, 11a and 12a (variants of Option C (V1)), are also included. Table 4.2 which follows provides a summary of all options in numerical order as they appear in the remainder of this report.

Table 4.1: The Options in Relation to Scoping Phases

Option		Section	Project Phase
1	P1	1	Initial Scoping-Pre-Public Engagement
2	P2	1	
3	P3	1	
4	P4	1	
5	A	2	
6	B	2	
7	C	2	
8	D	2	
9	C (V1) Full SH1 Widening	2	Further Scoping-Post Public Engagement
10	C (V1) Managed Motorway 1	2	
11	C (V1) Managed Motorway 2	2	
12	C (V1) No SH1 Widening	2	
13	C (V2) Full SH1 Widening	2	
14	C (V2) Managed Motorway 1	2	
15	C (V2) Managed Motorway 2	2	
16	C (V2) No SH1 Widening	2	
17	C Full SH1 Widening (Update Tawa IC)	2	
18	C Managed Motorway 1 (Update Tawa IC)	2	
19	C Managed Motorway 2 (Update Tawa IC)	2	
20	C No SH1 Widening (Update Tawa IC)	2	
21	D (Update Tawa IC)	2	
22	D (V1)	2	
23	D (V2)	2	
1a	P1 Variant 1	1	Options Developed During MCA Assessment
1b	P1 Variant 2	1	
9a	C(V1)-Variant 1	2	
10a	C(V1)-Variant 1 Managed Motorway 1	2	
11a	C(V1)-Variant 1 Managed Motorway 2	2	
12a	C(V1)-Variant 1 No SH1 Upgrade	2	

Table 4.2: The Options in Numerical Order

	Option	Section
1	P1	1
1a	P1 Variant 1	1
1b	P1 Variant 2	1
2	P2	1
3	P3	1
4	P4	1
5	A	2
6	B	2
7	C	2
8	D	2
9	C (V1) Full SH1 Widening	2
9a	C(V1)-Variant 1	2
10	C (V1) Managed Motorway 1	2
10a	C(V1)-Variant 1 Managed Motorway 1	2
11	C (V1) Managed Motorway 2	2
11a	C(V1)-Variant 1 Managed Motorway 2	2
12	C (V1) No SH1 Widening	2
12a	C(V1)-Variant 1 No SH1 Upgrade	2
13	C (V2) Full SH1 Widening	2
14	C (V2) Managed Motorway 1	2
15	C (V2) Managed Motorway 2	2
16	C (V2) No SH1 Widening	2
17	C Full SH1 Widening (Update Tawa IC)	2
18	C Managed Motorway 1 (Update Tawa IC)	2
19	C Managed Motorway 2 (Update Tawa IC)	2
20	C No SH1 Widening (Update Tawa IC)	2
21	D (Update Tawa IC)	2
22	D (V1)	2
23	D (V2)	2

As stated above details of all these options, including indicative details on earthwork volumes, are provided in Appendix A.

5 Route Options Assessment

5.1 Introduction

This section documents the route option evaluation process following the PFR option recommended from the Ngauranga Triangle Strategy Study. This process is summarised in Figure 5.1 below and described throughout this section.

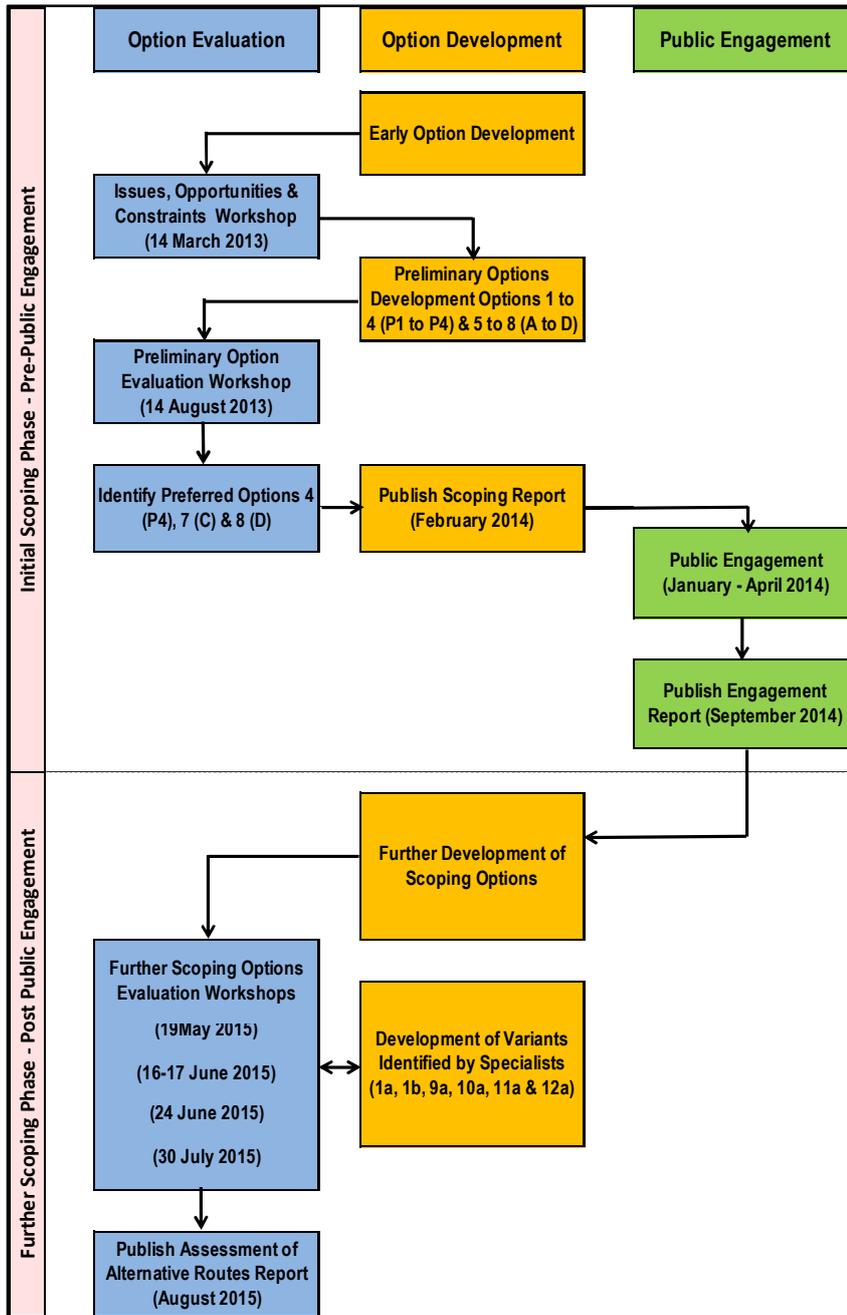


Figure 5.1: Route Options Assessment Process

The route options assessment process can be viewed in two phases as illustrated in Figure 5.1 above. The first phase is identified as the initial scoping phase in which options were developed and evaluated by the project team and key stakeholders prior to engaging with the public. The second phase is identified as further scoping phase in which options were further developed and evaluated following feedback from the public.

5.2 Initial Scoping Phase – Pre-Public Engagement

5.2.1 Introduction

Full details on the option evaluation process during this phase is described in Section 23 of the Scoping Report. This section provides a brief overview of this phase.

5.2.2 Early Option Development

The option development process was initiated at a one day Issues, Opportunities and Constraints Workshop, held on 14 March 2013, with the project team and key stakeholders from the Transport Agency, HCC, WCC and GWRC. The project team included a group of specialists responsible for assessing the following criteria:

1. Landscape/Visual;
2. Ecology;
3. Archaeology; and
4. Resilience

At the workshop early assumptions were challenged while issues and opportunities were explored. By the conclusion of the workshop an early draft of the project objectives was issued and the basis of design was established.

5.2.3 Evaluation of Initial Scoping Phase Options

Following the Issues, Opportunities and Constraints Workshop preliminary Options 1 to 4 (P1 to P4) and Options 5 to 8 (A to D) were developed and evaluated by the specialists identified above, the project team and key stakeholders from the Transport Agency, HCC, WCC and GWRC at the Preliminary Option Evaluation Workshop held on 14 August 2013. The aim of this workshop was to provide an opportunity to challenge and discuss the specialists' ideas in a group forum, following their preliminary investigations. From this workshop a number of specialists were able make alterations to their evaluations which reflected a better understanding of the options.

The four initial Options 5 to 8 (A, B, C and D) were also evaluated from a transportation perspective to assess network performance, local intersection performance, travel time savings and traffic redistribution impacts using the Northern Wellington SATURN Model (NWSM) and Greater Wellington Regional Council's Wellington Transport Strategic Model (WTSM). From a modelling perspective it was not important which of the Section 1 Options 1 to 4 (P1 to P4) was combined with Options 5 to 8 (A to D) as the gradient and length of Options 1 to 4 were similar and they all shared the same form of interchange at Petone.

5.2.4 Identification of Preferred Options from Initial Scoping Phase Options

The preliminary options evaluation process followed during this phase identified Option 4 (P4) as the preferred option between Petone and the crest of the Wellington escarpment, and Options 7 (C) and 8 (D) as the preferred options between the crest of the Wellington escarpment and Transmission Gully, for reasons discussed in the Scoping Report. These options were then taken forward to the public engagement phase. As noted above public engagement took place between the end of January 2014 and April 2014.

5.3 Further Scoping Phase – Post Public Engagement

5.3.1 Introduction

This section describes the option evaluation process following feedback from the public engagement phase and ongoing consultation with key stakeholders.

5.3.2 Further Development of Scoping Options

The outcomes of the public engagement phase are provided in the Petone to Grenada Link Road Engagement Report⁷. This report identifies issues, opportunities, concerns and recommendations raised by key stakeholders, directly affected landowners and the public. This report was a key input to developing several variations to the options taken forward to the public engagement phase, namely Options 7 and 8 (C and D). Further details on the how feedback from the public engagement phase shaped the variations to Options 7 and 8 are provided in Appendix B.

5.3.3 Evaluation of Further Scoping Phase Options

Following feedback from the public engagement phase and on-going consultation with key stakeholders, the project team carried out a more detailed analysis of all the scoping phase options (i.e. options developed both pre and post public engagement phase).

Firstly, this involved carefully selecting a sub-group of specialists to assess both the initial scoping phase Options 1 to 4 (P1 to P4) and Options 5 to 8 (A to D) as well as the further options developed post public engagement (refer Options 9 to 23 in Table 4.1 of the previous section). The sub-group of specialists retained the group of specialists involved in the evaluation of the initial scoping phase options and included a number of others. The specialists involved had expertise in the following areas:

1. Transportation - General;
2. Transportation - Strategic;
3. Noise;
4. Social/Community
5. Business;

⁷ Petone to Grenada Link Road – Engagement Report 2014 (<http://www.nzta.govt.nz/assets/projects/petone-grenada-link-road/docs/p2g-engagement-report-201408.pdf>)

6. Recreation;
7. Cultural;
8. Ecology (Terrestrial, Marine, Avifauna, Freshwater);
9. Water Quality;
10. Urban Design;
11. Built Heritage;
12. Contaminated Land
13. Resilience

Secondly, this involved adopting an alternative option evaluation method to the one employed in the Scoping Report to evaluate all the options developed in both the pre and post public engagement phase of this project.

The alternative option evaluation method, referred to as the multi-criteria assessment (MCA) approach included the consideration of a greater number of options, criteria (against which to consider the options), and matters considered likely to arise from statutory instruments during the consenting/designation processes. The MCA framework is described in more detail in Section 10.

5.3.4 MCA Workshops

Four workshops were held as part of MCA process as follows:

1. Specialist Briefing Workshop (19 May 2015);
2. Specialist Assessment of Route Options (16 – 17 June 2015); and
3. Specialist Assessment Fill Disposal Workshop (24 June 2015); and
4. Project Team Assessment of Options Against Project Objectives (30 July 2015).

These workshops are described in Section 10 of this report.

6 Preliminary Cost Estimates

6.1 Introduction

The purpose of this section is to inform the preliminary economic assessment described in Section 7, which is provided to the Transport Agency as part of this report to enable that information to be factored into its decision on the route of the link road as it considers appropriate.

6.2 Basis of Estimates

Rough order cost estimates (ROC) were developed on a parameter cost basis to provide range of costs (identified as an 'Optimistic', 'Most Likely', and 'Pessimistic' cost) for the purpose of comparing the options. The estimates have been based on preliminary designs, available site information and other general information about the scope of work and type of construction. The 'Optimistic' estimate has been assessed at 70% of the 'Most Likely' estimate while the 'Pessimistic' estimate has been assessed at 150% of the 'Most Likely' estimate. As a result the ROC is represented as a range of cost between -30% and +50% of the 'Most Likely' estimate.

The estimates have been prepared to the cost index as at June 2015.

The estimates make no allowance for future escalation or GST.

6.3 Assumptions for Estimates

Property Costs

Property costs were developed to provide a net property cost for each option. The property types were selected to reflect the range of property values throughout the project area. 'High value' represents the commercial area at Petone in the vicinity of the proposed interchange while 'Medium High value' represents high density residential/commercial areas adjacent to the SH1 corridor between Grenada and Kenepuru. On the medium to lower spectrum 'Medium value' to 'Low value' represents semi-rural to rural areas between the SH1 and SH2 corridors.

The cost per hectare values shown in Table 6.1 below were derived from Transport Agency State highway valuation as at 30 June 2015. This valuation includes cost/ha values of State highway corridor land valued at the fair value or market value of the adjacent land through which it passes. The property costs only include the footprint of land affected by each route.

The property costs adopted are shown in the table below.

Table 6.1: Property Cost Range

Property Type	Cost / ha (\$M)
Very high value	4.0
High value	2.5
Medium high value	1.15
Medium value	0.7
Medium low value	0.2
Low value	0.05

Professional Fees and Client Managed Costs

15% of the physical works costs has been allowed for Consultant and the Transport Agency fees for the investigation (I&R), design (D&PD) and construction surveillance (MSQA) phases of this project.

Physical Works

Parameter costs have been developed for the physical works, on a cost per kilometre basis. These costs have been derived from various other projects throughout the country. Different rates were used for low, medium and high and very high earthwork quantities.

Parameter costs were adopted for each type of carriageway section as shown in Table 6.2.

Table 6.2: Costs of Physical Works

Description	Cost / km (\$M)
2 lane carriageway	
Low earthworks	4.0
Medium earthworks	5.0
High earthworks	6.0
4 lane carriageway	
Low earthworks	6.0
Medium earthworks	8.0
High earthworks	10.0
Very High earthworks	12.5
6 lane carriageway	
Low earthworks	8.0
Medium earthworks	10.0
High earthworks	15.0
Very High earthworks	30.0

In addition to green field development, most options require upgrading SH1 between the connection of each option to SH1 and the intersection of SH1 with Transmission Gully. Separate parameter costs were developed for the various types of upgrade to SH1 as shown in Table 6.3.

Table 6.3: Costs to Upgrade SH1

Description	Cost / km (\$M)
Upgrade SH1	
4 lanes to 6 lanes*	8.0
Realign SH1 with New Sections of Carriageway	
New 6 lanes**	20.0
New 4 lanes***	15.0

*Note this applies to the various C "Full Widening Options" and Options 5 & 6 (A & B) between Tawa and Transmission Gully (and Option 5 (A) between Grenada and the southern Tawa Curve.

**Note this applies to the various “Managed Motorway Options and Options 5 (A) over the 3 Tawa Curves and Option 6 (B) over the two northern Tawa curves.

*** Note this applies to the most southern Tawa Curve for Option 6 (B).

The physical works costs also include structures such as interchanges and bridges. Various interchange types are expected for each option ranging from full grade-separated interchanges to at-grade roundabouts. The various types of interchanges and corresponding lump sum cost developed for this project are summarised in Table 6.4.

Table 6.4: Costs Interchanges

Interchange Type	Cost (\$M)
Grade-separated simple	12.5
Grade-separated moderate	15.0
Grade-separated complex	20.0
At-grade complex	6.0
At-grade simple	2.0

While interchange costs were developed on a lump sum basis, bridge structure costs were based on a cost of \$3,500 per square metre (\$.035M/m²).

Contaminated Site Costs

Option 6 (B), Options 13 to 16 (C (V2) and its associated options) traverse through the Northern Landfill in deep cuts. There are considerable cost implications over and above a normal earthworks construction operation associated with cutting through and constructing a new carriageway through a landfill. These include excavating refuse material and its disposal, controlling stormwater contaminated with leachate, addressing odour issues and mitigating settlement of carriageway formation constructed over refuse material. An additional cost of \$15M has been assumed over and above the earthworks rates identified in Table 6.2 above to address these issues.

6.3 ROC Estimates Results

The ROC estimates for each option based on the parameter costs above are summarised in Table 6.5 below.

Table 6.5: ROC Estimates (\$M)

Option		Optimistic	Most Likely	Pessimistic
1	P1	70	100	150
1a	P1 - Variant 1*	Refer 1 above		
1b	P1 - Variant 2*	Refer 1 above		
2	P2	84	120	180
3	P3	84	120	180
4	P4	94	134	201
5	A	91	130	195
6	B	95	136	204
7	C	84	120	180
8	D	81	116	174

9	C (V1) Full SH1 Widening	93	133	200
9a	C(V1)-Variant 1*	Refer 9 above		
10	C (V1) Managed Motorway 1	108	155	232
10a	C(V1)-Variant 1 MM1*	Refer 10 above		
11	C (V1) Managed Motorway 2	108	154	230
11a	C(V1)-Variant 1 MM2*	Refer 11 above		
12	C (V1) No SH1 Widening	71	101	151
12a	C(V1)-Variant 1 No SH1 Upgrade*	Refer 12 above		
13	C (V2) Full SH1 Widening	91	131	196
14	C (V2) Managed Motorway 1	106	152	228
15	C (V2) Managed Motorway 2	106	151	226
16	C (V2) No SH1 Widening	69	98	147
17	C Full SH1 Widening	87	124	185
18	C Managed Motorway 1	93	133	200
19	C Managed Motorway 2	93	132	198
20	C No SH1 Widening	56	80	119
21	D Update Tawa IC	81	116	173
22	D (V1)	82	117	175
23	D (V2)	87	124	186

*Note: While there are considerable differences between Options 1a and 1b (P1 Variant 1 & 2) from Option 1, the ROCs for 1a and 1b are assumed to be the same as Option 1 for the purpose of comparing options. This is because Options 1a and 1b share a similar interchange and alignment between the Crest of the Wellington Escarpment and the coastal escarpment with Option 1 (P1) and any difference in cost is still expected to be within the cost range of Option 1. Likewise while Options 9a to 12a have differences to Options 9 to 12, any differences are also assumed to be within the ROC range of Options 9 to 12 respectively and therefore suitable for the purpose of comparing options.

7 Preliminary Economic Assessment

7.1 Introduction

The purpose of this section is to provide the Transport Agency with a preliminary economic assessment of each option as part of this report to enable this information to be factored into its decision on the route of the link road as it considers appropriate.

This section summarises the preliminary economic evaluation of the route options for the Petone to Grenada (P2G) project, in accordance with the Transport Agency Economic Evaluation Manual (EEM) procedures effective date 1 July 2013.

7.2 Basis of Evaluation

The evaluation is preliminary, as only travel time, vehicle operating costs and vehicle emissions benefits have been calculated for the purpose of relative comparing of the major route options. A full economic evaluation will be completed for the SAR.

7.2.1 Transportation Modelling

The initial scoping Options 5, 6, 7 and 8 (A, B, C and D) were modelled using the Northern Wellington SATURN model (NWSM) developed at initial scoping phase (pre-public engagement), referred to as the NWSM Scoping model. Models were developed for the AM, inter and PM peaks for the forecast years of 2021 and 2031. Full details on the modelling assumptions are provided in Section 13 of the Scoping Report.

The options developed at the post public engagement phase, following the initial scoping phase, were modelled using the updated Northern Wellington SATURN model (NWSM), referred to as the updated NWSM Scoping model. Likewise, models were developed for the AM, inter and PM peaks for the forecast years of 2021 and 2031.

The options developed at the post public engagement phase are variations of the initial scoping Options 7 and 8 (C and D) as described in the previous sections. For the purposes of the modelling three transportation options were developed to represent these variations as follows:

1. Option C with SH1 Widening (Tawa to Transmission Gully);
2. Option C with No SH1 Widening (Tawa to Transmission Gully); and
3. Option D.

Table 7.1 below shows which modelling option above was used to represent each of the option variations developed post public engagement phase.

Table 7.1: Modelling Assumptions

Option		Transportation Modelling Option
9	C (V1) Full SH1 Widening	1. Option C with SH1 Widening
9a	C (V1)-Variant 1	
10	C (V1) Managed Motorway 1	
10a	C (V1)-Variant 1 MM1	
11	C (V1) Managed Motorway 2	
11a	C (V1)-Variant 1 MM2	
12	C (V1) No SH1 Widening	2. Option C with No SH1 Widening
12a	C (V1)-Variant 1 No SH1 Upgrade	
13	C (V2) Full SH1 Widening	1. Option C with SH1 Widening
14	C (V2) Managed Motorway 1	
15	C (V2) Managed Motorway 2	
16	C (V2) No SH1 Widening	2. Option C with No SH1 Widening
17	C Full SH1 Widening	1. Option C with SH1 Widening
18	C Managed Motorway 1	
19	C Managed Motorway 2	
20	C No SH1 Widening	
21	D Update Tawa IC	3. Option D
22	D (V1)	
23	D (V2)	

The reasons only three transportation options are required to represent Options 9 to 23 (the variations of Options C and D) are because the differences between the variations in route are not significant enough to materially change the key transportation benefits and dis-benefits, which are considered to be driven by the performance of the intersections which are common to all these options. All three options include a link from Petone to the crest of the Wellington escarpment. Furthermore the ‘Managed Motorway’ options identified in Table 7.1 above are represented by the transportation modelling options with SH1 widening. This is because while the ‘Managed Motorway’ options have reduced shoulders there are mitigation measures if the outside lanes are blocked such as laybys and variable message signs to manage operational effects.

7.3 Economic Evaluation

7.3.1 Assumptions

Assumptions for the economic evaluation of the scheme are as follows:

- The Base Date for the evaluation is 1 July 2013;
- Time Zero is 1 July 2015;
- The evaluation period is 40 years;

- Project benefits start at the end of construction;
- Construction has been assumed to commence on 1 January 2020 for the duration of four years. Therefore a 36 year benefit period from years 11 to 46 has been assessed;
- Benefits have been straight line extrapolated between the model years of 2021, 2031 and 2041, and capped at 2041 levels for later years;
- The base assumption for the discount rate is 6%; and
- All update factors, base value travel times, congestion relief values, vehicle operating costs etc. are based on the Transport Agency's EEM Volume 1 (January 2013 Update).

Vehicular benefits have been based on the extrapolation of the AM, Inter Peak and PM Peak NWSM outputs, using the following annualisation factors:

- AM Pre-Peak: 245 days, at 0.5 hours per day (0700-0730);
- AM Peak: 245 days, at 1 hour per day (0730-0830);
- AM Post Peak: 245 days, at 0.5 hours per day (0830-0900);
- Inter Peak: 245 days, at 7 hours per day (0900-1600);
- PM Pre-Peak: 245 days, at 0.5 hours per day (1600-1630);
- PM Peak: 245 days, at 2 hours per day (1630-1730);
- PM Post Peak: 245 days, at 2 hours per day (1730-1800);
- All update factors, base value travel times, congestion relief values, vehicle operating costs etc. are based on the Transport Agency's EEM (July 2013).
- Weekends and Public Holidays Peak: 120 days, at 7 hours per day (1100-1800) at 1.077 x Inter Peak volumes; and
- Weekends and Public Holidays Off Peak: 120 days, at 17 hours per day (1800-1100), at 0.315 x Inter Peak volumes.

These annualisation factors were obtained by analysis of 2011 count data on SH1 near Tawa College (01N01058) and on SH2 north of Block Road (00200969).

7.4 Costs

7.4.1 Undiscounted and Discounted Present Value (PV) Costs

Table 7.2 below summarises the undiscounted and discounted PV costs, based on the 'Most Likely' ROC estimates identified in the previous section, for Options 5 to 23. The 'Most Likely' ROC costs for Options

5 to 23 have been combined with the lowest and highest cost Option 1 (P1) and Option 4 (P4) respectively to provide lower bound and upper bound costs.

Table 7.2: Summary of Undiscounted & PV Costs (\$M)

Option		Combined With P1		Combined With P4	
		Un-discounted Cost	PV Cost	Un-discounted Cost	PV Cost
5	A	230	146	264	167
6	B	236	149	270	171
7	C	220	139	254	161
8	D	216	137	250	158
9	C (V1) Full SH1 Widening	233	166	267	190
9a	C(V1)-Variant 1 Full SH1 Widening	233	166	267	190
10	C (V1) Managed Motorway 1	255	181	289	205
10a	C(V1)-Variant 1 Managed Motorway 1	255	181	289	205
11	C (V1) Managed Motorway 2	254	180	288	205
11a	C(V1)-Variant 1 Managed Motorway 2	254	180	288	205
12	C (V1) No SH1 Widening	201	143	235	167
12a	C(V1)-Variant 1 No SH1 Widening	201	143	235	167
13	C (V2) Full SH1 Widening	231	164	265	188
14	C (V2) Managed Motorway 1	252	179	286	203
15	C (V2) Managed Motorway 2	251	179	285	203
16	C (V2) No SH1 Widening	198	141	232	165
17	C Full SH1 Widening	224	159	258	183
18	C Managed Motorway 1	233	166	267	190
19	C Managed Motorway 2	232	165	266	189
20	C No SH1 Widening	180	128	214	152
21	D Update Tawa IC	216	153	250	178
22	D (V1)	217	154	251	178
23	D (V2)	224	159	258	183

7.4.2 Maintenance Costs

Maintenance costs have been omitted at this preliminary level, as these are likely to be reasonably similar for all options and therefore not material to the economic evaluation.

7.5 Benefits

This section outlines the tangible benefits of the options, based on the Transport Agency's EEM Volumes 1 and 2. All base value travel times, congestion relief values, vehicle operating costs and update factors etc. have been based on the January 2013 Update of the EEM.

The benefits summarised in this section are stated as a comparison of the options and the 'Do Minimum' scenario using a variable trip matrix methodology.

Only travel time and vehicle operating cost (VOC) benefits have been calculated from NWSM modelling outputs, based on 'Urban Arterial' costs. Vehicle emissions (CO₂) reductions have been estimated at 5% of VOC benefits. These benefits make up the majority of total benefits of the scheme, and therefore are appropriate for comparing options.

The PV benefits of the options are summarised in Table 7.3 below.

Table 7.3: Summary of PV Benefits (\$M)

Option		Benefits			
		Travel Time	VOC	CO ₂	PV Benefits
5	A*	299.8	35.1	1.4	336.3
6	B*	224.4	34.4	1.4	260.1
7	C*	289.7	41.0	1.6	332.3
8	D*	277.6	43.4	1.7	322.7
9	C (V1) Full SH1 Widening	313.9	43.3	2.1	359.4
9a	C(V1)-Variant 1 Full SH1 Widening	313.9	43.3	2.1	359.4
10	C (V1) Managed Motorway 1	313.9	43.3	2.1	359.4
10a	C(V1)-Variant 1 Managed Motorway 1	313.9	43.3	2.1	359.4
11	C (V1) Managed Motorway 2	313.9	43.3	2.1	359.4
11a	C(V1)-Variant 1 Managed Motorway 2	313.9	43.3	2.1	359.4
12	C (V1) No SH1 Upgrade	283.6	42.7	2.1	328.5
12a	C(V1)-Variant 1 No SH1 Upgrade	283.6	42.7	2.1	328.5
13	C (V2) Full SH1 Widening	313.9	43.3	2.1	359.4
14	C (V2) Managed Motorway 1	313.9	43.3	2.1	359.4
15	C (V2) Managed Motorway 2	313.9	43.3	2.1	359.4
16	C (V2) No SH1 Widening	283.6	42.7	2.1	328.5
17	C Full SH1 Widening	313.9	43.3	2.1	359.4
18	C Managed Motorway 1	313.9	43.3	2.1	359.4
19	C Managed Motorway 2	313.9	43.3	2.1	359.4
20	C No SH1 Widening	283.6	42.7	2.1	328.5
21	D Update Tawa IC	322.7	40.7	2.0	365.5
22	D (V1)	322.7	40.7	2.0	365.5
23	D (V2)	322.7	40.7	2.0	365.5

*Note the PV Benefits for Options A to D are based on the initial scoping phase NWSM model (Refer Appendix E of the Scoping Report for further details).

7.6 Evaluation Results

7.6.1 Benefit Cost Ratios

The benefit / cost ratios (BCRs) for the Options 9 to 23 combined with Options 1 and 4 (P1 and P4) are summarised in Tables 7.4 and 7.5 respectively.

Table 7.4: Benefit Cost Ratios – Combined With P1

Options		PV Costs (\$M)	PV Benefits (\$M)	BCR
5	A	146	336.3	2.3
6	B	149	260.1	1.7
7	C	139	332.3	2.4
8	D	137	322.7	2.4
9	C (V1) Full SH1 Widening	166	359	2.2
9a	C(V1)-Variant 1 Full SH1 Widening	166	359	2.2
10	C (V1) Managed Motorway 1	181	359	2.0
10a	C(V1)-Variant 1 Managed Motorway 1	181	359	2.0
11	C (V1) Managed Motorway 2	180	359	2.0
11a	C(V1)-Variant 1 Managed Motorway 2	180	359	2.0
12	C (V1) No SH1 Upgrade	143	329	2.3
12a	C(V1)-Variant 1 No SH1 Upgrade	143	329	2.3
13	C (V2) Full SH1 Widening	164	359	2.2
14	C (V2) Managed Motorway 1	179	359	2.0
15	C (V2) Managed Motorway 2	179	359	2.0
16	C (V2) No SH1 Widening	141	329	2.3
17	C Full SH1 Widening	159	359	2.3
18	C Managed Motorway 1	166	359	2.2
19	C Managed Motorway 2	165	359	2.2
20	C No SH1 Widening	128	329	2.6
21	D Update Tawa IC	153	366	2.4
22	D (V1)	154	366	2.4
23	D (V2)	159	366	2.3

Table 7.5: Benefit Cost Ratios – Combined With P4

Options		PV Costs (\$M)	PV Benefits (\$M)	BCR
5	A	167	336.3	2.0
6	B	171	260.1	1.5
7	C	161	332.3	2.1
8	D	158	322.7	2.0
9	C (V1) Full SH1 Widening	190	359.4	1.9
9a	C(V1)-Variant 1 Full SH1 Widening	190	359.4	1.9
10	C (V1) Managed Motorway 1	205	359.4	1.8
10a	C(V1)-Variant 1 Managed Motorway 1	205	359.4	1.8
11	C (V1) Managed Motorway 2	205	359.4	1.8
11a	C(V1)-Variant 1 Managed Motorway 2	205	359.4	1.8
12	C (V1) No SH1 Upgrade	167	328.5	2.0
12a	C(V1)-Variant 1 No SH1 Upgrade	167	328.5	2.0
13	C (V2) Full SH1 Widening	188	359.4	1.9
14	C (V2) Managed Motorway 1	203	359.4	1.8
15	C (V2) Managed Motorway 2	203	359.4	1.8
16	C (V2) No SH1 Widening	165	328.5	2.0
17	C Full SH1 Widening	183	359.4	2.0
18	C Managed Motorway 1	190	359.4	1.9
19	C Managed Motorway 2	189	359.4	1.9
20	C No SH1 Widening	152	328.5	2.2
21	D Update Tawa IC	178	365.5	2.1
22	D (V1)	178	365.5	2.0
23	D (V2)	183	365.5	2.0

The range in BCRs for each option identified in the tables above are summarised in Table 7.6 below.

Table 7.6: Benefit Cost Ratios – Range

Options		BCR	
5	A	2.0 - 2.3	Scoping NWSM
6	B	1.5 - 1.7	
7	C	2.1 - 2.4	
8	D	2.0 - 2.4	
9	C (V1) Full SH1 Widening	1.9 - 2.2	Updated NWSM
9a	C(V1)-Variant 1 Full SH1 Widening	1.9 - 2.2	
10	C (V1) Managed Motorway 1	1.8 - 2.0	
10a	C(V1)-Variant 1 Managed Motorway 1	1.8 - 2.0	
11	C (V1) Managed Motorway 2	1.8 - 2.0	
11a	C(V1)-Variant 1 Managed Motorway 2	1.8 - 2.0	
12	C (V1) No SH1 Upgrade	2.0 - 2.3	
12a	C(V1)-Variant 1 No SH1 Upgrade	2.0 - 2.3	
13	C (V2) Full SH1 Widening	1.9 - 2.2	
14	C (V2) Managed Motorway 1	1.8 - 2.0	
15	C (V2) Managed Motorway 2	1.8 - 2.0	
16	C (V2) No SH1 Widening	2.0 - 2.3	
17	C Full SH1 Widening	2.0 - 2.3	
18	C Managed Motorway 1	1.9 - 2.2	
19	C Managed Motorway 2	1.9 - 2.2	
20	C No SH1 Widening	2.2 - 2.6	
21	D Update Tawa IC	2.1 - 2.4	
22	D (V1)	2.0 - 2.4	
23	D (V2)	2.0 - 2.3	

Table 7.6 shows the BCRs for all options are reasonably close apart from Option 6 (B) which is moderately lower than the others.

8 Alternatives Assessment - Methodology

This section sets out the methodology that has been used to evaluate the alternatives by assessing each options ability to meet the project objectives, and using a range of transport and environmental related criteria – also known as a multi-criteria analysis. The findings of the assessment are reported in subsequent sections. The process is summarised in the diagram below.

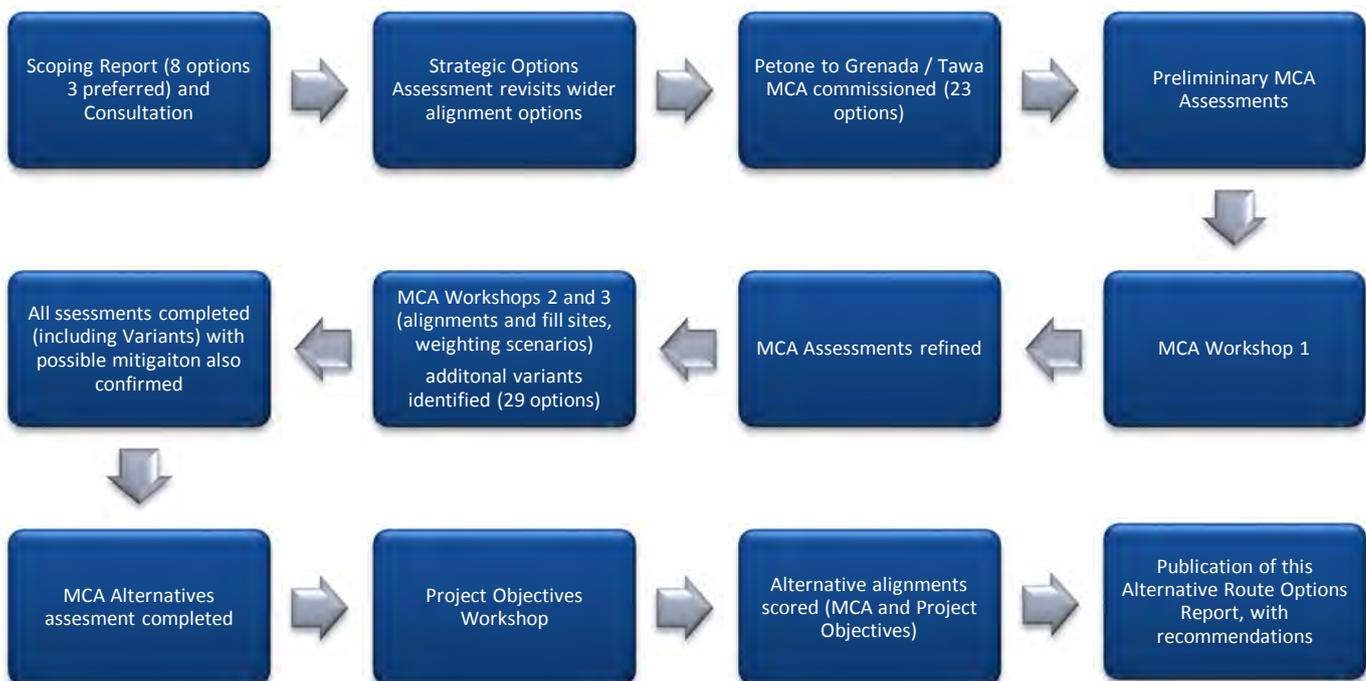


Fig. 8.1: Alternative assessment Process for Petone to Grenada

8.1 Assessment of Route Options Against Project Objectives

An earlier *Strategic Options Assessment* (refer Section 3) considering project objectives was undertaken of a range of options between the lower Hutt Valley and SH1 between Johnsonville and Porirua/Transmission Gully. A project team workshop was undertaken for the options contained within that report, assessing all options. Consistent with that approach a project team considered the 29 options east and west of the crest of the Wellington escarpment identified in this report against the six project objectives. All of the route options both east and west of the crest of the Wellington escarpment have been assessed against the project objectives. This assessment is contained in Section 11.

All route options were scored according to the same scoring system used for the *Strategic Options Assessment* (that Assessment is referred to earlier in this report). The project team's assessment of the options against the project objectives took into account the MCA assessment of the effects of the project by the individual experts.

Where relevant, information gathered for the MCA assessment was also used for the assessment against project objectives. Issues associated with resilience and transport identified through the MCA process was reviewed by the project team to provide additional information upon which to base their scoring.

The findings of the assessment against project objectives will be used to help provides recommendations to the Transport Agency to inform its decision on which option will be proceeded with.

It is of note that all project objectives are in some way transport related other than Objective 6, which relates to the management of environmental effects. The methodology applied by the project team in considering Objective 6 – which relied in large part on the assessments carried out by the experts when assessing environmental effects - is described in detail in section 11.

8.1.1 Approach

In assessing the route options against the project objectives, the following aspects of the project team's adopted approach are of particular note:

- Objective 3 includes consideration of network resilience (the ability of the network to recover from incidents, both hazard (eg earthquake) and event (e.g. vehicle accident) related. All aspects of resilience are also appropriately considered in Objective 5 (see below) and thus there is double-counting of network resilience in this regard.
- In considering Objective 4 it is assumed that all routes will be built to a minimum safe standard in compliance with the current Safe Systems approach. Differentiation occurs where any option may provide a feature or component which addresses an existing safety problem or contributes to a new safety risk.
- Objective 5 considers both the resilience of the network to natural events and the resilience of the network to other incidents.
- Only development areas already in the District Plan and/or any other extant statutory planning documents are considered.
- This assessment assumes all options have incorporated the environmental mitigation identified in the respective MCA reports (including as set out in the "reasonable mitigation" position discussed at section 8 below and set out at Appendix C to this report).
- Assessment against Objective 6 was confirmed after an assessment taking into account the MCA specialists assessments. This is discussed in detail in section 11 of this report.

8.1.2 Eight Level ‘Traffic Light’ Criteria Scoring

Figure 8.2 below gives the 8 level scoring definitions used for both the MCA and the project Objectives Assessment.

Interpretation - 8 Level Traffic Light Scoring		
<u>Environmental Effects (MCA)</u>	<u>Score</u>	<u>Project Objectives</u>
Significant Positive	3	Very Consistent
Moderate Positive	2	Moderately Consistent
Minor Positive	1	Slightly Consistent
Neutral (or de minimis)	0	Neutral
Minor Negative	-1	Slightly Inconsistent
Moderate Negative	-2	Moderately Inconsistent
Significant Negative	-3	Very Inconsistent

Fatal/Unacceptable Negative	F	Completely Inconsistent
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Figure 8.2: Eight-level scoring used for assessment against project objectives, and MCA assessment

8.2 Selection of MCA Criteria

It is important to the MCA process to select an appropriate range and number of criteria enabling useful comparison of route alignment options and informing decision-making as to route choice. It was important that only criteria likely to be of relevance in this way were selected, and also that important criteria were not omitted. Criteria were therefore specifically selected to reflect the matters in relation to the environment (in its widest sense) likely to be key considerations, particularly with respect to positive and/or negative impacts.

To optimise the selection of criteria, at the beginning of the MCA process the identification and selection of MCA criteria was made taking into consideration:

- Matters of concern identified during earlier consultation
- Matter identified in Part 2 of the RMA likely to be of relevance
- Features or aspects of the environment identified in Regional and/or District Plans likely to of relevance
- Findings and information derived from the scoping stage of the project (such as knowledge of sites and features and the nature of the likely works)
- Criteria used in similar processes in the Wellington Region
- A recognition that the various routes pass between, through or near to a diverse range of environments and landuses including urban, rural, lifestyle, recreation, heritage and a range of topographies including flat, rolling, and steep/escarpment. And in some places are highly visible from a distance.
- Professional expertise and experience from similar processes⁸

In selecting the criteria there was a deliberate intent to identify adverse environmental effects (to in turn allow effects to be as much as practicable avoided, remedied or mitigated) and to address matters identified as likely to be significant in the RMA and its statutory instruments, including the Regional and District Plans and higher level documents. Other statutory considerations such as the Reserves Act have been considered in the specific MCA assessments.

Care was also taken to minimise the degree of overlap between the criteria, although inevitably there is overlap between some different aspects of the environment, such as between transport and resilience, or urban design and landscape architecture. In all cases the selected criteria enabled an understanding of an aspect of the environment of relevance to the project.

⁸ Based on professional judgement, expertise and experience in Assessment of Effects processes

Importantly the interaction and possible overlap between some aspects of the environment and the criteria used to understand them meant that as assessments were undertaken by specialists, care was taken to ensure that all specialists were briefed identically, were aware of the other assessments being undertaken, and were encouraged in to interact with other specialists. Specialists were also provided with updates of the findings made by the other specialist in dedicated workshops.

Fourteen criteria were identified that are able to be assessed and provide an understanding of six different parts or aspects of the wider environment, and how each of those parts of the environment might be affected by respective routes. Together these criteria span the local business environment, the transport network, built-human environment, social environment, natural environment (including contaminated land), and culture and heritage environment. All can be considered to reflect a relevant aspect of the environment in its widest sense, and are broadly consistent with the RMA definitions of ‘environment’ and ‘effect’.

The relationship between the criteria and these aspects of the environment are shown below. This relationship is recognised throughout the MCA assessment.

Environmental Aspects (six selected)	Selected Criteria (fourteen selected)
Business	Business
Transport	Resilience
	Transport
Built-Human	Noise
	Urban Design
	Recreation
Social	Social
Culture and Heritage	Archaeology
	Built Heritage
	Cultural
Natural Environment (including contaminated land)	Land Contamination
	Landscape and Visual
	Ecology
	Water Quality and Hydrology

Table 8.1: Environment and MCA Criteria

8.3 Multi-Criteria Analysis tool (MCA)

8.3.1 MCA Table and Scoring

Generally, the specialists were asked to assess each option in terms of his or her expertise using the 8-level scoring system in Figure 8.2 above. More specifically, the rationale used to determine each of the scores is summarised within the respective assessments.

Each alternative was also scored as both an 'unmitigated' and 'mitigated' route option. These and the approach taken are explained in the following sections.

Where an 'F' (fatal) score is identified by any specialist for their criteria the option is scored 'F' irrespective of any other scores. All options received an 'F' score in the 'unmitigated' scenario (mostly due to water quality issues). Options were only discarded even if the option still scored an 'F' in the mitigated scenario.

Note that on this basis the comparisons in Section 10 only refer to 'mitigated' options as all unmitigated options scored 'F' scores owing to environmental effects being unacceptable. Similarly, the scores presented in Section 11 (and discussed in the final sections of this report) are the 'mitigated' scores. Tables showing unmitigated option scoring can be found in Appendix F.

Unmitigated / 'Base Position' and Mitigated / 'Reasonable Mitigation' Position and Scores

In a memo dated 26 June 2015 (included as Appendix C to this report), specialists were instructed to:

"...presume that the "base position" is part of the options being assessed and will therefore be in place when assessing and assigning "without mitigation" scores for each route option. The "reasonable mitigation" represents the level of mitigation or enhancement that the Transport Agency can at this stage commit to implementing if experts consider it necessary in respect of each of the aspects discussed below. All scoring of options with mitigation must be based on a common understanding of what is comprised in that option – including any mitigation. All specialists therefore at this stage need to presume that all of the identified "reasonable mitigation" set out in this memo will be in place when assessing giving "with mitigation" scores, even if the expert in question would not necessarily recommend that mitigation.

The unmitigated scenario was the initial assessment of the option. These looked at the option as initially briefed, but as refined in line with the 'base position' in respect of all options advised by the project team to the specialists.

The base position incorporates measures that might reasonably be considered 'mitigation', but which the project team confirmed would be automatically included in any event, but which the project team confirmed would occur irrespective of the specialists' specific recommendations, such as to meet minimum expectations or meet minimum standards of the Transport Agency, such as minimum safety standards.

The mitigated scores were then assigned in line with the 'reasonable mitigation' confirmed in the 26 June memo. All specialists were instructed to assign their with mitigation scores on the basis that all 'reasonable mitigation' measures identified in the memo would be implemented (even where that reasonable mitigation was proposed by other experts). Specialists were entitled to outline additional proposed mitigation as part of their 'with mitigation' scores, as long as that additional proposed mitigation was not directly contrary to a reasonable mitigation position set out in the 26 June memo. Members of the project team were able to consider the mitigation proposed by experts when reviewing the assessment reports, and if necessary discuss the mitigation proposed with the experts to ensure the mitigation proposed was feasible and not contradictory between experts.

The 'base position' and 'reasonable mitigation' was confirmed in response to questions and comments from specialists (including at the first and in particular second workshops). The 26 June memo was therefore developed following initial input from specialists as to the likely steps they considered would be necessary to mitigate / minimise the adverse effects of the project.

The memo was circulated to ensure consistency, so that all specialists were made aware of the option and the base position mitigation as confirmed by the Transport Agency.

Mitigation measures were identified (in the 26 June memo and in the expert assessments) to address adverse environmental effects, given that any option selected by the Transport Agency and taken forward through an RMA process will necessarily incorporate numerous such measures. It is important under the RMA that adverse effects are appropriately avoided, remedied, or mitigated. Technical specialists were thus asked to advise on additional forms of mitigation beyond the 'base position' noted above.

This approach has other benefits, not least that the specialists were able to be involved much earlier in the alternative development process, thereby maximising opportunity for responsive design, and ultimately better quality environmental outcomes.

Further detail of mitigation identified by the specialists can be found in the respective specialist reports.

Why Consider Unmitigated and Mitigated

All assessments undertaken by the specialists were initially based on the 'base position' scenario, with no additional mitigation in place. This first assessment for each of the route options enabled a better understanding of the potential for and nature of effects that might arise from the routes. This in turn enabled the more informed identification of possible mitigation to address these effects. Additional mitigation was set out in a combination of the 'reasonable mitigation' positions addressed in the 26 June memo, and in the expert assessment reports.

The side-by-side comparison of the unmitigated / base and the mitigated scenarios also offered an understanding of the potential effectiveness of the mitigation proposed, or put another way the improvement of the mitigated option relative to the 'unmitigated' options.

Where mitigation involved actual identification of another route that a further comparison between routes could be made, such as with the Variant options (for example options 12 and 12a). See section 4 of this report.

This method is considered to be a more accurate means of scoring alternatives than a simple unmitigated scenario. Significantly the scoring of alternatives is substantially different with mitigation in place as opposed to without it.

Value of this approach to Project Objective 6

The comparative scoring of both unmitigated and mitigated scenarios was used to facilitate a better understanding of the ability of the respective routes to meet project objective 6 - which relates to the management of environmental effects. Recognising that the total avoidance or elimination of environmental effects is not achievable, Objective 6 reflects an intent by the Transport Agency to manage any such effects. Mitigation has been proposed for each of the proposed routes and a comparison between the 'unmitigated' and mitigated options for the routes shows how effectively the effects associated with each of the routes is able to be managed. This means that comparative assessments can be made for (both routes and fill sites):

- Environmental effects comparison between options
- Environmental effects comparison between unmitigated and mitigated scenarios

- Effectiveness of mitigation in managing environmental effect (mitigated versus unmitigated)

The approach to the assessment of each option against Objective 6 is discussed in detail in section 11 below.

9 Proposed Fill Disposal Sites

9.1 Initial identification and assessment of possible Fill sites

Any combination of routes east and west of the crest of the Wellington escarpment will generate significant volumes of surplus fill as illustrated in the table in Appendix A showing the surplus fill volumes for all options. Option 4 (P4) generates the most surplus fill among the routes east of the crest of the Wellington escarpment (approximately 9 million m³) and Option 22 (D (V1)) generates the most surplus fill among the routes west of the crest of the Wellington escarpment (approximately 4 million m³). Combined, these two options represent a “worst case” scenario of around 13 million m³ of surplus fill.

Consequently a “long list” of technically feasible fill sites, was identified for investigation as part of the project. These sites were all in relatively close proximity to the routes and combined were intended to provide sufficient capacity for a “worst-case” scenario (i.e. the combination of options which generated the most surplus fill) as identified above.

Having fill sites able to take excavated material as fill in close proximity to the route alignments was considered an advantage to the project, particularly in terms of minimising impact on the public and minimising cost. For this reason potential fill sites, close to the route alignment, which could be accessed using construction haul routes rather than the public road network, were identified for their suitability. Given that the volume of fill material could potentially be significant, it was determined that the MCA specialists should also consider the suitability of the potential fill sites. As part of the identification of possible mitigation specialists identified that proximity to the routes meant construction and mitigation could occur at the same time.

For each fill site location, the extent of fill that could be accommodated, possible ‘shaping’ options, and the environmental details (such as hazards, ecology and the like) were identified.

The “long list” of fill sites was discussed at both Workshop 1 and Workshop 2 by the technical specialists. The experts provided their initial feedback on the 7 identified fill sites.

Following that feedback and discussion, a dedicated Workshop 3 (occasionally referred to as the fill Workshop) was also held to further refine the location, extent and ‘shaping’ of fill by a smaller group of the most relevant technical specialists who had self-selected at Workshop 2 (see also section 11 below). Following the discussions held at Workshop 3, refined versions of the fill sites – now reduced to 5 in total – were presented to the wider group of technical specialists for reassessment.

A further consideration is that the selection of the fill sites and the order in which they might be used is affected by their proximity to the road construction work and the ‘haul’ routes that might be used between the excavation and fill sites respectively.

9.2 Refined assessment

A valuable consequence of Workshop 3 was that some fill sites were discarded, other fill sites identified, and the extent and ‘shape’ of the fill that could be placed on some sites was modified. Descriptions of these changes can be found in Appendix D. This exercise was specifically undertaken to try and understand how the potential impacts of fill placement on these sites could be best managed. Discussion

was largely associated with the volume, extent and final shaping of the fill, and the desirability of avoiding specific areas within the fill site area for environmental reasons.

Consequently the volume, extent, and final shape of potential fill placement, and the sequence of use of fill sites was altered reflecting the common findings of the specialists and with the intent of enhanced management of the potential effects of the fill.

Opus was able to confirm that it would be feasible to refine the fill sites in general accordance with what was collectively proposed by the experts at Workshop 3. The potential fill sites as refined in and following Workshop 3 (and assessed by the experts in their final reports as reported in section 11 below) are identified in Figure 9.1 below.

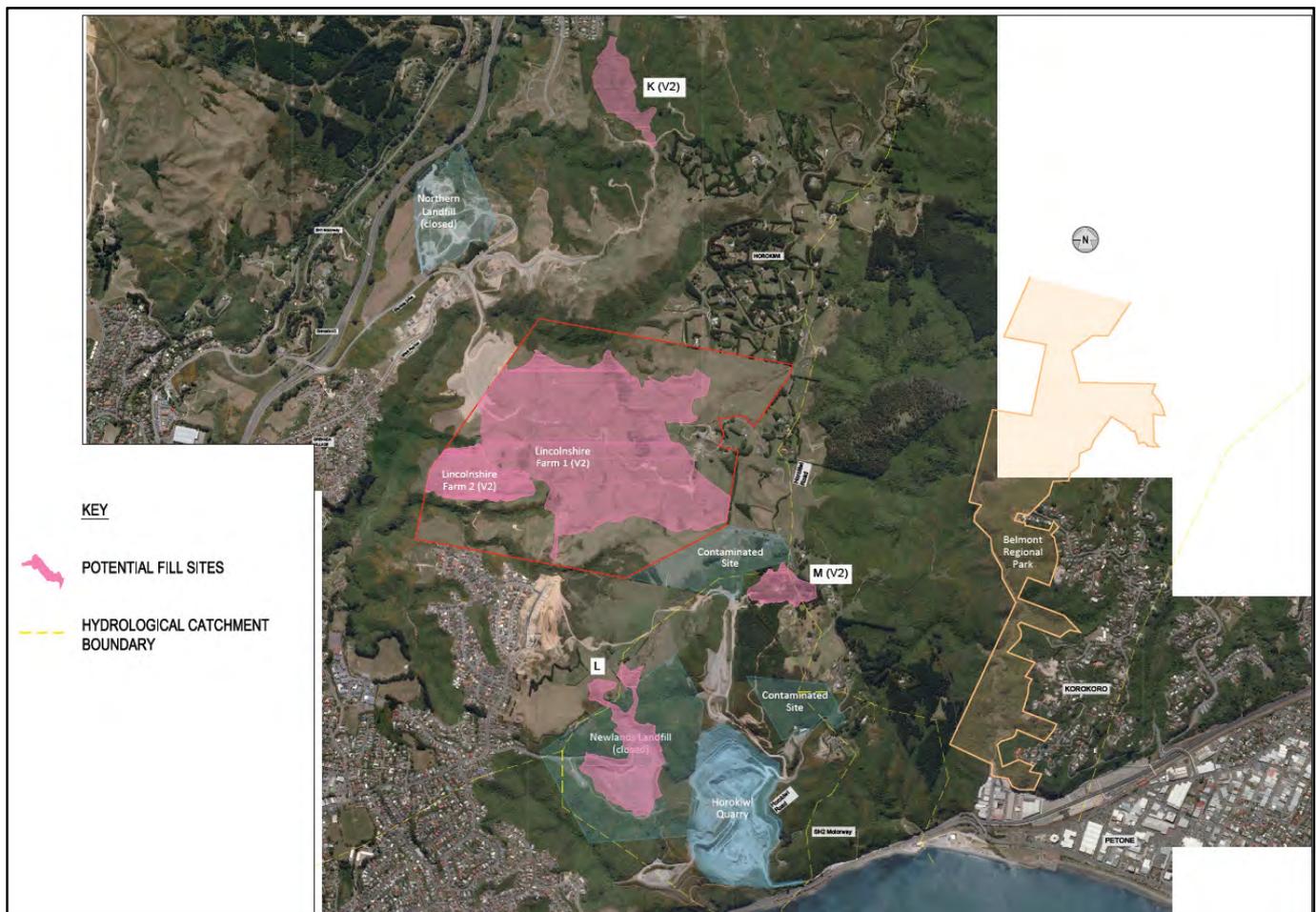


Figure 9.1: Potential Fill Sites

Further details on these potential fill sites are provided in Appendix E.

9.3 Levels of fill generated does not influence MCA and Project Objectives scoring of routes

Following the discussions at Workshop 3 and the production by Opus of the refined fill sites, it became clear that the key experts who had attended Workshop 3 (ie those who considered effects of fill disposal

were potentially significant in respect of their discipline) considered that in general terms the fill sites could be refined so that the overall effects of the use of each of the fill sites could be managed so that they would be at an acceptable level. In some cases – particularly in respect of urban design – it was felt that the use of the fill sites in a refined manner could bring positive enabling effects.

The generally acceptable level of adverse effects that the use of each of the refined fill sites will generate was confirmed by the assessment of the full expert team (see the table reproduced at section 11 of this report where the fill site scores are shown).

It was also confirmed that the identified refined fill sites remained capable of accommodating all the fill generated by most (though not all) route options. The project team is confident that if necessary additional fill capacity could be identified and developed in a way that the environmental effects of fill disposal are acceptable.

On this basis, it is considered that the amount of fill generated by each option need not be a key factor in the choice of route by the NZTA, at least in terms of environmental effects and consistency with the project objectives. The experts were specifically instructed not to take into account the amount of fill generated by each option (and the possible impact of fill disposal) when assessing and scoring the route options. Similarly, the project team did not consider the level of fill that would be generated by the each option was assessing the options against project objectives.

9.4 Final fill site makeup including other opportunities

The ability to progress the project does not absolutely depend on the use of the fill sites identified and assessed following Workshop 3. As discussed above, the work carried out identifying and refining the fill sites assessed gives comfort that the level of fill generated by each option need not be determinative (in environmental / objective fit terms) in route selection.

The identified fill sites are in general terms close to the alignment and therefore desirable in constructability terms. Their availability for use for placement of fill will be subject to a range of considerations (including discussions with landowners). It may be the case that additional options for disposal of fill may be available and/or required.

This assessment identifies the respective capability of each of the fill sites to accommodate fill, and an order of sequence of use of fill site as agreed by the MCA specialists. This information will be available for decision makers alongside the MCA assessment, and the assessment against project objectives. The findings of the fill assessment can be found in section 11.12.

While there are potential opportunities for utilising surplus fill, such as reclaiming land for the Wellington Hutt Valley Cycleway project and selling quality material, it was considered that there were additional levels of uncertainty in respect of those opportunities. In particular, using fill from the project to reclaim land for the Cycleway project requires the Cycleway project – which is in the early stages of development – to obtain the necessary consents. These other possible opportunities were not formally assessed. It is anticipated that if such fill sites become available that the Transport agency will consider them as they arise.

10 Summary of MCA Specialist Findings

This section draws directly on the MCA specialist assessments to provide a succinct background summary of the main findings by MCA criteria. Specialised scoring by the specialists is presented in the 'Unweighted' route alignments tables and fill sites table in Section 11 of this report.

10.1 Business

The proposed link road will contribute to economic growth in the local region through better access to jobs and markets, improved efficiency in freight movements, and the potential for additional land to be opened up for commercial development along the route and adjacent to existing commercial land uses. There are however some direct adverse effects on existing business activities that will cause displacement of these businesses along the route. Compensation under the Public Works Act 1981 is considered to be appropriate mitigation for adverse business impacts that directly result from the link road.

The impact assessment identified two main clusters of business activities in Petone and Grenada North that will be directly affected by some of the route options. In Petone, the interchange is expected to displace all existing businesses operating to the north of SH2 and three businesses on the Petone foreshore, irrespective of the preferred scoping Option 1, 1a, 1b, 2, 3 or 4. The Tawa interchange is also expected to adversely affect business activity in the Grenada North industrial area.

10.2 Natural Hazards and Resilience

The principal natural hazards that affect the route are earthquakes (including associated ground shaking, fault rupture hazard, landslides, liquefaction / lateral spreading, tsunami) and storms (associated flooding, storm surge and slope failures). Enhancing resilience of the transport network, including against natural hazards, is a key objective for the project.

The concept of resilience is wider than natural disasters and covers the capacity of public, private and civic sectors to withstand disruption, absorb disturbance, act effectively in a crisis, adapt to changing conditions (including climate change), and grow over time. When considering the resilience of access of a road network as a whole, resilience depends on:

- Route Resilience
 - i. less vulnerable to failures in natural hazards
 - ii. ability to recover quickly after closures
- Network Resilience from Redundancy and Connectivity
 - i. Redundancy – availability of alternate routes in hazards, accidents or maintenance
 - ii. Connectivity – trip diversity and ability to move from one link to other to avoid blockage.

Resilience studies of the road networks in the region indicate the poor resilience of access into the region in the aftermath of hazard events such as a large earthquake or storms. The loss of access will severely impact the bringing in of essential goods and services such as food and medicine as well as materials and equipment for response and recovery. Not only will the region be cut off, the individual districts will be cut off from each other, making it difficult for the districts to help each other.

The Wellington Region has very limited redundancy and connectivity in its network outside the city centres. In this context, the Petone to Grenada link, and the option to extend it to link with Transmission Gully, provide opportunities to enhance access resilience into the Hutt Valley in the aftermath of hazard events such as earthquakes and storms, and improve redundancy of access. The link and the Takapu link to Transmission Gully (Options 8, 21, 22 and 23) also has the potential to enhance network resilience by providing enhanced redundancy and connectivity.

For the routes east of the crest of the Wellington escarpment, Option 3 (P3) scored the highest with a significant positive rating without mitigation. Option 4 (P4) scored the second highest when mitigation measures are implemented to stabilise the rock cuttings close to the Korokoro Stream western flank. Option 1a (P1 Variant 1) is fatally flawed as the route will have very poor resilience in earthquake and tsunami events. Also construction of this option will reduce the resilience of the existing SH2 and hence the existing network. Option 1 (P1) scores significant negative as it offers very poor resilience and could worsen the resilience of the existing network as the southern section of this option is located along the eroded fault scarp directly above SH2. Option 2 (P2) scored neutral because although it offers poor resilience as it straddles the very steep slopes along the western flank of the Korokoro Valley it provides improved redundancy and connectivity to the road network.

For the routes west of the crest of the Wellington escarpment Options 8, 21, 22 and 23 (Option D and Option D variations) scored the highest with a significant positive rating without mitigation. This is because these options provide good route resilience, and excellent redundancy and connectivity to the road network between Wellington and the Hutt Valley and the State highway and road network as a whole. These s bypasses vulnerable sections of the existing network and the vulnerable southern part of the Transmission Gully route. Option 5 (A) scored minor positive as it has good hazard resilience but does not provide appreciable redundancy and network resilience. Similarly Options 7 (C), 9 (C (V1) Full SH1 Widening), 9a (C(V1)-Variant 1 Full SH1 Widening) and 17 (C Full SH1 Widening) scored minor positive. This is because while these options have good natural hazard resilience, operationally they only provide some redundancy for the section of SH1 between Tawa and Grenada but no redundancy north of Tawa. The C and C (V1) managed motorway options (Options 10, 10a, 11, 11a, 18 and 19) scored neutral with no mitigation but minor positive with mitigation, which involved appropriate measures to resolve the existing vulnerabilities along the managed motorway section (SH1 between Tawa and Transmission Gully). Options 12 (C (V1) No SH1 Upgrade) and 20 (C No SH1 Widening) scored neutral as these options do not resolve the existing vulnerabilities along SH1 between Tawa and Transmission Gully. All C (V2) options (Options 13, 14 15 and 16) scored neutral primarily because the resilience benefits are offset by the dis-benefits from building through a landfill area and compromising the resilience of that key section of the route.

If a fill site is assessed as unlikely to have an effect on the resilience of the P2G route, even under natural hazard events (provided it is engineered to best practice standards), then it has been assessed as Neutral, as the fill sites presented do not provide a resilience “benefits”. Where fill sites could potentially negatively affect the resilience of the P2G route, then a negative score was given. The fill site with the lowest score is site L, as placement of fill on refuse dumps could become unstable in natural hazard events, and will have an adverse effect of resilience of the existing SH2.

10.3 Transport

The Transportation (General) Assessment has assessed the transport-related effects of the route options, including (as relevant) in terms of safety, efficiency, modal choice, connectivity, accessibility, and resilience (with respect to typical network operations).

The assessment has confirmed that the preferred options (from a transport perspective) are Options 7, 9, 9a, 10, 10a, 11, 11a, 13, 14 and 15 (Options C and its variants with SH1 upgrades) and Options 8, 21, 22 and 23 (D and its variants), incorporating 'mitigation' design measures that address an existing safety issue in a section of SH1 known as the 'Tawa curves' as well as consideration of pedestrian and cyclists facilities within the future SAR assessment. In terms of effects on the transport network during construction, the Managed Motorway options (Options 10, 10a, 11, 11a, 14, 15, 18 and 19) would potentially have the most significant adverse effects.

The overall MCA ranking has been undertaken and Option 1 (P1) as proposed is considered the least desirable option of Options 1 to 4 (P1 – P4), due to the longer length of the route. However, on balance this is considered marginal, and with consideration of improved pedestrian and safety features, Options 1 to 4 are all considered to be positive from a transportation perspective.

Options 1a and 1b (P1 Variants 1 and 2) as proposed are not considered practicable within their current form. Option 1a was developed by the landscape specialists within the MCA process to minimise the extent of the interchange size, and within the area constraints identified by those specialists, the establishment of an interchange of a sufficient scale to cater for the existing and future traffic demands is not considered feasible. Option 1b interchange as proposed is similarly not considered workable, but could be mitigated with a comparable interchange proposed by Options 1 to 4.

This MCA analysis has found on balance that Options 7, 9 and 17 (being Option C Scoping, Option C (V1) Full SH1 Widening and C Full SH1 Widening) represent the preferred route, before mitigation is considered. Once mitigation has been considered, most of the options score moderate positive, with the exception of Option C (and its variants) without SH1 widening (Options 12, 12a, 16 and 20).

From a transportation perspective, the preferred fill site location(s) would be those located in closest proximity to the preferred route (to minimise the amount of travel associated with this activity).

10.4 Noise

The existing noise environment comprises the sources of noise that currently exist plus those sources of noise which are permitted to be established in the area. The Project area for has a mix of environments including existing State highways, industrial areas, nature reserves, residential and rural residential areas. Some areas are also under the flight path of Wellington Airport but as the airport is distant, planes are at a moderate altitude as they pass over the area.

Accurate calculation of road-traffic noise requires detailed engineering drawings as the propagation of noise is strongly influenced by the detail of the terrain between the road and the receiver. Such details are not available at this stage. Therefore the assessment of the impacts of all options was undertaken using some generalised calculations and judgements based on experience with other projects.

It is concluded that for all 29 options, with mitigation the noise levels would achieve acceptable levels in accordance with the applicable standards, NZS6806, and that the increase in noise would also be judged acceptable as judged by the research that underpins the former Transit NZ noise Guidelines. Further there do not appear to be noise impacts to land planned for future development that could not also be addressed by acceptable mitigation.

In all cases it appears that the mitigation measures of a quiet road surface, and standard barriers or bunds in locations where additional mitigation was needed would be all that is necessary. Such mitigation has been found to be acceptable in many other projects.

However the project does increase noise in the area so it has to be considered as a negative impact overall but recognising that some small positive impacts might result if mitigation on SH1 remedies an existing noisy situation for a few houses. Therefore, it is concluded that all options should be scored as minor negative (-1) for the option evaluation once mitigation is included as is expected by the RMA.

When wider issues such as noise of constructing the options and noise of placing surplus fill of some of the options, these activities are rated as only minor negative and so the overall rating remains as minor negative for all options.

10.5 Urban Design

The Petone to Grenada Project runs through the Lincolnshire Farm Structure Plan area. The Lincolnshire Farm Structure Plan (LFSP) and Northern Growth Management Framework (NGMF) envisage higher intensity mixed use suburban development as opposed to the existing low density predominantly residential suburbs. This supports higher growth in a more sustainable urban form, but requires greater connectivity because of the mixed use employment/residential trips and greater concentration of movements. This type of development will not be possible without the connectivity offered by the Project. Therefore the Project offers urban design benefits in that it enables land use form envisaged in the WCC District Plan.

The route alignments for Options C (V1) and its variants (Options 9 to 12a) together with Options 22 and 23 (Option D (V1) and D (V2)) are located along the edge of the LFSP so avoid severance effects. The increased separation from the existing land bridge and ability to shift the interchange ramps out of the gully reduces adverse amenity effects on Belmont Gully. Constructing a bridge crossing will further reduce amenity effects and avoid placing gully walking/cycling tracks in underpasses.

The NGMF shows future residential areas around Woodburn Reserve in the Takapu Valley, but these do not have supporting Structure Plans and Plan Changes. Therefore they are given less weight in the assessment. The NGMF aims to improve connectivity between Grenada North and Tawa, so route options that will allow improvement of pedestrian and cycle as well as vehicle linkages are rated higher in this assessment.

Of the three superior options in the LFSP area Option 9 (Option C (V1)) is the superior option in Grenada North. The severance of the Jamaica Rise footpath is the only important urban design issue.

Options 22 and 23 are also preferred from an urban design perspective as they avoid residential areas and the Grenada North sports fields. The key to these options will be the landscape and ecological assessments on the ridge above Grenada North and in Takapu Valley.

Petone is developing as a desirable urban village and Plan Change 29 aims to transition the light industrial area around Petone to a higher intensity mixed use commercial/residential area to support further growth. Linkages from Petone to the foreshore and Belmont Park are important in their own right but will become more important as land use intensifies.

Options which have less amenity effects for this growth area, and improve accessibility between Petone, the foreshore and the Belmont Park entrance are rated higher. For these reasons Option 1 (P1) is favoured

with a Minor Positive rating. Option 4 (P4) has a neutral rating and Options 2 and 3 (Options P2 and P3) have minor negative ratings.

Two variants of Option 1 were developed to try and minimise cuts into the coastal cliffs. The concept is relocate SH2, railway and Project road to reduce the cut into the base of the coastal cliff. Option 1a (P1 Variant 1) relocates SH2 and the railway away from the foreshore and places the P2G road on an elevated structure above the Honiana Te Puni Reserve. This results in more adverse effects with dominance over the foreshore reserve.

Option 1b (P1 Variant 2) relocates SH2 and the railway toward the foreshore and places the P2G road on an embankment at the base of the coastal cliff. The unmitigated scheme is not as good as Option 1 as the separation distance from the interchange and railway to the foreshore reduces.

The existing hilly topography in the LFSP area discourages the higher intensity mixed use development envisaged by the structure plan. Flatter sites allow more intensive development. Conversely the existing pattern of residential development with large retaining walls and cul-de-sac roads is driven by minimising earthworks costs. If placing the fill from the Project on the LFSP area flattens the topography it will encourage the urban form envisaged by the structure plan. Therefore the scores are very positive for this issue as it reduces a large financial barrier to achieving the higher intensity urban form. This is possible for Linc 1 and Linc 2 fill areas.

The other fill options are outside existing or future urban areas so receive a neutral urban design assessment.

10.6 Recreation

The two main effects on recreation relate to the impact of certain route options on Grenada North Park in the northern extent of the project, and Belmont Regional Park in the south. In particular, the Takapu Road and Cornish Street road end entrances to the Belmont Regional Park are affected by some of the route options. Protected Areas and a proposed community park within the Lincolnshire Farm future development area are also affected by the crest of the Wellington escarpment to Grenada route options.

The dominant recreation features in this area are the Belmont Regional Park along with a number of other Wellington City Council (WCC) managed reserves. While these mostly offer outdoor recreation activities and opportunities, these reserves also possess historical, amenity and ecological values. Many offer high vantage points from which views over Wellington suburbs can be enjoyed by recreational users.

The Grenada North Park is another key recreational feature in the project area and offers a large organised sports ground catering for cricket, football other informal recreation activities. This is impacted by two D route options (Options 8 and 21).

There are also varying effects from proposed routes on the recreation use of Grenada North Reserve, Hillcroft Road Scenic Reserve and Caribbean Drive Reserve. Local recreation use of the Horokiwi and Takapu areas will also be potentially affected by route options.

The route option east of the crest of the Wellington escarpment which rated as having the least significant adverse effects with mitigation are Options 4 (P4), 1a (P1 – Variant 2) and 1b (P1 – Variant 2). These options rated neutral. In contrast Option 3 (P3) was rated as having the most significant adverse effects with a rating of moderate negative.

The route options west of the crest of the Wellington escarpment which rated as having the least significant adverse effects are Options 5 (A), 6 (B), 9a (C (V1) - Variant 1), 12 (C (V1) – No SH1 widening), 12a (C (V1) Variant 1 No SH1 Widening), 13 (C (V2) Full SH1 Widening), 14 (C (V2) Managed Motorway 1), 15 (C (V2)

Managed Motorway 2), 16 (C (V2) No SH1 Widening) and 20 (C No SH1 Widening). Conversely the options with the most significant adverse effects are Option 4 (D) and Options 21 to 23 (D and its variations). These options rated significant negative.

Among the fill disposal sites, fill disposal site L is rated as having the most significant adverse effects with a rating of moderate negative.

10.7 Social and Community

The focus of this assessment of social and community impacts is at a local community level, rather than at a wider regional level. From the outset it is acknowledged that the public infrastructure nature of the Project will have significant social benefits at a regional level (e.g. improved connectivity, trip reliability, enhanced safety, resilience and economic growth). This is reflected in the project objectives and the very reason for the Project. This assessment looks at the effects (positive and negative) at a local level.

At a local level, the Project options are all assessed as having negative social effects, predominantly associated with people's health and wellbeing associated with stress and anxiety due to uncertainty about Project; impacts on community aspirations for the character of their neighbourhoods (especially rural); and property impacts (residential and community facilities).

Overall, from a social perspective, the key impacts associated with Options 1 to 4 (P1 – P4 and P1 variations) are property take (and associated effects relating to emotional attachment); impacts on community aspirations as a result of changes to neighbourhood and landscape character and the visual environment (associated with earthworks cuts), rural character (associated with the introduction of an urban element to the environment), ecological values (associated with the Korokoro Stream) and recreational opportunities (associated with impacts on Belmont Regional Park and the Petone Foreshore).

Option 3 (P3) and to a lesser extent Option 2 (P2) are likely to have the greatest adverse effects on recreational (Belmont Regional Park) and ecological values (Korokoro Stream), which in turn impacts on community aspirations for the protection of these sites/features. Options 1 and 4 (P1 and P4) avoid or minimise impacts on Belmont Regional Park and the Korokoro Stream, but Option 1 cuts into the coastal cliff face above SH2 and affects the ridgeline as seen from the Cornish Street entrance to Belmont Regional Park, affecting community aspirations to maintain the ridgeline and hilltop character of the area. Options 1a and 1b (P1 Variants 1 and 2) have the potential to result in adverse impacts on social connectedness, because they will encroach on the northern portion of Honiana Te Puni Reserve. This has the potential to result in a loss of sense of community amongst groups which utilise the Reserve if any of these facilities/activities are displaced (temporarily or permanently).

Overall, from a social perspective, Option 4 (P4) has a positive differentiator because it best meets the community's aspirations in terms of avoiding impacts on Belmont Regional Park and minimising ecological impacts.

Overall, from a social perspective, the key issues associated with the options east of the crest of the Wellington escarpment are:

- property take impacts and associated effects relating to emotional attachment from Options 5 to 8 (A – D) and Options 9 to 23 (Options C and D and their variations);
- impacts on educational facilities from Options 5 to 7 (A to C) and Options 9 to 20 excluding variations with no SH1 widening;

- impacts on recreational facilities from Options 4 and 20 to 23 (D and D variations); and
- changes to rural character in the Takapu Valley from Options 4 and 20 to 23 (D and D variations).

The variations have been developed to avoid or minimise impacts on residential properties. Options 9 to 12a, Options 13 to 16 and Options 22 to 23 avoid or minimise impacts on Grenada Sports Park. Options 22 to 23). The managed motorway options all result in reduced property impacts along SH1. However, all D options (Options 8, 21, 22 and 23) will impact on rural character of the Takapu Valley and this community's aspirations for their neighbourhood as a quiet sanctuary.

On balance, from a social perspective, the managed motorway options (Option 10, 10a, 11 and 11a) have a positive differentiator because of their reduced property impacts (including residential and school property) and avoidance of impacts on the rural character and community aspirations of the Takapu Valley.

Overall, it is assessed that the social effects associated with the proposed fill site options can be managed to neutral in the long term (M, K, LF1 and LF2). Temporary impacts on dog walking community associated with fill site L, which is located on Waihinahina Park, have potential to be negative, even with the implementation of mitigation.

10.8 Archaeology

Several archaeological sites are thought to be present within the general project area, however only two significant risks were identified: these include the Wellington Woollen Mill site near the mouth of the Korokoro Stream, and the historic Maori walking route between the Korokoro and Takapu Valleys.

Options 1 to 4 (P1 to P4), including Options 1a and 1b, were found to have a moderate negative effect after mitigation, as all four would impact the original site of the Britannia Flour Mill and the Wellington Woollen Mill, which operated at the mouth of the Korokoro Stream from at least the 1860s until the late 1960s. Although there is no way to avoid destroying the site, mitigation of the impact could be achieved through an archaeological investigation of the area prior to the road construction to avoid the loss of archaeological information. Archaeological investigation would be a legal requirement.

Options 5 and 6 (A and B) on the west of the crest of the Wellington escarpment were found to have low archaeological risk and thus have been assessed as having a neutral effect.

Options 7 and 8 (C and D), and Options 9 to 23 (C and D variations) west of the crest of the Wellington escarpment were found to have a minor negative effect due to the likelihood of affecting the original route of the Takapu to Korokoro track used during pre-European times. A mitigation option suggested in this report is the identification of the track route, and construction of a public walking track on the original track route, with signage. If the track route can be identified then archaeological monitoring as a form of mitigation should occur in this area.

The proposed fill sites have been assessed as having low archaeological potential, and thus have been assessed as having a neutral affect.

10.9 Built Heritage

There are five items of statutorily recognised built heritage and one item that is currently not recognised that are potentially impacted by the proposed Petone to Grenada project. Braid Cottage, Nott House and Greer House, all located in the Glenside suburb, are Wellington City Council listed heritage buildings that

are potentially affected by Options 5 and 6 (A and B) by the proposed slight widening of the existing highway into their eastern boundaries. Options 1, 2, 3 and 4 (P1 to P4), including Options 1a and 1b (P1 Variants) will have a visual impact on Petone's ANZAC flagpole, HNZ listed category 1, and will cause the need to demolish the Hutt City Council listed Wellington Woollen Mills marble wall at the eastern end of Cornish Street. Cox house, an unlisted Ian Athfield House in Horokiwi Road will potentially be visually and noise impacted by Options 1, 2 and 3, but will be demolished by Option 4. No fill sites will affect built heritage.

The assessment methodology used to assess the impacts is that used in the Transport Agency, *Guide to assessing historic heritage effects for State highway projects*, March 2014, which compares the heritage value of the item with the magnitude of impact.

Proposed mitigation is screening of the project from the three Glenside properties for Options 5 and 6 and Cox House for route Options 1, 2 and 3. Relocating and reconstructing the Woollen Mill wall with Options 1 to 4 would mitigate effects of the Project, while realigning Option 4 with screening, would mitigate effects on the Cox House. There is no need to mitigate effects on the ANZAC flagpole as the effects are neutral.

10.10 Cultural

The proposed Petone to Grenada Link Road project has the potential to impact both positively and adversely upon the cultural and spiritual values of Tangata Whenua in respect of the project area, which includes the area of Takapu in the north to Petone in the south. These impacts include possible damage to and destruction of sites of significance to tangata whenua, such as a historical Maori walking track and any (currently unrecorded) cultivation and midden sites that may be present within the project footprint. Options also adversely affect streams and other resources with ecological (and related cultural) values, as well as Maori-owned land parcels. Some of the proposed route options (the 'P1 variants') impact on land vested in tangata whenua recently by the Crown through a Treaty of Waitangi (Treaty) settlement, which related to historical Crown breaches of the Treaty stretching back over 126 years.

Various meetings with tangata whenua about the project has been held since 2013. A number of sites of significance have been initially identified, and others in the vicinity of the project will be recorded in a Cultural Impact Report which will be prepared by the iwi entities identified later the Cultural Assessment. Overall the impact of effects on cultural sites and values from Petone to 'the Crest' and the Crest to Grenada/Tawa/Porirua/Transmission Gully are seen by tangata whenua to be of high to medium severity. There are baseline mitigation strategies proposed by the NZ Transport Agency including monitoring and 'accidental discovery protocol' agreements and other measures to be explored and if possible addressed and recorded in Memoranda of Understanding between the NZ Transport Agency and iwi (such as recognising and providing for cultural values in ecological areas), and the preparation of a Cultural Impact Assessment which will consolidate and record traditional knowledge about the area. Overall the potential measures to address cultural effects represent an opportunity for the project to improve on the current situation.

As well as iwi/hapu representatives of tangata whenua, a number of other Maori organisations, agencies and individuals have raised concerns with proposed works as they feel they will be adversely affected both culturally and spiritually. Engagement with these parties will continue and will form part of the Cultural Impact Assessment inputs.

10.11 Land Contamination

For the Petone to the crest of the Wellington escarpment route Options 1 to 4 (P1-P4) the contaminated site scores are minor negative without mitigation and neutral to minor positive after mitigation. The contaminated site issues for these options are small considered in the overall scale of the project. All four routes are similar at the Petone interchange. Options 1 and 4 appear to traverse contaminated sites noted as “transport” and “steelworks”. However contamination associated with these would be expected to be limited to surficial soil contamination by metals or at worst a UST (underground fuel storage tank). These are in effect routine situations for contaminated land in urban areas. The Petone to Grenada project may in fact be the catalyst for remediation of these sites to the overall benefit of groundwater quality in the immediate vicinity.

There are no significant contaminated land issues raised by most of the routes west of the crest of the Wellington escarpment, namely Options 5 to 23, except for Option 6 (B) and Options 13 to 16 (C (V2) and its variants) as both traverse the closed Northern Landfill. These latter options involve deep cuts of up to 15 m and require disposal of between approximately 45,000 m³ and 111,000 m³ of old landfill material. Substantial issues arise with differential settlement, odour, wastewater disposal and landfill material disposal. Without mitigation these issues constitute fatal flaws. With mitigation these issues will remain as significant negative for Options 13 to 16 (C (V2) and its variants) and fatal for Option 6 (B). If the Transport Agency was to consider progressing Options 13 to 16 (C (V2) and its variants) further assessment would need to be carried out in order to conclusively determine whether these options might also be fatally flawed.

No significant contaminated land issues are raised with the proposed fill sites.

10.12 Landscape/Visual

Key issues from a landscape perspective are the protection of the ridgelines and hilltops which provide the characteristic structure of Wellington City, and divide the council areas from each other, which are incorporated into various Councils' plans.

Currently the main area through which the proposal runs is rural, though the central areas of Lincolnshire Farms are subject to a Structure Plan which provides a framework for the future development. This is strongly patterned around the gully and ridge system of the area. Potential connections north to Transmission Gully are through the strongly rural area of the Takapu Valley. Other options connect to SH1 at Grenada or Tawa and propose a variety of works to address the increased roading demand within this existing corridor. At the southern junction at Petone, the physical landscape is very precipitous and very visible, with the proposed link road having to traverse the scarp face which surrounds the harbour.

The impact on the landscape, regardless of which option is preferred, is significant and, due to the extent of excavation, cut faces and fill areas, including fill disposal sites, is negative. The ability to avoid effects is challenged by the geometric design parameters and the ability to mitigate effects is limited. There is potential to mitigate effects to some degree but this primarily requires protection of gullies within the site from filling with surplus earthworks, or use of embankments across culverts rather than bridges.

All routes at the southern end have very significant negative effects and minimal opportunity for mitigation. Of the routes proposed, Option 4 (P4) is preferable as this avoids both the cliff face and the Korokoro Valley. Option 3 (P3) is marginally acceptable in landscape terms if the Korokoro valley is to be compromised. In terms of mitigation, both of these require creative design of the junction with SH2 to

create a new landscape, improve the access to Belmont Regional Park and protect heritage features in the area.

Significant cuts into and through the Horokiwi Ridge are required regardless of the option chosen to link Petone to the crest of the Wellington escarpment and through the Lincolnshire Farms Structure Plan area. For the central section linking from the crest of the Wellington escarpment to Grenada and Tawa, Options 13 to 16 (C (V2) and its variations) have less impact on the natural landform, and have some positive elements in potential for improving the environment of the SH1 corridor and Tawa intersection. There are varying effects for the options upgrading the SH1 north to join to the Transmission Gully route. At this stage, in landscape terms no particular option of highway management has significant advantages over another.

The D options (Options 8, 21, 22 and 23) which link to Tawa but also follow a green field route along the Takapu valley will cause change in character and significant detriment to the local environment of this tight quiet and discrete rural valley. These options also requires an interchange with the Transmission Gully route near the ridge line at the top of the valley. Any route avoiding the Takapu Valley will have less negative effects.

Filling of gullies would remove existing vegetation and watercourses, as well as recreational opportunities and open space linkages. Bridging of main gullies has been identified as positive contribution to mitigation of effects. Fill sites may lend themselves to alternative land use but restoration to existing use has been assumed. Two fill site options Lincolnshire Farm 1 (Version 2) and Lincolnshire Farm (Version 2) involve extensive depths of fill being spread over the current upland rolling country of the Lincolnshire Farms Structure Plan area. Either of these with fine tuning of intersection location and provision of bridges, as included as mitigation on route options, could complement the future landscape form of the structure plan.

10.13 Ecology

Of the route options east of the crest of the Wellington escarpment, namely Options 1 to 4 (P1-P4), the ecological values are highest around the Korokoro Stream where Option 2 (P2) and more so, Option 3 (P3), are likely to have the greatest adverse effects on ecological values which are difficult to mitigate within the catchment affected. Options 1 (P1) and 4 (P4) have the least potential adverse effects on ecology which are considered likely to mitigate within the catchment affected.

Options 5 to 8 (A-C) and Options 9 to 20 (variations of C) west of the crest of the Wellington escarpment have been divided into two areas for the purposes of this assessment, these being “greenfield” and adjacent to “SH1”. Options 4 and 21 to 23 (D and its variations) occur entirely within greenfield areas not adjacent to SH1 and therefore are not divided into two sections for the purposes of the ecological assessment of options. The ecological values within greenfield areas (including Belmont Stream and tributaries, seepages and wetlands within Lincolnshire Farms, and Car Haul Stream) are higher than those adjacent to SH1. Options 4 and 21 to 23 (D and its variations) pass across numerous tributaries of the Takapu Stream, in addition to effects on Belmont Stream, seepages and wetlands and Car Haul Stream tributaries. Options 5 to 8 (A, B and C) and Options 9a, 10a, 11a, 12a (C (V1) Variant 1 options) and Options 14 to 20, have the least potential adverse effects on ecological values (noting that bridging reduces ecological effects), all of which are considered able to be mitigated within the catchments affected. Options 9, 10, 11 and 12 (C (V1) variants) and Options 4 and 21 to 23 (D and its variations) are likely to have significant adverse effects on ecological values that are unlikely to be able to be mitigated within the catchments affected.

In summary, the preferred options from an ecological perspective are Options 1 and 4 (P1 and P4) for routes east of the crest of the Wellington escarpment, and Options 5 and 6 A and B with bridge, Option 7

(C with bridge), Options 9a, 10a, 11a and 12a (C (V1) Variant 1 options), any of the C V2 variants and any of the other option C variants (excluding C (V1)) for Section 2. It is noted that P1 generates significantly less fill than Option 4 (P4) and therefore would have the least overall effects when fill sites are taken into consideration.

Assessment of fill disposal site options identified Lincolnshire Farms 2 (Linc 2) to be the least preferred from an ecological perspective, followed by Lincolnshire Farms 1 (Linc 1). Options L, K and M are likely to have the least adverse ecological effects which can be sufficiently mitigated within the catchments affected.

10.14 Water Quality

The water quality and hydrology assessment indicates that none of the route options and fill sites would have acceptable adverse effects or meet the project objectives without mitigation. This is because it is unlikely that the project would gain consents for discharges, damming, diversions and works in the beds of streams without undertaking good practice mitigation.

With standard mitigation measures taken into account, Option 4 (P4) has lesser potential adverse water quality and hydrology effects compared with the other Options 1 to 3 (P1 to P3), because it has less impact on streams compared with Option 2 and Option 3, and while steep it has less erosion prone soils compared with Option 1.

Option 5 (A), Option 7 (C) and Options 9a, 10a, 11a and 12a (C (V1) Variant 1 options) have lesser potential adverse water quality and hydrology effects compared with Options 5 to 8 (A, B, C, D), with lesser impacts on streams, a lesser construction footprint, and the avoidance of the landfill. The disadvantage of all options which include upgrading SH1 compared with Options 8, 21, 22 and 23 (Option D and D variations), is the challenge in providing retrofit stormwater management on SH1.

Of the fill sites, L has lesser potential adverse water quality and hydrology effects, with lesser impacts on streams and gullies compared with the other options.

The construction stage mitigation includes good practice erosion and sediment control and controlling the active earthworks area. For the operational phase, it includes good practice stormwater management, including water quality and hydrological impact management.

The analysis indicates that there is very little to differentiate the route options once mitigation is applied. However, some of the options will require more complex mitigation than others. If the recommended mitigation is put in place, all options would have "minor negative" water quality and hydrology related effects (or in some cases would be neutral).

11 Assessment of Alternatives

11.1 Project Objectives and Multi Criteria Analysis

This assessment of alternative routes is based on two individual components, being:

- An assessment against Project Objectives; and
- A Multi-Criteria Analysis (MCA).

The findings of both assessments have been used in combination to understand the relative merits of the 29 proposed alternative route options, and to identify which route scores most highly, against the project objectives, using an MCA process, and overall.

The findings of these assessments follow in this Section, and are summarised in Section 12. Further information from the assessments can be found in the Appendices as referenced in the following section.

This section is structured so that the assessment against project objectives is presented first, followed by the results of the MCA assessment by the experts of the environmental effects. However, it is noted that the MCA process was carried out before the assessment against the project objectives. As discussed in sections 6 and 8 above, and below, the project team drew on the assessments carried out by the experts of the environmental effects of the various options in carrying out the assessment of the options against the project objectives.

11.2 Assessment Against Project Objectives

The six objectives for this project have previously been described in Section 2. For ease of reference they are identified again in the table below and in the assessment summary table.

An important part of determining the route to take forward is how well each route achieves the specific project objectives. Assessing performance against the objectives has been undertaken largely by the same project team that considered the previous wider range of options referred to in Section 3. A similar approach to scoring the options was also taken for consistency.

The project objectives contain primarily transport network related objectives, and the assessment of these objectives (1 – 5) draws on knowledge from the project team, and other data prepared by Opus transportation specialists. Objective 6 is an environmental objective and takes a different approach, being in relation to the management of environmental effects as far as is practicable.

Assessment of the options against the project objectives benefitted from the assessments completed by the MCA specialists.

The assessment of objective 5 ‘resilience’ was directly derived from the MCA resilience criteria scores (mitigated) given the direct relevance of these to both assessments. The assessment of the environmental Objective 6 did not include consideration of the transport assessments undertaken. Although it is recognised that the transportation network is part of the ‘environment’ as defined by the RMA, transportation was considered to be adequately addressed by the focus of all other objectives and there was a desire to avoid potential ‘double-counting’ of transportation effects or benefits.

The findings of this assessment have informed recommendations to the Transport Agency and, together with those recommendations, are presented in full to inform the Transport Agency's decision as to the preferred route

Table 11.1 Project Objectives

Project Objective (and reference to below table)	
1 - Economic Growth	To enhance local, regional and national economic growth and productivity for people and freight
2 - Connectivity	To improve connectivity between the lower Hutt Valley and Johnsonville and Porirua
3 - Journey Time	To reduce journey times and improve journey time reliability between the lower Hutt Valley, Ngauranga and Porirua, and on the Wellington State highway network
4 - Safety	To enhance safety of travel on the Wellington State highway network
5 - Resilience	To enhance resilience of the Wellington State highway network
6 - Environmental	To manage the immediate and long term social, cultural, land use and other environmental impacts of the Project on the Wellington region and its communities by so far as practicable avoiding, remedying or mitigating any such effects through route and alignment selection, expressway design and conditions
<i>Method Statement</i>	<i>By developing and constructing a cost efficient new road alignment to expressway standards between SH2 in the lower Hutt Valley and SH1 north of Ngauranga.</i>

11.2.1 Quantitative assessment against Project Objectives 1-5

The route options were assessed by the project team in a workshop format in late July 2015, generally consistent with the *Strategic Options Workshop* undertaken in April 2015 (refer Section 3). The project team were informed by knowledge of route options provided by Opus and which has been summarised in Sections 4 - 7 of this report, such as the economic benefits, journey time savings, resilience and BCRs. Further information was also available from several relevant assessments undertaken as part of the MCA process.

Overall the project team used the same scoring process as the earlier *Strategic Options Workshop* and considered the original routes and newer variant routes equally.

11.2.2 Assessment against Project Objective 6

As stated in Section 11.2, Objective 6 is an environmental objective and takes a different approach, being in relation to the management of environmental effects as far as is practicable. The approach the project team adopted was to develop a quantitative score for each option and use it to inform the scoring for each option based on a qualitative approach. The quantitative score was determined by summing the respective environmental scores attributed by each specialist area (taking into account the respective

importance of each specialism as determined by the ‘workshop weighting’ system) and applying a common divider to this score to fit within the -3 to +3 scoring range. This is illustrated in the formula below.

$$n = 3 - \frac{\text{total (specialist scores separately multiplied by specialist workshop weighting)}}{24}$$

In the formula above n equals the quantitative score and ‘24’ equals the common divider. This common divider is based on the 12 specialist areas included in the assessment against this objective multiplied by 2 to fit within the -3 to +3 scoring range. While there are 14 environmental specialist areas it is recognised that the transportation network is part of the ‘environment’ as defined by the RMA. Therefore transportation was considered to be adequately addressed by the focus of objectives 1 to 5 and to avoid potential ‘double counting’ of transportation effects or benefits the two transportation specialist areas were not included in the scoring. Consequently the number of specialist areas included in this assessment is 12 as identified above.

Results are a negative number, which doesn’t reflect the nature of the objective so were subtracted from a perfect score of 3 to derive a positive score that is replicable and bears relevance to the MCA scoring, i.e. a score of -1 resulted in a final score of 2, a score of -3 resulted in a score of 0.

The results of the quantitative approach for Objective 6 are summarised in Tables 11.2 and represent the level of potential environmental effects of each option.

The scores from the quantitative approach above only represent the level of potential environmental effects of each option (based on the with mitigation scenario). However, this objective focuses on the ability to manage those effects through avoiding, remedying or mitigating them early in the identification and development of route options. For this reason the project team also considered a qualitative approach which takes this into account. Both quantitative and qualitative assessments by the project team are summarised in Table 11.2 below.

In assigning the qualitative scores, the approach taken by the project team was to take the quantitative scores as a baseline, and then to:

- Consider the extent to which the option in question had been subject to amendments to minimise and manage environmental effects. The intention was to give credit to options where those options had been developed to mitigate environmental effects, thereby reflecting the management of environmental effects through the development of the project options. So, the "variant" options were given credit on this basis; and
- Consider the potential for further mitigation of the adverse environmental effects of the option (beyond the "with mitigation" scenario scores). So, on this basis P1 and P4 scored better than P2 and P3, including because it was felt the adverse ecological effects, for example, of P1 and P4 would be more amenable to mitigation than those of P2 and P3 given their incursion into Belmont Regional Park.

The individual qualitative scores were discussed and agreed between the project team.

However, it is recognised that Objective 6 is very broad and difficult to precisely define for the purposes of assessment. For that reason, the assessment of each option against the project objectives is presented below in two alternative forms:

- With the options assessed against Objectives 1 – 6 (with objective 6 assessed as set out above, i.e. both quantitative and qualitative); and
- With the options assessed only against Objectives 1 – 5. On this alternative formulation, no additional assessment against Objective 6 is considered, on the basis that the intention of Objective 6 is addressed by the overall scoring of the effects of each option by the experts (including under the various weighting systems developed and explained earlier). In this scenario, in considering objective 6, either a specific "proxy" set of scores from the individual experts' assessments can be substituted (see further discussion below); or the MCA results from the individual experts' assessments can be looked at in the round.

Table 11.2 Assessment of Options against Project Objectives (Quantitative assessment of Objective 6)

Project Objective	EAST OF THE CREST						WEST OF THE CREST																							
	1. P1	1a. P1 Variant 1	1b. P1 Variant 2	2. P2	3. P3	4. P4	5. A	6. B	7. C	8. D	9. C(V1)	9a. C(V1)-Variant 1	10. C(V1) MM1	10a. C(V1)-Variant 1 MM1	11. C(V1) MM2	11a. C(V1)-Variant 1 MM2	12. C(V1) No SH1 Upgrade	12a. C(V1)-Variant 1 No SH1 Upgrade	13. C(V2)	14. C(V2) MM1	15. C(V2) MM2	16. C(V2) No SH1 Upgrade	17. C Full Widening	18. C MM1	19. C MM2	20. C No SH1 Upgrade	21. D Update Tawa I/C	22. D(V1)	23. D(V2)	
	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score
Project Objective 1 To enhance local, regional and national economic growth and productivity for people and freight;	3	3	3	3	3	3	2	2	2	3	3	3	3	3	3	3	2	2	3	3	3	2	3	3	3	2	3	3	3	
Project Objective 2 To improve connectivity between the lower Hutt Valley and Johnsonville and Porirua;	3	3	3	3	3	3	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
Project Objective 3 To reduce journey times and improve journey time reliability between the lower Hutt Valley, Ngauranga and Porirua, and on the Wellington State Highway network;	3	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3	3	3	2	3	3	3	2	3	3	3	
Project Objective 4 To enhance safety of travel on the Wellington state highway network;	3	2	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
Project Objective 5 To enhance resilience of the Wellington State Highway network;	-3	F	-3	0	3	2	1	0	1	3	1	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	0	3	3	
Project Objective 6 To manage the immediate and long term social, cultural, land use and other environmental impacts of the Project on the Wellington region and its communities by so far as practicable avoiding, remedying or mitigating any such effects through route and alignment selection, expressway design and conditions;	0	F	0	-1	-1	0	1	F	2	0	2	3	2	3	2	3	2	3	2	2	2	2	2	2	2	2	3	0	1	
Overall Scoring	9	UNACCEPTABLE	9	11	14	14	12	UNACCEPTABLE	13	14	14	15	14	15	14	15	11	12	13	13	13	11	14	14	14	12	14	15	15	
Overall Ranking Against Project Objectives		UNACCEPTABLE			1=	1=		UNACCEPTABLE				1=		1=		1=												1=	1=	

The assessment of options against the project objectives using the quantitative scoring for Objective 6 identifies both Option 3(P3) and Option 4 (P4) east of the crest as preferred and three to the west Options 9a (C(v1) Variant 1), 10a (C(v1) Variant 1 MM1) and 11a (C(v1) Variant 1 MM2), as well as options 22 (D(V1)) and 23 (D(V2)). The west of the crest scores are generally scored fairly closely under this assessment.

Table 11.3 Assessment of Options against Project Objectives 1-6 (Qualitative Assessment of Objective 6)

Project Objective	EAST OF THE CREST							WEST OF THE CREST																							
	1. P1	1a. P1 Variant 1	1b. P1 Variant 2	2. P2	3. P3	4. P4	5. A	6. B	7. C	8. D	9. C(V1)	9a. C(V1)-Variant 1	10. C(V1) MM1	10a. C(V1)-Variant 1 MM1	11. C(V1) MM2	11a. C(V1)-Variant 1 MM2	12. C(V1) No SH1 Upgrade	12a. C(V1)-Variant 1 No SH1 Upgrade	13. C(V2)	14. C(V2) MM1	15. C(V2) MM2	16. C(V2) No SH1 Upgrade	17. C Full Widening	18. C MM1	19. C MM2	20. C No SH1 Upgrade	21. D Update Tawa I/C	22. D(V1)	23. D(V2)		
	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score
Project Objective 1 To enhance local, regional and national economic growth and productivity for people and freight;	3	3	3	3	3	3	2	2	2	3	3	3	3	3	3	3	2	2	3	3	3	2	3	3	3	2	3	3	3	3	
Project Objective 2 To improve connectivity between the lower Hutt Valley and Johnsonville and Porirua;	3	3	3	3	3	3	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
Project Objective 3 To reduce journey times and improve journey time reliability between the lower Hutt Valley, Ngauranga and Porirua, and on the Wellington State Highway network;	3	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3	3	3	2	3	3	3	2	3	3	3	3	
Project Objective 4 To enhance safety of travel on the Wellington state highway network;	3	2	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
Project Objective 5 To enhance resilience of the Wellington State Highway network;	-3	F	-3	0	3	2	1	0	1	3	1	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	0	3	3	3	
Project Objective 6 To manage the immediate and long term social, cultural, land use and other environmental impacts of the Project on the Wellington region and its communities by so far as practicable avoiding, remedying or mitigating any such effects through route and alignment selection, expressway design and conditions;	0	F	0	-2	-2	0	0	F	-1	-2	0	1	1	2	1	2	1	2	-1	0	0	0	-1	0	0	0	-2	-1	-1	-1	
Overall Scoring	9	COMPLETELY INCONSISTENT		9	10	13	14	11	COMPLETELY INCONSISTENT		10	12	12	13	13	14	13	14	10	11	10	11	11	9	11	12	12	9	12	13	13
Overall Ranking Against Project Objectives		COMPLETELY INCONSISTENT				1		COMPLETELY INCONSISTENT						1=		1=															

The assessment of options against the project objectives using a project team derived qualitative scoring for Objective 6 reduces the number of highest scoring alignments to just one east of the crest and two to the west. These routes, 4, 10a, and 11a also scored also scored highly in the quantitative assessment in table 11.3.

A scoring of just objectives 1 to 5, see table 11.4 below, gives a similar highest scoring option east of the crest in option 3, but west of the crest routes 21, 22 and 23 score most highly without negative environmental effects considered. These results in table 11.4 are however intended to be read with the outcomes of the MCA assess for environmental factors.

In Table 11.2, Objective 6 scores effectively replicated the unweighted scores from the MCA assessments. An alternative approach is to use one of the weighted sets of scores as a "proxy" for the Objective 6 scores. An appropriate proxy (specifically recognising the importance of Part 2 RMA considerations) would be to import the RMA Section 6 weighting scores (see the scores in Tables 11.16 (east of the crest) and 11.26 (west of the crest)). In either case, option 4 remains favoured east of the crest. West of the crest, it is noted that the "D" options perform poorly in the RMA Section 6 scenario (as well as in any of the environmental based MCA assessments). Taking the results of Tables 11.4, 11.16 and 11.26 together options 9a, 10a, 11a, 12a, 18 and 19 score highly.

Table 11.4 Assessment of Options against Project Objectives 1-5 only

Project Objective	EAST OF THE CREST						WEST OF THE CREST																																									
	1. P1	1a. P1 Variant 1	1b. P1 Variant 2	2. P2	3. P3	4. P4	5. A	6. B	7. C	8. D	9. C(V1)	9a. C(V1)-Variant 1	10. C(V1) MM1	10a. C(V1)-Variant 1 MM1	11. C(V1) MM2	11a. C(V1)-Variant 1 MM2	12. C(V1) No SH1 Upgrade	12a. C(V1)-Variant 1 No SH1 Upgrade	13. C(V2)	14. C(V2) MM1	15. C(V2) MM2	16. C(V2) No SH1 Upgrade	17. C Full Widening	18. C MM1	19. C MM2	20. C No SH1 Upgrade	21. D Update Tawa I/C	22. D(V1)	23. D(V2)																			
	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score																		
Project Objective 1 To enhance local, regional and national economic growth and productivity for people and freight;	3	3	3	3	3	3	2	2	2	3	3	3	3	3	3	3	2	2	3	3	3	2	3	3	3	2	3	3	3																			
Project Objective 2 To improve connectivity between the lower Hutt Valley and Johnsonville and Porirua;	3	3	3	3	3	3	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3																		
Project Objective 3 To reduce journey times and improve journey time reliability between the lower Hutt Valley, Ngauranga and Porirua, and on the Wellington State Highway network;	3	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3	3	3	2	3	3	3	2	3	3	3	3																		
Project Objective 4 To enhance safety of travel on the Wellington state highway network;	3	2	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2																		
Project Objective 5 To enhance resilience of the Wellington State Highway network;	-3	F	-3	0	3	2	1	0	1	3	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	0	3	3	3																			
Overall Scoring	9	COMPLETELY INCONSISTENT					9	12	15	14	11	COMPLETELY INCONSISTENT					11	14	12	12	12	12	12	12	9	9	11	11	11	9	12	12	12	9	14	14	14											
Overall Ranking Against Project Objectives		COMPLETELY INCONSISTENT						COMPLETELY INCONSISTENT						COMPLETELY INCONSISTENT						COMPLETELY INCONSISTENT						COMPLETELY INCONSISTENT						COMPLETELY INCONSISTENT						COMPLETELY INCONSISTENT						COMPLETELY INCONSISTENT				

Scoring only objectives 1- 5 identifies Option 3 (P3) as preferred east of the crest closely followed by Option 4 (P4). West of crest, Options 8(D), 21 (D updated Tawa I/C), 22 (D(V1)) and 23 (D(V2)). It also shows that 9 options are then 5th equal.

The summary table 11.5 below shows the final scoring of each route option against the respective project objectives (including Objective 6) on both a quantitative and qualitative basis. All Objectives are of equal importance in this table with no weighting applied. The respective assessed scores in table 11.2 and 11.3 are simply tallied and averaged to find the option most consistent with the project objectives.

Table 11.5 Overall Quantitative & Qualitative Scores against All Objectives

Options		Overall Quantitative Environmental Score	Qualitative Score
1	P1	0	0
1a	P1 - Variant 1	F	F
1b	P1 - Variant 2	0	0
2	P2	-1	-2
3	P3	-1	-2
4	P4	0	0
5	A	1	0
6	B	F	F
7	C	2	-1
8	D	0	-2
9	C (V1) Full SH1 Widening	2	0
9a	C(V1)-Variant 1 Full SH1 Widening	3	1
10	C (V1) Managed Motorway 1	2	1
10a	C(V1)-Variant 1 Managed Motorway 1	3	2
11	C (V1) Managed Motorway 2	-1	1
11a	C(V1)-Variant 1 Managed Motorway 2	2	2
12	C (V1) No SH1 Upgrade	2	1
12a	C(V1)-Variant 1 No SH1 Upgrade	3	2
13	C (V2) Full SH1 Widening	2	-1
14	C (V2) Managed Motorway 1	2	0
15	C (V2) Managed Motorway 2	2	0
16	C (V2) No SH1 Widening	2	0
17	C Full SH1 Widening	2	-1
18	C Managed Motorway 1	2	0
19	C Managed Motorway 2	2	0
20	C No SH1 Widening	3	0
21	D Update Tawa IC	0	-2

Options		Overall Quantitative Environmental Score	Qualitative Score
22	D (V1)	1	-1
23	D (V2)	1	-1

11.2.3 Weighted assessment of Options against Project Objectives

In the comparative scoring of options in the above tables no particular importance (or weighting) has been assigned to any particular objective. All objectives were scored equally as no specific primacy was attached to any particular objective. For the purposes of further analysis however the following table 11.6 shows highest scoring option/s if a weighting was applied to each objective, based on the quantitative scores discussed above. The weighting used in this table is a 50% weighting (the value of the weighted objective equals that of all other objectives combined, consistent with the scenario weighting system used in the MCA assessment).

Table 11.6 Weighted assessment of Options against Project Objectives (Quantitative Assessment)

Weighted Objective	Most Consistent East of the Crest	Most Consistent West of the Crest
Project Objective 1	Options 3 and 4	Options 9a, 10a, 11a, 22 and 23
Project Objective 2	Options 3 and 4	Options 9a, 10a, 11a, 22 and 23
Project Objective 3	Options 3 and 4	Options 9a, 10a, 11a, 22 and 23
Project Objective 4	Options 3 and 4	Options 5
Project Objective 5	Option 3	Options 22 and 23
Project Objective 6	Option 4	Options 9a, 10a and 11a

Even with weightings in place this assessment still shows Options 3 and 4 scoring consistently most highly east of the crest, and similarly options 9a, 10a and 11a scoring more highly west of the crest.

Table 11.7 Routes Most Consistent with Project Objectives (Quantitative Assessment)

Project Objectives Best Scoring Connected	East	West					
Route 3 or 4-9a or 10a or 11a, 22 & 23							
Overall Ranking of Alternatives by Quantitative Weighting	3. P3	4. P4	10a. C (v1) Variant 1 MM2	9a C(v1) Variant 1	11a C(v1) Variant 1 MM2	22 D(V1)	23 D(V2)
Project Objectives							
1 – Economic Growth	1=	1=	1=	1=	1=	1=	1=
2 - Connectivity	1=	1=	1=	1=	1=	1=	1=
3 – Journey Time	1=	1=	1=	1=	1=	1=	1=
4 - Safety	1=	1=	2=	2=	2=	2=	2=

5 - Resilience	1	2	5=	5=	5=	1=	1=
6 - Environmental	2	1	1=	1=	1=	16=	16=
Overall Ranking	1st=	1st=	1st=	1st=	1st=	2 nd =	2 nd =

The above table 11.7 shows the respective ranking of most consistent routes by objectives based on the quantitative assessment in Table 11.3.

11.3 Summary

The following summarises the respective performance of the route options against project objectives 1 to 6. It addresses overall consistency taking into account the three approaches to assessing consistency with Objective 6 and the weighting scenarios identified in Table 11.6.

11.3.1 East of the crest

The routes east of the crest of the Wellington escarpment, namely Options 1 to 4 (P1 – P4) scored fairly similarly against most of the project objectives irrespective of the approach used to measure objective 6. Principal differences between the routes were that Option 1a (Option 1 – Variant 1) was considered completely inconsistent with resilience objective 5 and environmental objective 6. Option 1a had been identified in an attempt to mitigate some environmental effects (landscape and visual) but ultimately was unacceptable for resilience and environmental reasons. Options 3 (P3) and 4 (P4) which were two of the original Scoping Stage options scored significantly higher than other options, most notably for resilience. Option 3 (P3) scored slightly higher for resilience than Option 4 (P4) but management of environmental effects was more difficult leaving both scoring equal highest in the quantitative assessment but option 4 scoring higher in the two other scenarios - Qualitative and Objectives 1-5 plus MCA Environmental Scores. Overall that leave route Option 4 more consistently high scoring.

Overall none of these options scored particularly highly against Objective 6 whichever assessment approach was used. This was expected given the extensive earthworks required, sensitive nature of parts of the receiving environment and high visibility of the site.

11.3.2 West of the crest

The routes west of the crest of the Wellington escarpment scored more closely. Five route options scored equally in the quantitative assessment in Table 11.3, namely Option 9a C (V1) Variant 1 which is an option developed to avoid environmental impacts on Car Haul Stream, Options 10a C (V1) Variant 1 MM2, and Option 11a C (V1) Variant 1 MM2 which are very similar but feature managed motorway improvements to SH1 and Options 22 D (V1) and 23 D (V2) which are both variations of Option 21 to minimise residential property impacts in Grenada and impacts on the North Grenada Sports Fields. A selection of other routes west of the crest of the Wellington escarpment scored almost as highly. The most common differentiator between these options was Objective 6 in respect of environmental impacts. The qualitative assessment in Table 11.4 reduced the number of highest scoring western route options to two – 10a and 11a.

This most likely reflects that Options 9a, and particularly 10a, and 11a were specifically identified through the MCA process to reduce environmental impacts and thus the greater consistency of these options with that Objective 6.

These findings were tested against scenarios where individual project objectives scored more highly than others. This highlighted some variation in highest scoring alignment, most notably if the objective to ‘enhance resilience of the Wellington state highway network’ is considered most important – in such a scenario the route comprising option 3 – 22 or 23 scores most highly. However when considered overall the findings of the weighted assessment are generally consistent with Tables 11.3 and 11.4.

The highest scoring connected route (east and west of the crest of the Wellington escarpment) as a whole – taking into account scores against all project objectives assessments- can be interpreted as route 4 together with either 10a or 11a (and 9a also scoring well).

Table 11.8: Project Objectives Best Scoring Connected Route

Overall Ranking of Alternatives by Assessment	Quantitative Objective 6	Qualitative Objective 6	Objectives 1-5 only	MCA RMA Section 6 *	Overall				
Eastern	3, 4	4	3	4	4				
Western	9a, 10, 11a, 22, 23	10a, 11a	21, 22, 23	18, 19	10a				
					11a				
					22				
					23				
					3-9a	4-10a	3-21	4-18	4-10a
					3-10	4-11a	3-22	4-19	4-11a
					3-11a		3-23		4-22
					3-22				4-23
					3-23				
					4-9a				
4-10									
4-11a									
4-22									
4-23									
Highest scoring Routes									

* For details of the this approach refer to the following section

11.4 Multi-Criteria Analysis

11.4.1 MCA Workshop 1: Specialists Briefing

All fourteen discipline specialists required to assess the alternative routes were provided with a common set of background documents, and attended a briefing workshop on 19 May 2015. The MCA assessment criteria and scoring definitions were included in the briefing material and further discussed at the workshop amongst the specialists at the workshop. The respective alternative routes were also described at the workshop, and preliminary thoughts of each of the specialists based on the earlier briefing documents identified to the wider group, enabling comment. This also enabled some early understanding of likely issues and opportunities across the wider group, and early awareness of potential overlap between specialist assessments.

The intent and content of the second workshop was briefly outlined.

11.4.2 MCA Workshop 2: Alternatives Assessment

A second two-day workshop was held on 16-17 June 2015, with its purpose being to enable the respective findings of each of the specialists to be presented, for opportunities for mitigation to be discussed, and to enable the specialists to provide their own common view on the respective priority (weighting) that in their view should be applied to the criteria.

This weighting for criteria identified by this workshop is included in the weightings section.

11.4.3 MCA Workshop 3: Alternative Fill Sites

As a result of the large amount of excess material that be generated by some of the alternatives, attention and assessment was also given to the potential suitability for 7 fill sites to respectively accommodate some of the material. Combined the capacity of the fill sites as initially identified was sufficient to accommodate all fill material from any of the routes.

Workshop 3 (specifically looking at fill sites) was held on 24 June 2015 and was effectively an extension of Workshop 2. Workshop 3 was attended by those specialists who had specifically identified potential significant positive or negative effects associated with those fill sites and identified value in further understanding and assessment of the placement and extent of the fill. At Workshop 3 the specialists considered and discussed each of the fill sites with the project team, including collectively identifying potential changes to the fill sites that would reduce the adverse effects / increase the beneficial effects that the use of the fill sites would generate.

The extent of fill and proximity of fill sites to some routes also meant an assessment taking into account how and to what extent each fill site might accommodate fill material was undertaken. Most significant were the Lincolnshire Farms structure plan area fill sites. These were the largest considered and straddled some of the new routes. This meant that if these fill sites were used, there was an opportunity to construct the route and place the fill in a manner enabling possible mutual benefit to both the new road and the eventual development of Lincolnshire Farms.

Following the 3rd Workshop, work was undertaken to refine the fill sites that the experts were being asked to assess. Amended fill site details were then shared with all experts, and all experts were asked to base their MCA assessments of the fill sites on the amended fill sites identified following the 3rd Workshop. The total number of fill sites to be assessed was reduced to five.

Once mitigation is in place, and adding together all scores on an unweighted basis, the identified fill sites score a total of -1 or better. This indicates that the effects of the fill sites can be effectively limited and mitigated. It is not considered that the amount of fill generated by each option should influence the scoring of alternative routes in the MCA process.

Experts were directed not to take into account the amount of fill generated by a route option when assessing and scoring route options.

11.4.4 Consideration of Unmitigated and Mitigated Scenarios

Specialists have been asked to consider the impacts of the routes both with and without mitigation (see more detailed discussion in section 8 above). This reflects that mitigation could result in a significant change to the scoring attributed to an option, and this could be sufficient to alter the overall ranking of the alternatives.

All the scores presented in this section 11 are based on the 'with mitigation' scores assigned by the experts in their assessments. This is because it is considered that the 'reasonable mitigation' identified in the 26 June memo and the mitigation proposed by the specialists in their assessments represents a more realistic picture of the likely effects of a fully developed version of each option. In addition, all options were given an 'F' in the unmitigated scores, largely because of water quality issues.

Full detail of the scores assigned by the experts in their assessments – including both the 'without mitigation' and 'with mitigation' scores – can be found in Appendix F.

11.4.5 Unweighted and Weighted Sensitivity Testing Scenarios

Fourteen criteria to test the route options were identified in section 8.2. These aligned to and were grouped by six RMA Part 2 related environmental considerations as shown in Table 8.1. These criteria and environmental considerations have been used throughout the Unweighted and Weighted sensitivity testing scenarios. However for each scenario equal or varying weightings (using multipliers) have been applied to the criteria and/or environmental considerations. These scenarios are explained in the following sections.

11.4.5.1 Unweighted Testing Scenarios

Two 'unweighted' scenarios have been tested for both the east and west route options respectively. These are:

- a) A criteria based assessment where all fourteen criteria are scored as equal
- b) An environmental consideration based assessment where all six environmental considerations are scored as equal (but the individual criteria associated with each environmental consideration share its total value equally)

These scenarios represent unweighted 'raw' scores as attributed by the specialists. The criteria based assessment (a) has scored all criteria equally meaning that the highest scoring route is purely as scored by all specialists when scores are combined.

Recognising that some environmental considerations (such as the built environment) were represented by more than one criteria, and therefore arguably overrepresented relative to other environmental considerations such as culture and heritage a second unweighted test (b) was applied where all

environmental considerations were treated equally. Achieving the latter meant attributing a lesser score (a percentage) to criteria that collectively represented a single environmental consideration enabling an equal scoring of the latter.

No Weighting Applied (all individual criteria score equally at 10)		Criteria	All Weighting Scenarios Equal (all Environmental Considerations score combined total of 10)		Score
Individual MCA Criteria	Individual MCA Criteria		Individual MCA Criteria	Individual MCA Criteria	
Business	Business	1.00	Business (10 total)	Business	10.00
Transport	Natural Hazards and Network Resilience	1.00	Transport (10 total)	Natural Hazards and Network Resilience	5.00
	Transport	1.00		Transport	5.00
Built and Human Environment	Noise	1.00	Built and Human Environment (10 total)	Noise	3.33
	Urban Design	1.00		Urban Design	3.33
	Recreation	1.00		Recreation	3.33
Social	Social	1.00	Social (10 total)	Social	10.00
Heritage and Culture	Archaeology	1.00	Heritage and Culture (10 total)	Archaeology	3.33
	Built Heritage	1.00		Built Heritage	3.33
	Cultural	1.00		Cultural	3.33
Natural Environment	Land Contamination (potential for)	1.00	Natural Environment (10 total)	Land Contamination (potential for)	2.50
	Landscape/Visual	1.00		Landscape/Visual	2.50
	Ecology	1.00		Ecology	2.50
	Water Quality	1.00		Water Quality	2.50

Fig. 11.1: Unweighted Scenarios by Criteria and Environmental Considerations showing allocation of scoring

11.4.5.2 Weighted Sensitivity Testing Scenarios

A series of weighted scenarios have been applied to the MCA scoring to assist in analysing the respective merits of the alternatives. This enabled the influence of giving increased weight to various factors on the overall scores assigned for each option to be tested.

One such scenario was devised at workshop 2 when the specialists collectively discussed and agreed weightings for each criterion, referred to in this report as the 'workshop weighting'. This is described in more detail in the following section.

In addition to the workshop weighting, 6 category based sensitivity weightings have been applied. Under each of these 6 weightings, a specific category was given increased weight in arriving at overall scores for each option. The 6 categories are associated with a particular criterion or like-cluster of criteria that bear a relationship to the type of assessments undertaken, and to RMA matters such as amenity, natural environment, culture and heritage.

The importance of appropriately addressing matters emphasised in Part 2 of the RMA has been reflected in the MCA assessment. The "raw" assessments of themselves address Part 2 - individual assessment

topics were developed with the matters emphasised in Part 2 (including the matters listed in sections 6 and 7 of the RMA) in mind; and experts were directed to consider relevant Part 2 matters in carrying out their assessments.

Part 2 of the RMA has been further considered and reflected in the development of the weighted scenarios summarised above. In particular:

- workshop participants were specifically directed to consider Part 2 in determining the workshop weighting; and
- the 6 further sensitivity weightings give additional weight to a specific criterion or clusters of criteria in order to test scores if those issues are prioritised. This provides additional information for the NZTA in considering the extent to which each route option meets the overall sustainable management purpose of the RMA.

Finally, a "Section 6 RMA" weighting scenario has been developed to test the overall scores where the matters emphasised in section 6 of the RMA (and of particular relevance in the context of the project) are given additional weight. This weighting is intended to account for the direction in section 6 that the listed matters be "recognise[d] and provide[d] for" as "matters of national importance". In the section 6 RMA weighting scenario, the following assessments were given additional weight:

- Landscape and visual (to reflect section 6(a) noting that the landscape assessment does not identify any outstanding natural features or landscapes for the purpose of section 6(b) is not relevant in the context of this project);
- Ecology (to reflect section 6(c));
- Cultural (to reflect section 6(e));
- Built heritage and archaeology (to reflect section 6(f)).

The various "P" options will have some effect on public access to and along the coastal marine area (the Petone foreshore) in terms of section 6(d) of the RMA, and as such is addressed in the social and recreation assessments. However, the section 6 RMA weighting scenario does not give additional weighting to those assessments because each of those options includes a mitigation scenario that will maintain or enhance access to and along the foreshore.

There were therefore a total of eight weightings applied, in addition to the two unweighted scenarios described above, as follows:

- Workshop weighting;
- Business (giving increased weight to the business impact assessment);
- Transport (giving increased weight to a combination of the resilience and transport assessments);
- Built-human environment (giving increased weight to a combination of the noise, urban design and recreation assessments);
- Social (giving increased weight to the social assessment);
- Culture and heritage (giving increased weight to a combination of the archaeology, built heritage and cultural assessments);

- Natural environment and contamination (giving increased weight to a combination of the land contamination, landscape and visual, ecology and water quality assessments); and
- Section 6 RMA weighting.

Assessing the route options under these weightings provides a broad range of additional information for the NZTA to consider in its decision as to route. The weighted scores have also influenced the recommendations included in this report.

11.4.5.3 Workshop Weighting

One weighting scenario was to test the weightings that the technical specialists collectively agreed based on the respective importance of each of the individual assessment criteria. In arriving at the workshop weighting, the specialists were asked to agree on an appropriate system of relative weightings to apply to their 'raw' scores to inform an overall assessment of the alternative routes, taking into account the relevant statutory context (including Part 2 and other relevant provisions of the RMA) and the context of the project (ie a link road between Petone and Grenada/Tawa/Transmission Gully).

The workshop weighting reflects the collective view of the experts as to the relative importance of each criterion in the overall assessment. It was agreed at the end of Workshop Two, at which point the experts had a good understanding of what they considered to be the effects of the various options and the project as a whole.

This is a very valuable weighting scenario as it applies a weighting collectively agreed by the specialists against these scores. It shows a collectively agreed ranking scenario of priority between the respective criteria and thus the respective environmental defects. This is important information for the Transport Agency decision-makers in understanding how to consider the weighting scenarios that follow.

The weightings attributed by the specialists are as shown in Fig.11.2 and have been applied to both the east and west routes (see further explanation in section 8.3 and assessments in following Sections 11.9 and 11.10).

Workshop Weighting Scores as identified (up to maximum of 10)	Individual MCA Criteria	W e i g h t i n g
Business	Business	4
Transport	Natural Hazards and Network Resilience	9
	Transport	9
Built and Human Environment	Noise	6
	Urban Design	7
	Recreation	6
	Social	7
Heritage and Culture	Archaeology	4
	Built Heritage	6
	Cultural	7
Natural Environment	Land Contamination (potential for)	4
	Landscape/Visual	9
	Ecology	8
	Water Quality	6

Fig. 11.2 Workshop Weightings (1 – 10 weighting scale)

11.4.5.4 Sensitivity Weightings

This sensitivity testing used a simple numeric weighting applied to the particular criteria. Essentially this attributed a total of 100 (or 100%) across all weighting scenarios, with the weighted scenario receiving 50% and the other scenarios 10% each. For example the sensitivity weighting for Culture and Heritage applied a total multiplier of 50 distributed across all Culture and Heritage criteria and 10 respectively across all other scenario criteria to better understand how the route would score if these criteria were considered to be most critical. This process was repeated for all sensitivity testing scenarios.

Note that if a % were used (50% rather than a weighting of 50) the outcome would be identical.

Weighting Scenarios (50% to weighted scenario, 10% to unweighted criteria)	Individual MCA Criteria	Weighting	
Business	Business	10.00	Total of 10
Transport	Natural Hazards and Network Resilience	5.00	Total of 10
	Transport (TIA)	5.00	
Built and Human Environment	Noise	3.33	Total of 10
	Urban Design	3.33	
	Recreation	3.33	
Social	Social and Community	10.00	Total of 10
Heritage and Culture	Archaeology	16.67	Total of 50
	Built Heritage	16.67	
	Cultural	16.67	
Natural Environment	Land Contamination (potential for)	2.50	Total of 10
	Landscape/Visual	2.50	
	Ecology	2.50	
	Water Quality	2.50	

Fig. 11.3: Environmental Weighting Scenarios example - Heritage and Culture

11.5 East of the Crest of the Wellington Escarpment - Unweighted

11.5.1 Unweighted

Using no sensitivity weightings with all criteria raw mitigated scores multiplied by 1, Option 4 (P4) is clearly the preferred route, scoring significantly better against all other options. This is the *Criteria Equal* score.

To further test the options on an unweighted basis all environmental considerations (scenarios) were attributed an equal weighting score of 10, divided amongst their respective criteria. Option 3 (P3) score more highly, but Option 4 (P4) was still the highest scoring route. This is the *Scenarios Equal* score.

The respective criteria score show a number of differences with option 4 scoring more highly on built environment and natural environment, but less well on transport (resilience) and culture and heritage.

Table 11.9: East of the crest of the Wellington escarpment Unweighted Individual Criteria

No Weighting Applied (all individual criteria score equally at 10)	Individual MCA Criteria	C r i t e r i a	1. P1	1a. P1-Variant 1	1b. P1-Variant 2	2. P2	3. P3	4. P4	Individual MCA Criteria
			Score	Score	Score	Score	Score	Score	
			Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	
			We	We	We	We	We	We	
Business	Business	1.00	-1	-1	-1	-1	-1	-1	Business
Transport	Resilience	1.00	-3	F	-3	0	3	2	Natural Hazards and Network Resilience
	Transport	1.00	2	-1	0	2	2	2	Transport
Built-Human Environment	Noise	1.00	-1	-1	-1	-1	-1	-1	Noise
	Urban Design	1.00	2	-2	2	0	0	1	Urban Design
	Recreation	1.00	-1	-2	-3	-1	-2	0	Recreation
Social	Social	1.00	-2	-2	-2	-2	-2	-2	Social
Culture and Heritage	Archaeology	1.00	-2	-2	-2	-2	-2	-2	Archaeology
	Built Heritage	1.00	0	0	0	0	0	0	Built Heritage
	Cultural	1.00	-1	-3	-3	-1	-1	-1	Cultural
Natural Environment and Contamination	Land Contamination	1.00	0	0	0	0	0	0	Land Contamination (potential)
	Landscape and Visual	1.00	-3	-2	-2	-3	-3	-3	Landscape/Visual
	Ecology	1.00	0	0	0	-1	-2	0	Ecology
	Water Quality	1.00	-1	-1	-1	-1	-1	-1	Water Quality
	Overall scores		-11	F	-16	-11	-10	-6	Overall scores
	Notes: All Criteria Score 1	Ranking	3=			3=	2	1	Ranking

Table 11.10: East of the crest of the Wellington escarpment - Unweighted Scenarios

All Scenarios Equal	Individual MCA Criteria	S c e n a r i o s	1. P1	1a. P1-Variant 1	1b. P1-Variant 2	2. P2	3. P3	P4	Individual MCA Criteria
			Score	Score	Score	Score	Score	Score	
			We	We	We	We	We	We	
			We	We	We	We	We	We	
Business	Business	10.00	-10	-10	-10	-10	-10	-10	Business
Transport	Resilience	5.00	-15	F	-15	0	15	10	Natural Hazards and Network Resilience
	Transport	5.00	10	-5	0	10	10	10	Transport
Built-Human Environment	Noise	3.33	-3	-3	-3	-3	-3	-3	Noise
	Urban Design	3.33	7	-7	7	0	0	3	Urban Design
	Recreation	3.33	-3	-7	-10	-3	-7	0	Recreation
Social	Social	10.00	-20	-20	-20	-20	-20	-20	Social
Culture and Heritage	Archaeology	3.33	-7	-7	-7	-7	-7	-7	Archaeology
	Built Heritage	3.33	0	0	0	0	0	0	Built Heritage
	Cultural	3.33	-3	-10	-10	-3	-3	-3	Cultural
Natural Environment and Contamination	Land Contamination	2.50	0	0	0	0	0	0	Land Contamination (potential)
	Landscape and Visual	2.50	-8	-5	-5	-8	-8	-8	Landscape/Visual
	Ecology	2.50	0	0	0	-3	-5	0	Ecology
	Water Quality	2.50	-3	-1	-3	-3	-3	-3	Water Quality
	Overall scores		-55	F	-76	-49	-40	-30	Overall scores
	Notes: All Environmental Factors Equal	Ranking				3	2	1	Ranking

11.6 East of the Crest of the Wellington Escarpment - Weighted Scenario Testing

11.6.1 Technical Specialist - Workshop Weighted

Table 11.11 shows that when the specialists Workshop Weighting is applied the highest scoring option is Option 4 (P4), followed by Option 3 (P3). The heavier weightings applied to Transport and Resilience are influential in the scoring in this scenario.

Table 11.11: East of the crest of the Wellington escarpment Specialists Workshop Weighted

Workshop Weighting Scores as identified (up to maximum to 10)	Individual MCA Criteria	W e i g h t i n g	1. P1	1a. P1-Variant 1	1b. P1-Variant 2	2. P2	3. P3	4. P4	Individual MCA Criteria
			Score	Score	Score	Score	Score	Score	
			Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	
			We	We	We	We	We	We	
Business	Business	4	-4	-4	-4	-4	-4	-4	Business
Transport	Resilience	9	-27	F	-27	0	27	18	Natural Hazards and Network Resilience
	Transport	9	18	9	0	18	18	18	Transport
Built and Human Environment	Noise	6	-6	-6	-6	-6	-6	-6	Noise
	Urban Design	7	14	-14	14	0	0	7	Urban Design
	Recreation	6	-6	-12	-18	-6	-12	0	Recreation
Social	Social	7	-14	-14	-14	-14	-14	-14	Social
Culture and Heritage	Archaeology	4	-8	-8	-8	-8	-8	-8	Archaeology
	Built Heritage	6	0	0	0	0	0	0	Built Heritage
	Cultural	7	-7	-21	-21	-7	-7	-7	Cultural
Natural Environment and Contamination	Land Contamination	4	0	-4	0	0	0	0	for)
	Landscape and Visual	9	-27	-18	-18	-27	-27	-27	Landscape/Visual
	Ecology	8	0	0	0	-8	-16	0	Ecology
	Water Quality	6	-6	-1	-6	-6	-6	-6	Water Quality
	Overall scores		-73	F	-108	-68	-55	-29	Overall scores
	Ranking				3	2	1		Ranking
	Notes: Specialists Weighting								

Option 4 has significantly outsourced other options for cultural and economic criteria and outscores options 2 and 3 for ecology. Option 4 scores poorly on landscape and visual impact, but other options also score poorly against this criterion which reflect the significant cut and earthworks required for this section of the new route irrespective which option is chosen. Option 3 outscores Option 4 for resilience.

Once again Option 3 is the second highest scoring option.

11.6.2 Business Impacts Weighted

With a Business Impact weighted sensitivity scenario Option 4 (P4) is once more preferred, scoring higher than all other options. The Business Impacts assessment weighting itself is of limited usefulness for the eastern routes as all options scored equally - the disruption to business from all the eastern options is very similar. This ranking is determined by other non-economic criteria.

Note that this criterion principally relates to direct impacts on individual businesses, rather than assessing the wider economic effects of the options

Table 11.12: East of the crest of the Wellington escarpment Business Impacts Weighted

Weighting Scenarios Weighting Scenarios (50% to weighted scenario, 10% to unweighted criteria)	Individual MCA Criteria	W e i g h t i n g	P1	P1-Variant 1	P1-Variant 2	P2	P3	P4	Individual MCA Criteria
			Score	Score	Score	Score	Score	Score	
			Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	
			We	We	We	We	We	We	
Business	Business	50	-50	-50	-50	-50	-50	-50	Business
Transport	Resilience	5	-15	F	-15	0	15	10	Natural Hazards and Network Resilience
	Transport	5	10	5	0	10	10	10	Transport
Built-Human Environment	Noise	3.333	-3	-3	-3	-3	-3	-3	Noise
	Urban Design	3.333	7	-7	7	0	0	3	Urban Design
	Recreation	3.333	-3	-7	-10	-3	-7	0	Recreation
Social	Social	10	-20	-20	-20	-20	-20	-20	Social
Culture and Heritage	Archaeology	3.333	-7	-7	-7	-7	-7	-7	Archaeology
	Built Heritage	3.333	0	0	0	0	0	0	Built Heritage
	Cultural	3.333	-3	-10	-10	-3	-3	-3	Cultural
Natural Environment	Land Contamination	2.5	0	-3	0	0	0	0	Land Contamination (potential for)
	Landscape and Visual	2.5	-8	-5	-5	-8	-8	-8	Landscape/Visual
	Ecology	2.5	0	0	0	-3	-5	0	Ecology
	Water Quality	2.5	-3	-1	-3	-3	-3	-3	Water Quality
	Overall scores		-95	F	-116	-89	-80	-70	Overall scores
	Ranking					3=	2	1	Ranking
	Notes: Weighted = 50%, Unweighted = 10%								

11.6.3 Transport Weighted

Five of the six project objectives relate specifically to transport and resilience, highlighting the importance of these assessments. In respect of the resilience MCA assessment specifically, option 3 (P3) scored best followed by option 4 (P4). Options 1a (P1(v1) and 1b (P1(v2)) score relatively poorly because of increased risk of failure of the new route onto SH2 in a seismic event, potentially closing both routes. P1 Variant 1 scored a ‘Fatal’ for this reason and was removed from further consideration.

Table 11.13: East of the crest of the Wellington escarpment Transport Weighted

Weighting Scenarios Weighting Scenarios (50% to weighted scenario, 10% to unweighted criteria)	Individual MCA Criteria	W e i g h t i n g	1. P1	1a. P1-Variant 1	1b. P1-Variant 2	2. P2	3. P3	4. P4	Individual MCA Criteria
			Score	Score	Score	Score	Score	Score	
			We	We	We	We	We	We	
Business	Economic/ Business	10.00	-10	-10	-10	-10	-10	-10	Business
Transport	Resilience	25.00	-75	F	-75	0	75	50	Natural Hazards and Network Resilience
	Transport	25.00	50	25	0	50	50	50	Transport
Built-Human Environment	Noise	3.33	-3	-3	-3	-3	-3	-3	Noise
	Urban Design	3.33	7	-7	7	0	0	3	Urban Design
	Recreation	3.33	-3	-7	-10	-3	-7	0	Recreation
Social	Social	10.00	-20	-20	-20	-20	-20	-20	Social
Culture and Heritage	Archaeology	3.33	-7	-7	-7	-7	-7	-7	Archaeology
	Built Heritage	3.33	0	0	0	0	0	0	Built Heritage
	Cultural	3.33	-3	-10	-10	-3	-3	-3	Cultural
Natural Environment and Contamination	Land Contamination	2.50	0	-3	0	0	0	0	Land Contamination (potential for)
	Landscape and Visual	2.50	-8	-5	-5	-8	-8	-8	Landscape/Visual
	Ecology	2.50	0	0	0	-3	-5	0	Ecology
	Water Quality	2.50	-3	-1	-3	-3	-3	-3	Water Quality
	Overall scores		-75	F	-136	-9	60	50	Overall scores
	Ranking					3	1	2	Ranking
	Notes: Weighted = 50%, Unweighted = 10%								

In respect of the transport MCA assessment, Options 1, 2, 3, and 4 score equal best.

Under the transport and resilience weighting (which of course also takes into account the other assessments), P3 scores best followed closely by P4. All other options returned negative scores (with Option 1a (P1(v1)) being fatally flawed on resilience grounds).

11.6.4 Built-Human Environment Weighted

Under this environmental sensitivity weighting scenario Option 4 (P4) is once more the highest ranked route option when assessed against other options, scoring significantly ahead of the other options. This is in large part because Option 4 scores relatively strongly across the three built-human environment criteria that are emphasised in this weighting scenario.

Table 11.14: East of the crest of the Wellington escarpment Built Human Environment Weighted

Weighting Scenarios Weighting Scenarios (50% to weighted scenario, 10% to unweighted criteria)	Individual MCA Criteria	W e i g h t i n g	1. P1	1a. P1-Variant 1	1b. P1-Variant 2	2. P2	3. P3	4. P4	Individual MCA Criteria
			Score	Score	Score	Score	Score	Score	
			We	We	We	We	We	We	
Business	Business	10.00	-10	-10	-10	-10	-10	-10	Business
Transport	Resilience	5.00	-15	F	-15	0	15	10	Natural Hazards and Network Resilience
	Transport	5.00	10	5	0	10	10	10	Transport
Built-Human Environment	Noise	16.67	-17	-17	-17	-17	-17	-17	Noise
	Urban Design	16.67	33	-33	33	0	0	17	Urban Design
	Recreation	16.67	-17	-33	-50	-17	-33	0	Recreation
Social	Social	10.00	-20	-20	-20	-20	-20	-20	Social
Culture and Heritage	Archaeology	3.33	-7	-7	-7	-7	-7	-7	Archaeology
	Built Heritage	3.33	0	0	0	0	0	0	Built Heritage
	Cultural	3.33	-3	-10	-10	-3	-3	-3	Cultural
Natural Environment and Contamination	Land Contamination	2.50	0	-3	0	0	0	0	Land Contamination (potential for)
	Landscape and Visual	2.50	-8	-5	-5	-8	-8	-8	Landscape/Visual
	Ecology	2.50	0	0	0	-3	-5	0	Ecology
	Water Quality	2.50	-3	-1	-3	-3	-3	-3	Water Quality
Overall scores	Overall scores		-55	F	-103	-76	-80	-30	Overall scores
	Ranking		2			3	4	1	Ranking
Notes: Weighted = 50%, Unweighted = 10%									

11.6.5 Social Impact Weighted

If a social impact sensitivity weighting is applied route Option 4 (P4) is the highest scoring, with little difference relative to Option 3 (P3). However all route options east of the crest of the Wellington escarpment score equally with respect to social impact sensitivity meaning route selection is not particularly sensitive to this criteria. The difference in scoring between Option 3 and Option 4 is related to the greater impact from Option 3 (P3) on recreation and ecology associated with its proximity to Belmont Regional Park.

Table 11.15: East of the crest of the Wellington escarpment Social Impact Weighted

Weighting Scenarios Weighting Scenarios (50% to weighted scenario, 10% to unweighted criteria)	Individual MCA Criteria	W e i g h t i n g	1. P1	1a. P1-Variant 1	1b. P1-Variant 2	2. P2	3. P3	4. P4	Individual MCA Criteria
			Score	Score	Score	Score	Score	Score	
			Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	
			We	We	We	We	We	We	
Business	Business	10.00	-10	-10	-10	-10	-10	-10	Business
Transport	Resilience	5.00	-15	F	-15	0	15	10	Natural Hazards and Network Resilience
	Transport	5.00	10	5	0	10	10	10	Transport
Built and Human Environment	Noise	3.33	-3	-3	-3	-3	-3	-3	Noise
	Urban Design	3.33	7	-7	7	0	0	3	Urban Design
	Recreation	3.33	-3	-7	-10	-3	-7	0	Recreation
Social	Social	50.00	-100	-100	-100	-100	-100	-100	Social
Culture and Heritage	Archaeology	3.33	-7	-7	-7	-7	-7	-7	Archaeology
	Built Heritage	3.33	0	0	0	0	0	0	Built Heritage
	Cultural	3.33	-3	-10	-10	-3	-3	-3	Cultural
Natural Environment and Contamination	Land Contamination	2.50	0	-3	0	0	0	0	Land Contamination (potential for)
	Landscape and Visual	2.50	-8	-5	-5	-8	-8	-8	Landscape/Visual
	Ecology	2.50	0	0	0	-3	-5	0	Ecology
	Water Quality	2.50	-3	-1	-3	-3	-3	-3	Water Quality
Overall scores			-135	F	-156	-129	-120	-110	Overall scores
Ranking						3	2	1	Ranking
Notes: Weighted = 50%, Unweighted = 10%									

11.6.6 Culture and Heritage Weighted

Assessing the route options against culuture and heritage, Option 4 (P4) and 3 (P3) are very similar, albeit Option 4 is preferred. Option 3 scores equal in many criteria and higher in resilience, it slips behind overall relative to Option 4 (P4) mainly due to urban design, recreation and ecology.

Table 11.16: East of the crest of the Wellington escarpment Culture and Heritage Weighted

Weighting Scenarios Weighting Scenarios (50% to weighted scenario, 10% to unweighted criteria)	Individual MCA Criteria	W e i g h t i n g	1. P1	1a. P1-Variant 1	1b. P1-Variant 2	2. P2	3. P3	4. P4	Individual MCA Criteria
			Score	Score	Score	Score	Score	Score	
			Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	
			We	We	We	We	We	We	
Business	Business	10.00	-10	-10	-10	-10	-10	-10	Business
Transport	Resilience	5.00	-15	F	-15	0	15	10	Natural Hazards and Network Resilience
	Transport	5.00	10	5	0	10	10	10	Transport
Built-Human Environment	Noise	3.33	-3	-3	-3	-3	-3	-3	Noise
	Urban Design	3.33	7	-7	7	0	0	3	Urban Design
	Recreation	3.33	-3	-7	-10	-3	-7	0	Recreation
Social	Social	10.00	-20	-20	-20	-20	-20	-20	Social
Culture and Heritage	Archaeology	16.67	-33	-33	-33	-33	-33	-33	Archaeology
	Built Heritage	16.67	0	0	0	0	0	0	Built Heritage
	Cultural	16.67	-17	-50	-50	-17	-17	-17	Cultural
Natural Environment and Contamination	Land Contamination	2.50	0	-3	0	0	0	0	Land Contamination (potential for)
	Landscape and Visual	2.50	-8	-5	-5	-8	-8	-8	Landscape/Visual
	Ecology	2.50	0	0	0	-3	-5	0	Ecology
	Water Quality	2.50	-3	-1	-3	-3	-3	-3	Water Quality
Overall scores			-95	F	-142	-89	-80	-70	Overall scores
Ranking						3	2	1	Ranking
Notes: Weighted = 50%, Unweighted = 10%									

11.6.7 Natural Environment and Contamination Weighted

This weighting applied a higher score to those criteria associated with the natural environments, including ecology, hydrology (and water quality), landscape-visual and land contamination. The results indicate that when natural environmental factors are given a higher priority, the preferred Petone to the Crest route remains unchanged at Option 4 (P4).

The respective ranking of all other options also remains unchanged under this scenario. What is significant is how much more strongly Option 1b (P1-Variant 2) scores under this weighted scenario although it still only scores third highest. This strongly indicates that for options east of the crest of the Wellington escarpment, there is a slight degree of preference to Option 1b from a natural environment and contamination perspective.

Table 11.17: East of the crest of the Wellington escarpment Natural Environment Weighted

Weighting Scenarios Weighting Scenarios (50% to weighted scenario, 10% to unweighted criteria)	Individual MCA Criteria	W e i g h t i n g	1. P1	1a. P1-Variant 1	1b. P1-Variant 2	2. P2	3. P3	4. P4	Individual MCA Criteria
			Score	Score	Score	Score	Score	Score	
			Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	
			We	We	We	We	We	We	
Business	Business	10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	Business
Transport	Resilience	5.00	-15	F	-15	0	15	10	Natural Hazards and Network Resilience
	Transport	5.00	10	5	0	10	10	10	Transport
Built-Human Environment	Noise	3.33	-3	-3	-3	-3	-3	-3	Noise
	Urban Design	3.33	7	-7	7	0	0	3	Urban Design
	Recreation	3.33	-3	-7	-10	-3	-7	0	Recreation
Social	Social	10.00	-20	-20	-20	-20	-20	-20	Social
Culture and Heritage	Archaeology	3.33	-7	-7	-7	-7	-7	-7	Archaeology
	Built Heritage	3.33	0	0	0	0	0	0	Built Heritage
	Cultural	3.33	-3	-10	-10	-3	-3	-3	Cultural
Natural Environment and Contamination	Land Contamination	12.50	0	-13	0	0	0	0	Land Contamination (potential for)
	Landscape and Visual	12.50	-38	-25	-25	-38	-38	-38	Landscape/Visual
	Ecology	12.50	0	0	0	-13	-25	0	Ecology
	Water Quality	12.50	-13	-1	-13	-13	-13	-13	Water Quality
	Overall scores		-95	F	-106	-99	-100	-70	Overall scores
	Ranking		2			3		1	Ranking
	Notes: Weighted = 50%, Unweighted = 10%								

11.6.8 RMA Section 6 Weighted

As described above this scenario gives higher weighting to those criteria that relate to the matters listed in Section 6 of the RMA (and that are of particular relevance in the context of the project). The results show that preferred Petone to the Crest route remains unchanged at Option 4 (P4).

The next preferred options are Option 1 (P1), followed by Option 3 (P3) and Option 2 (P2).

Table 11.18: RMA Section 6 Weighted

RMA Section 6 Weighting Applied (all weighted criteria score 50, others 10)	Individual MCA Criteria	S e c t i o n 6 R e s i l i e n c e R a n k i n g	1. P1	1a. P1-Variant 1	1b. P1-Variant 2	2. P2	3. P3	4. P4	Individual MCA Criteria
			Score	Score	Score	Score	Score	Score	
			Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	
			We	We	We	We	We	We	
Business	Business	10.00	-10	-10	-10	-10	-10	-10	Business
Transport	Resilience	10.00	-30	F	-30	0	30	20	Natural Hazards and Network Resilience
	Transport	10.00	20	-10	0	20	20	20	Transport
Built-Human Environment	Noise	10.00	-10	-10	-10	-10	-10	-10	Noise
	Urban Design	10.00	20	-20	20	0	0	10	Urban Design
	Recreation	10.00	-10	-20	-30	-10	-20	0	Recreation
Social	Social	10.00	-20	-20	-20	-20	-20	-20	Social
Culture and Heritage	Archaeology	50.00	-100	-100	-100	-100	-100	-100	Archaeology
	Built Heritage	50.00	0	0	0	0	0	0	Built Heritage
	Cultural	50.00	-50	-150	-150	-50	-50	-50	Cultural
Natural Environment and Contamination	Land Contamination								Land Contamination (potential for)
	Landscape and Visual	10.00	0	0	0	0	0	0	Landscape/Visual
	Ecology	50.00	-150	-100	-100	-150	-150	-150	Ecology
	Water Quality	10.00	0	0	0	-50	-100	0	Water Quality
	Overall scores		-350	F	-440	-390	-420	-300	Overall scores
	Ranking		2			3	4	1	Ranking

11.7 West of the Crest of the Wellington Escarpment – Unweighted

Using no sensitivity weightings, there are three highest scoring options, Option 9a (C (V1)-Variant 1), Option 10a (C (V1)-Variant 1 MM), and Option 11a (C (V1)-Variant 1 MM2) as shown on table 11.19 below. These options score a total of 3, while 4 options score a total of 1: Option 10 (C (V1) MM1), Option 11 (C (V1) MM2), Option 18 (CMM1) and Option 19 (CMM2). No other options score higher than a total of 0.

Table 11.19: West of the crest of the Wellington escarpment Unweighted Individual Criteria

No Weighting Applied (all individual criteria score equally at 10)	Individual MCA Criteria	Criteria	5. A	6. B	7. C	8. D	9. C(V1)	9a. C(V1)-Variant 1	10. C(V1) MM1	10a. C(V1)-Variant 1	11. C(V1) MM2	11a. C(V1)-Variant 1	12. C(V1) No SH1	12a. C(V1)-Variant 1	13. C(V2)	14. C(V2) MM1	15. C(V2) MM2	16. C(V2) No SH1	17. C Full Widening	18. C MM1	19. C MM2	20. C No SH1	21. D Update	22. D(V1)	23. D(V2)	Criteria	
			Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score		Score
			Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated		Mitigated
			We	We	We	We	We	We	We	We	We	We	We	We	We	We	We	We	We	We	We	We	We	We	We		We
Business	Business	1.00	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	Business	
Transport	Natural Hazards and Network Resilience	1.00	1	0	1	3	1	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	0	3	3	3	Natural Hazards and Network Resilience
	Transport	1.00	2	2	2	2	2	2	2	2	2	2	1	1	2	2	2	1	2	2	2	1	2	2	2	2	Transport
Built and Human Environment	Noise	1.00	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	Noise
	Urban Design	1.00	-2	-2	0	-2	2	3	2	3	2	3	2	3	0	0	0	0	0	0	0	0	0	-2	2	2	Urban Design
	Recreation	1.00	0	0	-1	-1	-1	0	-1	-1	-1	-1	0	0	0	0	0	0	0	-1	-1	-1	0	-2	-2	-1	Recreation
Social	Social	1.00	-2	-2	-2	-2	-2	-2	-1	-1	-1	-1	-1	-1	-2	-1	-1	-1	-1	-2	-1	-1	-1	-2	-2	-2	Social
Heritage and Culture	Archaeology	1.00	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	Archaeology
	Built Heritage	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Built Heritage
	Cultural	1.00	0	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Natural Environment	Land Contamination (potential for)	1.00	0	F	0	0	0	0	0	0	0	0	0	0	-3	-3	-3	-3	0	0	0	0	0	0	0	0	Land Contamination (potential for)
	Landscape/Visual	1.00	-1	-1	-2	-3	-2	-2	-2	-2	-2	-2	-2	-2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-3	-3	-3	Landscape/Visual
	Ecology	1.00	0	0	0	-3	-1	0	-1	0	-1	0	-1	0	0	0	0	0	0	0	0	0	0	-3	-3	-3	Ecology
	Water Quality	1.00	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	Water Quality
	Overall scores		-3	F	-1	-5	0	3	1	3	1	3	0	2	-3	-2	-2	-3	0	1	1	0	-6	-2	-1	Overall scores	
	Ranking						1=		1=		1=															Ranking	
	Notes:																										
	All Criteria Score 1																										

As with East of the Crest options, to further test the options on an unweighted basis all scenarios were attributed an equal weighting score of 10, divided equally amongst their respective criteria. This would determine if sub-criteria scoring might influence the overall scoring.

Under this scenario there are two preferred route options Option 10a (C (V1)-Variant 1 MM), and Option 11a (C (V1)-Variant 1 MM2) as shown on table 11.20 below. The third equal best scoring routes were Option 10 (C(v1)MM1) and Option 11 (C(v1)MM2). These were closely followed by Option 9a(C(V1) variant 1) (which scored first equal in the unweighted individual criteria assessment) and Option 12a (C V1)-Variant 1 No SH1 Upgrade). The scores are shown below in table 11.20.

Table 11.20: West of the crest of the Wellington escarpment Unweighted Scenarios

All Weighting Scenarios Equal (all Environmental Considerations score combined total of 10)	Individual MCA Criteria	S c e n a r i o s	5. A	6. B	7. C	8. D	9. C(V1)	9a. C(V1)- Variant 1	10. C(V1)- MM1	10a. C(V1)- Variant 1	11. C(V1)- MM2	11a. C(V1)- Variant 1	12. C(V1) No SH1	12a. C(V1)- Variant 1	13. C(V2)	14. C(V2) MM1	15. C(V2) MM2	16. C(V2) No SH1	17. C Full Widening	18. C MM1	19. C MM2	20. C No SH1	21. D Update	22. D(V1)	23. D(V2)	Criteria	
			Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score		Score
			Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated		Mitigated
			We	We	We	We	We	We	We	We	We	We	We	We	We	We	We	We	We	We	We	We	We	We	We		We
Business (10 total)	Business	10.00	10	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	Business	
Transport (10 total)	Natural Hazards and Network Resilience	5.00	5	0	5	15	5	5	5	5	5	5	0	0	0	0	0	0	5	5	5	0	15	15	15	Natural Hazards and Network Resilience	
	Transport	5.00	10	10	10	10	10	10	10	10	10	10	5	5	10	10	10	10	5	10	10	5	10	10	10	Transport	
Built and Human Environment (10 total)	Noise	3.33	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	Noise	
	Urban Design	3.33	-7	-7	0	-7	7	10	7	10	7	10	7	10	0	0	0	0	0	0	0	0	-7	7	7	Urban Design	
	Recreation	3.33	0	0	-3	-3	-3	0	-3	-3	-3	-3	0	0	0	0	0	0	-3	-3	-3	0	-7	-7	-3	Recreation	
Social (10 total)	Social	10.00	-20	-20	-20	-20	-20	-20	-10	-10	-10	-10	-10	-10	-20	-10	-10	-10	-10	-20	-10	-10	-10	-20	-20	-20	Social
Heritage and Culture (10 total)	Archaeology	3.33	0	0	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	Archaeology	
	Built Heritage	3.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Built Heritage	
	Cultural	3.33	0	0	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	Cultural	
Natural Environment (10 total)	Land Contamination (potential for)	2.50	0	F	0	0	0	0	0	0	0	0	0	0	-8	-8	-8	-8	0	0	0	0	0	0	0	Land Contamination (potential for)	
	Landscape/Visual	2.50	-3	-3	-5	-8	-5	-5	-5	-5	-5	-5	-5	-5	-3	-3	-3	-3	-3	-3	-3	-3	-8	-8	-8	Landscape/Visual	
	Ecology	2.50	0	0	0	-8	-3	0	-3	0	-3	0	-3	0	0	0	0	0	0	0	0	0	-8	-8	-8	Ecology	
	Water Quality	2.50	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	Water Quality	
Overall scores			-10	F	4	-2	8	17	18	24	18	24	12	17	-3	8	8	3	7	17	17	10	-6	8	11	Overall scores	
Ranking									3=	1=	3=	1=														Ranking	

11.8 West of the Crest of the Wellington Escarpment – Weighted Scenario Testing

The same weighting scenarios were applied to the West of the Crest options as those applied to the East of the Crest options. The results are set out below.

11.8.1 Business

Applying a business sensitivity weighting Options 10a (C (V1)-Variant 1 MM), and 11a (C (V1)-Variant 1 MM2) are again the highest scoring. Again as with East of the Crest this reflects where other criteria that have scored this route highly as Business impacts score all routes the same. Urban design is the strongest scoring criteria, and social impacts are less than for some other options.

Further information can be found in Section 9 and Appendix F.

Table 11.21: West of the crest of the Wellington escarpment Business Weighted

Weighting Scenarios	Individual MCA Criteria	Weighting	5. A	6. B	7. C	8. D	9. C(V1)	9a. C(V1)-Variant 1	10. C(V1) MM1	10a. C(V1)-Variant 1	11. C(V1) MM2	11a. C(V1)-Variant 1	12. C(V1) No SH1	12a. C(V1)-Variant 1	13. C(V2)	14. C(V2) MM1	15. C(V2) MM2	16. C(V2) No SH1	17. C Full Widening	18. C MM1	19. C MM2	20. C No SH1	21. D Update	22. D(V1)	23. D(V2)	Criteria		
			Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score		Score	Score
			Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We		Mitigated We	Mitigated We
Business	Business	50.00	50	50	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	Business		
Transport	Natural Hazards and Network Resilience	5.00	5	0	5	15	5	5	5	5	5	5	0	0	0	0	0	0	5	5	5	0	15	15	15	Natural Hazards and Network Resilience		
	Transport	5.00	10	10	10	10	10	10	10	10	10	10	5	5	10	10	10	10	5	10	10	10	5	10	10	Transport		
Built and Human Environment	Noise	3.33	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	Noise		
	Urban Design	3.33	-7	-7	0	-7	7	10	7	10	7	10	7	10	0	0	0	0	0	0	0	0	-7	7	7	Urban Design		
	Recreation	3.33	0	0	-3	-3	-3	0	-3	-3	-3	-3	0	0	0	0	0	0	-3	-3	-3	0	-7	-7	-7	Recreation		
Social	Social and Community	10.00	-20	-20	-20	-20	-20	-20	-10	-10	-10	-10	-10	-10	-20	-10	-10	-10	-20	-10	-10	-10	-20	-20	-20	Social and Community		
Heritage and Culture	Archaeology	3.33	0	0	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	Archaeology		
	Built Heritage	3.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Built Heritage		
	Cultural	3.33	0	0	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	Cultural		
Natural Environment	Land Contamination (potential for)	2.50	0	F	0	0	0	0	0	0	0	0	0	0	-8	-8	-8	-8	0	0	0	0	0	0	0	Land Contamination (potential for)		
	Landscape/Visual	2.50	-3	-3	-5	-8	-5	-5	-5	-5	-5	-5	-5	-5	-3	-3	-3	-3	-3	-3	-3	-3	-8	-8	-8	Landscape/Visual		
	Ecology	2.50	0	0	0	-8	-3	0	-3	0	-3	0	-3	0	0	0	0	0	0	0	0	0	-8	-8	-8	Ecology		
	Water Quality	2.50	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	Water Quality		
Overall scores			30	F	84	78	88	97	98	104	98	104	92	97	78	88	88	83	87	97	97	90	74	88	91	Overall scores		
Total = 100	Ranking								3=	1=	3=	1=													Ranking			
Notes:			Weighted = 50%, Unweighted = 10%																									

11.8.2 Transport

This weighting clustered together the Transport and Natural Hazards-Network Resilience criteria. The highest scoring options against these two criteria combined were Options 8, 21, 22 and 23 (D options with links to Transmission Gully via Takapu Valley). These options scored very highly for Resilience. However these "D" options all scored relatively poorly in the various environmental criteria, particularly social impact, visual and ecology. Notwithstanding that the preferred option under this weighting is Option 23 (D (V2)), with the "D" options being the top four scoring options. This is the only instance where a D option is the highest scoring option.

Table 11.22: West of the crest of the Wellington escarpment Transport Weighted

Weighting Scenarios	Individual MCA Criteria	Weighting	5. A	6. B	7. C	8. D	9. C(V1)	9a. C(V1)-Variant 1	10. C(V1) MM1	10a. C(V1)-Variant 1	11. C(V1) MM2	11a. C(V1)-Variant 1	12. C(V1) No SH1	12a. C(V1)-Variant 1	13. C(V2)	14. C(V2) MM1	15. C(V2) MM2	16. C(V2) No SH1	17. C Full Widening	18. C MM1	19. C MM2	20. C No SH1	21. D Update	22. D(V1)	23. D(V2)	Individual MCA Criteria	
			Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score		Score
			Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We		Mitigated We
Business	Business	10.00	10	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	Business	
Transport	Natural Hazards and Network Resilience	25.00	25	0	25	75	25	25	25	25	25	25	0	0	0	0	0	0	25	25	25	0	75	75	75	Natural Hazards and Network Resilience	
	Transport	25.00	50	50	50	50	50	50	50	50	50	50	25	25	50	50	50	25	50	50	50	25	50	50	50	Transport	
Built and Human Environment	Noise	3.33	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	Noise	
	Urban Design	3.33	-7	-7	0	-7	7	10	7	10	7	10	7	10	0	0	0	0	0	0	0	0	-7	7	7	Urban Design	
	Recreation	3.33	0	0	-3	-3	-3	0	-3	-3	-3	-3	0	0	0	0	0	0	-3	-3	-3	0	-7	-7	-3	Recreation	
Social	Social	10.00	-20	-20	-20	-20	-20	-20	-10	-10	-10	-10	-10	-10	-20	-10	-10	-10	-20	-10	-10	-10	-20	-20	-20	Social	
Heritage and Culture	Archaeology	3.33	0	0	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	Archaeology	
	Built Heritage	3.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Built Heritage	
	Cultural	3.33	0	0	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	Cultural	
Natural Environment	Land Contamination (potential for)	2.50	0	F	0	0	0	0	0	0	0	0	0	0	-8	-8	-8	-8	0	0	0	0	0	0	0	Land Contamination (potential for)	
	Landscape/Visual	2.50	-3	-3	-5	-8	-5	-5	-5	-5	-5	-5	-5	-5	-3	-3	-3	-3	-3	-3	-3	-3	-8	-8	-8	Landscape/Visual	
	Ecology	2.50	0	0	0	-8	-3	0	-3	0	-3	0	-3	0	0	0	0	0	0	0	0	0	-8	-8	-8	Ecology	
	Water Quality	2.50	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	Water Quality	
Overall scores			50	25	64	98	68	77	78	84	78	84	32	37	38	48	48	23	67	77	77	30	94	108	111	Overall scores	
Total = 100	Ranking					3																	2	1	Ranking		
Notes:			Weighted = 50%, Unweighted = 10%																								

11.8.3 Built and Human Environment

Using this weighting the best scoring option is Option 12a (C (V1)-Variant 1 No SH1 Upgrade). This option scored best for urban design and recreation. It also scored amongst the better scores for social impact. All options scored equally for noise. Option 12a scored amongst the lowest scores for resilience.

Further information can be found in Section 9 and Appendix F.

Table 11.23: West of the crest of the Wellington escarpment Built and Human Environment Weighted

Weighting Scenarios	Individual MCA Criteria	Weighting	5. A	6. B	7. C	8. D	9. C(V1)	9a. C(V1)-Variant 1	10. C(V1) MM1	10a. C(V1)-Variant 1 MM1	11. C(V1) MM2	11a. C(V1)-Variant 1 MM2	12. C(V1) No SH1 Upgrade	12a. C(V1)-Variant 1 No SH1 Upgrade	13. C(V2)	14. C(V2) MM1	15. C(V2) MM2	16. C(V2) No SH1 Upgrade	17. C Full Widening	18. C MM1	19. C MM2	20. C No SH1 Upgrade	21. D Update Tawa I/C	22. D(V1)	23. D(V2)	Individual MCA Criteria	
			Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score		Score
			Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We		Mitigated We					
Business	Business	10.00	10	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	Business	
Transport	Natural Hazards and Network Resilience Transport	5.00	5	0	5	15	5	5	5	5	5	5	0	0	0	0	0	0	5	5	5	0	15	15	15	Natural Hazards and Network Resilience Transport)	
		5.00	10	10	10	10	10	10	10	10	10	10	10	5	10	10	10	10	5	10	10	10	10	10	10		
Built and Human Environment	Noise	16.67	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	Noise	
	Urban Design	16.67	-33	-33	0	-33	33	50	33	50	33	50	33	50	0	0	0	0	0	0	0	0	0	-33	33	33	Urban Design
	Recreation	16.67	0	0	-17	-17	-17	0	-17	-17	-17	-17	0	0	0	0	0	0	-17	-17	-17	-17	-33	-33	-17	Recreation	
Social	Social	10.00	-20	-20	-20	-20	-20	-20	-10	-10	-10	-10	-10	-10	-20	-10	-10	-10	-10	-20	-10	-10	-10	-20	-20	-20	Social
Heritage and Culture	Archaeology	3.33	0	0	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	Archaeology	
	Built Heritage	3.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Built Heritage	
	Cultural	3.33	0	0	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	Cultural	
Natural Environment (10%)	Land Contamination (potential for)	2.50	0	F	0	0	0	0	0	0	0	0	0	0	-8	-8	-8	-8	0	0	0	0	0	0	0	Land Contamination (potential for)	
	Landscape/Visual	2.50	-3	-3	-5	-8	-5	-5	-5	-5	-5	-5	-5	-5	-3	-3	-3	-3	-3	-3	-3	-3	-3	-8	-8	-8	Landscape/Visual
	Ecology	2.50	0	0	0	-8	-3	0	-3	0	-3	0	-3	0	0	0	0	0	0	0	0	0	0	-8	-8	-8	Ecology
	Water Quality	2.50	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	Water Quality
Total = 100	Overall scores		-50	F	-23	-56	8	44	18	37	18	37	25	49	-16	-6	-6	-11	-20	-10	-10	2	-73	-6	11	Overall scores	
	Ranking						2		3=		3=		1													Ranking	
	Notes: Weighted = 50%, Unweighted = 10%																										

11.8.4 Heritage and Culture

Apart from Options 5 and 6 these options all scored equally in these criteria, meaning that this weighting has had little bearing on the relative scoring of the various options. This assessment suggests that there is relatively little sensitivity to Heritage and Culture criteria amongst the west of the crest of the Wellington escarpment options, noting that more detailed assessment at AEE stage may identify other features.

Table 11.24: West of the crest of the Wellington escarpment Heritage and Culture Weighted

Weighting Scenarios (50% to weighted scenario, 10% to unweighted criteria)	Individual MCA Criteria	Weighting	5. A	6. B	7. C	8. D	9. C(V1)	9a. C(V1)- Variant 1	10. C(V1)- MM1	10a. C(V1)- Variant 1	11. C(V1)- MM2	11a. C(V1)- Variant 1	12. C(V1) No SH1	12a. C(V1)- Variant 1	13. C(V2)	14. C(V2)- MM1	15. C(V2)- MM2	16. C(V2) No SH1	17. C Full Widening	18. C MM1	19. C MM2	20. C No SH1	21. D Update	22. D(V1)	23. D(V2)	Criteria	
			Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score		Score
			Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We		Mitigated We
Business	Business	10.00	10	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	Business	
Transport	Natural Hazards and Network Resilience	5.00	5	0	5	15	5	5	5	5	5	5	0	0	0	0	0	0	5	5	5	0	15	15	15	Natural Hazards and Network Resilience	
	Transport (TIA)	5.00	10	10	10	10	10	10	10	10	10	10	5	5	10	10	10	5	10	10	10	5	10	10	10	Transport (TIA)	
Built and Human Environment	Noise	3.33	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	Noise	
	Urban Design	3.33	-7	-7	0	-7	7	10	7	10	7	10	7	10	0	0	0	0	0	0	0	0	-7	7	7	Urban Design	
	Recreation	3.33	0	0	-3	-3	-3	0	-3	-3	-3	-3	0	0	0	0	0	0	-3	-3	-3	0	-7	-7	-3	Recreation	
Social	Social and Community	10.00	-20	-20	-20	-20	-20	-20	-10	-10	-10	-10	-10	-10	-20	-10	-10	-10	-20	-10	-10	-10	-20	-20	-20	Social and Community	
Heritage and Culture	Archaeology	16.67	0	0	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	-17	Archaeology	
	Built Heritage	16.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Built Heritage	
	Cultural	16.67	0	0	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	Cultural	
Natural Environment	Land Contamination (potential for)	2.50	0	F	0	0	0	0	0	0	0	0	0	0	-8	-8	-8	-8	0	0	0	0	0	0	0	Land Contamination (potential for)	
	Landscape/Visual	2.50	-3	-3	-5	-8	-5	-5	-5	-5	-5	-5	-5	-5	-3	-3	-3	-3	-3	-3	-3	-3	-3	-8	-8	Landscape/Visual	
	Ecology	2.50	0	0	0	-8	-3	0	-3	0	-3	0	-3	0	0	0	0	0	0	0	0	0	0	-8	-8	Ecology	
	Water Quality	2.50	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	Water Quality
Total = 100	Overall scores		-32	F	-14	-31	-10	31	32	37	32	37	25	31	11	21	21	16	20	30	30	23	8	21	24	Overall scores	
	Ranking							3=	3=	1=	3=	1=														Ranking	
	Notes: Weighted = 50%, Unweighted = 10%																										

11.8.5 Social Impact

The highest scoring options under this sensitivity scenario were Option 10a (C (V1)-Variant 1 MM), and Option 11a (C (V1)-Variant 1 MM2), both of which were amongst the better scoring of the social impact scores.

Table 11.25: West of the crest of the Wellington escarpment Social impact Weighted

Weighting Scenarios (50% to weighted scenario, 10% to unweighted criteria)	Individual MCA Criteria	Weighting	5. A	6. B	7. C	8. D	9. C(V1)	9a. C(V1)-Variant 1	10. C(V1) MM1	10a. C(V1)-Variant 1	11. C(V1) MM2	11a. C(V1)-Variant 1	12. C(V1) No SH1	12a. C(V1)-Variant 1	13. C(V2)	14. C(V2) MM1	15. C(V2) MM2	16. C(V2) No SH1	17. C Full Widening	18. C MM1	19. C MM2	20. C No SH1	21. D Update	22. D(V1)	23. D(V2)	Individual MCA Criteria	
			Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score		Score
			Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We		Mitigated We					
Business	Business	10.00	10	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	Business
Transport	Natural Hazards and Network Resilience	5.00	5	0	5	15	5	5	5	5	5	5	0	0	0	0	0	0	5	5	5	0	15	15	15	Natural Hazards and Network Resilience	
	Transport	5.00	10	10	10	10	10	10	10	10	10	10	5	5	10	10	10	10	5	10	10	10	5	10	10	10	Transport
Built and Human Environment	Noise	3.33	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	Noise
	Urban Design	3.33	-7	-7	0	-7	7	10	7	10	7	10	7	10	0	0	0	0	0	0	0	0	-7	7	7	7	Urban Design
	Recreation	3.33	0	0	-3	-3	-3	0	-3	-3	-3	-3	0	0	0	0	0	0	-3	-3	-3	0	-7	-7	-7	-3	Recreation
Social	Social	50.00	-100	-100	-100	-100	-100	-100	-50	-50	-50	-50	-50	-50	-100	-50	-50	-50	-100	-50	-50	-50	-50	-100	-100	-100	Social
Heritage and Culture	Archaeology	3.33	0	0	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	Archaeology
	Built Heritage	3.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Built Heritage
	Cultural	3.33	0	0	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	Cultural
Natural Environment	Land Contamination (potential for)	2.50	0	F	0	0	0	0	0	0	0	0	0	0	-8	-8	-8	-8	0	0	0	0	0	0	0	0	Land Contamination (potential for)
	Landscape/Visual	2.50	-3	-3	-5	-8	-5	-5	-5	-5	-5	-5	-5	-5	-3	-3	-3	-3	-3	-3	-3	-3	-3	-8	-8	-8	Landscape/Visual
	Ecology	2.50	0	0	0	-8	-3	0	-3	0	-3	0	-3	0	0	0	0	0	0	0	0	0	0	-8	-8	-8	Ecology
	Water Quality	2.50	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	Water Quality
	Overall scores		-90	F	-76	-82	-72	-63	-22	-16	-22	-16	-28	-23	-83	-33	-33	-38	-73	-23	-23	-30	-86	-73	-69	Overall scores	
Total = 100		Ranking						3=	1=	3=	1=															Ranking	
		Notes:																									
		Weighted = 50%, Unweighted = 10%																									

11.8.6 Natural Environment

Under the Natural Environment scenario the highest scoring route is Option 18 (C MM1), closely followed by Option 10a (C (V1)-Variant 1 MM), and Option 11a (C (V1)-Variant 1 MM2). In the individual criteria assessments this option scored joint highest in the landscape and visual, ecology assessments, social impact and equal with other criteria for and water quality-hydrology. Many of the options were scored similarly by these criteria assessments.). The best scoring option was thus largely derived by the cumulative total scores across in particular natural environment criteria and other criteria.

Table 11.26: West of the crest of the Wellington escarpment Natural Environment impact Weighted

Weighting Scenarios (50% to weighted score)	Individual MCA Criteria	Weighting	5. A	6. B	7. C	8. D	9. C(V1)	9a. C(V1)- Variant 1	10. C(V1)- MM1	10a. C(V1)- Variant 1	11. C(V1)- MM2	11a. C(V1)- Variant 1	12. C(V1)- No SH1	12a. C(V1)- Variant 1	13. C(V2)	14. C(V2)- MM1	15. C(V2)- MM2	16. C(V2)- No SH1	17. C Full Widening	18. C MM1	19. C MM2	20. C No SH1	21. D Update	22. D(V1)	23. D(V2)	Individual MCA Criteria	
			Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score		Score
			Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We		Mitigated We
Business	Business	10.00	10	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	Business	
Transport	Natural Hazards and Network Resilience	5.00	5	0	5	15	5	5	5	5	5	5	0	0	0	0	0	0	5	5	5	0	0	15	15	15	Natural Hazards and Network Resilience
	Transport	5.00	10	10	10	10	10	10	10	10	10	10	5	5	10	10	10	10	5	10	10	10	5	10	10	10	Transport
Built and Human Environment	Noise	3.33	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	Noise
	Urban Design	3.33	-7	-7	0	-7	7	10	7	10	7	10	7	10	0	0	0	0	0	0	0	0	0	-7	7	7	Urban Design
	Recreation	3.33	0	0	-3	-3	-3	0	-3	-3	-3	-3	0	0	0	0	0	0	-3	-3	-3	0	0	-7	-7	-3	Recreation
Social	Social	10.00	-20	-20	-20	-20	-20	-20	-10	-10	-10	-10	-10	-10	-20	-10	-10	-10	-10	-20	-10	-10	-10	-20	-20	-20	Social
Heritage and Culture	Archaeology	3.33	0	0	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	Archaeology
	Built Heritage	3.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Built Heritage
	Cultural	3.33	0	0	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	Cultural
Natural Environment	Land Contamination (potential for)	12.50	0	F	0	0	0	0	0	0	0	0	0	0	-38	-38	-38	-38	0	0	0	0	0	0	0	0	Land Contamination (potential for)
	Landscape/Visual	12.50	-13	-13	-25	-38	-25	-25	-25	-25	-25	-25	-25	-25	-13	-13	-13	-13	-13	-13	-13	-13	-13	-38	-38	-38	Landscape/Visual
	Ecology	12.50	0	0	0	-38	-13	0	-13	0	-13	0	-13	0	0	0	0	0	0	0	0	0	0	-38	-38	-38	Ecology
	Water Quality	12.50	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13
	Overall scores		-30	F	-26	-72	-32	-13	-22	-6	-22	-6	-28	-13	-53	-43	-43	-48	-13	-3	-8	-10	-76	-63	-59	Overall scores	
Total = 100	Notes: Weighted = 50%, Unweighted = 10%	Ranking							2=		2=								1							Ranking	

11.8.7 Specialists Workshop Weighting

The workshop weighting scenario finds the highest scoring western option being Option 10a (C (V1)-Variant 1 MM1), or Option 11a (C (V1)-Variant 1 MM2), consistent with a significant number of the sensitivity scenarios. Given how this weighting was derived it provides a reassurance as to the value of the weighting scenarios and reinforces options 10a and 11a as the clear highest scoring options west of the crest of the Wellington escarpment.

Table 11.27: West of the crest of the Wellington escarpment Specialists Workshop Weighted

Workshop Weighting	Individual MCA Criteria	W e i g h t i n g	5. A	6. B	7. C	8. D	9. C(V1)	9a. C(V1)- Variant 1	10. C(V1) MM1	10a. C(V1)- Variant 1	11. C(V1) MM2	11a. C(V1)- Variant 1	12. C(V1) No SH1	12a. C(V1)- Variant 1	13. C(V2)	14. C(V2) MM1	15. C(V2) MM2	16. C(V2) No SH1	17. C Full Widening	18. C MM1	19. C MM2	20. C No SH1	21. D Update	22. D(V1)	23. D(V2)	Criteria		
			Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score		Score	Score
			Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We	Mitigated We		Mitigated We	Mitigated We
Business	Business	4	4	4	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	Business	
Transport	Natural Hazards and Network Resilience	9	9	0	9	27	9	9	9	9	9	9	0	0	0	0	0	0	9	9	0	0	27	27	27	Natural Hazards and Network Resilience		
	Transport	9	18	18	18	18	18	18	18	18	18	18	9	9	18	18	18	18	9	18	18	18	9	18	18	18	Transport)	
Built and Human Environment	Noise	6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	Noise	
	Urban Design	7	-14	-14	0	-14	14	21	14	21	14	21	14	21	0	0	0	0	0	0	0	0	-14	14	14	14	Urban Design	
	Recreation	6	0	0	-6	-6	-6	0	-6	-6	-6	-6	0	0	0	0	0	0	-6	-6	-6	0	-12	-12	-12	-6	Recreation	
Heritage and Culture	Social	7	-14	-14	-14	-14	-14	-14	-7	-7	-7	-7	-7	-7	-14	-7	-7	-7	-14	-7	-7	-7	-14	-14	-14	-14	Social	
	Archaeology	4	0	0	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	Archaeology	
	Built Heritage	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Built Heritage	
Natural Environment	Cultural	7	0	0	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	Cultural	
	Land Contamination (potential for)	4	0	F	0	0	0	0	0	0	0	0	0	0	-12	-12	-12	-12	0	0	0	0	0	0	0	0	Land Contamination (potential for)	
	Landscape/Visual	9	-9	-9	-18	-27	-18	-18	-18	-18	-18	-18	-18	-18	-9	-9	-9	-9	-9	-9	-9	-9	-9	-27	-27	-27	Landscape/Visual	
	Ecology	8	0	0	0	-24	-8	0	-8	0	-8	0	-8	0	0	0	0	0	0	0	0	0	0	-24	-24	-24	Ecology	
	Water Quality	6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	Water Quality	
	Overall scores		-18	F	-5	-34	1	22	8	23	8	23	-4	11	-11	-4	-4	-13	4	11	2	-1	-40	-12	-6	Overall scores		
	Ranking							3		1=		1=														Ranking		
	Notes: Scores allocated by MCA Criteria specialists as a group																											

11.8.8 RMA Section 6 Weighting

Applying a RMA Section 6 ‘Matters of National Importance’ to relevant criteria has shown a different option/s as the highest scoring routes – 18 and 19. Following closely behind are alignments 17 and 20, and then 9a, 10a, and 11a. The scoring of the next highest options is pertinent given that options 18 and 19 do not score as well under other scenarios.

Table 11.29: RMA Section 6 Weighting

RMA Section 6 Weighting Applied (all weighted criteria score 50, others 10)	Individual MCA Criteria	S E C t o r M i n i s t e r i e s	RMA Section 6																							Criteria	
			5. A	6. B	7. C	8. D	9. C(V1)	9a. C(V1)- Variant 1	10. C(V1) MM1	10a. C(V1)- Variant 1	11. C(V1) MM2	11a. C(V1)- Variant 1	12. C(V1) No SH1	12a. C(V1)- Variant 1	13. C(V2)	14. C(V2) MM1	15. C(V2) MM2	16. C(V2) No SH1	17. C Full Widening	18. C MM1	19. C MM2	20. C No SH1	21. D Update	22. D(V1)	23. D(V2)		
			Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score		Score
			Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated	Mitigated		Mitigated
Business	Business	10.00	10	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	Business		
Transport	Natural Hazards and Network Resilience	10.00	10	0	10	30	10	10	10	10	10	10	0	0	0	0	0	0	10	10	10	0	30	30	30	Natural Hazards and Network Resilience	
	Transport	10.00	20	20	20	20	20	20	20	20	20	20	10	10	20	20	20	10	20	20	20	10	20	20	20	Transport	
Built and Human Environment	Noise	10.00	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	Noise	
	Urban Design	10.00	-20	-20	0	-20	20	30	20	30	20	30	20	30	0	0	0	0	0	0	0	0	-20	20	20	Urban Design	
	Recreation	10.00	0	0	-10	-10	-10	0	-10	-10	-10	-10	0	0	0	0	0	0	-10	-10	-10	0	-20	-20	-10	Recreation	
Social	Social	10.00	-20	-20	-20	-20	-20	-20	-10	-10	-10	-10	-10	-10	-20	-10	-10	-10	-20	-10	-10	-10	-20	-20	-20	Social	
Heritage and Culture	Archaeology	50.00	0	0	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	Archaeology	
	Built Heritage	50.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Built Heritage	
	Cultural	50.00	0	0	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	Cultural	
Natural Environment	Land Contamination (potential for)	10.00	0	F	0	0	0	0	0	0	0	0	0	0	-30	-30	-30	-30	0	0	0	0	0	0	0	Land Contamination (potential for)	
	Landscape/Visual	50.00	-50	-50	-100	-150	-100	-100	-100	-100	-100	-100	-100	-100	-50	-50	-50	-50	-50	-50	-50	-50	-150	-150	-150	Landscape/Visual	
	Ecology	50.00	0	0	0	-150	-50	0	-50	0	-50	0	-50	0	0	0	0	0	0	0	0	0	-150	-150	-150	Ecology	
	Water Quality	10.00	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	Water Quality	
	Overall scores		-70	F	-50	-250	-80	-10	-70	-10	-70	-10	-80	-20	-30	-20	-20	-30	0	10	10	0	-260	-220	-210	Overall scores	
	Ranking																	3=	1=	1=	3=				Ranking		
	Notes: All Weighted criteria score 50																										

11.9 Summary of MCA Analysis – Best Scoring Options and Full Routes

The MCA Analysis has provided an understanding of the respective scoring of the routes by individual criteria and by weighted sensitivity scenarios.

11.9.1 East of the Crest of the Wellington Escarpment

Option 4 (P4) scored highest on both unweighted assessments; and highest across most MCA weightings (including the Section 6 RMA weighting and the specialist's own workshop weighting).

Option 3 (P3) scored second highest on both unweighted assessments and across most weightings. Option P3 did score highest under the transport weighting, with Option P4 (a relatively close) second.

Option 3 (P3) has less earthworks than Option 4 (P4) but runs north along the Korokoro valley in an embankment fill and directly impacts on Belmont Regional Park. Option 3 (P3) has greater environmental effects than Option 4 but does have some network resilience benefits.

Although two variants of Option 1 were considered to try and reduce the impact from cuts, ultimately these scored poorly, with Option 1a (P1 Variant 1) "fatally flawed" and Option 1b (P1 Variant 2) scoring poorly across the range of unweighted and weighted scenarios.

Unless transport is exclusively prioritised ahead of all other MCA considerations, Option P4 is clearly the best performing East of the Crest option.

11.9.2 West of the Crest of the Wellington Escarpment

In general terms, there were a number of options for the western section of the project that scored similarly well across the range of unweighted and weighted scenarios. Across the range of scenarios, the "C" options usually outperformed the "A", "B" and "D" options.

The C(V1) Variant 1 options that provided for improvements to the existing SH1 - Options 9a (C(V1) - Variant 1 Full SH1 Widening, Options 10a (C (V1)-Variant 1 MM1), and 11a (C (V1)-Variant 1 MM2) - scored equal best on an unweighted (individual criteria) basis. Options 10a (C (V1)-Variant 1 MM1), and 11a (C (V1)-Variant 1 MM2), scored highly across all weightings; and received the joint-best scores on an unweighted (scenarios) basis, and using the workshop weightings (with Option 9a just behind on workshop weightings).

The exception to the general trend of the "C" (and particularly C (V1)-Variant 1) options being favoured was under the transport weighed scenario, which strongly favoured the "D" options. Option 23 (D (V2) scored best, followed by Option 22 (D (V1), and Option 8 (D), with Option 21 (D Update) fourth best. Options 10a (V1)-Variant 1 MM1), and 11a (C (V1)-Variant 1 MM2) scored best among the non-"D" options. The "D" options did not perform particularly well under most other unweighted and weighted scenarios.

Under the RMA Section 6 weighting, Options 18 (C MM1) and 19 (C MM2) scored best, followed by Options 17 (C Full SH1 Widening) and 20 (C No SH1 Upgrade). Options 10a (C (V1)-Variant 1 MM1), and 11a (C (V1)-Variant 1 MM2) scored fifth and sixth best under this weighting, Options 18 and 19 generally did not perform particularly well under most other unweighted and weighted scenarios.

11.9.3 Conclusions on best performing overall routes

Overall, if the unweighted and weighted assessments are viewed as a whole, Option 4(P4) is clearly the best performing "eastern" option.

The picture is slightly more complex for the "western" section (partly because of the much greater number of options. However, viewing all the assessments as a whole, the "C" route options generally perform better than the "A", "B" and "D" Options. In particular, Options 10a (C (V1)-Variant 1 MM1) and 11a (C (V1)-Variant 1 MM2) can be seen as the best performing options.

The exception is that under the transport weighting, the "D" options perform very strongly, and are clearly ahead of the other options (with Option 23 (D (V2) scoring best).

Overall and across the range of unweighted and weighted assessments, based on the findings from the MCA process a full route combination of Option 4 (P4)-10a (C (V1)-Variant 1 MM1), or Option 4 (P4) - 11a (C (V1)-Variant 1 MM2) score best.

This route combination provides the most direct link from Petone to the crest of the Wellington escarpment while avoiding Belmont Regional Park, but does feature the deepest cuts. From the crest of the Wellington escarpment the route passes through the Lincolnshire Farms structure plan area before connecting to SH1 at Tawa and Grenada. There is no connection to Transmission Gully. Improvements to the SH1 corridor incorporate a 'managed motorway' option (either MM1 or MM2) which minimises land take (relative to full SH1 widening) while still adding capacity on the network. These options also respond positively to Lincolnshire Farms, noting that any potential deposition of fill in that location might also need to be addressed.

Because of its iterative approach, the MCA enabled evolution of some options into modified options that responded to particular issues and/or opportunities identified by specialists during the process. This is considered to have been one of the main benefits of the approach taken. As a result the specialists and project team were able to consider how best to minimise effects and optimise opportunity associated with routes. Options 10a and 11a were both developed through this process.

This provides considerable assurance that the project team has considered an extensive array of options, many of which were specifically considered with the intent of reducing effects or increasing benefits, or both.

Table 11.30: MCA Best Scoring Route

Top Three Options by Criteria	East			West		
	1st	2nd	3rd	1st	2nd	3rd
1 – Business	4	3	2	10a, 11a	-	10, 11
2 - Transport	3	4	2	23	22	8
3 – Built and Human Environment	4	1	2	12a	9a	10a, 11a
4 - Social	4	3	2	10a, 11a	-	10, 11
5 –Culture and Heritage	4	3	2	10a, 11a	-	10, 11
6 – Natural Environment	4	1	2	18	10a, 11a	-
7. – RMA Section 6	4	1	2			
8 – Unweighted (individual criteria)	4	3	2,1	9a, 10a, 11a	-	-
9 – Unweighted (scenarios)	4	3	2	10a, 11a	-	10, 11
10 – Specialists Workshop Weighting	4	3	2	10a, 11a	-	9a

11.10 Fill Sites

This section should be read with the understanding that while the availability of the fill sites is highly desirable, the selection of routes is not dependent upon this (see Section 9).

11.10.1 Suggested order of use of Fill sites

The preferred fill site identified is Lincolnshire Farm 2 (Linc 2), with the form identified by the Version 2 design. This design was the outcome of the MCA Specialists Workshop 3, which specifically sought to ensure that environmental effects on the finished site were as well managed as possible. The order of preference of fill sites based on MCA analysis of fill sites is as follows:

1. Linc 2 (Version 2);
2. Site K (Version 2);
3. Linc 1 (Version 2);
4. Site M (Version 2); and
5. Site L.

Table 11.31: Fill Sites

Criteria	Site K (Version 2)		Site M (Version 2)		Linc 1 (Version 2)		Linc 2 (Version 2)		Site L	
	Score		Score		Score		Score		Score	
	Unmit.	Mitigated	Unmit.	Mitigated	Unmit.	Mitigated	Unmit.	Mitigated	Unmit.	Mitigated
Economic/ Business	0	0	0	0	0	0	0	0	0	0
Resilience	0	0	0	0	-1	0	0	0	-2	-2
Transport	0	0	0	0	0	0	0	0	0	0
Noise	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
Urban Design	2	2	0	0	3	3	3	3	0	0
Recreation	2	2	0	0	-1	1	2	2	-2	1
Social	-1	0	-1	0	-1	0	-1	0	-1	-1
Archaeology	0	0	0	0	0	0	0	0	0	0
Built Heritage	0	0	0	0	0	0	0	0	0	0
Cultural	-2	1	-1	0	-3	1	-3	1	-1	0
Land Contamination	0	0	1	1	0	0	0	0	1	1
Landscape and Visual	-2	-2	-2	-1	-2	-2	-1	0	-1	0
Ecology	0	0	0	0	-2	-1	-3	-1	-3	0
Water Quality	-3	0	-3	0	F	-1	F	-1	-3	0
Overall scores	-5	2	-7	-1	-8	0	-4	3	-13	-2
Ranking	2		4		3		1		5	
<i>Notes:</i>	<i>Unmit = Unmitigated No Weighting Applied</i>									

11.10.2 Further refinement of fill sites

While generally the order of use of the sites could follow this ranking, it is recognised that the order that fill is placed has a strong relationship with the order of construction. Also very important is the nature any agreements with parties with an interest in the land accommodating the fill sites.

The exact order of placement, further detail in respect of placement, and mitigation of effects will need to be further developed as part of a designation and resource consent process as is appropriate under the RMA.

12 Summary of Findings Including Highest Scoring Options

12.1 Summary

Twenty-nine route options between Petone and Tawa-Grenada-Transmission Gulley have been assessed both against the Transport Agency's project objectives, and by using a multi-criteria assessment approach. The purpose of these assessments is to better understand which of the route choices best achieve the project objectives and gives the best environmental outcome. For robustness these assessments have incorporated a range of scenarios to test how the respective options score with different objectives or criteria increased in significance. These testing scenarios also include use of both quantitative and qualitative data to assess project objectives, and consideration of factors such as Section 6 of the RMA which is likely to be of particular importance in any consenting process. Through this process some routes consistently scored highly. The following sections respectively identify the highest scoring routes east of the crest and west of the crest, and then as a connected route overall.

12.1.1 East of the Crest

The most consistently high scoring option east of the crest is Option 4 (P4), as the highest scoring option for most assessments against the project objectives, and in most MCA assessments. Option 4 also scores highest when assessed using RMA section 6 criteria only.

Option 3 (P3) scored equal highest (with Option 4) in the "quantitative Objective 6" assessment and in the "Objectives 1 – 5 only" assessment against Objectives. It scored second best across many (but not all) unweighted and weighted MCA assessments.

Taking these results as a whole, Option 4 (P4) was the best performing east of the crest option, with Option 3 (P3) second best. If transport aims and objectives are prioritised over all other issues, then Option 3 (P3) is the best option.

Overall none of these options scored particularly highly against Objective 6, and generate a range of moderate to significant adverse environmental effects. This was expected given the extensive earthworks required, sensitive nature of parts of the receiving environment and high visibility of the site.

A potentially negative aspect of Option 4 is that it also generates the largest amount of spoil that would need disposal of the six east of the crest options. Fill will need to be disposed of either in the fill sites identified and assessed in this report, or elsewhere.

If Option 4 is selected, the fill generated by the overall route might (depending on the west of the crest option selected) produce more fill than can be accommodated in the fill sites identified and assessed in the report. A summary of findings in respect of the fill sites follows. As set out in section 9 above, it is not considered that the level of fill generated by each option should be a factor in selecting the route options for the project.

12.1.2 West of the crest

The routes west of the crest of the Wellington escarpment scored very closely on the assessment against project objectives and in the MCA assessment, with no clear highest scoring alignment across the various assessments.

Options 10a C (V1) Variant 1 MM2, and Option 11a C (V1) Variant 1 MM2 can be considered to be the best scoring options overall when considered across the range of assessments against the project objectives, but Option 9a C (V1) Variant 1; and Options 22 D (V1) and 23 D (V2) - both variations of Option 21 to minimise residential property impacts in Grenada and impacts on the North Grenada Sports Fields - also score highly. If an assessment against RMA Section 6 is used to assess objective 6 a further two options score highly – 18 and 19 which are both managed motorway options similar in some respect to 9a, 10a, and 11a.

A selection of other routes west of the crest of the Wellington escarpment scored almost as highly. These included Options 9, 10, 11, 13, 14, 15, and 17. The most common differentiator between these options was Objective 6 in respect of environmental impacts. The higher scoring of Options 9a, and particularly 10a, and 11a almost certainly reflects that these options were specifically identified and developed through the MCA process to reduce environmental impacts.

When considered against the various unweighted and weighted RMA assessments, Options 10a C (V1) Variant 1 MM2, and Option 11a C (V1) Variant 1 MM2 again generally scored very well. . The RMA Section 6 weighting identified route options 18 and 19 as highest scoring (but those options don't perform nearly as well against other assessments).

The "C" options generally outperformed the "A", "B", and "D" options. The exception was that the "D" options were strongly favoured under the transport weighting – with the additional link to the planned Transmission Gully via the Takapu Valley ensuring "D" options scored best here. Option 23 (D (V2)) scored best under this weighting. Options 10a and 11a scored the best of the non-"D" options under the transport weightings.

The "D" options generally perform poorly under the unweighted and other weighted assessments including the Section 6 RMA weighting – which is in large part based on the adverse environmental effects that the construction of the Takapu Valley road would generate.

12.1.3 Connected east and west of the crest

Option 4 with either 10a or 11a can be identified as the best performing connected route (east and west of the crest of the Wellington escarpment) across the range of project objectives and MCA assessments.

Option 3 connected with either of these routes would be a second highest scoring alternative with resilience benefits but environmental disbenefits. The latter mean that consenting may be more difficult for a new route incorporating option 3.

However if the objective to 'enhance resilience of the Wellington state highway network' is considered most important, and the transport benefits of the project are prioritised above all other consideration, an overall route comprising options 3 – 22 or 23 scores most highly. However, the relatively poor scoring of such as alignment against project objective 6 and the MCA in respect of adverse environmental effects means that such an alignment might be difficult to secure through RMA processes.

The tables below show a simplified breakdown of the overall highest scoring routes (divided into eastern and western) against the various project objectives and MCA assessments.

Table 12.1: Project Objectives Best Scoring Connected Route

Overall Ranking of Alternatives by Assessment	Quantitative Objective 6	Qualitative Objective 6	Objectives 1-5 only	MCA RMA Section 6	Overall
Eastern	3, 4	4	3	4	4
Western	9a, 10, 11a, 22, 23	10a, 11a	21, 22, 23	18, 19	10a 11a 22 23
Highest scoring connected Routes	3-9a	4-10a	3-21	4-18	4-10a
	3-10	4-11a	3-22	4-19	4-11a
	3-11a		3-23		4-22
	3-22				4-23
	3-23				
	4-9a				
	4-10				
	4-11a				
	4-22				
	4-23				

Table 12.2: MCA Best Scoring Route

MCA Best Scoring Connected Route 3 East West
or 4-9a or 10a or 11a

Top Three Options by Criteria	1st	2nd	3rd	1st	2nd	3rd
1 – Business	4	3	2	10a, 11a	-	10, 11
2 - Transport	3	4	2	23	22	8
3 – Built and Human Environment	4	1	2	12a	9a	10a, 11a
4 - Social	4	3	2	10a, 11a	-	10, 11
5 – Culture and Heritage	4	3	2	10a, 11a	-	10, 11
6 – Natural Environment	4	1	2	18	10a, 11a	-
7. – RMA Section 6	4	1	2	18, 19	17, 20	9a,10a, 11a
8 – Unweighted (individual criteria)	4	3	2,1	9a, 10a, 11a	-	-
9 – Unweighted (scenarios)	4	3	2	10a, 11a	-	10, 11
10 – Specialists Workshop Weighting	4	3	2	10a, 11a	-	9a

Taken together these find the connected route most consistent with both project objectives and the MCA is to be 4 – 10a or 4 – 11a. This is illustrated in table 12.3 which shows the clear dominance of route 4 and routes 10a and 11a.

Table 12.3 Overall Highest Scoring Route

MCA Best Scoring Connected Route 3 East West
or 4-9a or 10a or 11a

Highest scoring options	1st	2nd	3rd	1st	2nd	3rd
Project Objectives	4	3	2	10a, 11a	22, 23	9a
MCA (overall) ⁹	4	3	1	10a, 11a	11	9a

⁹ MCA Overall does include RMA Section 6 criteria

RMA Section 6	4	1	2	18, 19	17, 20	9a, 10a, 11a
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12.2 Highest Scoring Route Option

The highest scoring route with respect to achieving the project objective was Options 4 (P4) and 3 (P3) for routes east of the crest of the Wellington escarpment and 9a (C (V1)-Variant 1), 10a (C (V1)-Variant 1 MM1), 11a (C (V1)-Variant 1 MM2), 22 (D (V1)) and 23 (D (V2)) for routes west of the crest of the Wellington escarpment.

For the MCA assessment Options 4 (P4) scores highest for the eastern section and 10a (C (V1)-Variant 1 MM1) and 11a (C (V1)-Variant 1 MM2) scores highest for the western section.

These results give a very high level of consistency across the project objectives, and the MCA assessment (including its sensitivity weighted scenarios). Overall, taking both project objectives and MCA into consideration the highest scoring combined route is both:

- Option 4 (P4)-10a (C (V1)-Variant 1 MM1), and
- Option 4 (P4) – 11a (C (V1)-Variant 1 MM2)

Option 3 (P3) provides a second highest scoring option for the eastern section, and could also be coupled with Option 10a or Option 11a.

12.3 BCRs and RMA Consenting

Cost estimates, BCRs and property costs have been presented in Sections 4 to 7 of this report. Of these the BCR is the most likely to be pertinent to the selection of a preferred option, however as discussed earlier in this report (see section 7) the BCR ratios for the respective route are all fairly close. A small number of routes are below a BCR of 2, but all are reasonably close.

The provisions of the RMA and statutory instruments such as Regional and District Plans were also considered, primarily in the respective assessments by the MCA specialists. The difficulty, and potential timeframes, associated with consenting a major infrastructure project can be a key consideration when selecting a preferred route. The approach taken in the MCA has deliberately taken into consideration RMA elements with a view to identifying consenting hurdles, and potential mitigation of effects that could begin to better understand and address consenting hurdle. An outcome of this approach is the mitigation identified in all of the MCA specialist reports.

It can be assumed that all of the options identified in this assessment will present consenting challenges. Those options that scored 'Fatal' would be extremely difficult to secure consents for, and again the MCA provides an indication of this that is relevant to the consideration of consenting.

Any RMA decision making process will undertake the required assessments, including RMA Part 2 assessments. These will take into account the positive benefits of the routes as well as the potential effects on the environment. A full assessment of potential effects and mitigation will need to be completed as part of an AEE and resource consent (or designation) application process. The scale of effects and best approaches to address these will be better understood at that time.

For the purposes of this assessment, the focus has been on completing an assessment of option against identified project objectives, and a MCA analysis to understand which route option will be meet the

needs of the Transport Agency and transport network, while still managing adverse environmental effect as far as is practicable.

12.4 Surplus Material and Fill Sites

A series of appropriate fill sites have been identified. This assessment has identified the order in which the identified fill sites could most approximately be used, and the ultimate extent of fill and final form of these sites. The assessment of these sites was undertaken in conjunction with the assessment of the option routes, ensuring the where these are in close proximity to each other adequate mitigation and/or benefits can be derived. The preferred order of use of the fill sites is as follows:

1. Linc 2 (Version 2)
2. Site K (Version 2)
3. Site L
4. Linc 1 (Version 2)
5. Site M (Version 2)

Notwithstanding the above, the availability of these fill sites is largely neutral with respect to route selection. If these sites are not all available or if additional capacity is necessary, the project team is confident that further appropriate fill sites can be identified. Route choice is thus not dependent upon availability of specific fill sites and the respective generation of fill that requires disposal elsewhere is not itself part of the MCA process. Note that some consequential environmental effects associated with earthworks (such as large-scale earthworks from cuts) have already been assessed as part of the MCA process for each route.

At the time this assessment was completed it was unclear which of the identified fill sites might be available as appropriate negotiations and agreements had not been concluded. The use and availability of the fill sites and associated mitigation of effects should be further considered as part of successive stages of design and assessment of any preferred or selected route.

13 Recommendations

13.1 Take Option 4-10a or 4-11a Forward to the Next Stage

It is recommended that the NZTA take forward a combination of Option 4 (P4) and either Option 10a C (V1) Variant 1 MM2 or Option 11a C (V1) Variant 1 MM2 as the preferred route for the P2G connection.

As set out above, these routes consistently scored strongly across the range of MCA and project objectives assessments undertaken.

It should be noted that these options generate a significant quantity of fill. In particular, Option 4 (P4) generates the most excess fill of all the "east of the crest" options. However, based on the findings discussed earlier in this report (particularly at section 9), it is not considered that other options should be preferred on the basis of the relative amounts of fill generated by each option. It is noted that a

combination of Option 4 (P4) and either Option 10a C (V1) Variant 1 MM2 or Option 11a C (V1) Variant 1 MM2 would generate slightly less fill than the total that can be accommodated in all of the five identified and assessed fill sites.

If the NZTA wishes to exclusively prioritise transport and resilience considerations, it should consider taking forward Option 3 (P3) in combination with a "D" option (possibly Option 23 (D (V2)) which scored best under the "transport" MCA weighting). However, the "D" options did not perform well against most assessments, which reflects the poor performance of those options when potential adverse environmental effects are taken into account. The experts identified a range of additional adverse environmental effects that the construction of the Takapu Valley road would bring over and above the other options.

13.2 Continued Responsive Multi-Disciplinary Design Approach

It is also recommended that the Transport Agency continue to engage with environmental specialists during the development of the next stage, and involve these specialists early so as to optimise the potential for mitigation to continue to be designed into the route. This will assist in avoiding, remedying or mitigating potential environmental impacts, and may assist the proposal to assess eventual consenting hurdles pursuant to the RMA.

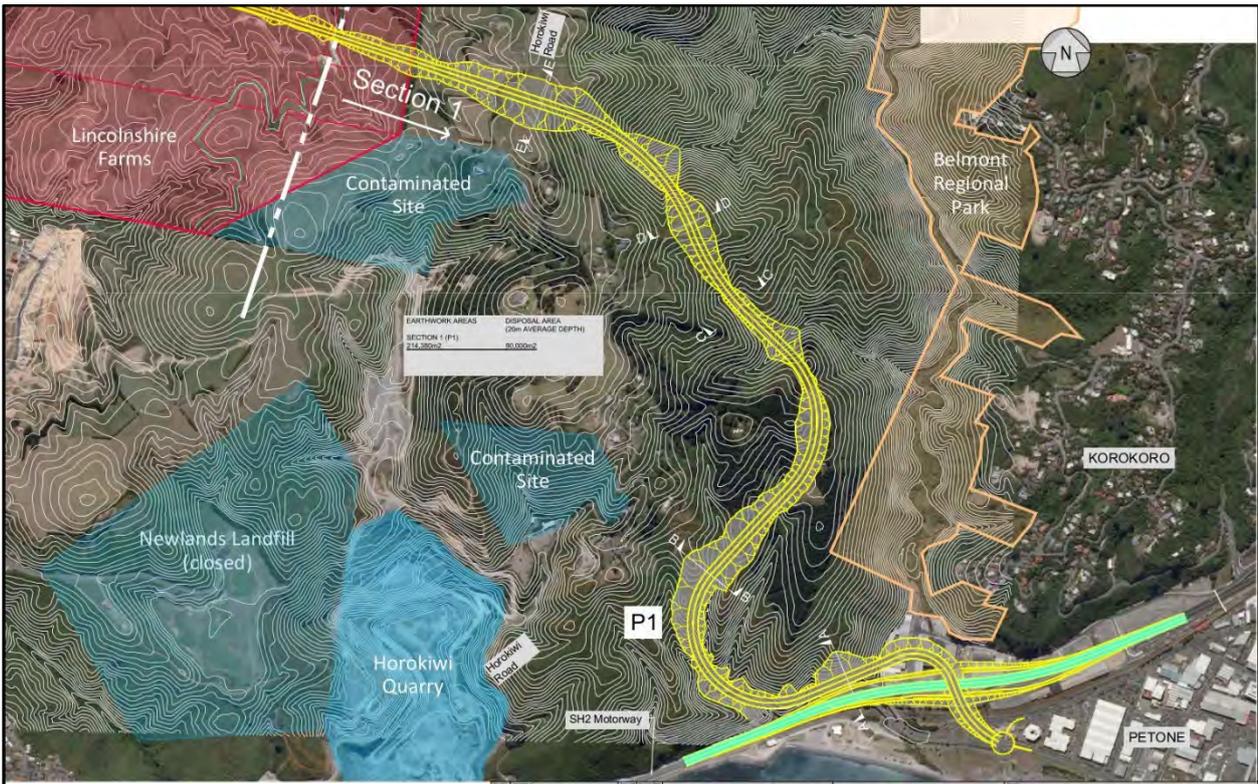
13.3 Maintain Options for Disposal of Fill

Although this work has identified potential sites for the disposal of fill, these sites are in private ownership and the level of surplus material generated by the highest scoring route combinations (Option 4 – 10a or Option 4 – 11a) is significant at approximately 10m m³ (refer to the table in Appendix A for surplus material generated by each option) The route itself does not depend upon any particular site for the disposal of material and with this in mind options for the disposal of such material should be kept open in case any of the identified sites in this report are not available when required.

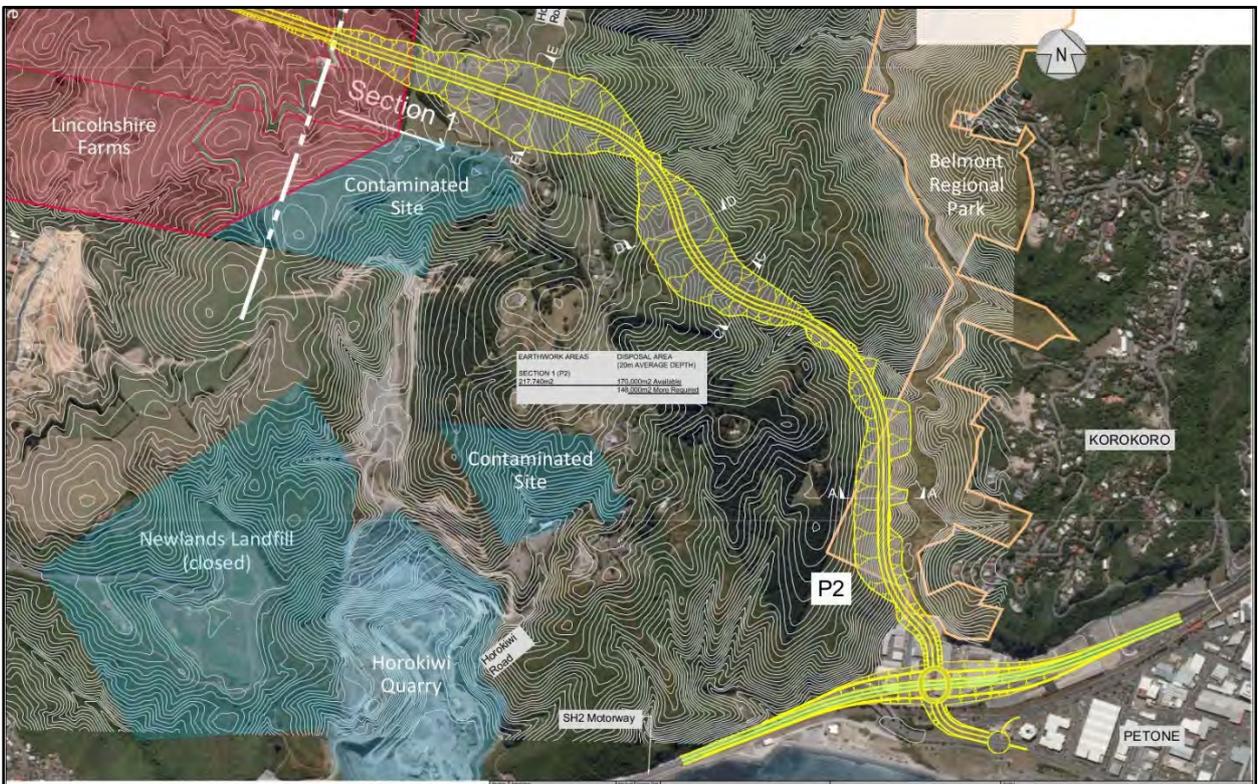
Appendix A - The Options

Note 1: Options 5 to 23 in the figures below are combined with Option 4 (P4) below for sake of continuity and context. Options 1 to 4 (P1 to P4) are interchangeable with Options 5 to 23 respectively, and vice versa.

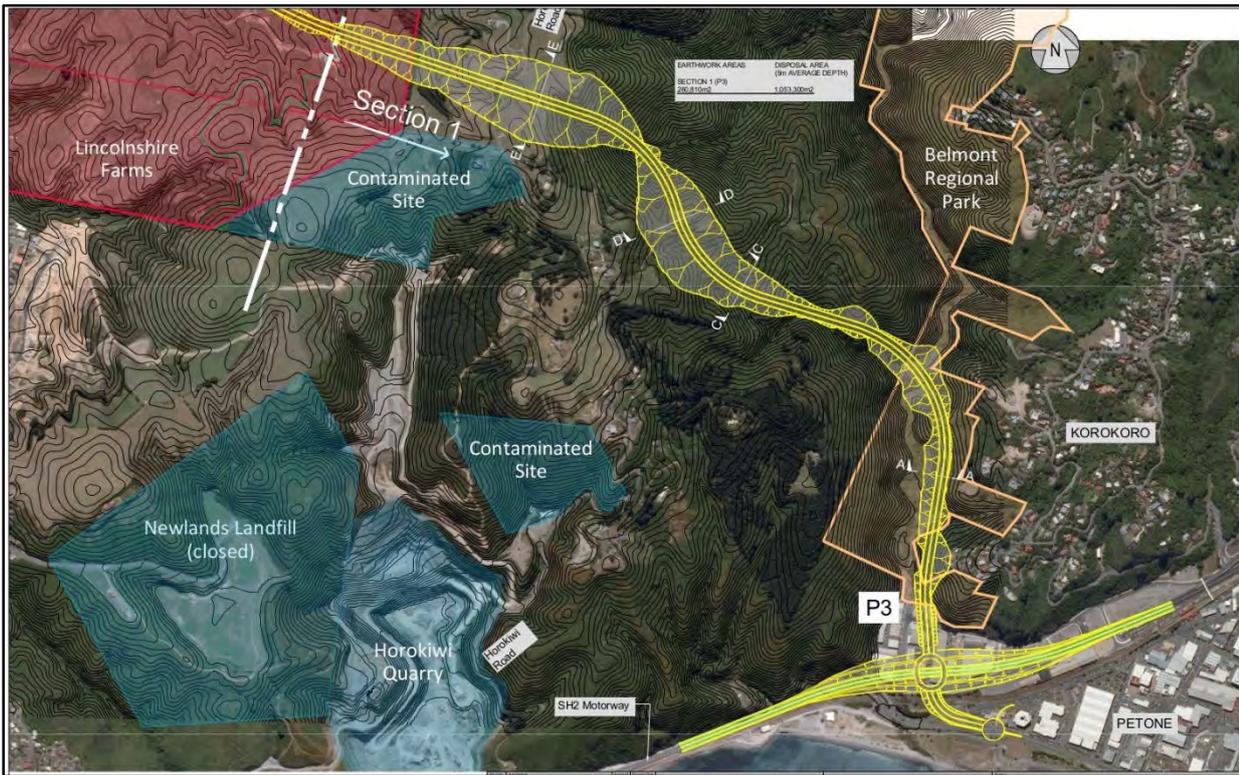
Note 2: Options 1 to 3 (P1 to P3) show a different interchange at Petone to Option 4 (P4). The interchange shown on Option 4 is the current form of the proposed interchange.



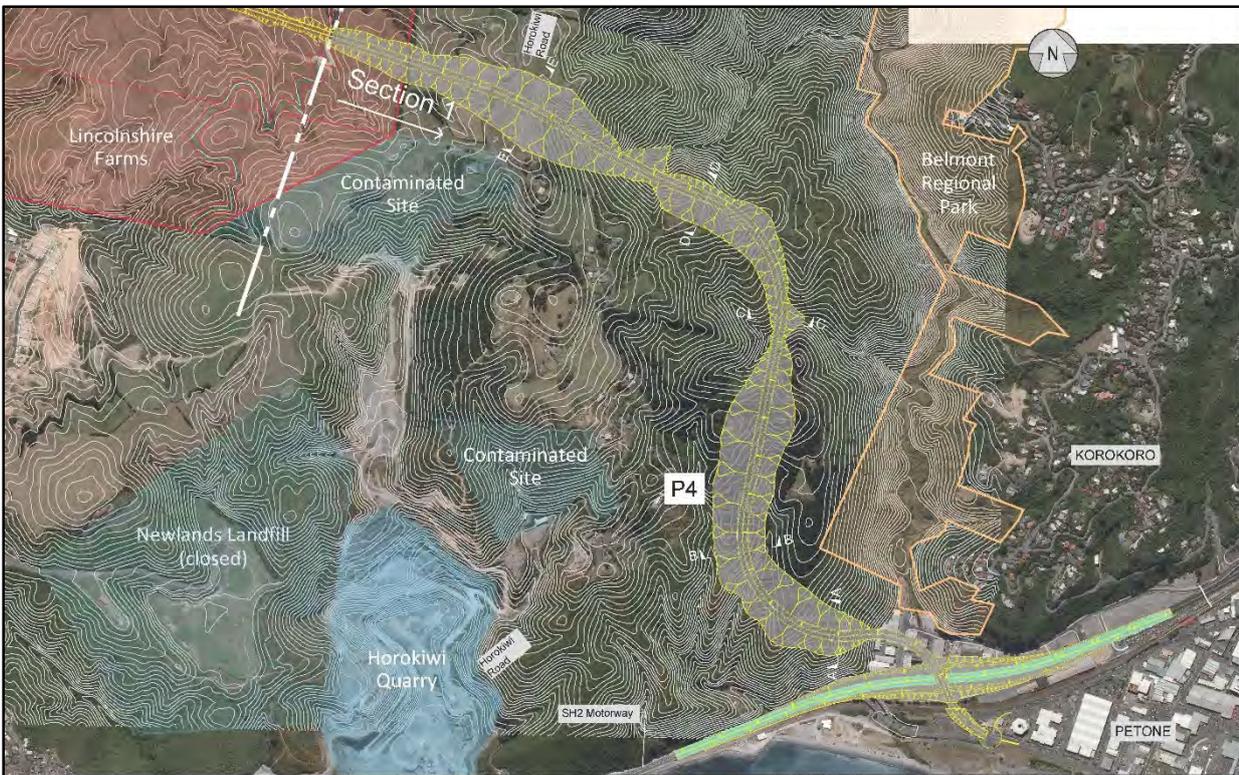
1. Option P1



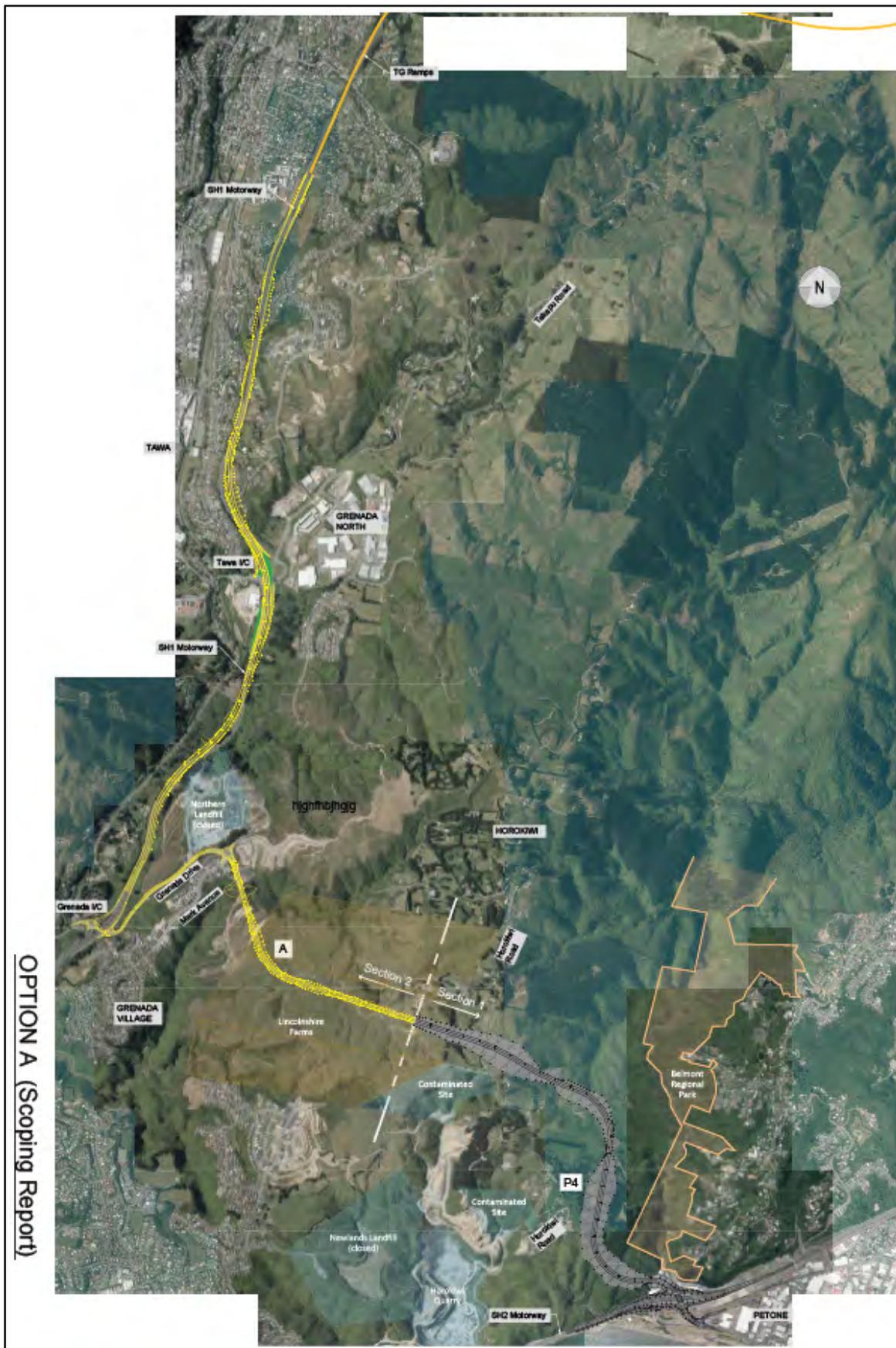
2. Option P2



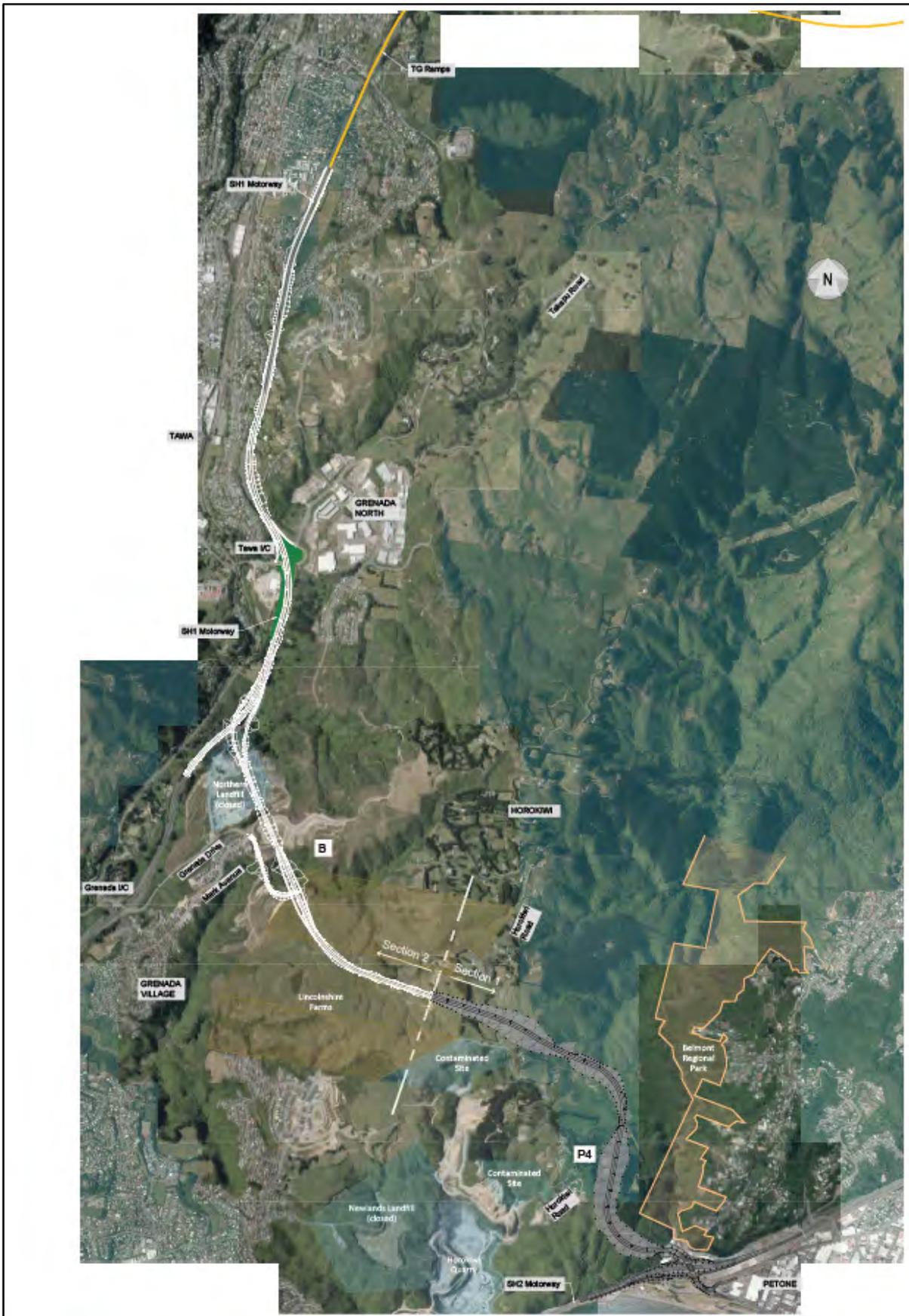
3. Option P3



4. Option P4



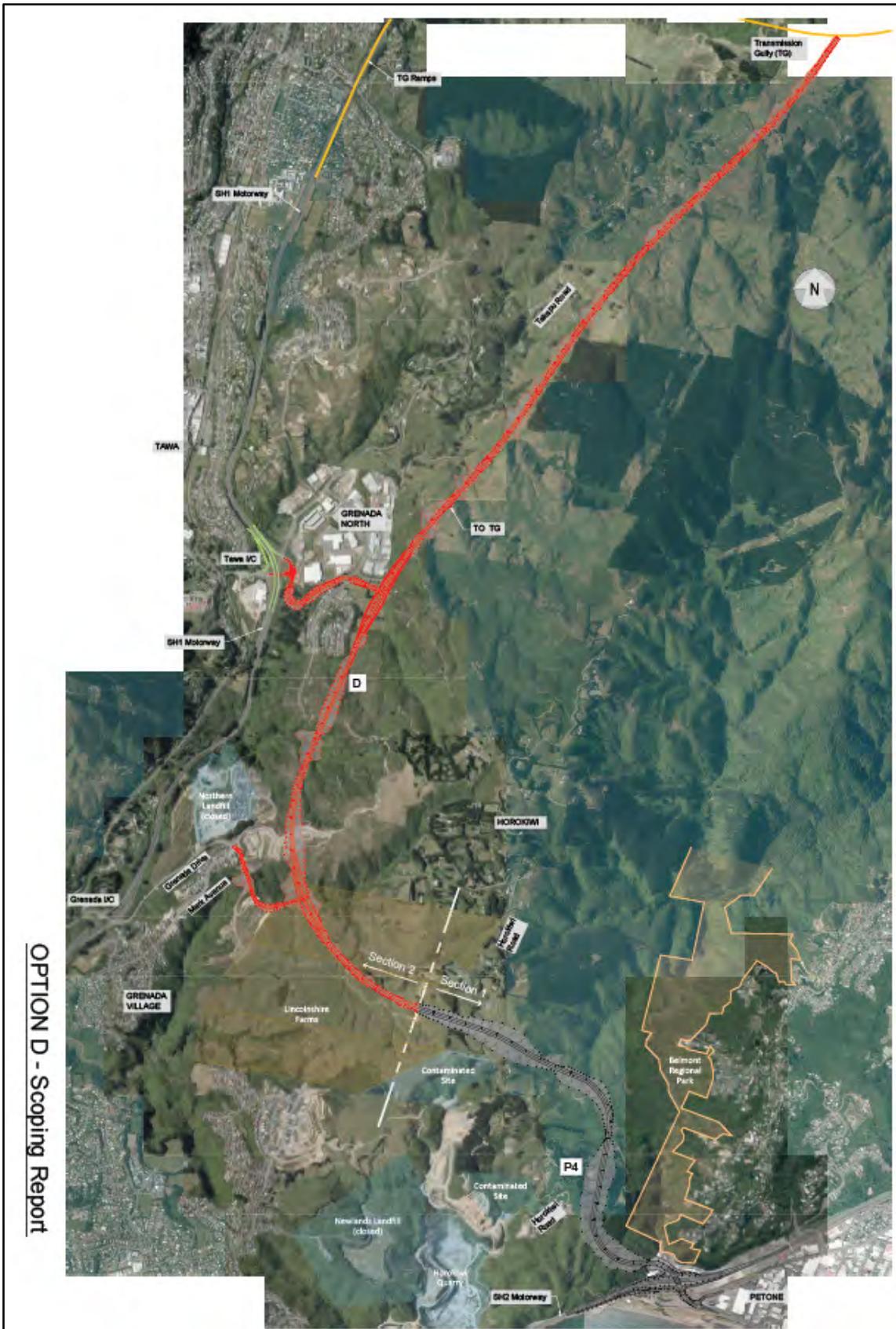
5. Option A



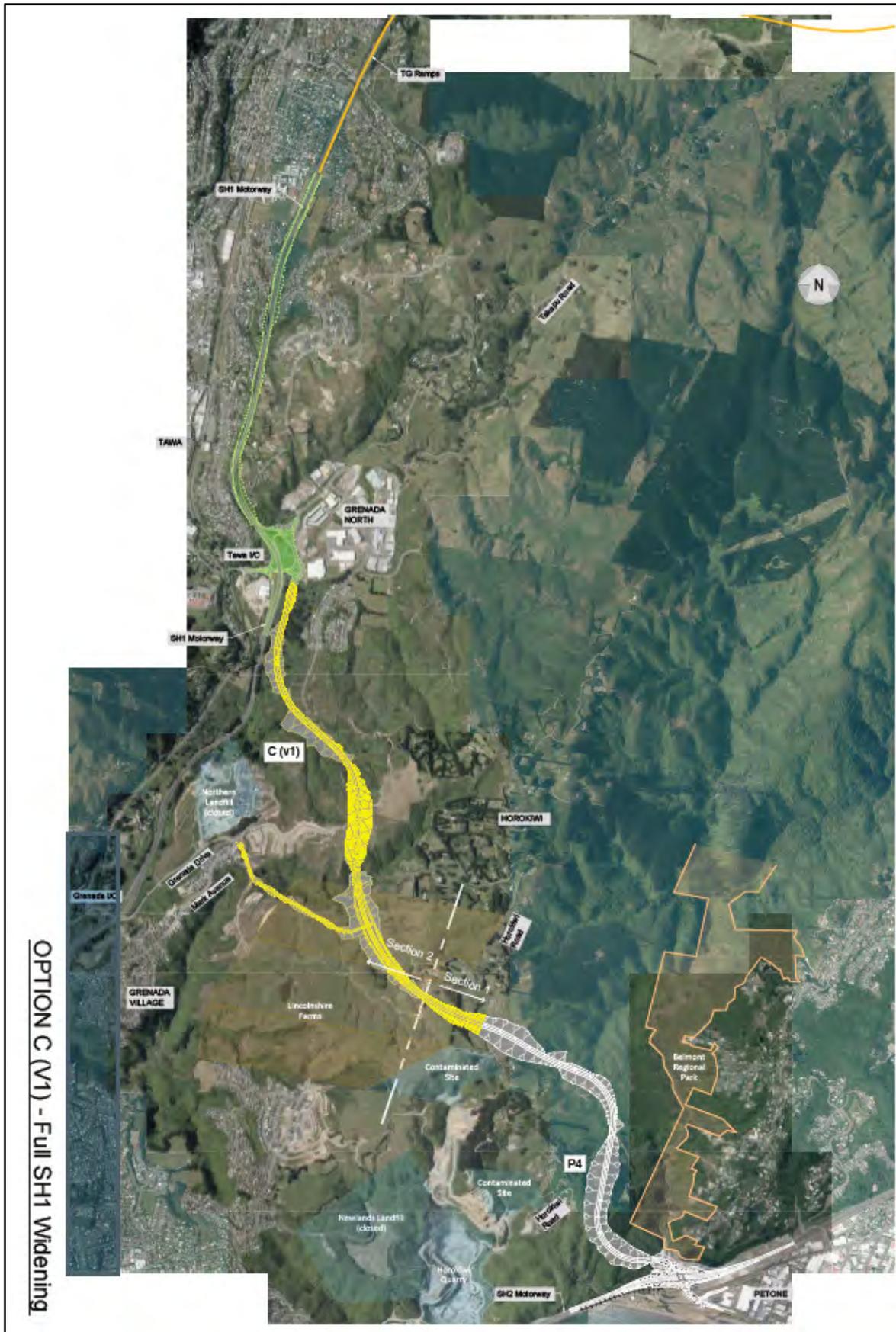
6. Option B



7. Option C

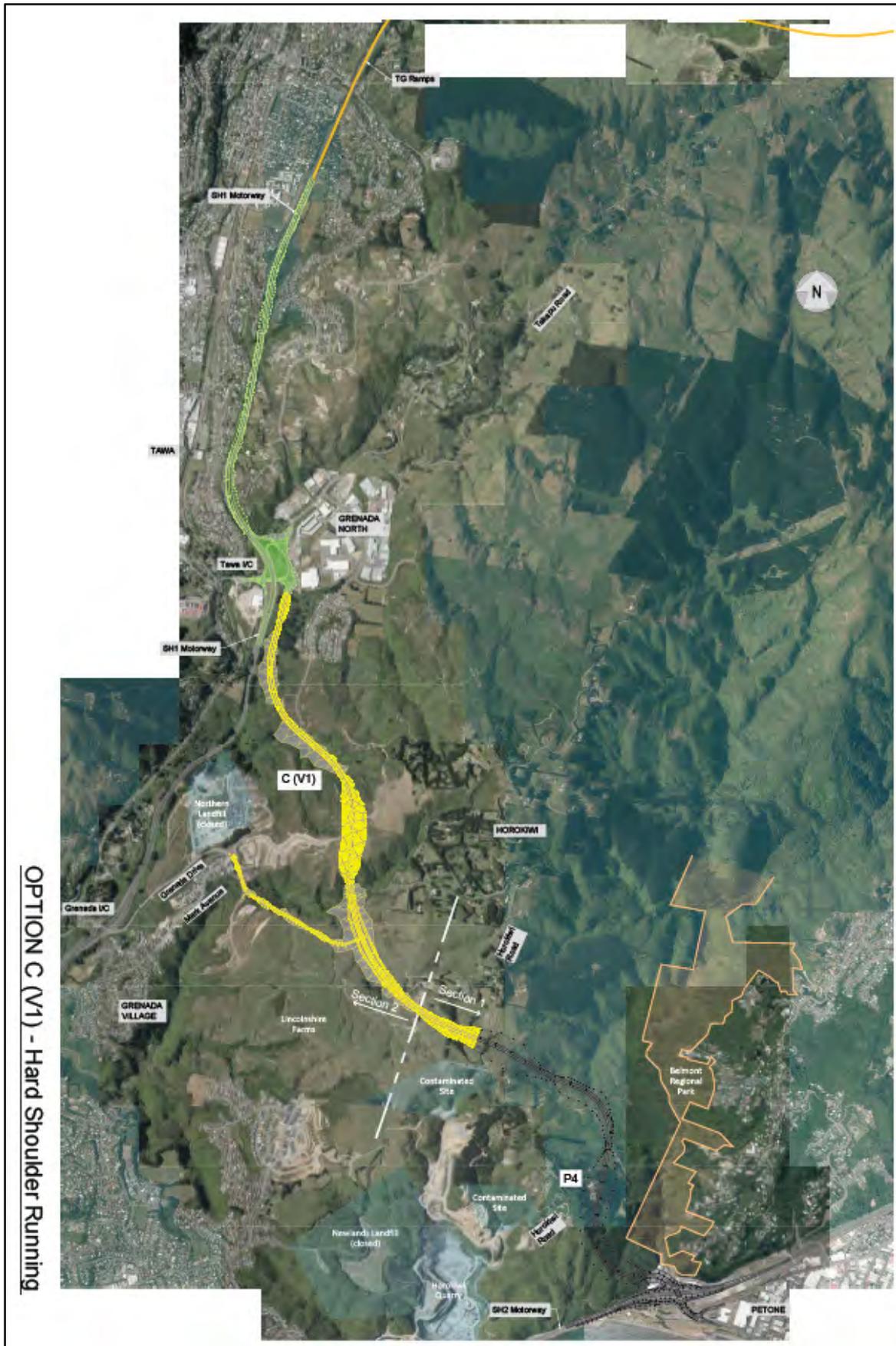


8. Option D

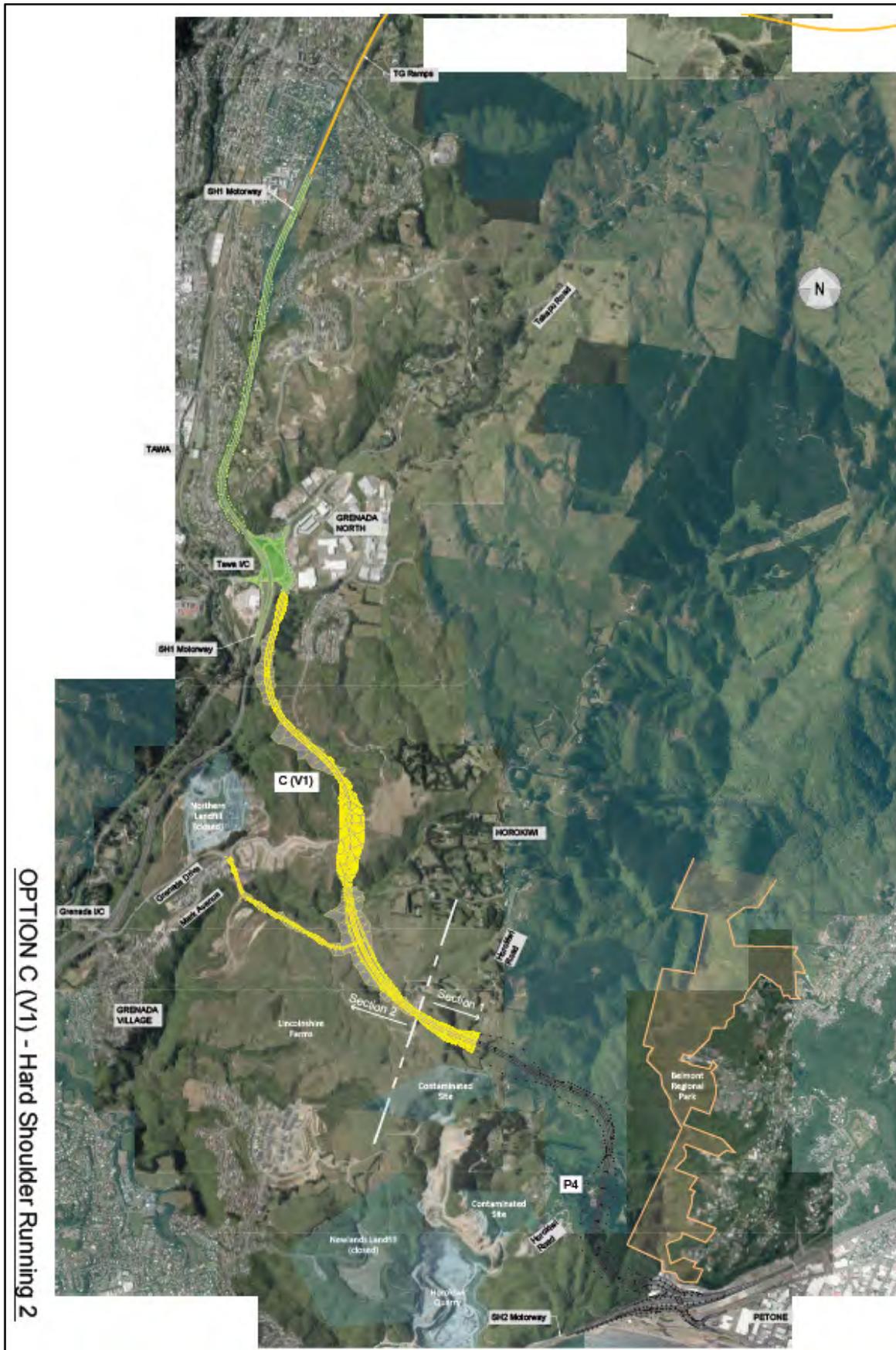


OPTION C (V1) - Full SH1 Widening

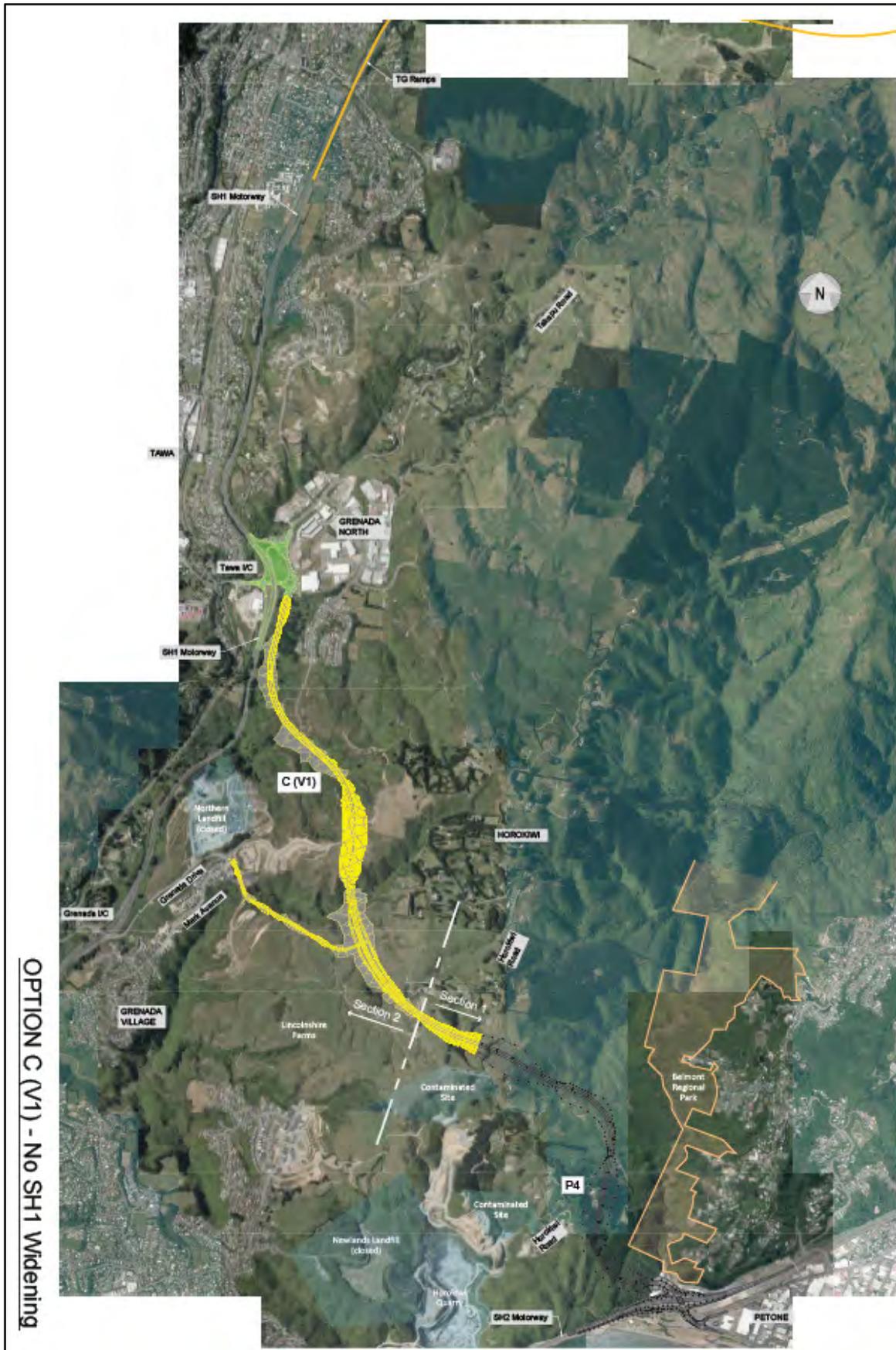
9. Option C (V1) Full SH1 Widening



10. Option C (V1) Managed Motorway 1

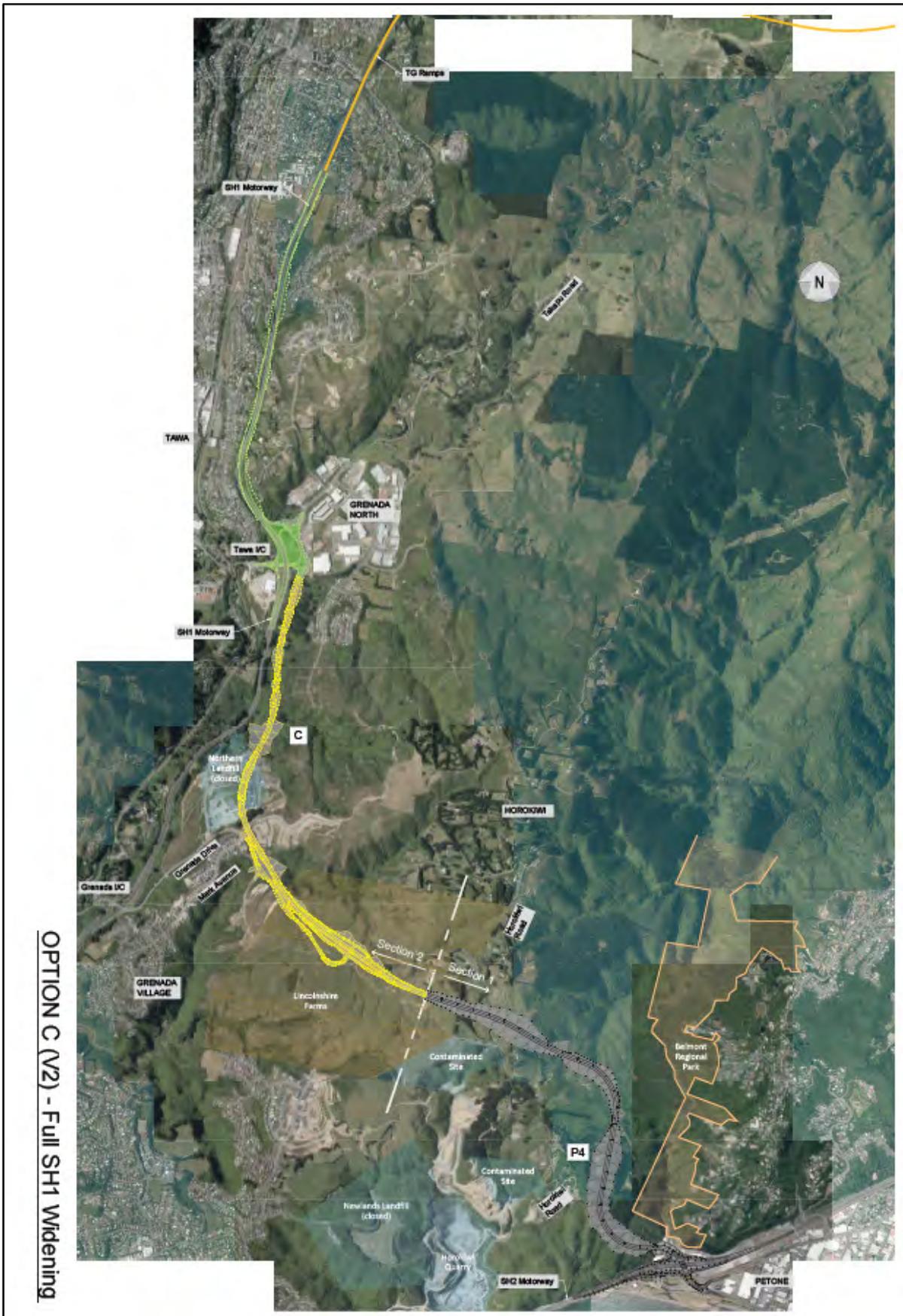


11. Option C (V1) Managed Motorway 2

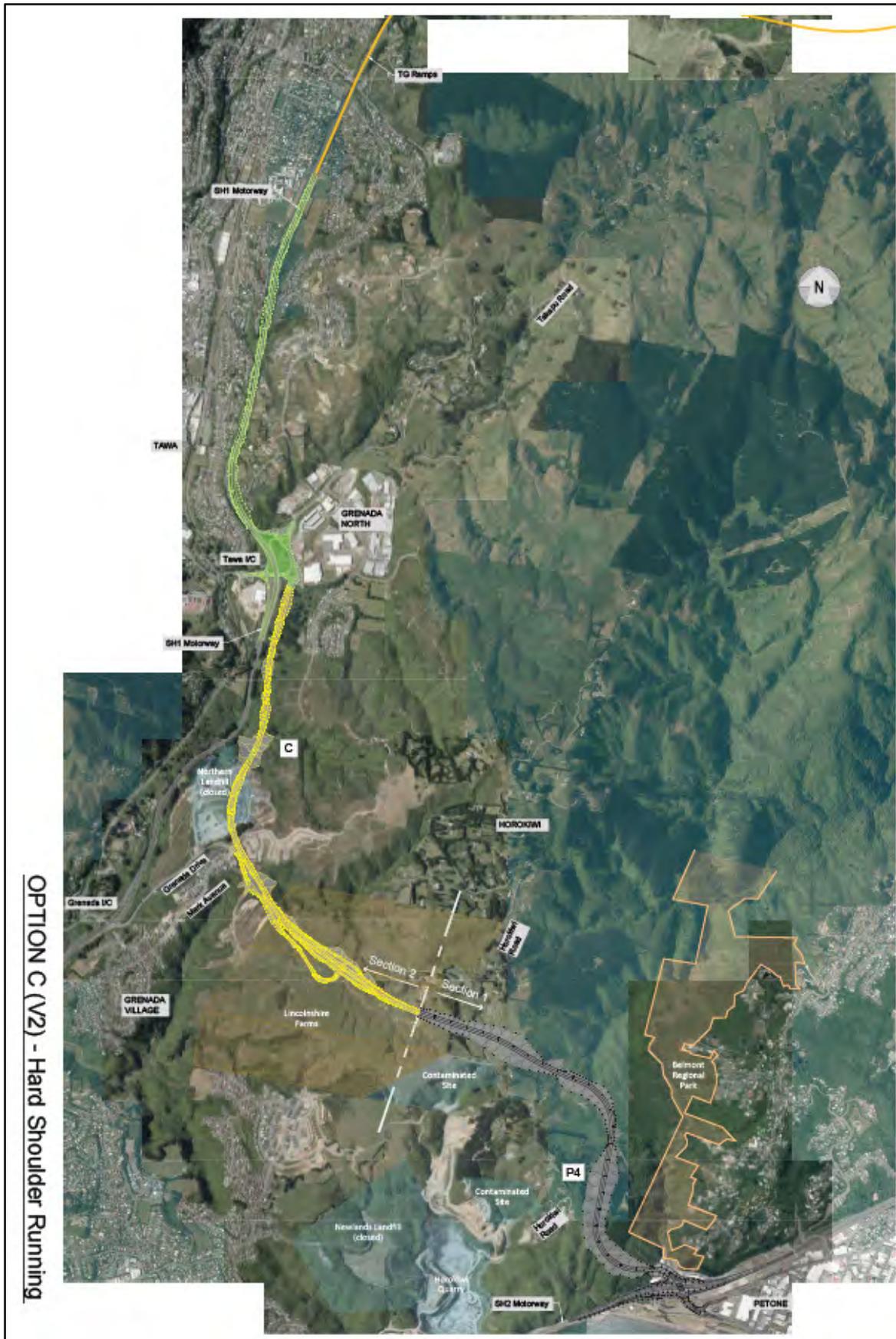


OPTION C (V1) - No SH1 Widening

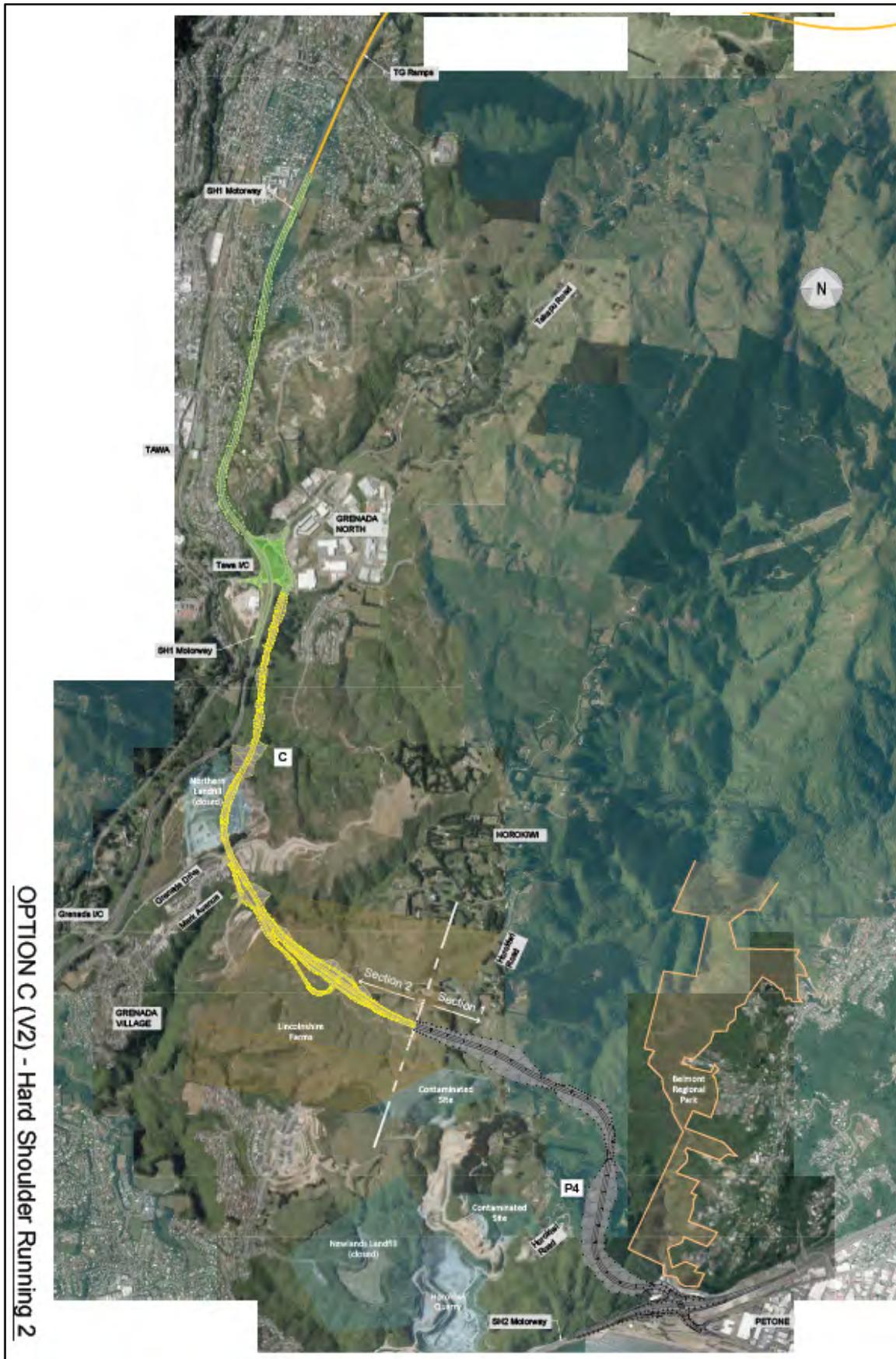
12. Option C (V1) No SH1 Widening



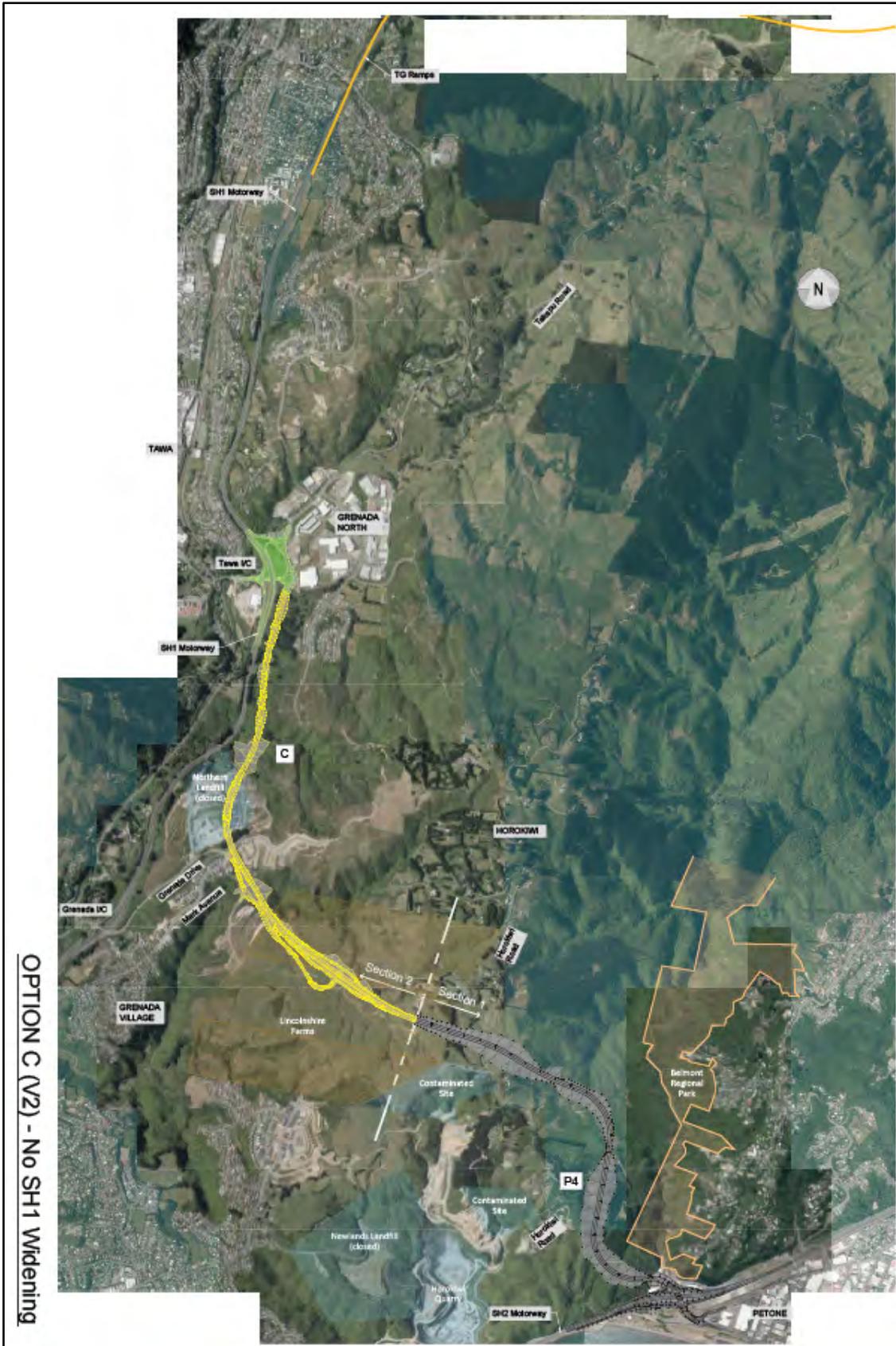
13. Option C (V2) Full SH1 Widening



14. Option C (V2) Managed Motorway 1



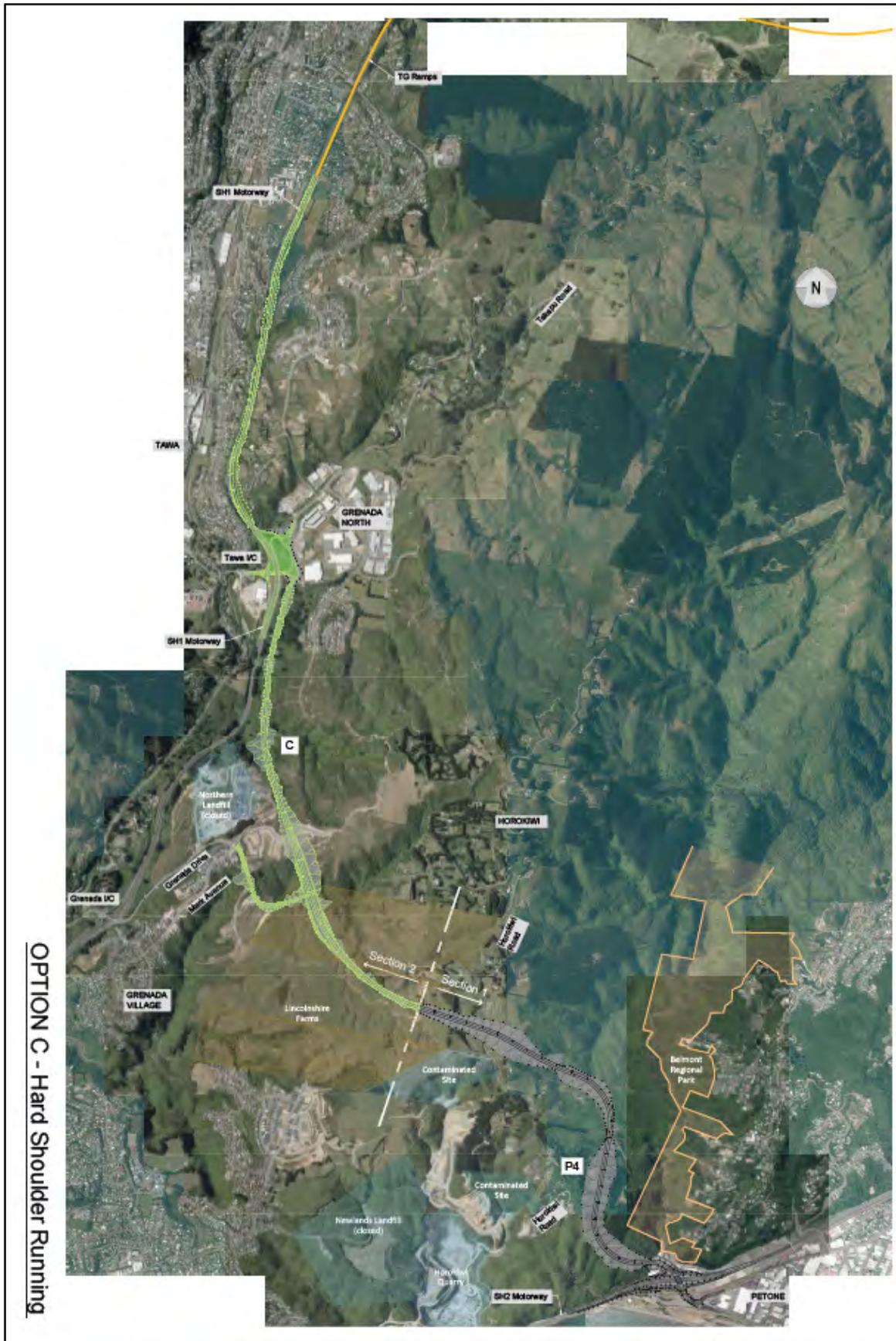
15. Option C (V2) Managed Motorway 2



16. Option C (V2) No SH1 Widening



17. Option C Full SH1 Widening



18. Option C Managed Motorway 1



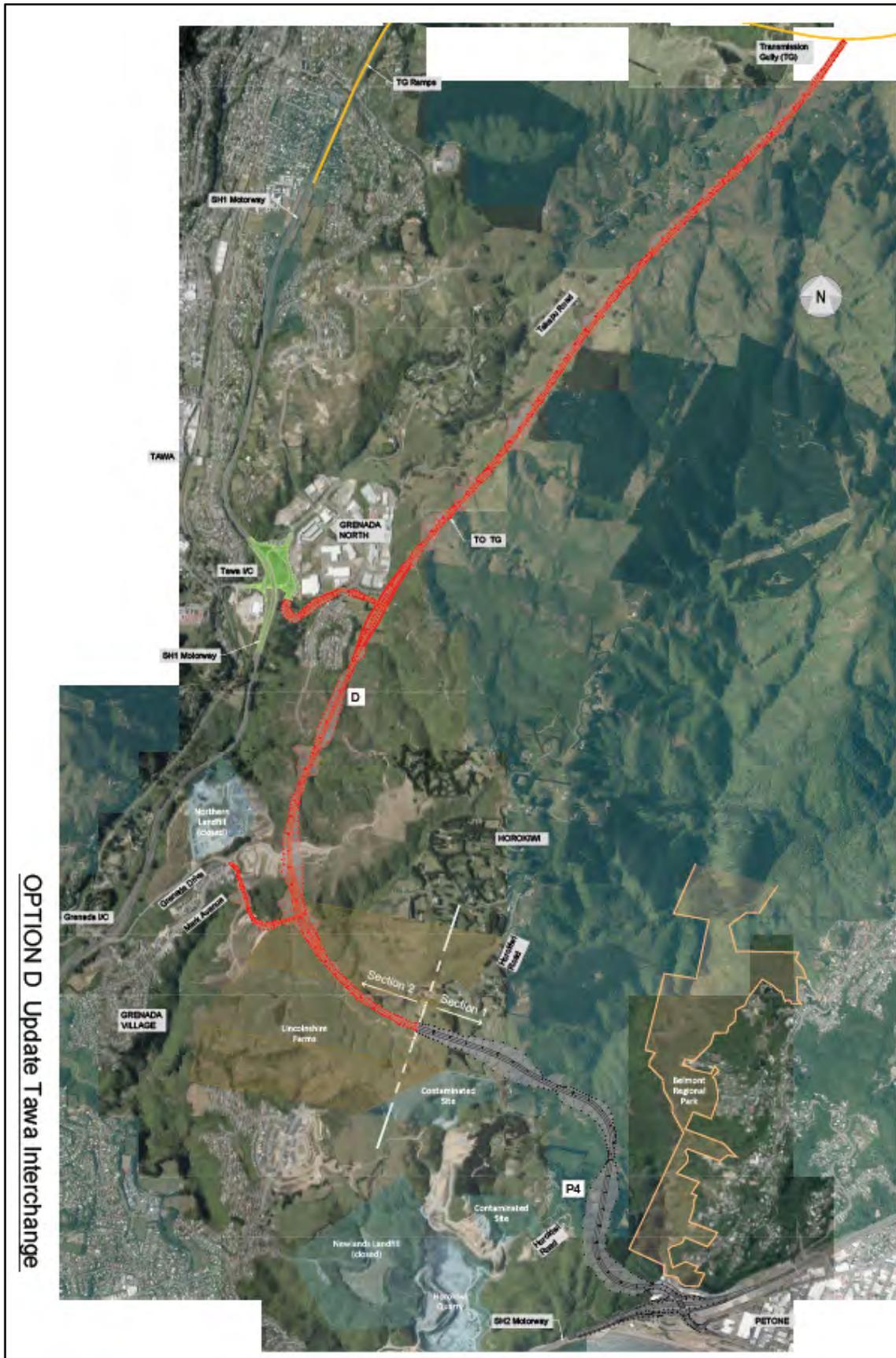
OPTION C - Hard Shoulder Running 2

19. Option C Managed Motorway 2



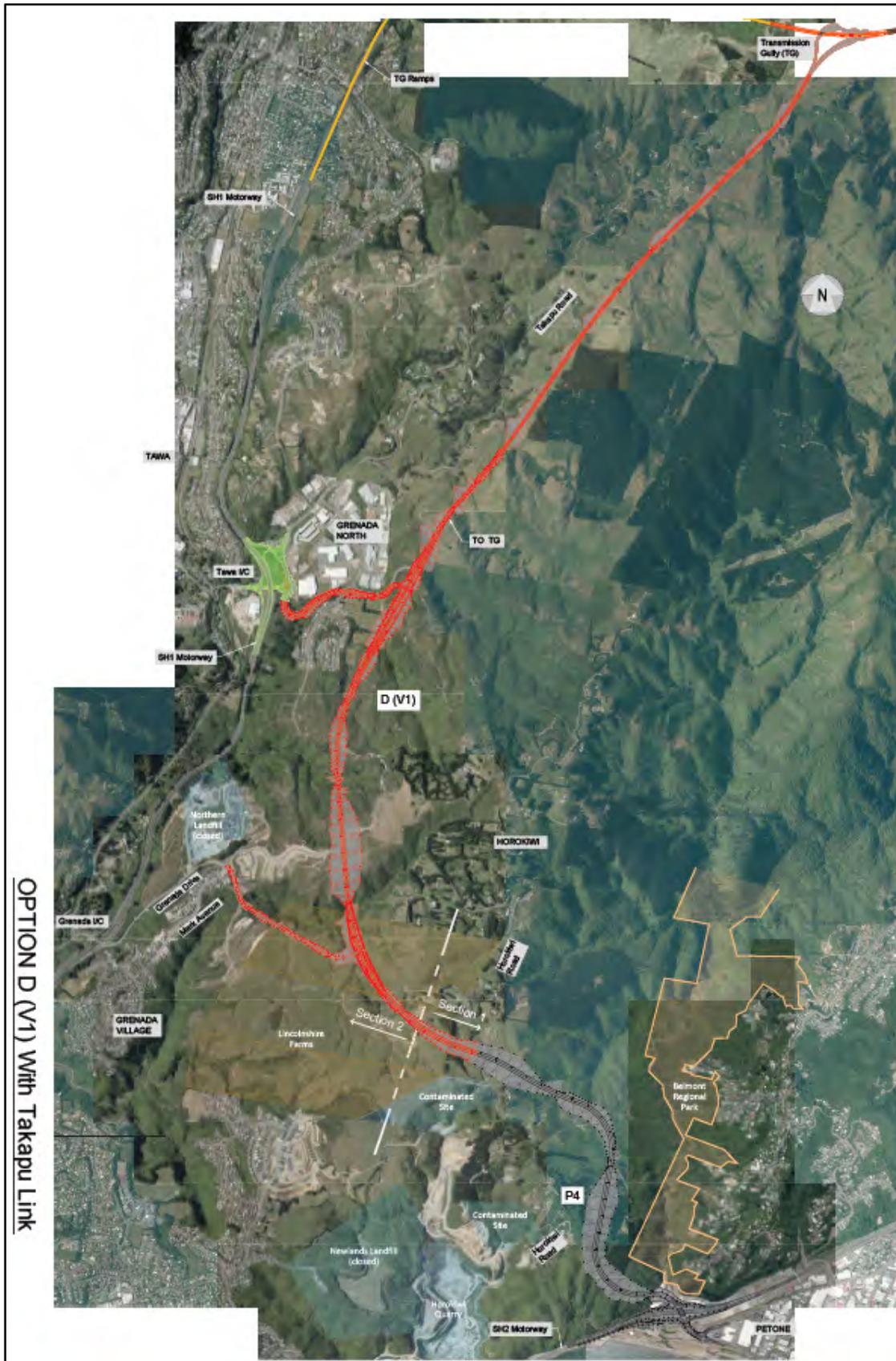
OPTION C - No SH1 Widening

20. Option C No SH1 Widening

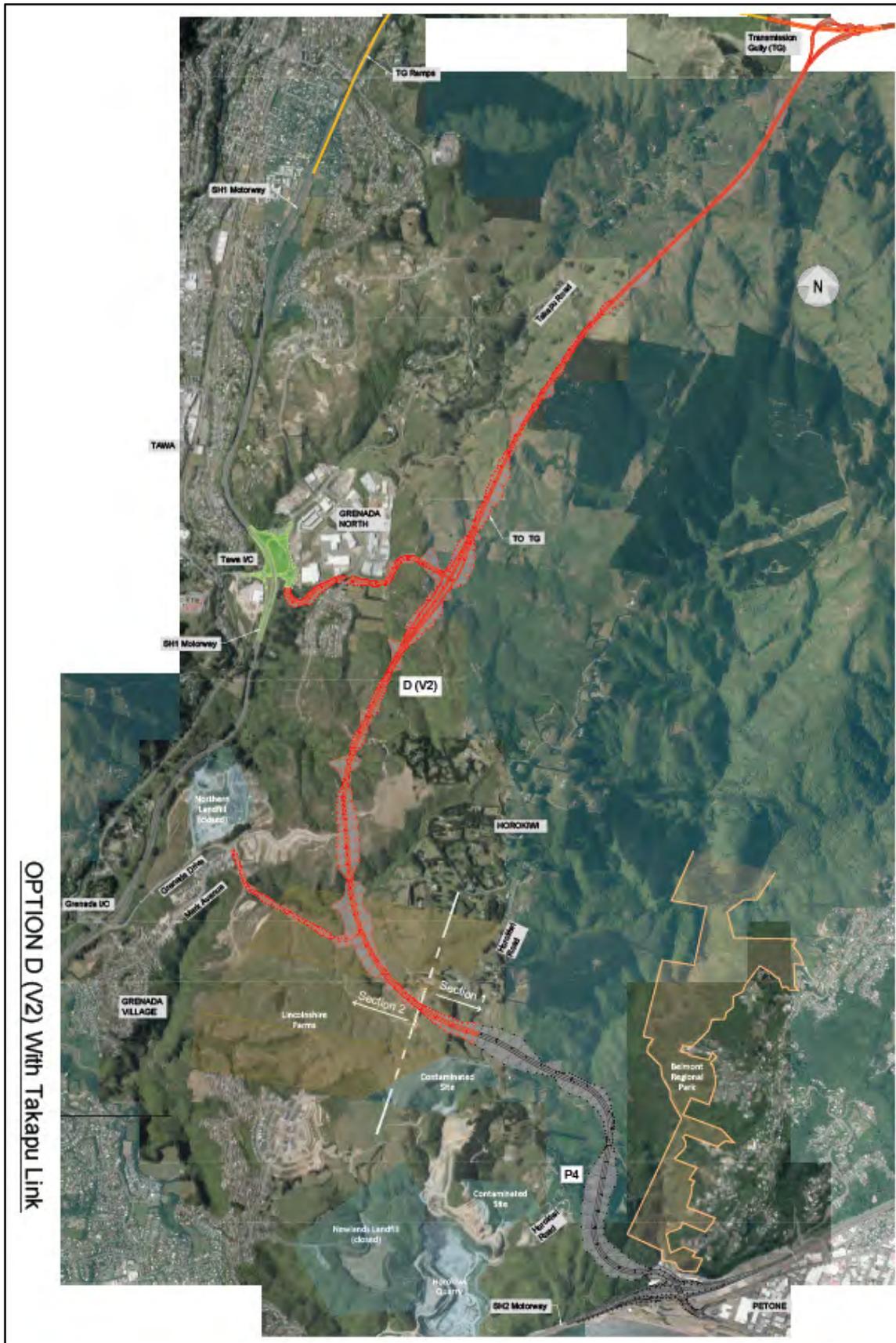


OPTION D Update Tawa Interchange

21. Option D Update Tawa IC



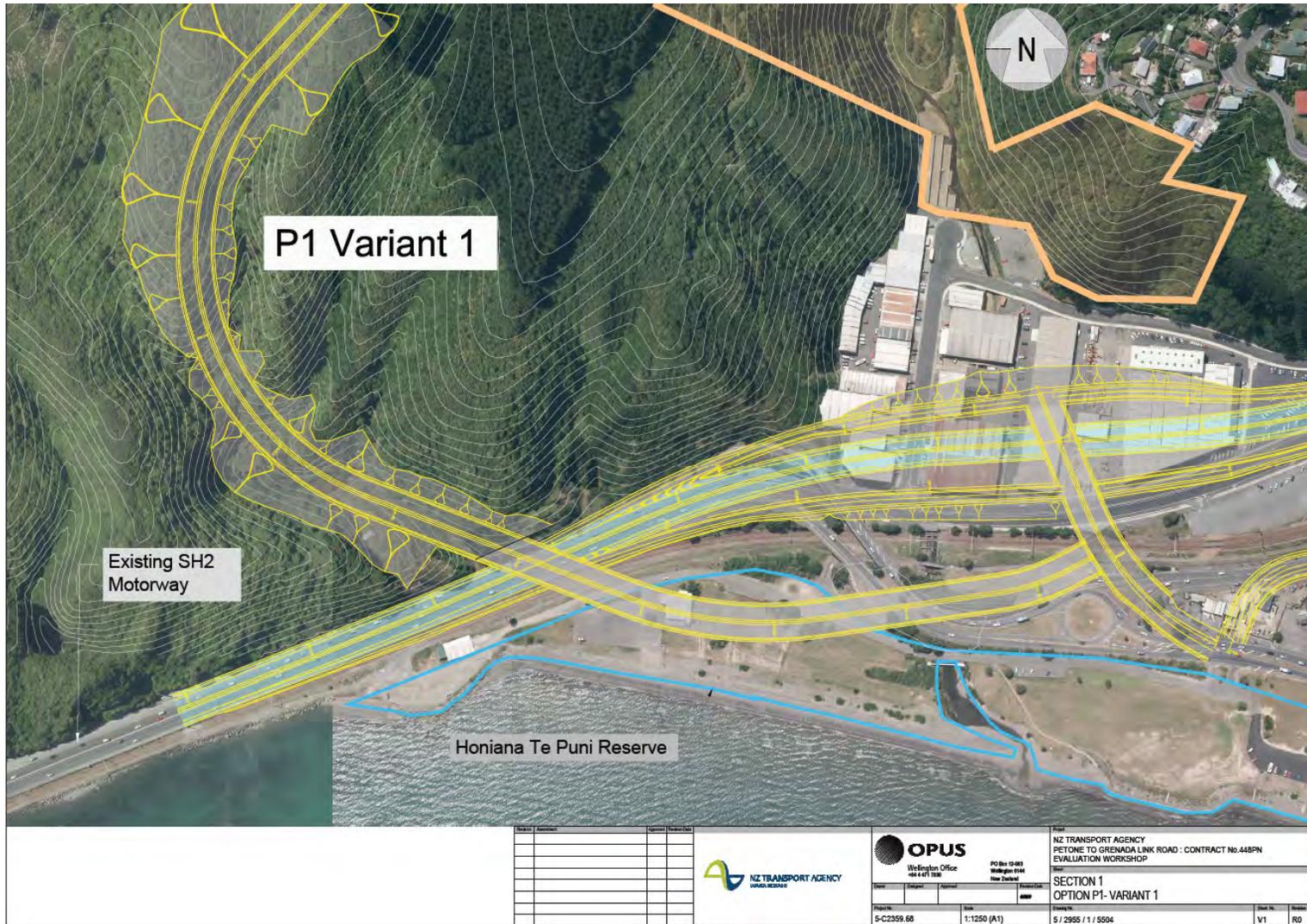
22. Option D (V1)



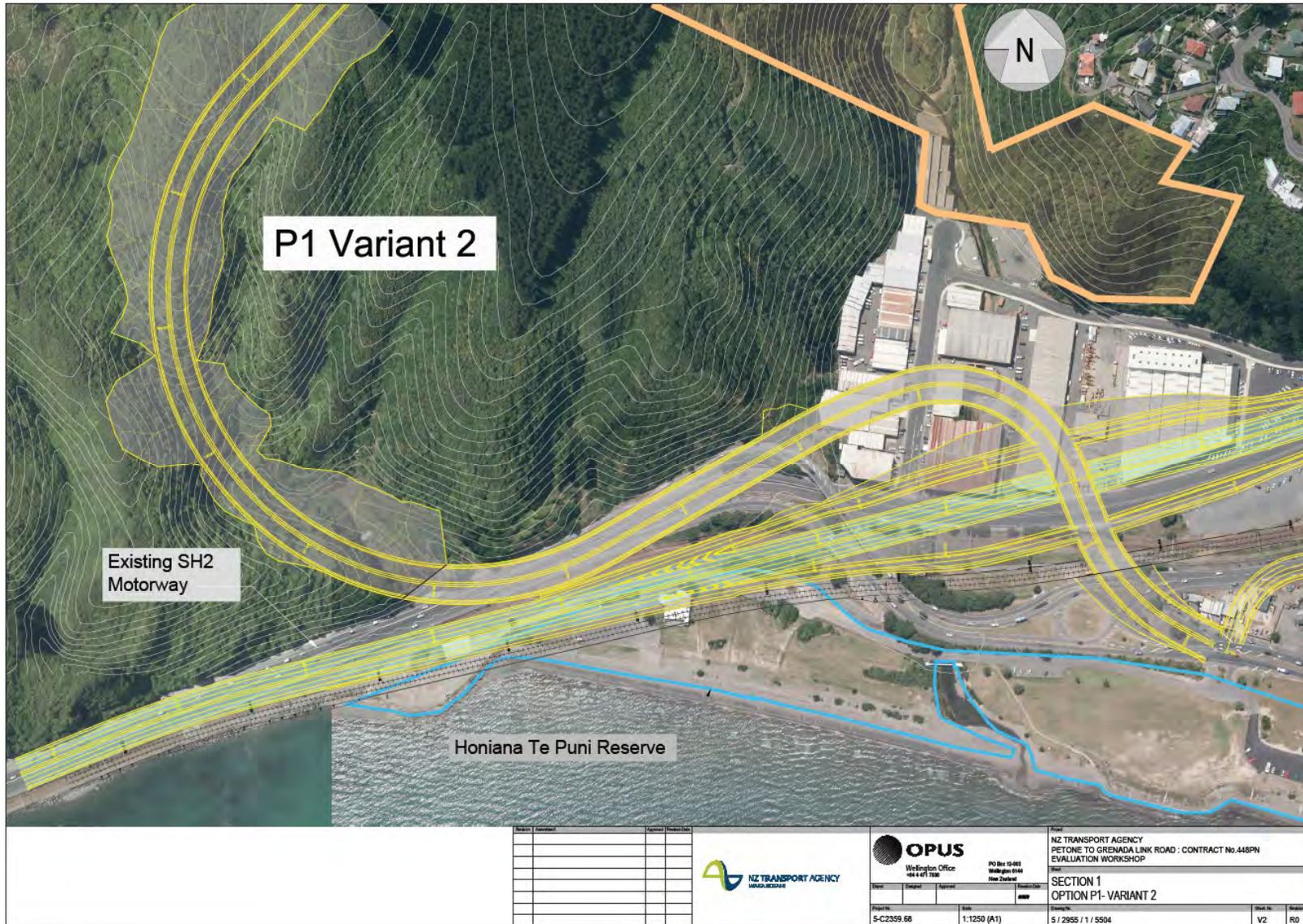
OPTION D (V2) With Takapu Link

23. Option D (V2)

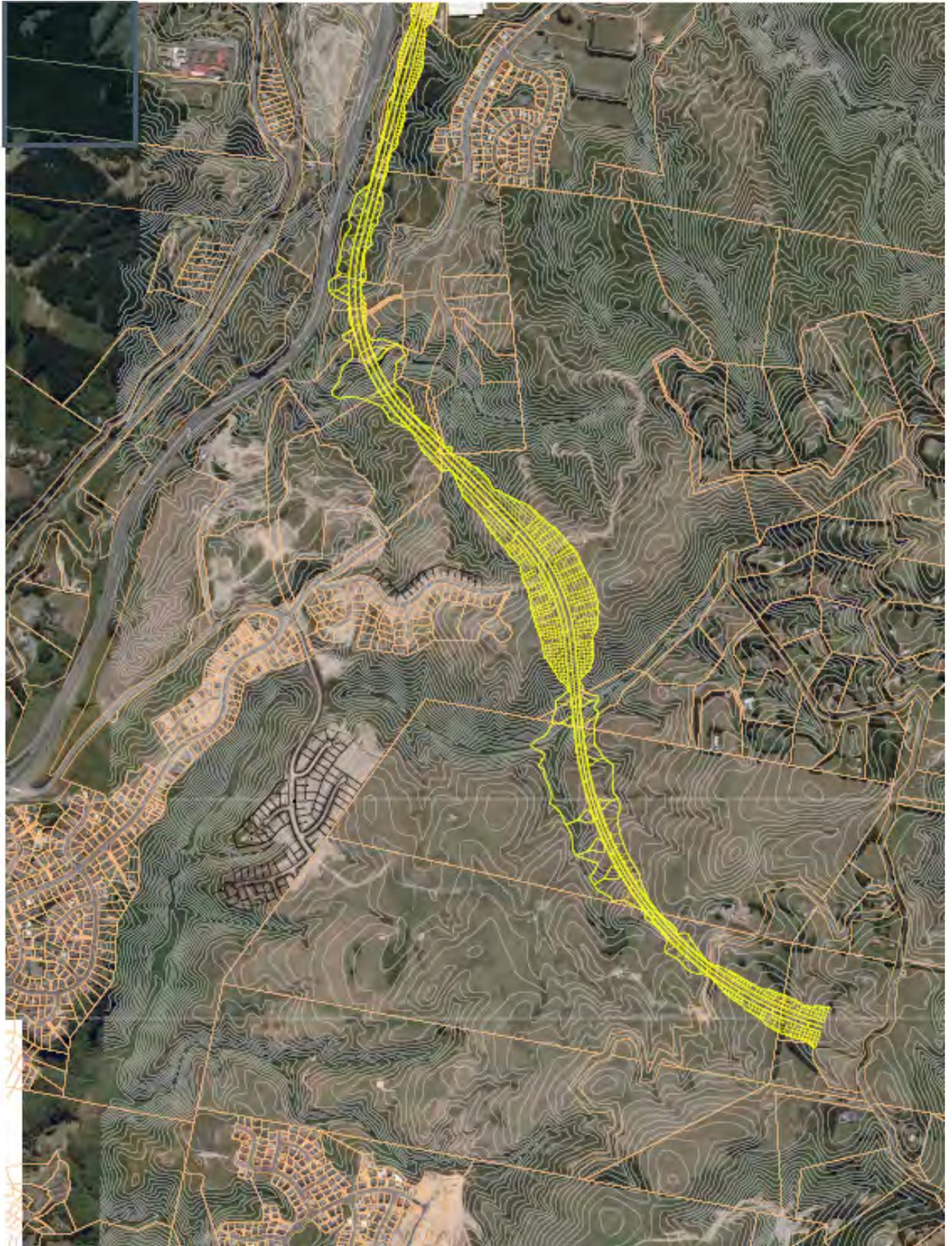
Petone to Grenada Assessment of Alternative Options



1a. Option P1 – Variant 1



1b. Option P1 – Variant 2



9a to 12a. Option C (V1) – Variant 1

Petone to Grenada Assessment of Alternative Options

Option		Earthwork Volumes (m ³)			
		Cut (m ³)	Fill (m ³)	Surplus Fill (m ³)	Upper Bound Surplus Fill (m ³)**
1	P1 (Scoping)	2,750,000	940,000	1,810,000	2,100,000
1a	P1 Variant 1*	2,750,000	940,000	1,810,000	2,100,000
1b	P1 Variant 2*	2,750,000	940,000	1,810,000	2,100,000
2	P2 (Scoping)	6,680,000	320,000	6,360,000	7,300,000
3	P3 (Scoping)	6,300,000	1,030,000	5,270,000	6,100,000
4	P4 (Scoping)	8,110,000	90,000	8,030,000	9,200,000
5	A (Scoping)	630,000	400,000	240,000	300,000
6	B (Scoping)	880,000	850,000	30,000	35,000
7	C (Scoping)	2,230,000	1,040,000	1,190,000	1,400,000
8	D (Scoping)	2,090,000	2,520,000	-430,000	n/a
9	C (V1) Full SH1 Widening	2,460,000	3,140,000	-680,000	n/a
9a	C(V1)-Variant 1	3,050,000	2,370,000	680,000	800,000
10	C (V1) Managed Motorway 1	2,410,000	3,090,000	-680,000	n/a
10a	C(V1)-Variant 1 MM1	3,000,000	2,330,000	670,000	800,000
11	C (V1) Managed Motorway 2	2,290,000	3,090,000	-800,000	n/a
11a	C(V1)-Variant 1 MM2	2,870,000	2,320,000	550,000	600,000
12	C (V1) No SH1 Widening	2,260,000	3,070,000	-810,000	n/a
12a	C(V1)-Variant 1 No SH1 Upgrade	2,850,000	2,310,000	550,000	600,000
13	C (V2) Full SH1 Widening	2,970,000	2,960,000	10,000	n/a
14	C (V2) Managed Motorway 1	2,910,000	2,920,000	-10,000	n/a
15	C (V2) Managed Motorway 2	2,790,000	2,910,000	-120,000	n/a
16	C (V2) No SH1 Widening	2,770,000	2,900,000	-130,000	n/a
17	C Full SH1 Widening	2,230,000	1,040,000	1,190,000	1,400,000
18	C Managed Motorway 1	2,180,000	1,000,000	1,180,000	1,400,000
19	C Managed Motorway 2	2,060,000	990,000	1,060,000	1,200,000
20	C No SH1 Widening	2,030,000	980,000	1,060,000	1,200,000
21	D Update Tawa IC	2,090,000	2,520,000	-430,000	n/a
22	D (V1)	5,580,000	1,990,000	3,590,000	4,100,000
23	D (V2)	4,790,000	3,060,000	1,730,000	2,000,000

*Note – The earthworks volumes for these options are assumed to be similar to Option 1 (P1)

**Note – The Upper Bound surplus volumes assume 15% over the surplus fill volumes

Figure 1a shows that Options 7 (C) and 8 (D) from the crest of the Wellington escarpment to Transmission Gully. Option 1 (P4) is shown from Petone to the crest of the Wellington escarpment but is not considered in this section.

The variations of Options 7 (C) and 8 (D) are considered in two sections as follows:

- Section 2: The crest of the Wellington escarpment and Tawa;
- Section 3: Tawa and Transmission Gully

Within Section 2 the following variations are presented:

- 2 variations of Option 7 (C) between The crest of the Wellington escarpment and Tawa
- 2 variations of Option 8 (D) between The crest of the Wellington escarpment and Tawa

Similarly within Section 3 the following variations are presented:

- 2 variations of Option 7 (C) between Tawa and Transmission Gully
- 2 variations of Option 8 (D) between Tawa and Transmission Gully

These are described below.

Section 2: Option Variations Between The crest of the Wellington escarpment and Tawa

This section describes the refinements to Options 7 (C) and 8 (D) between the crest of the Wellington escarpment and Tawa. For clarity this section is shown in Figure 2b below.

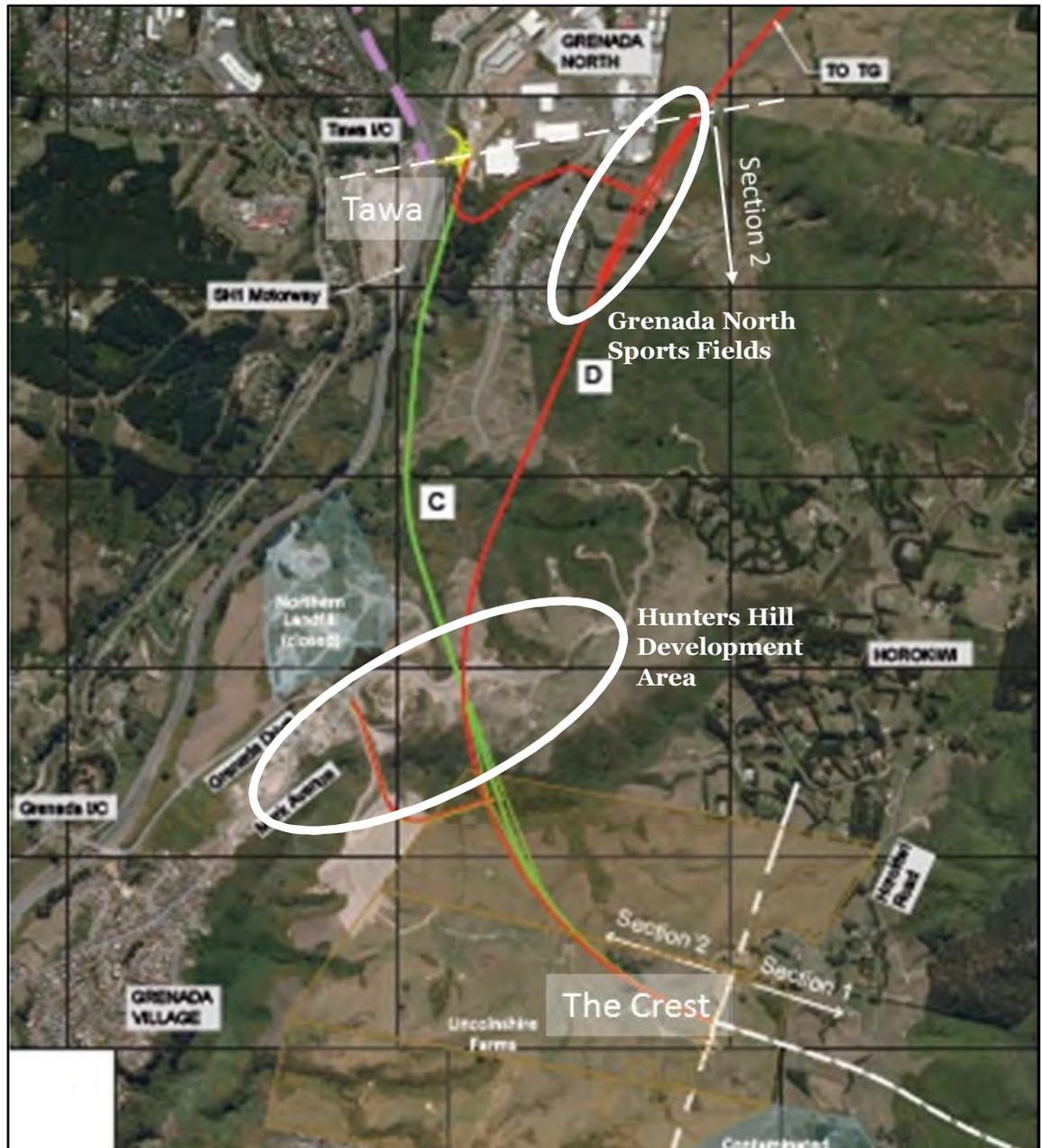


Figure 2b - Options 7 (C) and 8 (D) (Scoping Stage) Section 2

During the consultation phase the project team liaised with Lincolnshire Farm Development, Hunters Hill Development and directly affected landowners in Grenada. Based on feedback from these parties and feedback from the Engagement Report alterations to Options 7 (C) and 8 (D) in Hunters Hill Development area were

developed to minimise the impact on the ongoing development. The impacts of Options 7 (C) and 8 (D) in this area are shown in Figures 2c and 2d below.

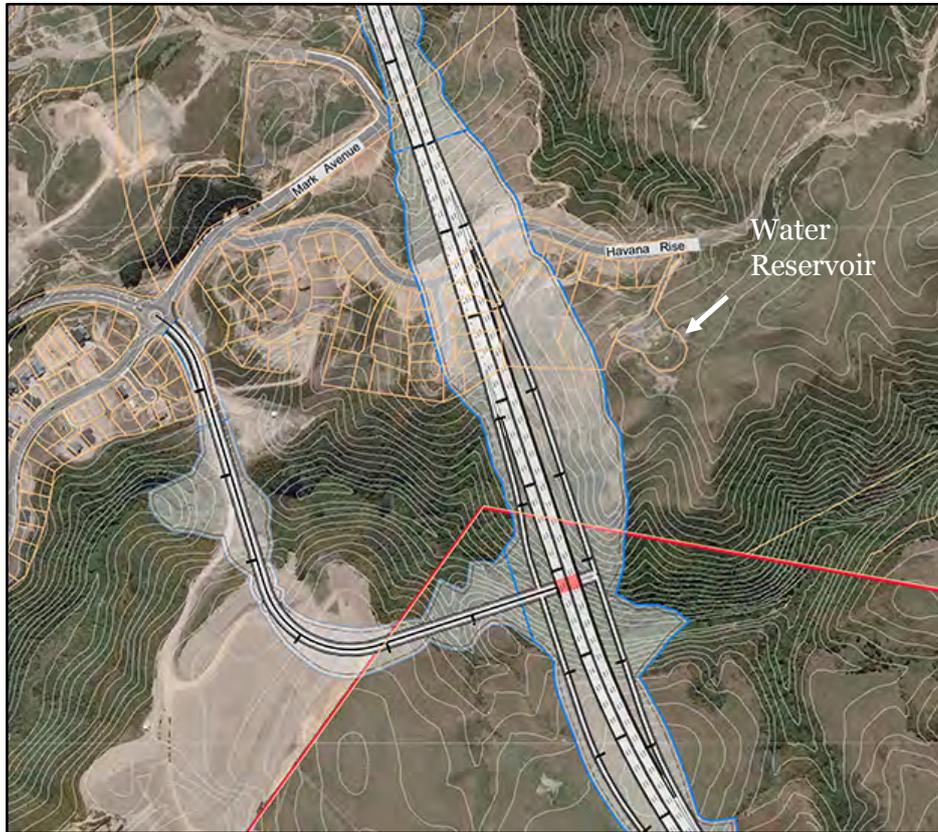


Figure 2c – Impact of Option 7 (C) at Hunters Hill

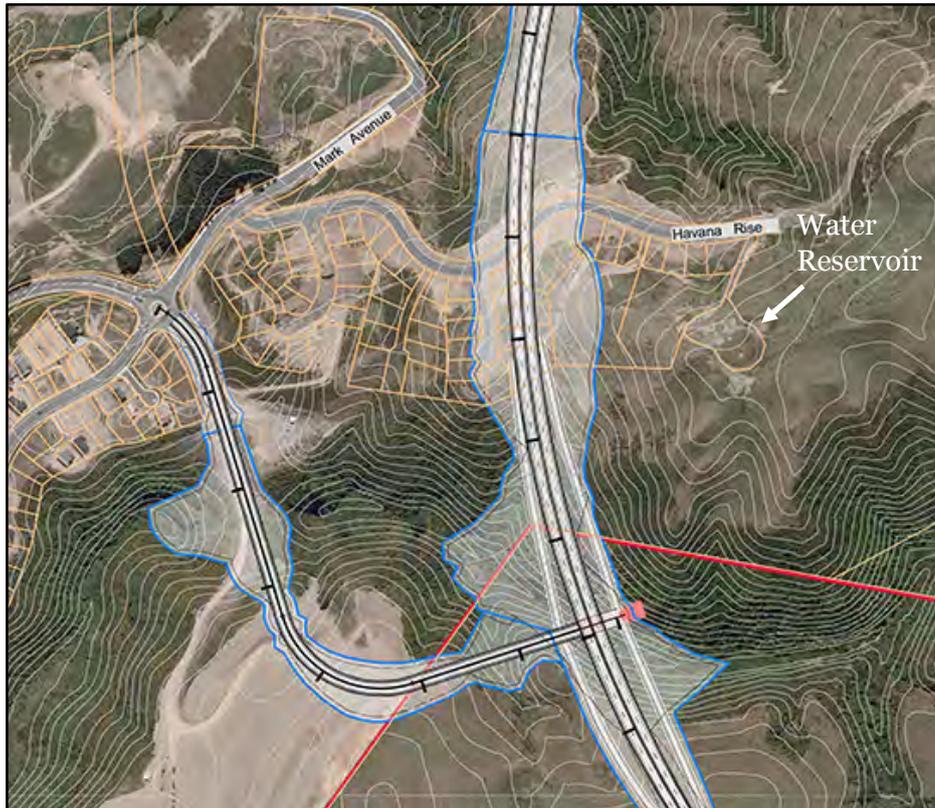


Figure 2d – Impact of Option 8 (D) at Hunters Hill

Refinements were developed to both Options 7 (C) and 8 (D) in this area and are described below.

Option 7 (C) (Section 2) Variation 1 (V1)

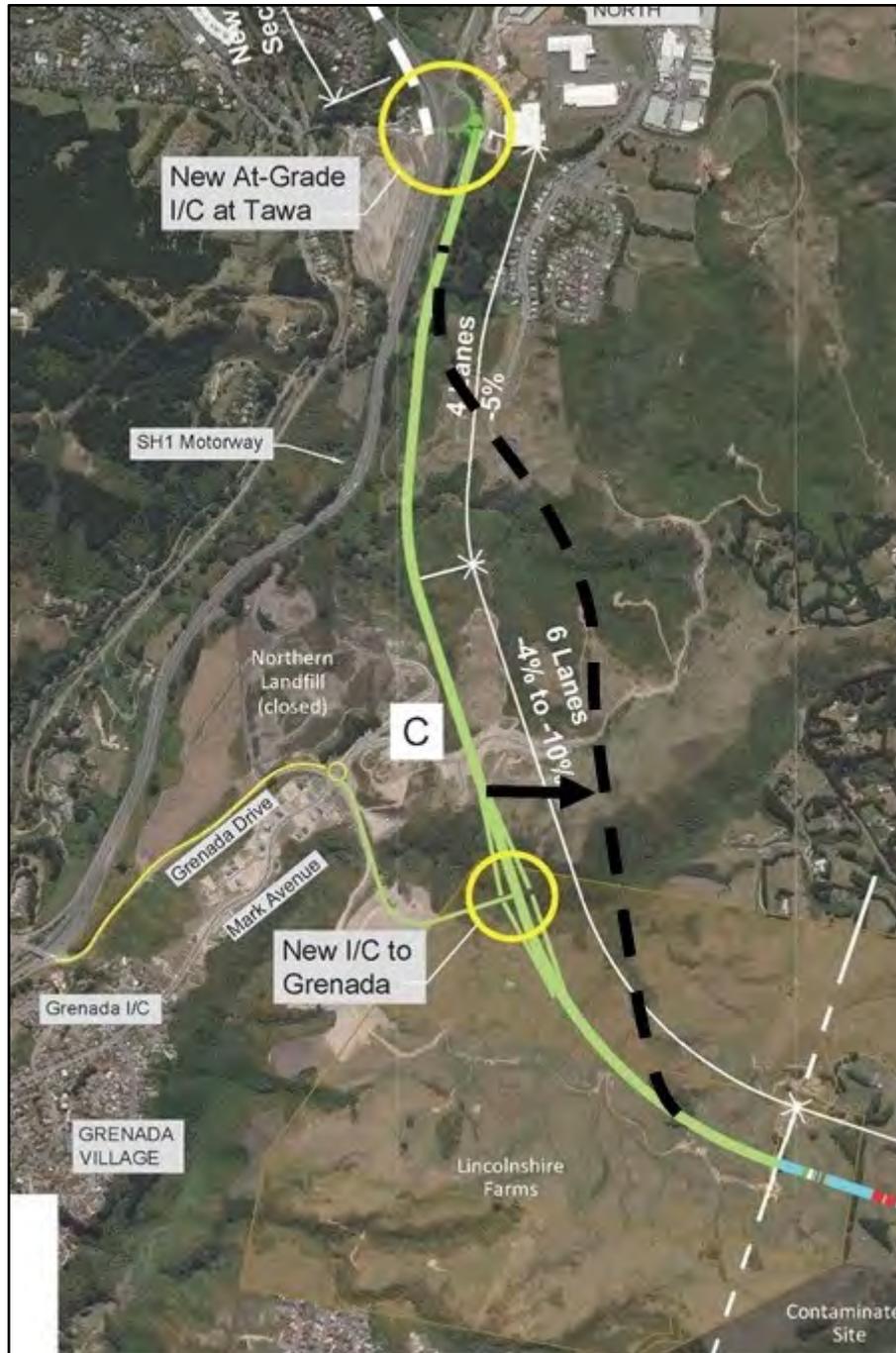


Figure 2e – Option 7 (C) (Section 2) Variation 1

This option deviates to the east of the scoping phase route to avoid the ongoing development along Havana Rise as shown in Figure 2e above. This option also avoids a water reservoir recently constructed to service the development in this area. Refer Attachment One for further details.

Option 7 (C) (Section 2) Variation 2 (V2)



Figure 2f – Option 7 (C) (Section 2) Variation 2

This option is shown in Figure 2f above. This option deviates to the west of the scoping phase route to avoid the ongoing development along Havana Rise and roughly follows the indicative route identified in the Lincolnshire Farm Structure Plan (<http://wellington.govt.nz/your-council/projects/lincolnshire-farm>) through this area. This option also passes through the Northern Landfill. Details on a construction issues of this option passing through the landfill are provided in Attachment Three.

Option 8 (D) (Section 2) Variation 1 (V1)



Figure 2g – Option 8 (D) (Section 2) Variation 1

This option is shown in Figure 2g above. This option, like Option 7 (C) (V1) deviates to the east of the scoping phase route to avoid the ongoing development along Havana Rise. This option also avoids a water reservoir recently constructed to service the development in this area. Beyond Havana Rise Option 8 (D) (V1) runs just to the east of the scoping phase route. The location of the new interchange to Tawa is located to the east of the scoping phase location which occupied the Grenada North Park Sports Fields. The new location avoids the majority of the Grenada North Park Sports Fields. Further details are provided in Attachment One.

Option 8 (D) (Section 2) Variation 2 (V2)



Figure 2h – Option 8 (D) (Section 2) Variation 2

This option is shown in Figure 2h above. This option, like Option 8 (D) (V1) deviates to the east of the scoping phase route to avoid the ongoing development along Havana Rise. This option also avoids a water reservoir recently constructed to service the development in this area. However, this option remains further to the east of the scoping phase route than Option 8 (D) (Section 2) Variation 1 described in the previous section. The location of the new interchange to Tawa completely avoids the Grenada North Park Sports Fields. Further details are provided in Attachment Three.

New Interchange at Tawa

All the options described above include a new interchange at Tawa. This interchange has been refined since the scoping phase based on public feedback. The revised interchange is shown in Figure 2i below and is included in all the options in Attachment One apart from the Scoping Options 5 to 8.



Figure 2i – New Interchange at Tawa

Section 3: Option Variations Between Tawa and Transmission Gully

This section describes the refinements to Options 7 (C) and 8 (D) between Tawa and Transmission Gully. For clarity this section is shown in Figure 2j below.

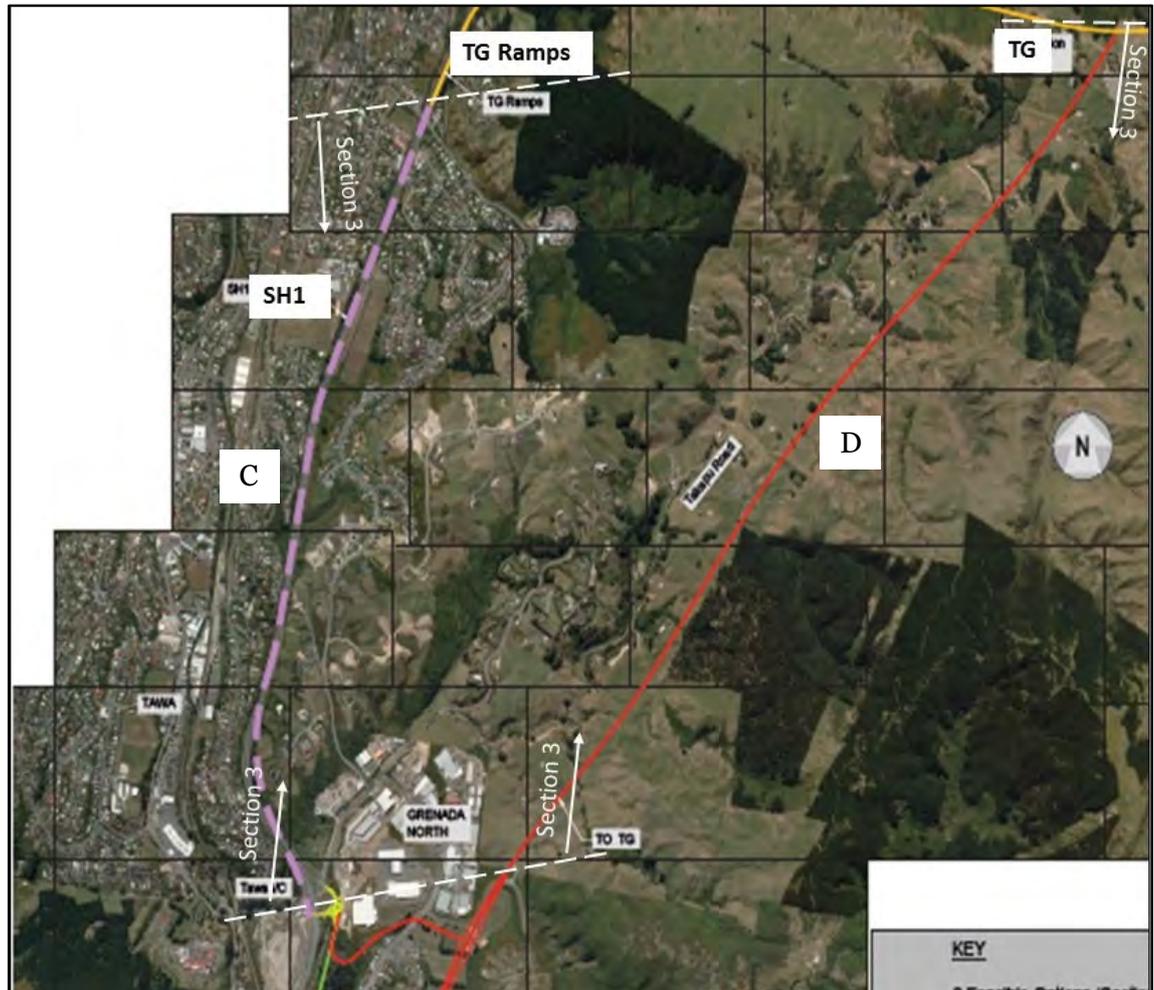


Figure 2j – Options 7 (C) & 8 (D) (Scoping Stage) Between Tawa & Transmission Gully

During the consultation phase the project team liaised with the Tawa community and directly affected landowners in both Tawa and Takapu Valley. Based on feedback from these parties and feedback from the Engagement Report refinements were developed to both Options 7 (C) and 8 (D). These are described below.

Option 7 (C) (Section 3) – 6 Laning SH1 Full Shoulders & Existing Median

This option is similar to the scoping phase option and involves increasing SH1 from 4 lanes to 6 lanes between a new interchange at Tawa and its intersection with Transmission Gully. A new 6 lane section is proposed at the southern section to ease the existing curve just north of the Tawa interchange (Note: The Ngauranga Triangle Strategy Study identified this curve as one of three curves in the vicinity of the Tawa interchange that requires improving as a result of a high number of accidents along this section). Upgrading from 4 lanes to 6 lanes is proposed for the remaining section up to Transmission Gully. This is illustrated in Figure 2k below.

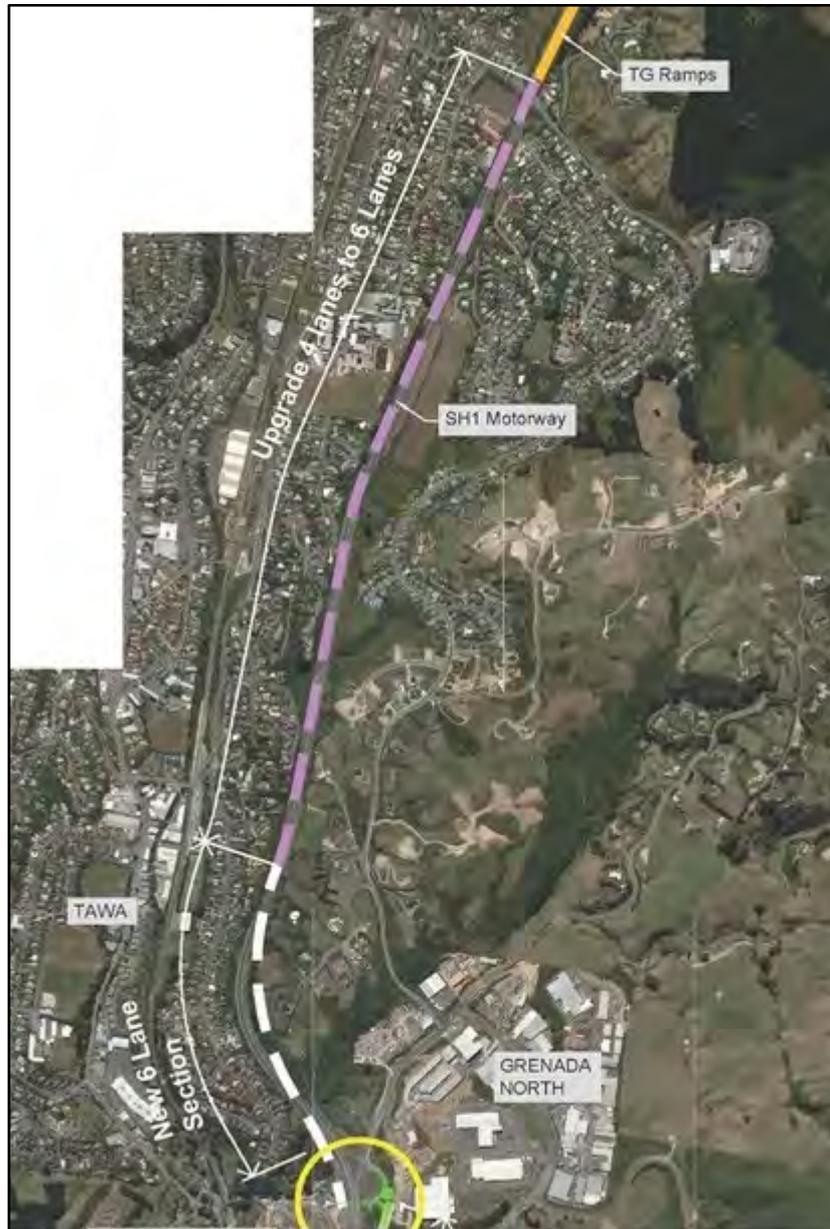


Figure 2k – Option 7 (C) (Section 3) – 6 Laning SH1 with Full Shoulders and Extg Median

Upgrading from 4 lanes to 6 lanes for this option involves upgrading two of the three 'Tawa Curves', namely the curve at the intersection itself and the curve immediately north'. This option also involves retaining the existing wire rope median, northbound and southbound lanes and providing an additional outer northbound and southbound lane including shoulders. The cross section proposed for upgraded section will also be applied to the new section. This is shown in Figure 2l below.

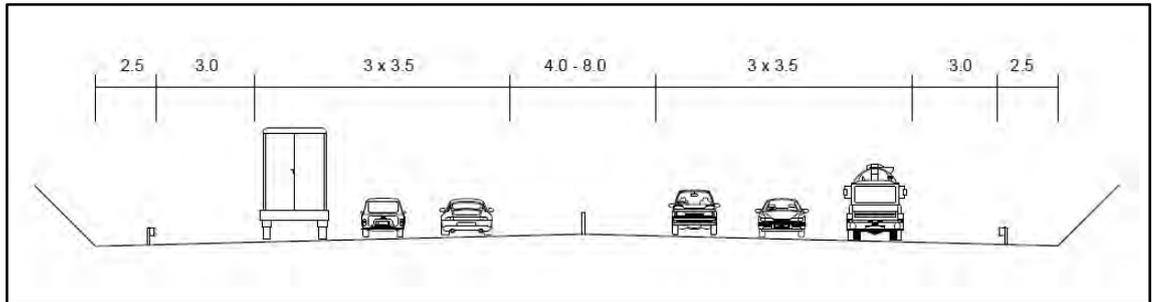


Figure 2l – Typical Cross Section of 6 Laning SH1 Full Shoulders & Existing Median

Widening outside the existing carriageway means the additional lanes can be constructed with minimal impact on traffic which will continue to utilise the existing lanes. Consequently widening on both sides of the road has advantages from a cost and disruption perspective. The key reasons for this are the cross-sectional profile of the road and the median infrastructure. SH1 between Tawa and Transmission Gully generally has a cross section like an upside down W with low points in the median and on the shoulder of each carriageway. Widening on both sides of the carriageway by extending the profile of the road at the edge of each carriageway adding an extra lane as illustrated in Figure 2m below.

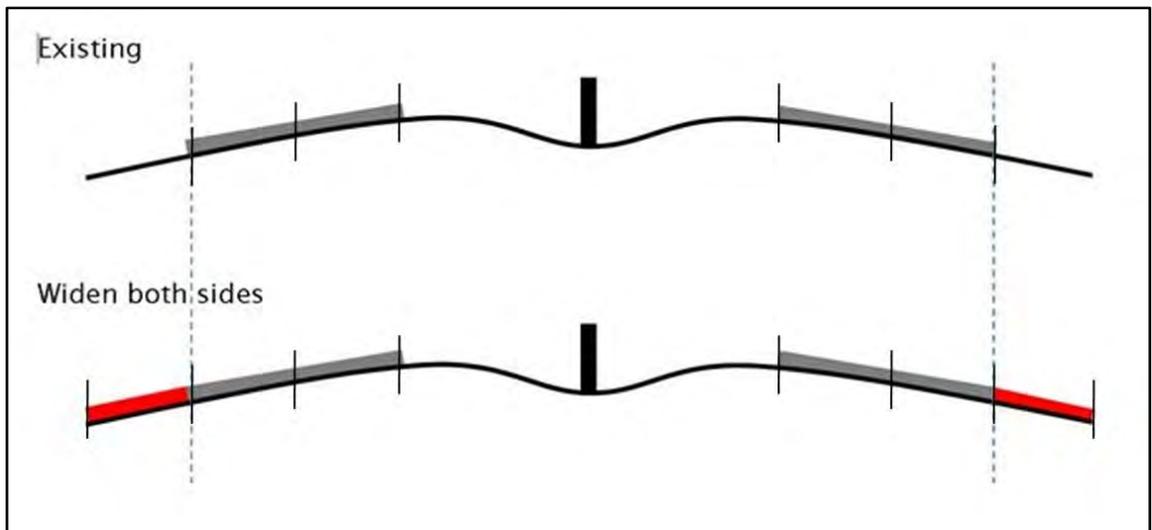


Figure 2m – Adding Additional Lanes on Outside of Existing Carriageway

Further details on the full widening of SH1 between Tawa and Transmission Gully are provided in Figure 2p below. Note Figure 14a does not include the revised interchange at Tawa. Also note that Attachment One contains 3 options with full widening on SH1 between Tawa and Transmission Gully.



Figure 2p –SH1 Full Widening Between Tawa and Transmission Gully (Adding Additional Lanes on Outside of Existing Carriageway)

Option 7 (C) (Section 3) – 6 Laning SH1 Managed Motorway and Solid Median Barrier (V1)

This option is illustrated in Figure 2q below.



Figure 2q – Option 7 (C) (Section 3) – 6 Laning SH1 with Managed Motorway and Solid Median Barrier V1

This option involves reducing the overall width of the carriageway proposed in the previous option by adopting hard shoulder running and reducing the width of the existing median, which currently ranges in width between 4m and 8m, with a solid median barrier. Hard shoulder running involves providing an additional outer lane with a limited shoulder which provides no refuge. To mitigate this overhead gantries supporting variable message signs are provided at regular intervals. The cross section proposed for this option is shown in Figure 2r below.

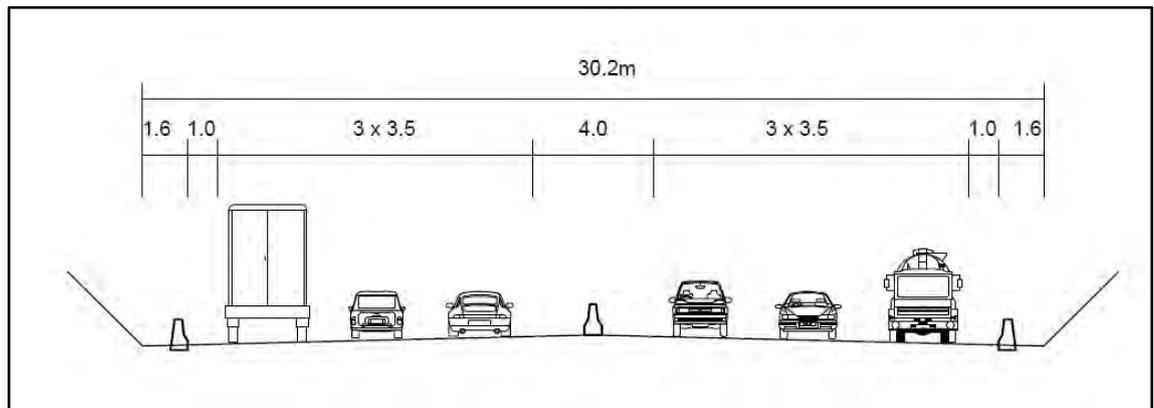


Figure 2r – Typical Cross Section of 6 Laning SH1 With Managed Motorway and Solid Median Barrier

While this option has less impact on properties adjacent to SH1 than the previous option (6 laning with full shoulders) it will have a greater impact on road users during the construction period. The previous option involved retaining the existing median and 4 lane cross section and widening outside the existing carriageway. The hard shoulder running option with a solid median involves extending the carriageway into the existing median by reducing the width of the existing median. However the existing median is not wide enough to accommodate 2 new lanes and a solid median. As a result the new 6 lane carriageway profile will extend both into the existing median and outside the existing carriageway as illustrated in Figure 2s below.

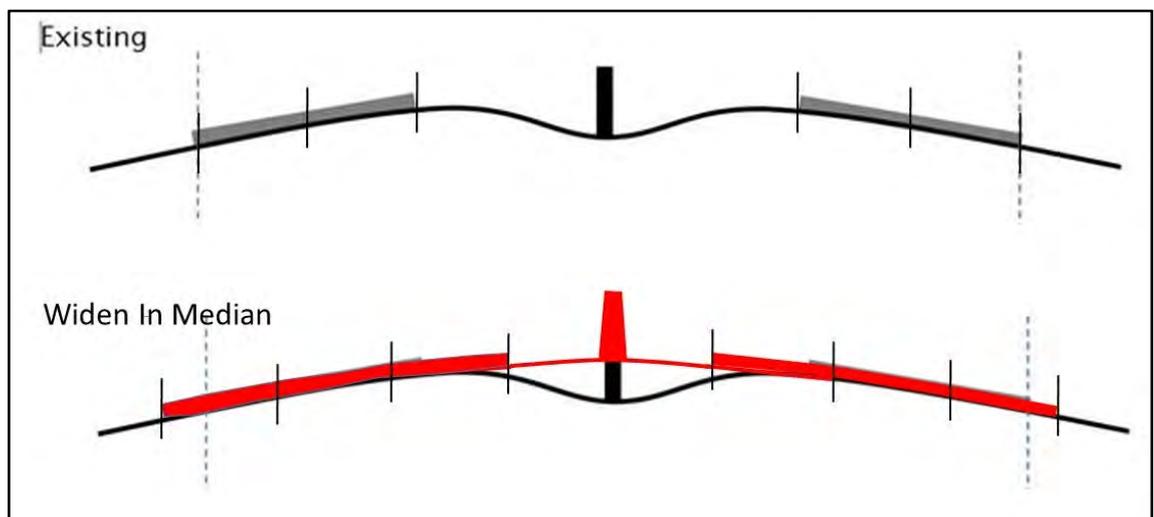


Figure 2s – Adding Additional Lanes Within Median

Given the existing profile within the median is a low point, as shown above, parts of the carriageway would need to be reconstructed. Furthermore the existing lanes will not align with the new lanes which will result in a greater disruption to road users during construction.

Like the previous option upgrading SH1 from 4 lanes to 6 lanes for this option involves upgrading two of the three 'Tawa Curves', namely the curve at the intersection itself and the curve immediately north'. Further details of this option between Tawa and Transmission Gully are shown in Figure 2t below. Note Figure 2t also does not include

the revised interchange at Tawa. Also note that Attachment One contains 3 options with 'Managed Motorway' on SH1 between Tawa and Transmission Gully.



Figure 2t –SH1 Managed Motorway 1 Between Tawa and Transmission Gully

7 (C) (Section 3) – 6 Laning SH1 Managed Motorway 2 and Solid Median Barrier

This option is similar to the 6 Laning SH1 Managed Motorway 1 described above but retains all widening within the SH1 corridor. In order to retain all widening within the SH1 corridor some cut slopes and fill batters have been steepened to avoid impact on adjacent properties. The steeper cut slopes and fill batters will be engineered to ensure slope stability. However, by retaining all widening within SH1 corridor, one of the “Tawa Curves” just north of the Tawa interchange will not be upgraded (i.e. realigned to ease the horizontal curvature). Further details of this option between Tawa and Transmission Gully are shown in Figure 2u below.



Figure 2u –SH1 Managed Motorway 1 Between Tawa and Transmission Gully

Option 8 (D) (Section 3) Variation 1

This option is illustrated in Figure 2v below.



Figure 2v – Option 8 (D) (Section 3) – Variation 1 (V1)

This option is linked to Option 8 (D) (Section 2) – Variation 1 and continues from the new interchange just to the east of the Grenada North Sports Fields to a new connection at Transmission Gully. This option is 2 lanes and follows the same route as the scoping phase route.

While this option is provided in Attachment One Figures 2w and 2x below provide further detail of this option between Tawa and Transmission Gully.

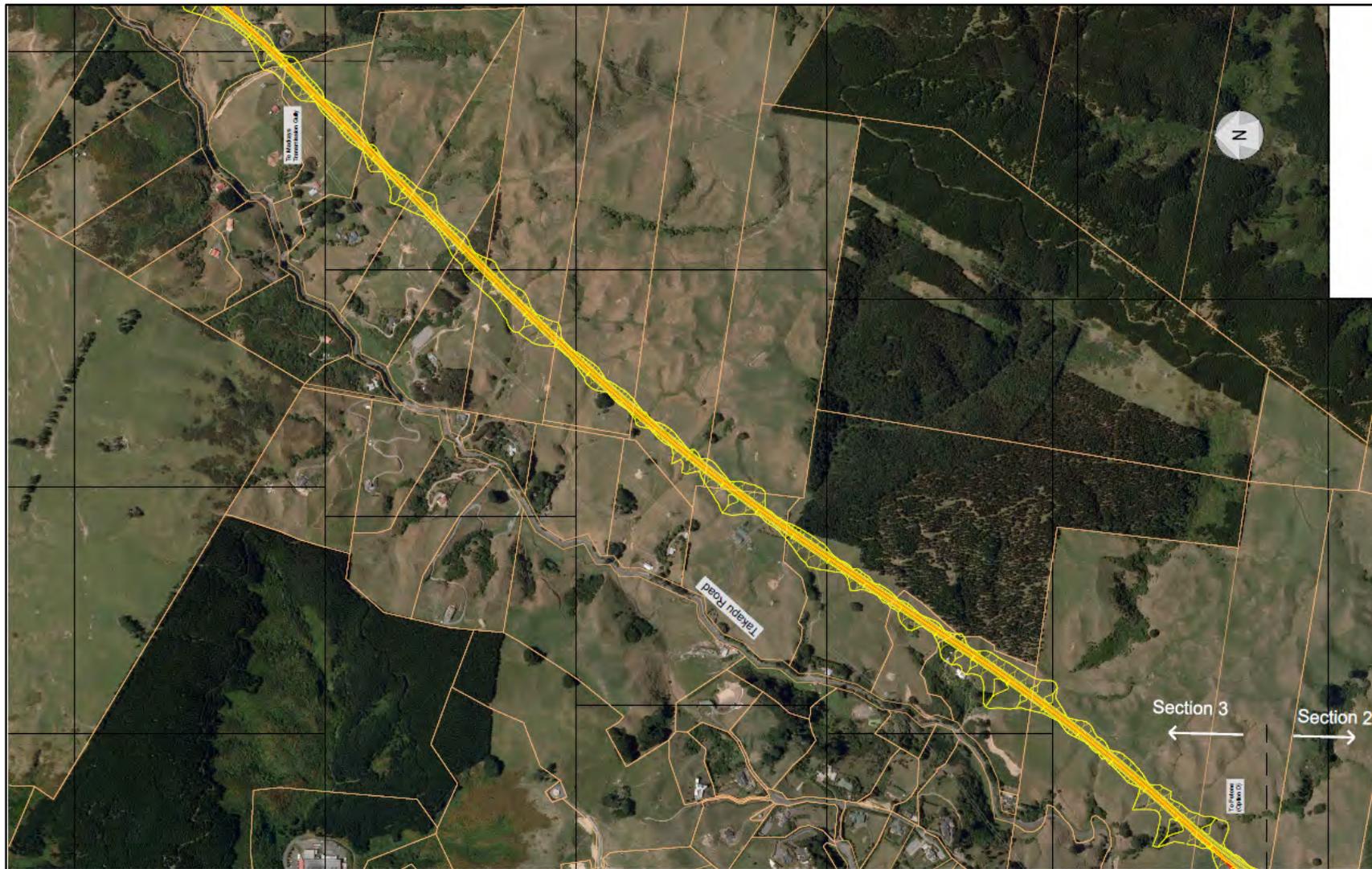


Figure 2w – Option 8 (D) (V1) With Takapu Link between Tawa and Transmission Gully – Part 1

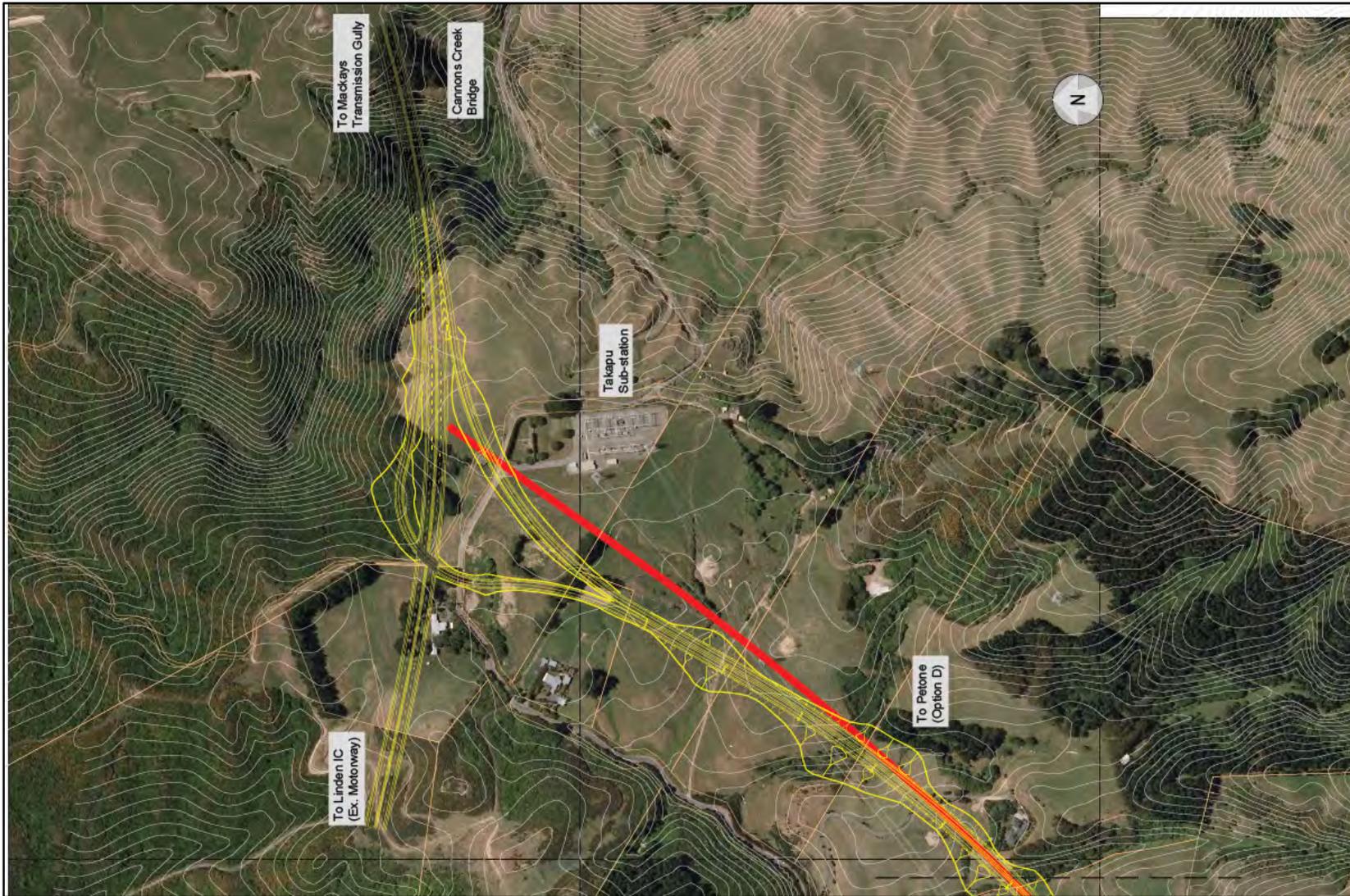


Figure 2x – Option 8 (D) (V1) With Takapu Link between Tawa and Transmission Gully– Part 2

Option 8 (D) (Section 3) Variation 2

This option is illustrated in Figure 2y below.



Figure 2y – Option 8 (D) (Section 3) – Variation 2 (V2)

This option is linked to Option 8 (D) (Section 2) – Variation 2 and continues from a new interchange to the east of the Grenada North Sports Fields to a new connection at Transmission Gully. This option is 2 lanes and typically runs to the east of previous Option 8 (D) route. While this option is also provided in Attachment One, Figures 2z and 2zz below provide further detail of this option between Tawa and Transmission Gully.

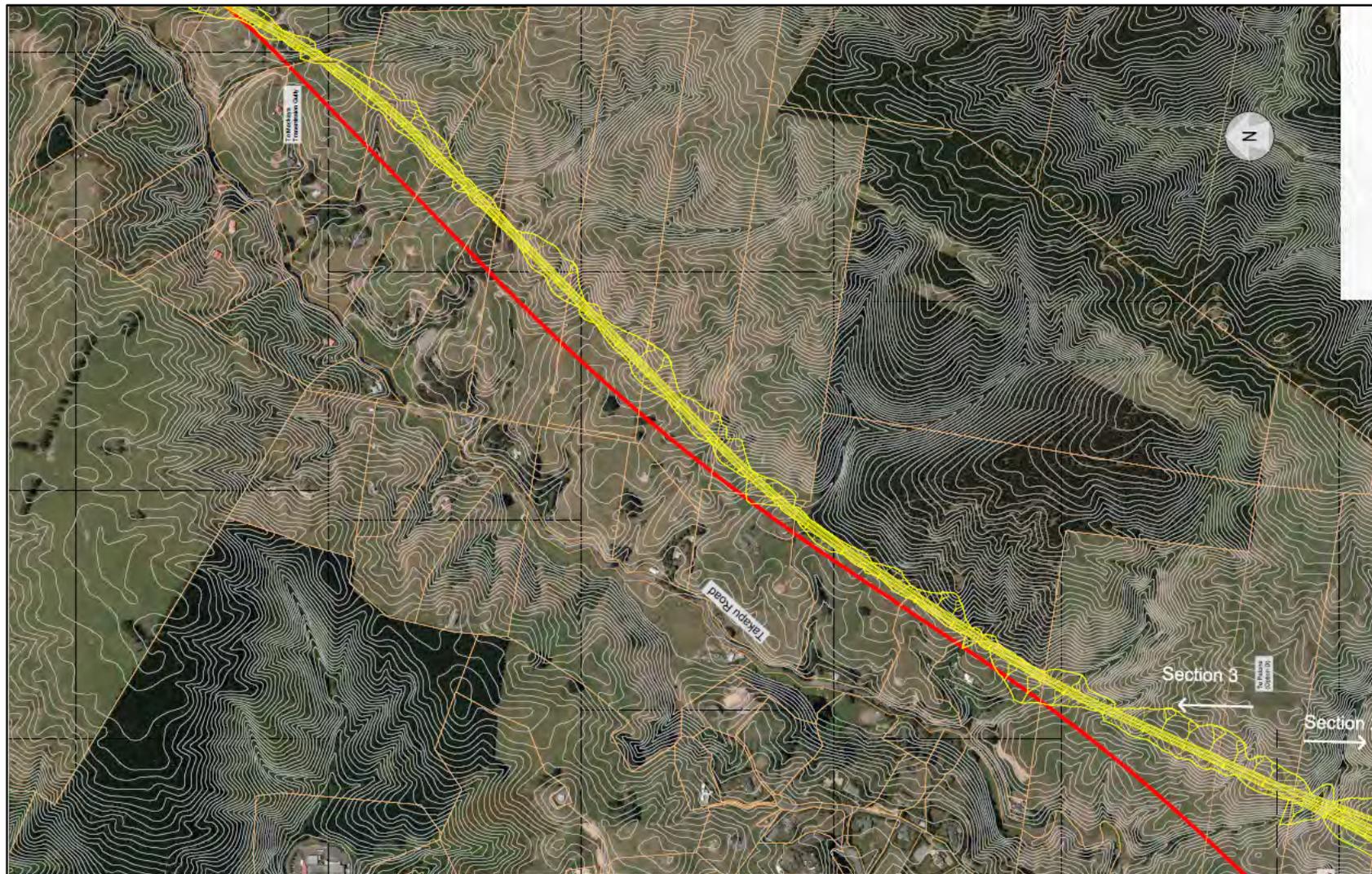


Figure 2z – Option 8 (D) (V2) With Takapu Link between Tawa and Transmission Gully– Part 1

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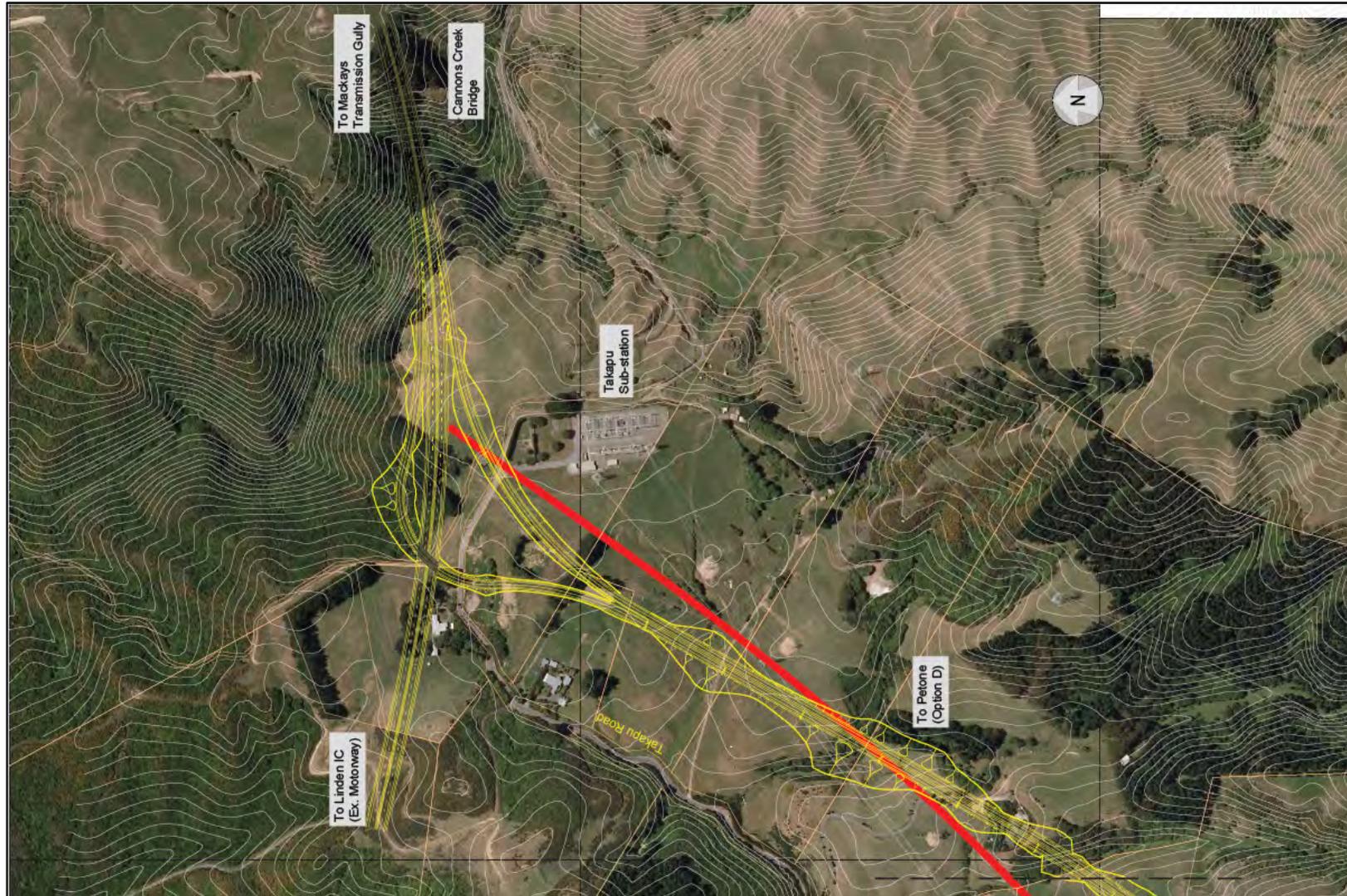


Figure 2zz – Option 8 (D) (V2) With Takapu Link between Tawa and Transmission Gully – Part 1

Appendix C - P2G Specialist Assessment – Base Position and Reasonable Mitigation Assumptions



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SUBJECT	P2G Specialist Assessment – Base Position and Reasonable Mitigation Assumptions	

A. Introduction

This memo provides clarification of the "base position" and "reasonable mitigation" in respect of particular aspects of the P2G proposals raised by experts at the workshop held on 16 and 17 June 2015.

Specialists should presume that the "base position" is part of the options being assessed and will therefore be in place when assessing and assigning "without mitigation" scores for each route option. The "reasonable mitigation" represents the level of mitigation or enhancement that the Transport Agency can at this stage commit to implementing if experts consider it necessary in respect of each of the aspects discussed below. All scoring of options with mitigation must be based on a common understanding of what is comprised in that option – including any mitigation. All specialists therefore at this stage need to presume that all of the identified "reasonable mitigation" set out in this memo will be in place when assessing giving "with mitigation" scores, even if the expert in question would not necessarily recommend that mitigation.

Each specialist has already provided their respective preliminary draft score in this manner. However please remember that all specialists may identify mitigation. As this gives rise to the possibility of inconsistent mitigation approaches, specialists have been encouraged to talk to other specialists in order to gain an understanding of the nature and extent of mitigation being considered by other specialists. In some cases it may be necessary for specialists to develop a common approach to mitigation and adjust their scores accordingly. At Workshop Two a session was devoted to further ensuring that such a

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common understanding of issues and mitigation was in place, enabling any significant inconsistencies or uncertainties to be identified and addressed. It is possible that with work subsequent to Workshop Two (and Workshop 3 to assess fill sites) that some adjustment of the mitigation identified by specialists will occur. In this instance it is important that you advise other specialists and the project team of such a change as early as possible.

Following receipt of the final draft technical assessments a list of mitigation by option will be compiled to ensure consistency and acceptability to Transport Agency and common understanding among specialists. Given mitigation was widely discussed at Workshop Two and Workshop 3 significant change is not anticipated, however if specialists consider change is needed to their earlier proposed mitigation it should be advised to the project team and other specialists without delay.

This position reflects that confirmed at Workshop Two on 16 and 17 June 2015. Any further queries about the "base position" and "reasonable mitigation" positions or any questions or clarity should be directed to Nick Aiken as soon as possible to avoid delay.

A clear narrative explaining the basis on which assessments have been carried out should be included in specialists' reports.

B. "Beach to bush" Pedestrian and Cycle Link at Petone

Base position:

The Beach to Bush Link would comprise a connecting route between Petone Foreshore and the Belmont Regional Park access at Korokoro. Presume that regardless of option, this connection would take the form of on-bridge connections rather than a stand-alone bridge structure. This connection could involve a clip-on bridge for pedestrians and cyclists, or the use of footways on the P2G connection itself adjacent to the main P2G Link to allow pedestrians and cyclists to cross SH2 and the rail line at Petone.

Note that the current preferred form of the Petone Interchange is a signalised intersection similar to that attached in Appendix 1 of this document and also illustrated in the link below.

<http://www.nzta.govt.nz/projects/petone-grenada-link-road/docs/faq-petone-interchange.pdf>

Reasonable mitigation:

None is proposed at this stage. Experts to advise if any further mitigation might be needed.

C. Gully Crossings

Base position:

Land bridges (embankment fills) with culverts at all gully crossings as shown on option drawings with culverts.

Note that Options 9a, 10a, 11a and 12a (C (V1)-Variant 1 options) have been introduced as new options resulting from Workshop 2. The base position for this option is the same for all options. That is, presume land bridges at all gully crossings as shown on option drawings.

Reasonable mitigation:

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An alternative form of crossing gullies to the land bridges (with culverts) would be bridge structures at specific gullies identified below.

Option 3 (P3): Presume the land bridge which crosses the Korokoro Stream in a 165m long culvert would be replaced by a bridge.

Option 6 (B): Presume the new land bridge which crosses the Belmont Stream in a 250m long culvert would be replaced by a bridge. Presume the existing land bridge which provides access to Mark Ave would remain and be widened as shown on the drawings.

Options 7 to 23. (Options C & D and Variations): Presume the new land bridges that cross the Belmont Stream in culverts, which range in length between 140m and 310m (as shown on the drawings), would be replaced by bridge structures. Presume the existing land bridge which provides access to Mark Ave in all these options would remain and be widened as shown on the drawings.

Options 9a, 10a, 11a and 12a (Option C (V1) – Variant 1 options): This option has been introduced as a variant to Options 9 to 12. Presume the new land bridge which crosses the Belmont Stream in a 230m long culvert would be replaced by bridge structure. Presume the existing land bridge which provides access to Mark Ave in all these options would remain and be widened as shown on the drawings.

D. Horokiwi Access

Base position:

Horokiwi Road access would be retained, in the form of a bridge, where it intersects with all Options P1 to P4.

Reasonable mitigation:

Direct access from Horokiwi to P2G can be provided via the P2G interchange in the vicinity of Lincolnshire Farms.

E. Pedestrian & Cycle Links Within Tawa

Base position:

Pedestrian and cycle links would be provided at the Tawa interchange to a reasonable level as advised by the relevant experts.

Reasonable mitigation:

None is proposed at this stage. Experts to advise if any further mitigation might be needed.

F. Belmont Gully Track South of Havana Rise

Base position:

Link severed by land bridge across Belmont Gully to varying extents by Options 5 to 23.

Reasonable mitigation:

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Connectivity would be provided. Experts to advise on the form that might be needed.

G. Noise Mitigation - SH1 Upgrades

Base position:

Open graded porous asphalt (OGPA) as a low noise road surface as opposed to a chip seal surface.

Reasonable mitigation:

E.1) Embankment Fills - Presume noise walls would be provided along SH1 at locations where the road is in an embankment fill and within approximately 30m of residential dwellings. Additionally presume similar noise walls would be provided adjacent to Tawa College and Tawa Intermediate (refer to Appendix 2 for details).

E.2) Road Cuts – Presume timber noise fences (2m high and 25mm thick) will be provided at the property boundaries of directly affected landowners where the road is in cut (refer to Appendix 2 for details).

H. Noise Mitigation – Greenfield

Base position:

Open graded porous asphalt (OGPA) as a low noise road surface as opposed to a chip seal surface.

Reasonable mitigation:

F.1) Embankment Fills – Presume earth bunds would be provided along the P2G route at locations where the road is in an embankment fill and within approximately 30m of residential dwellings (refer to Appendix 2 for details).

F.2) Road Cuts - Presume timber noise fences (2m high and 25mm thick) will be provided at the property boundaries of directly affected landowners where the road is in cut and the dwelling is within 30m of the road cut (refer to Appendix 2 for details).

I. SH1 Full Widening Tawa to Transmission Gully– Impact on Adjacent Local Roads

Base position:

Local roads which appear to be impacted by this option would be retained. These include Cecil Road, Mayfair Place and Bartlett Grove.

Reasonable mitigation:

No mitigation considered necessary at this stage as local roads will be retained. Experts to advise if any further mitigation might be needed.

J. Option 4 (P4) & Cox House

Base position:

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Option 4 (P4) as detailed in the Scoping Report. This requires the demolition or relocation of Cox House as it is within the construction footprint of the road cut.

Reasonable mitigation:

Presume Option 4 (P4) can be realigned to avoid Cox House with only minor route refinements (refer Appendix 3 for details).

K. P2G Link Interchange to Grenada – Location

Base position:

As shown on the option plans provided in Attachment One of the P2G Specialist Assessment Briefing Working Paper.

Reasonable mitigation:

Presume the location of the P2G interchange to Grenada, in the vicinity of Lincolnshire Farm, can be located further to the south so that the interchange ramps do not form part of the land bridge across the Belmont Stream gully.

L. Tawa Curves (Safety)

Base position:

The base position is shown on the table below.

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Option		Tawa Curves - Base Position		
		Curve Addressed (Y/N)		
		Southern Curve	Curve at Interchange	Northern Curve
5	Option A (Scoping)	Y	Y	Y
6	Option B (Scoping)	Y	Y	Y
7	Option C (Scoping)	N	Y	Y
8	Option D (Scoping)	N	Y	N
9	Option C (V1) Full SH1 Widening	N	Y	Y
10	Option C (V1)	N	Y	Y
11	Option C (V1) Managed Motorway 2	N	Y	N
12	Option C (V1)	N	Y	N
13	Option C (V2) Full SH1 Widening	N	Y	Y
14	Option C (V2)	N	Y	Y
15	Option C (V2) Managed Motorway 2	N	Y	N
16	Option C (V2) No SH1 Widening	N	Y	N
17	Option C Full SH1 Widening	N	Y	Y
18	Option C Managed Motorway 1	N	Y	Y
19	Option C Managed Motorway 2	N	Y	N
20	Option C No SH1 Widening	N	Y	N
21	Option D Update Tawa IC	N	Y	N
22	Option D (V1)	N	Y	N
23	Option D (V2)	N	Y	N

Reasonable mitigation:

Presume all three curves are addressed for Options 7 to 23 (note Options 5 (A) and 6 (B) already address all three Tawa curves). Addressing all three curves would involve additional property impacts at the southern curve for Options 7 to 23 and additional property impacts at the northern curve for Options 8, 11, 12, 15, 16, 19, 20, 21, 22 and 23. This is highlighted in the table below.

Petone to Grenada Assessment of Alternative Options

Option		Tawa Curves - Reasonable Mitigation		
		Curve Addressed (Y/N)		
		Southern Curve	Curve at Interchange	Northern Curve
5	A (Scoping)	Y	Y	Y
6	B (Scoping)	Y	Y	Y
7	C (Scoping)	Y	Y	Y
8	D (Scoping)	Y	Y	Y
9	C (V1) Full SH1 Widening	Y	Y	Y
9a	C(V1)-Variant 1	Y	Y	Y
10	C (V1) Managed Motorway 1	Y	Y	Y
10a	C(V1)-Variant 1	Y	Y	Y
11	C (V1) Managed Motorway 2	Y	Y	Y
11a	C(V1)-Variant 1	Y	Y	Y
12	C (V1) No SH1 Widening	Y	Y	Y
12a	C(V1)-Variant 1 No SH1 Upgrade	Y	Y	Y
13	C (V2) Full SH1 Widening	Y	Y	Y
14	C (V2) Managed Motorway 1	Y	Y	Y
15	C (V2) Managed Motorway 2	Y	Y	Y
16	C (V2) No SH1 Widening	Y	Y	Y
17	C Full SH1 Widening	Y	Y	Y
18	C Managed Motorway 1	Y	Y	Y
19	C Managed Motorway 2	Y	Y	Y
20	C No SH1 Widening	Y	Y	Y
21	D Update Tawa IC	Y	Y	Y
22	D (V1)	Y	Y	Y
23	D (V2)	Y	Y	Y

Specialists should presume that the impacts of addressing the northern curve would be similar to that shown for Options 7, 9, 10, 13, 14, 17 and 18 in the briefing document.

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Details on the impacts of addressing the southern curve for Options 7 to 23 are provided in Appendix 4.

M. Option A & Impact on Artemis Early Learning Facility

Base position:

Option 5 (A) involves widening Grenada Drive equally on both sides of the existing carriageway to create two lanes in each direction. Widening the existing carriageway directly impacts on the Artemis Early Learning Facility which is located on the corner of Grenada Drive and Aruba Grove as illustrated in Appendix 5.

Reasonable Mitigation:

Presume reasonable mitigation includes widening Grenada Drive on the southern side only in the vicinity of the Artemis Early Learning Facility thereby avoiding any direct impact on this facility.

N. Geotechnical Considerations on Cut and Fill Design, Bridge Structures at Petone and the location of the Petone Interchange

Base position:

Presume the following:

P.1) Cut & Fill Preliminary Design Assumptions - Presume that the cut and fill design of all options are based on the preliminary design assumptions identified in Section 11.5 of the Scoping Report. Further to these preliminary design assumptions presume that the base condition includes any opportunities to reduce cut heights and design cuts to stable slope angles with rock stabilisation measures as appropriate should detailed geotechnical investigations deem necessary.

P.2) Bridge Structures Preliminary Design Assumptions at Petone - Presume that bridge structures would be piled with ground improvements to provide protection against liquefaction.

P.3) Location of Petone Interchange for Options 1 to 4 (P1 to P4) and 1a (P1 Variant 1) – Presume that the location of the Petone interchange for Options 1 to 4 (P1 to P4) and 1a (P1 Variant 1) is located close to the Wellington Fault zone but as far north of this zone as possible to stay within the geometrical constraints of the these routes and the interchange itself.

P.4) Location of Petone Interchange for Option 1b (P1 Variant 2) – Presume that the location of the Petone interchange for Option 1b (P1 Variant 2) is located further south than the other options and therefore closer to the Wellington Fault zone to stay within the geometrical constraints of this route.

Reasonable mitigation:

None is proposed at this stage. Experts to advise if any further mitigation might be needed.

O. Options 1 to 4 Impacts on Property, Local Roads and Entrance to Belmont Regional Park (BRP) at Petone Interchange

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Base position:

Options 1 to 4 (P1 to P4) share the same proposed interchange and therefore presume that the property and local road impacts associated with the proposed interchange itself would be the same for these options. However the P2G connection to the proposed interchange differs for each option and consequently the property and local road impacts will differ when combined with the proposed interchange. This is described further below and illustrated in Appendix 6 for Options 1 to 4 combined with the proposed interchange. Note that further details of the properties identified in the figures in Appendix 6 for Options 1 to 4 have also been provided in GIS format and spreadsheet format. These identify all the properties directly impacted by each option as well as details on each property.

The location of the proposed interchange at Petone for Option 1a (P1 Variant 1) is the same for Options 1 to 4 but the P2G connection differs. Consequently the property and local road impacts will differ when combined with the proposed interchange. This is described further below.

The location of the proposed interchange at Petone for Option 1b (P1 Variant 2) is positioned further south than Options 1 to 4 and 1a. As a result the property and local road impacts of this option with the interchange in a new location will differ. This is described further below.

Option 1 (P1): No access from SH2 to Pito-One Road via Cornish Street and/or Priests Ave due to new interchange. Pito-One Road and the northern end of Cornish Street is still accessible from Hutt Road/Korokoro Crescent and provides access to the entrance of BRP and the businesses at north end of Cornish Street which are not directly impacted by the interchange.

Option 2 (P2): No access from SH2 to Pito-One Road via Cornish Street and/or Priests Ave due to new interchange. Pito-One Road is still accessible from Hutt Road/Korokoro Crescent but existing access to the entrance to BRP is cut off and all businesses north of Pito-One road are directly impacted by the interchange and this route.

Option 3 (P3): No access from SH2 to Pito-One Road via Cornish Street and/or Priests Ave due to new interchange. Pito-One Road is still accessible from Hutt Road/Korokoro Crescent but existing access to the entrance to BRP as well as all businesses at northern end of Cornish Street (which are not directly impacted by the interchange and this route) is cut off.

Option 4 (P4): No access from SH2 to Pito-One Road via Cornish Street and/or Priests Ave due to new interchange. Pito-One Road and the northern end of Cornish Street is still accessible from Hutt Road/Korokoro Crescent and provides access to the entrance of BRP and the businesses at north end of Cornish Street which are not directly impacted by the interchange.

Option 1a (P1 – Variant 1): No access from SH2 to Pito-One Road via Cornish Street and/or Priests Ave due to new interchange. Pito-One Road and the northern end of Cornish Street is still accessible from Hutt Road/Korokoro Crescent and provides access to the entrance of BRP and the businesses at north end of Cornish Street which are not directly impacted by the interchange. The P2G link connects to the southern end of the proposed interchange and as a result directly impacts on the Honiana Te Puni Reserve as shown in Appendix 6.

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Option 1b (P1 – Variant 2): No access from SH2 to Pito-One Road via Cornish Street and/or Priests Ave due to new interchange. Pito-One Road and the northern end of Cornish Street is still accessible from Hutt Road/Korokoro Crescent and provides access to the entrance of BRP and the businesses at north end of Cornish Street which are not directly impacted by the interchange. is positioned further south than Options 1 to 4 and 1a. As a result SH2 is realigned further to the south and directly impacts on the Honiana Te Puni Reserve as shown in Appendix 6.

Reasonable Mitigation:

Presume reasonable mitigation includes the following for each option.

Option 1 (P1): Provide left out access to Priests Ave from northbound off-ramp of new interchange. This will provide direct access to Pito-One Road from Priests Ave.

Option 2 (P2): Provide:

- i. left out access to Priests Ave from northbound off-ramp of new interchange. This will provide access to Pito-One Road from Priests Ave;
- ii. new entrance to BRP at eastern flank of Korokoro Valley.

Option 3 (P3): Provide:

- i. left out access to Priests Ave from northbound off-ramp of new interchange. This will provide access to Pito-One Road from Priests Ave;
- ii. maintain access to northern end of Cornish Street to access all businesses at northern end of Cornish Street (which are not directly impacted by the interchange and this route). This would be provided by a short bridge structure over Pito-One Road.
- iii. new entrance to BRP at northern end of Cornish Street on western flank of Korokoro Valley

Option 4 (P4): Provide left out access to Priests Ave from northbound off-ramp of new interchange. This will provide direct access to Pito-One Road from Priests Ave.

Option 1 (P1) – Variant 1: Provide left out access to Priests Ave from northbound off-ramp of new interchange. This will provide direct access to Pito-One Road from Priests Ave.

Option 1b (P1 – Variant 2): Provide left out access to Priests Ave from northbound off-ramp of new interchange. This will provide direct access to Pito-One Road from Priests Ave.

No further mitigation has been proposed at this stage. Experts to advise if any further mitigation might be needed, particularly for Options 1a and 1b (P1 – Variants 1 and 2) given their impact on the Honiana Te Puni Reserve.

P. P Option Impacts on the Britannia Flour Mill and the Wellington Woollen Manufacturing Company Mill at Petone Interchange

Base position:

Petone to Grenada Assessment of Alternative Options

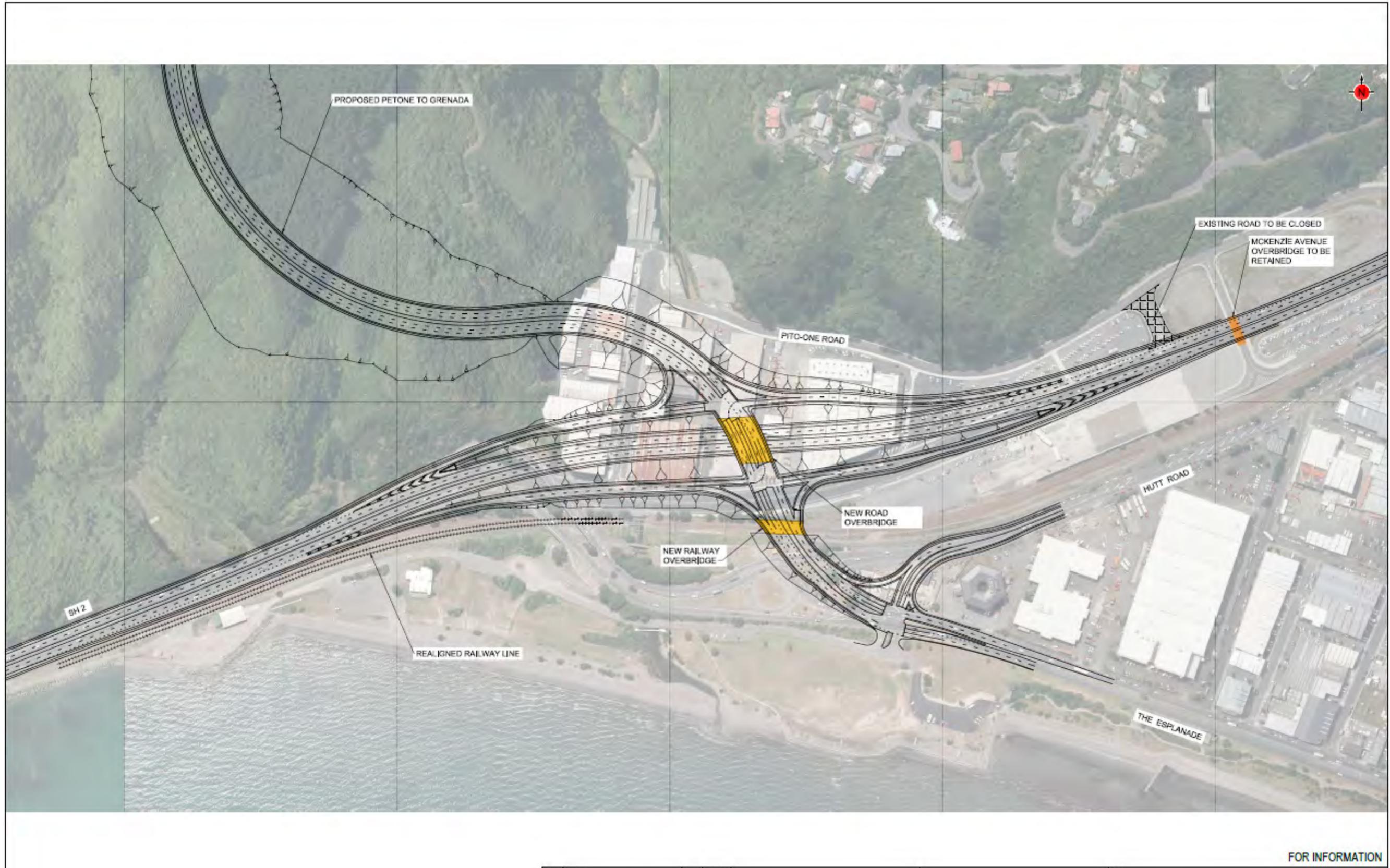
Options 1 to 4 (P1 to P4) all directly impact on the subsurface features of the Britannia Flour Mill and the Wellington Woollen Manufacturing Company sites which are within the construction footprint of proposed interchange. The ground disturbance to construct the proposed interchange has the potential to affect these features associated with the mills.

Reasonable Mitigation:

Presume reasonable mitigation includes the controlled archaeological investigation of the area after the demolition of the current buildings on the site which will allow for the retrieval and analysis of any archaeological material that can provide information about the buildings, and the mills that operated on the site. In addition presume that reasonable mitigation would include the installation of information panels at the entrance to BMR and the Korokoro Valley walking track which could incorporate archaeological and historic information about the mills recovered through the site investigation.

Petone to Grenada Assessment of Alternative Options

Appendix 1 – Petone Interchange Proposal



Petone to Grenada Assessment of Alternative Options

Appendix 2 – Noise Mitigation Plans

Key:

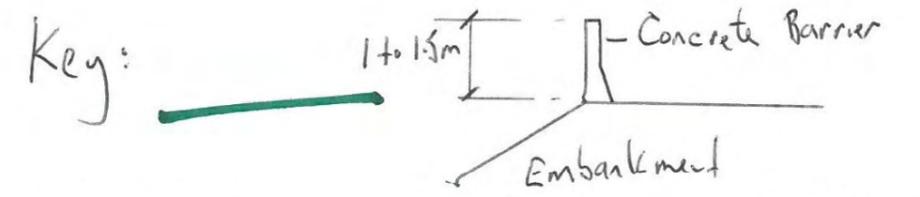


PETONE TO GRENADA TRANSPORTATION LINK - FEBRUARY 2014
AERIAL PHOTOGRAPHY FLOWN : 2010

OPTION C - EX. MOTORWAY (SH1 Full Widening)



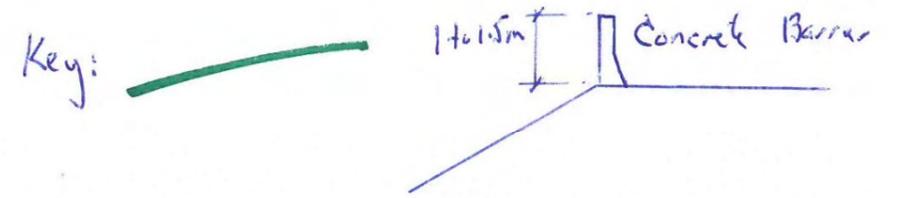
SH1 Upgrade Full Widening



PETONE TO GRENADA TRANSPORTATION LINK - MAY 2015
AERIAL PHOTOGRAPHY FLOWN : 2010

EXISTING MOTORWAY- SIX LANING HARD SHOULDER RUNNING WITH REDUCED MEDIAN (HSR 1) (Managed Motorway)
1

SH1 Upgrade Managed Motorway 1

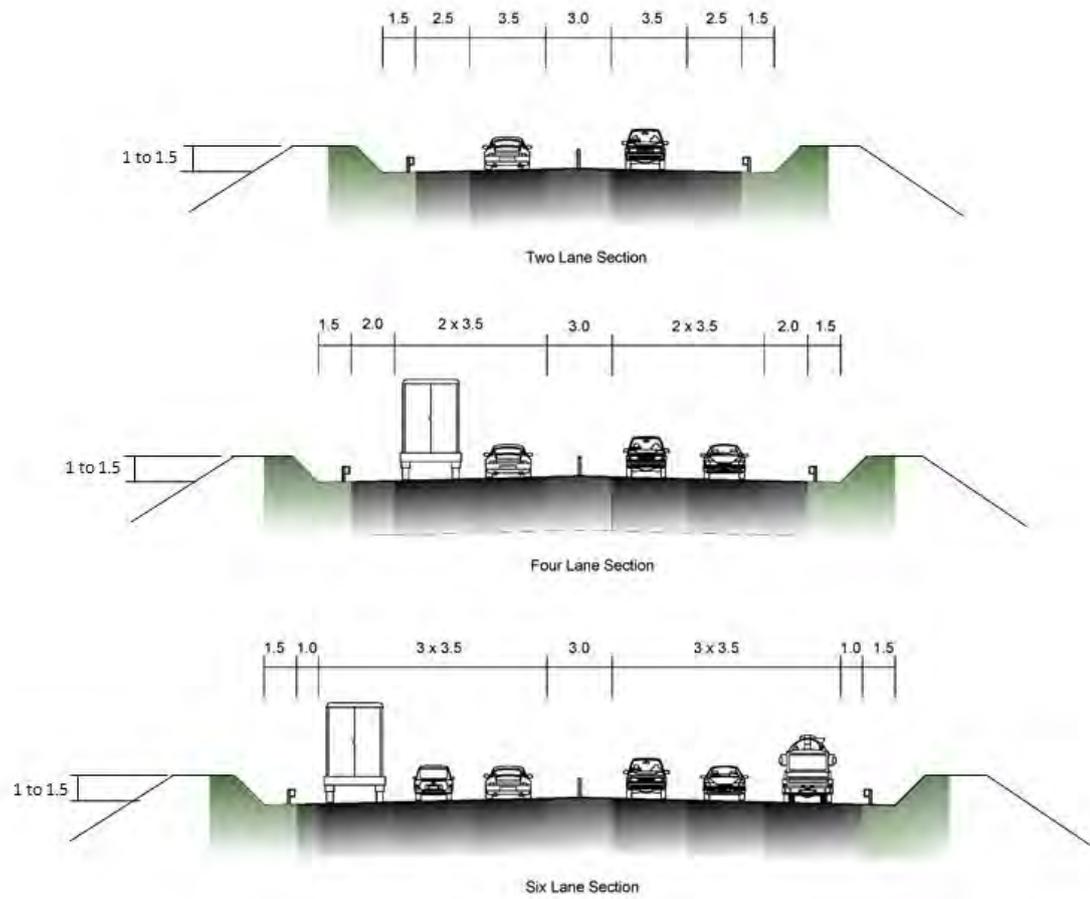


PETONE TO GRENADA TRANSPORTATION LINK - MAY 2015
AERIAL PHOTOGRAPHY FLOWN : 2013

EXISTING MOTORWAY- SIX LANING HARD SHOULDER RUNNING WITH REDUCED MEDIAN (HSR 2) (Managed Motorway)
2

SH1 Upgrade Managed Motorway 2

Petone to Grenada Assessment of Alternative Options

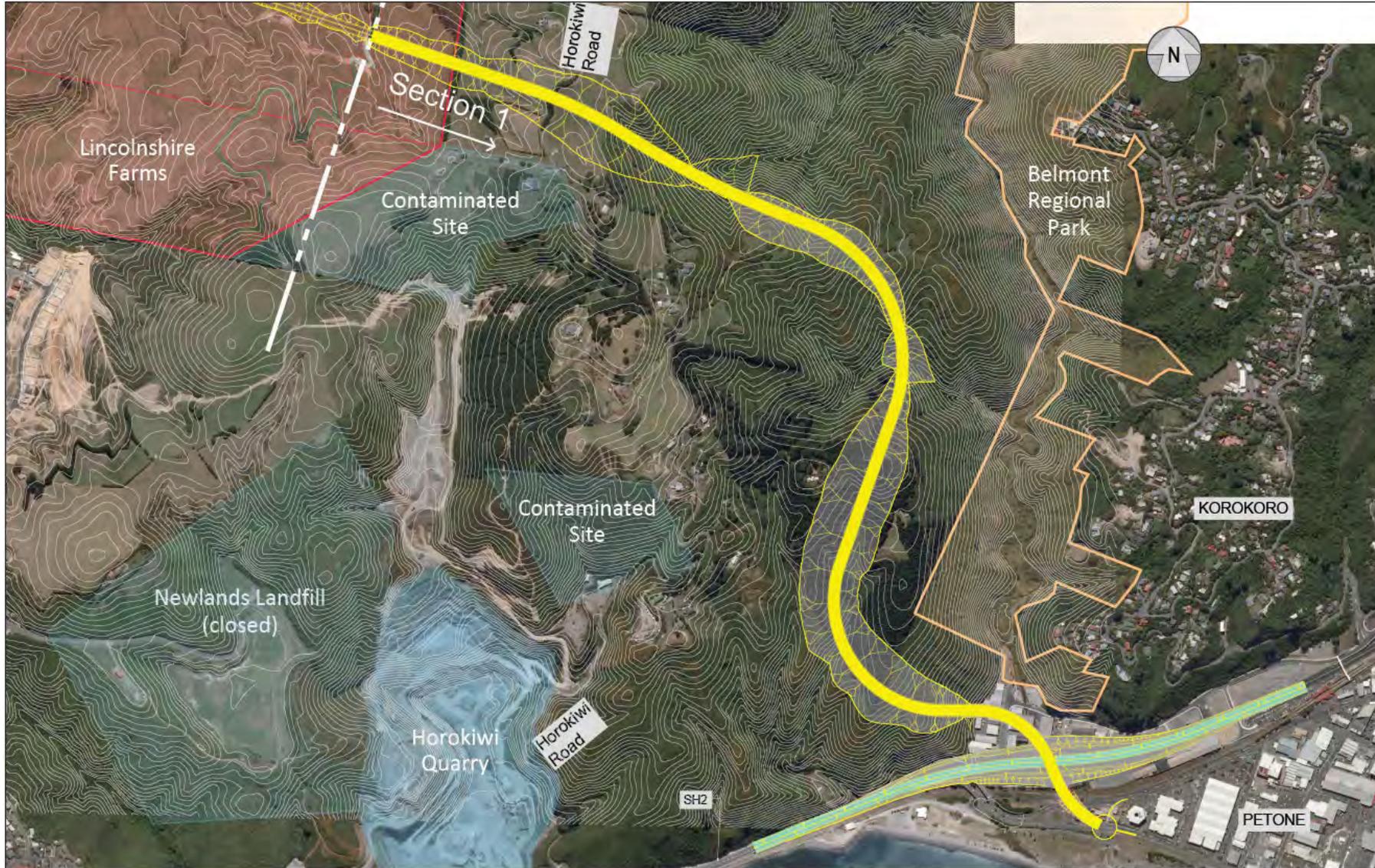


Earth Bunds on Carriageway Embankments – Greenfield Options

Petone to Grenada Assessment of Alternative Options

Appendix 3 – Option 4 (P4) Modified to Avoid Cox House

Petone to Grenada Assessment of Alternative Options



NOTES:
1. FOR CROSS SECTIONS REFER TO SHEET 11

Sheet	Revision	Approved	Revision Date



OPUS
Wellington Office
484 4 471 7330
PO Box 10-063
Wellington 6144
New Zealand

Drawn	Checked	Approved	Project Date
B.R.C			

Project: 5-C2359.22
Scale: 1:4000 (A1)

Project: NZ TRANSPORT AGENCY
PETONE TO GRENADA LINK ROAD : CONTRACT No.448PN
EVALUATION WORKSHOP

Sheet: SECTION 1
OPTION P4 MODIFIED TO AVOID COX HOUSE

Sheet No.	Scale
5 / 2955 / 1 / 5504	11M R0

Petone to Grenada Assessment of Alternative Options

Appendix 4 –Southern Tawa Curve Details



OPTION - Tawa South Curves

Petone to Grenada Assessment of Alternative Options

Drawing ID	Owner	Appelation	Address	Valuation Ref Number	Parcel ID
140	Growlock Trustees Limited	Pt Section 29 Porirua District WN526/164	400 Middleton Rd, Johnsonville-Glenside	16690-13800	3943689
141	Growlock Trustees Limited	Pt Section 30 Porirua District WN526/164	no details	16690-13800	3959895
225	Bruce James Murdoch Karen Joy Murdoch	Pt Section 33, Porirua District, 2.2012			3786708

Petone to Grenada Assessment of Alternative Options

Appendix 5 - Option 5 (A) & Impact on Artemis Early Learning Facility

Petone to Grenada Assessment of Alternative Options



Extent of OPTION A

OPTION A - Impact on Artemis Early Learning Limited
(1 Aruba Grove, Grenada Village)

Petone to Grenada Assessment of Alternative Options

Appendix 6 – Base Position Property & Local Road Impacts of Options 1 to 4 (P1 to P4)



Option 1 (P1) & Proposed Interchange at Petone



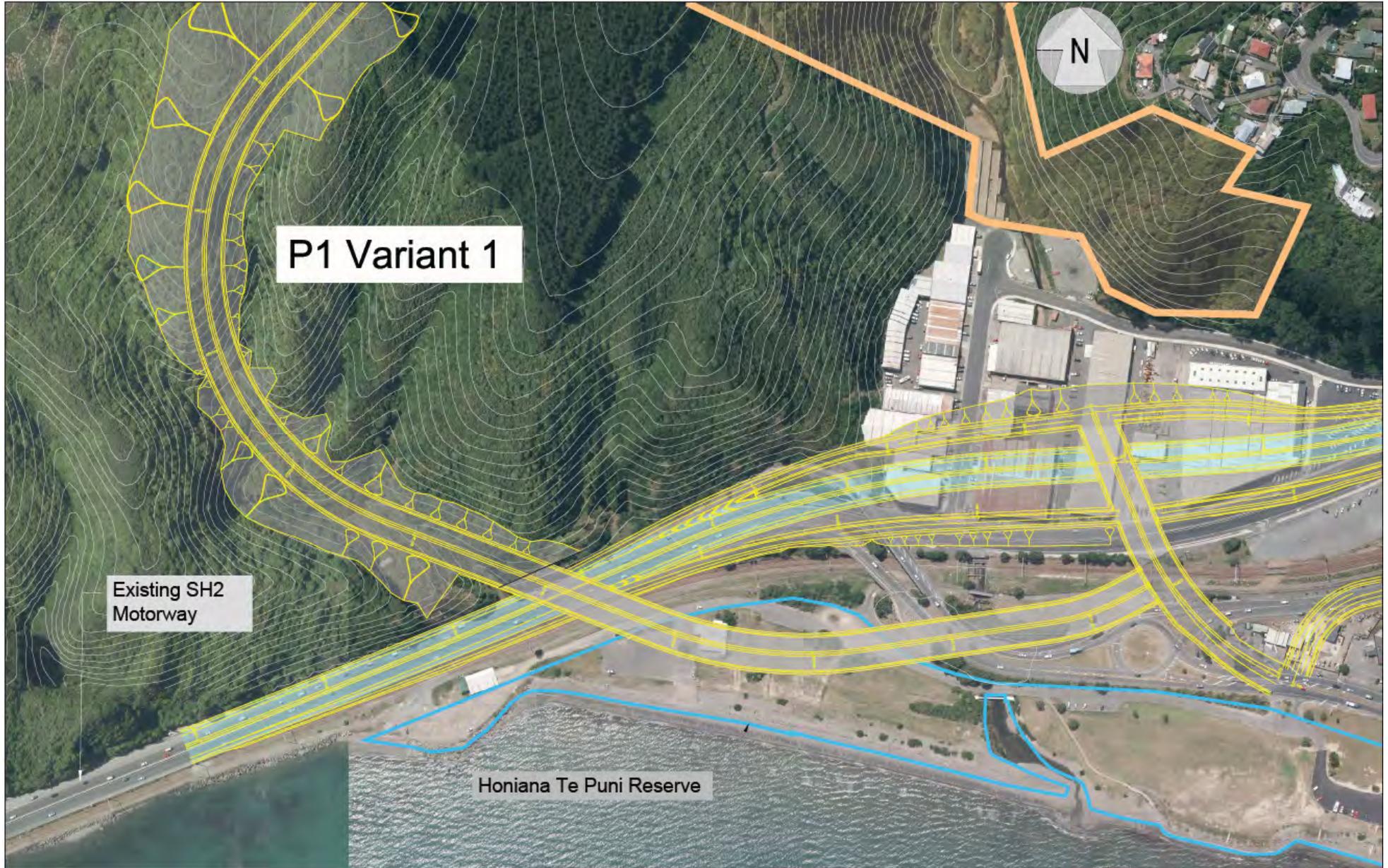
Option 2 (P2) & Proposed Interchange at Petone



Option 3 (P3) & Proposed Interchange at Petone



Option 4 (P4) & Proposed Interchange at Petone



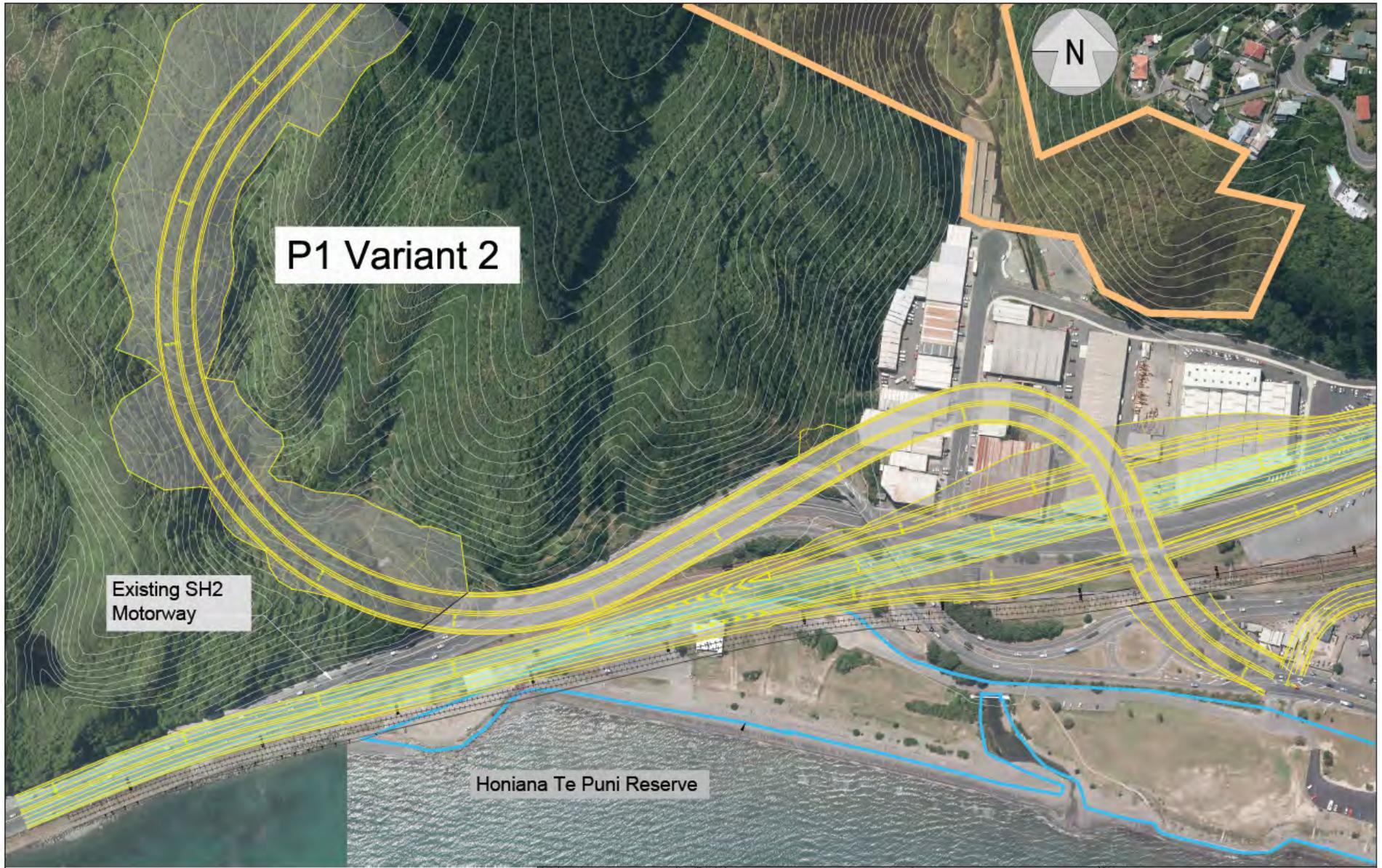
P1 Variant 1

Existing SH2
Motorway

Honiana Te Puni Reserve



Option 1a (P1 – Variant 1) & Proposed Interchange at Petone



Option 1b (P1 – Variant 2) & Proposed Interchange at Petone

Appendix D – Assessment of Route By Project Objectives

Project Objective	19. C MM2	20. C No SH1 Upgrade	21. D Update Tawa I/C	22. D(V1)	23. D(V2)
	Score	Score	Score	Score	Score
Project Objective 1	This option is significantly beneficial; it allows for improved freight connections on both the new Link Road and SH1 which would enhance	This option is moderately beneficial; it allows for improved freight connections on both the new Link Road and SH1 which would enhance	This option is very consistent as it provides better gradient and connections for freight through the provision of an additional link to SH1. Best match for national and regional growth aspirations.	This option is very consistent as it provides better gradient and connections for freight through the provision of an additional link to	This option is very consistent as it provides better gradient and connections for freight through the provision of an additional link to
score	3	2	3	3	3
Project Objective 2	This option is very consistent; it provides connectivity to Grenada and Tawa which improves connectivity to Porirua, Johnsonville and other suburbs on SH1.	This option is very consistent; it provides connectivity to Grenada and Tawa which improves connectivity to Porirua, Johnsonville and other suburbs on SH1.	This option is very consistent; it provides connectivity to Grenada, and Mark Avenue which improves connectivity to Porirua, Johnsonville and other suburbs on SH1. Option D also provides an additional connection to Transmission Gully (new SH1) which	This option is very consistent; it provides connectivity to Grenada, and Mark Avenue which improves connectivity to Porirua, Johnsonville and other suburbs on SH1. Option	This option is very consistent; it provides connectivity to Grenada, and Mark Avenue which improves connectivity to Porirua, Johnsonville and other suburbs on SH1. Option
score	3	3	3	3	3
Project Objective 3	This option is very consistent; it improves journey times and reliability between the lower Hutt Valley and other areas in the Ngauranga Triangle area. It provides improved journey time and reliability improvements throughout the area and on the SH network during normal operational conditions. Further improvements to journey time and reliability could	This option is moderately consistent; it improves journey times and reliability between the lower Hutt Valley and other areas in the Ngauranga Triangle area. It provides improved journey time and reliability improvements throughout the area and on the SH network during normal operational conditions. There is uncertainty about the impact of this option on	This option is very consistent; it improves journey times and reliability between the lower Hutt Valley and other areas in the Ngauranga Triangle area. It provides improved journey time and reliability improvements throughout the area and on the SH network. Further improvements to journey time and reliability could be made through improved design at Petone which could improve the consistency with the objectives. This option enhances journey time reliability at the Tawa interchange. Option D also provides an additional connection to Transmission	This option is very consistent; it improves journey times and reliability between the lower Hutt Valley and other areas in the Ngauranga Triangle area. It provides improved journey time and reliability improvements throughout the area and on the SH network. Further improvements to journey time and reliability could be made through improved design at	This option is very consistent; it improves journey times and reliability between the lower Hutt Valley and other areas in the Ngauranga Triangle area. It provides improved journey time and reliability improvements throughout the area and on the SH network. Further improvements to journey time and reliability could be made through improved design at
score	3	2	3	3	3
Project Objective 4	This new route meets minimum safety standards. This option improves all three Tawa Curves (assumed as reasonable mitigation). This option adds two interchanges, which adds some safety risk. The decongestion effect on the existing SH network has additional safety benefits.	This new route meets minimum safety standards. This option improves all three Tawa Curves (assumed as reasonable mitigation). This option adds two interchanges, which adds some safety risk. The decongestion effect on the existing SH network has additional safety benefits.	This new route meets minimum safety standards. This option enhances safety at the Tawa Interchange. This option improves all three Tawa Curves (assumed as reasonable mitigation) and has an additional interchange which adds additional safety risk. However the decongestion effect on the existing SH network has additional safety benefits.	This new route meets minimum safety standards. This option enhances safety at the Tawa Interchange. This option improves all three Tawa Curves (assumed as reasonable mitigation) and has an additional interchange which adds additional safety risk. However the decongestion effect on the existing SH network has additional safety benefits.	This new route meets minimum safety standards. This option enhances safety at the Tawa Interchange. This option improves all three Tawa Curves (assumed as reasonable mitigation) and has an additional interchange which adds additional safety risk. However the decongestion effect on the existing SH network has additional safety benefits.
score	2	2	2	2	2
Project Objective 5	This option is similar to Option C (V1) MM2 in terms of resilience. Hence refer to this option for comments.	This option is similar to Option C (V1) No SH1 Upgrade in terms of resilience. Hence refer to this option for comments.	This option provides good natural hazard resilience with low to moderate height cuts and fills. The moderately larger to larger box cutting in rock, through the Hunter's Hill ridge, can be engineered with appropriate slope angles and stabilisation measures to provide resilience. It also provides a complete bypass of some moderately vulnerable sections of SH 1 and also the southern section of the proposed Transmission Gully route with large box cuts in very poor ground. It also provides much improved resilience of access to the Hutt Valley from the north and in the Greater Wellington area in general in conjunction with a suitable option in the southern section between the Lincolnshire Farm area and Petone. Provides excellent operational resilience by providing an alternate route to the existing SH1 between MacKays Crossing and Grenada in conjunction with Transmission Gully, and to the Hutt Valley. It provides connectivity to Grenada south, Tawa, Porirua and further north along the Transmission Gully expressway, and enables bypass of any incidents on either route. Selection of this option which provides relatively good route resilience and	This option is similar to Option D Update Tawa I/C. Hence refer to this option for comments.	This option is similar to Option D Update Tawa I/C. Hence refer to this option for comments.
score	1	0	3	3	3
Project Objective 6	Affects residential areas in Grenada, but reduces effects on properties next to SH1	This option is aligned with this project objective and has no impact on properties and communities next to SH1. But still affects some ecological areas.	This option has significant or moderately negative effects on ecology, landscape/visual, social community, recreation and urban design.	Although this option is aligned with the project objective and avoids new residential developments in Grenada and sports fields in Grenada North, it has significant negative effects on ecology, landscape/visual and recreation.	Although this option is aligned with the project objective and avoids a new residential development in Grenada and Sports fields in North Grenada, it has significant to moderately negative effects on ecology, landscape/visual.
score	2	3	0	1	1
Method Statement	This option is cost efficient with a BCR of between 1.9 and 2.2 (depending on Petone option). Note that this BCR is calculated using the updated NWSM model. This is highly consistent with the project	This option is cost efficient with a BCR of between 2.2 and 2.6 (depending on Petone option). Note that this BCR is calculated using the updated NWSM model. This is highly consistent with the project	This option is cost efficient with a BCR of between 2.1 and 2.4 (depending on Petone option). This is highly consistent with the project objective.	This option is cost efficient with a BCR of between 2.0 and 2.4 (depending on Petone option). This is highly consistent with the project objective.	This option is cost efficient with a BCR of between 2.0 and 2.3 (depending on Petone option). This is highly consistent with the project objective.
	19. C MM2	20. C No SH1 Upgrade	21. D Update Tawa I/C	22. D(V1)	23. D(V2)

Appendix E: Potential Fill Sites

Fill Site Overview

The table below shows the capacity of each potential fill disposal site.

Fill Disposal Site	Capacity (m ³)
K (Version 2)	850,000
M (Version 2)	390,000
Lincolnshire Farm 1 (Version 2)	6,800,000
Lincolnshire Farm 2 (Version 2)	840,000
L	1,800,000
Total	10,680,000

A detailed description of each fill site is provided below. A contour plan of each site together with cross sections are also provided.

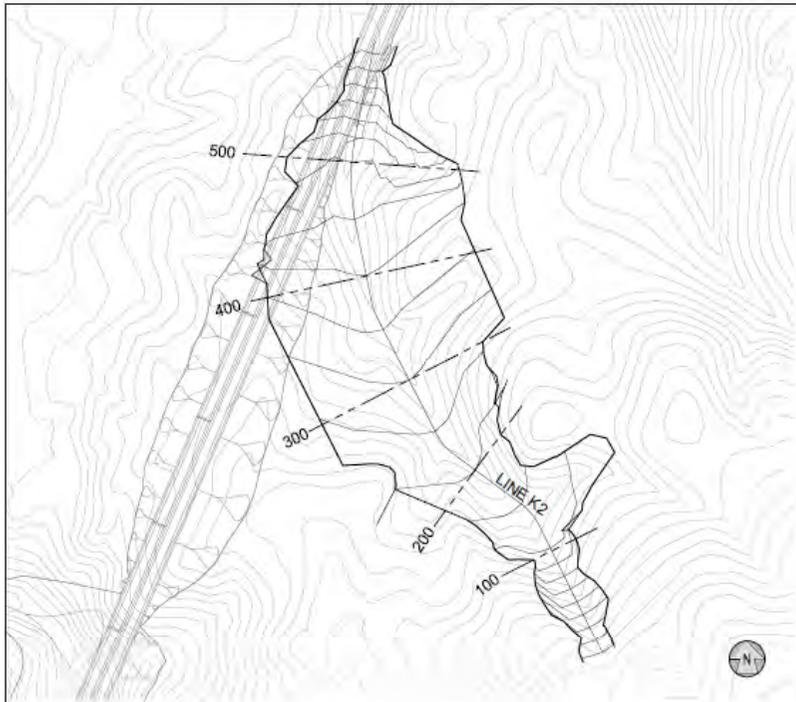
Fill Disposal Site K (Version 2)

Fill Site K (Version 2) is located in North Grenada in the upper reaches of a deep valley which forms a tributary of the Porirua Stream. This fill site was preferred by specialists at the Workshop 3 held on 24 June 2015 for the following reasons:

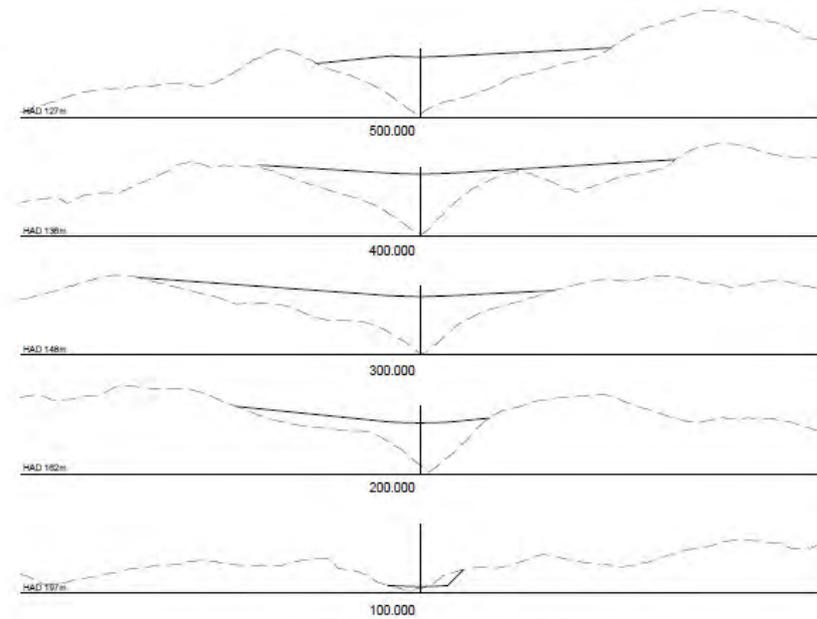
- Alignment with the Lincolnshire Farm Structure Plan (LFSP) from an urban design perspective. This site is identified as a clean fill site on Map 6 and also an area of limited development on Map 4 of this plan;
- Lower ecological values than other valleys in area.

The refinements to the original version of this site included increasing the size of the fill site by filling up to the tops of the valley edges to create a reasonably level surface.

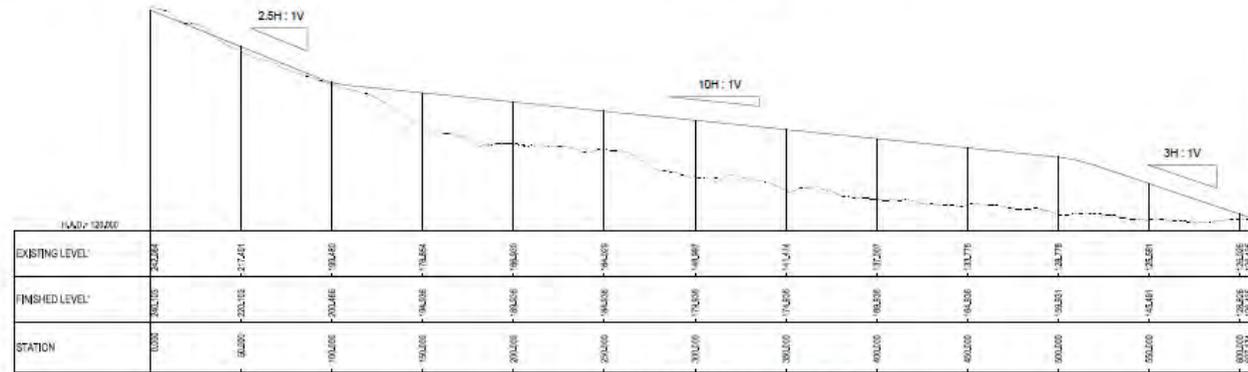
The revised fill site is approximately 600m long and approximately 250m wide at its widest point. The fill site follows the valley and slopes downwards from south to north. The longitudinal profile of the outer face varies from approximately 40% (1V to 2.5H) along the southern section, 10% (1V:10H) along the middle section and 30% (1V:3H) along the northern section. The middle section is approximately 400m long. The maximum fill depth is approximately 30m. The fill site is located within the northeast section of the Lincolnshire Farm Structure Plan (LFSP).



FILL AREA K2
SCALE 1:3000



CROSS SECTIONS ALONG LINE K2
SCALE 1:1250



LONGSECTION ALONG LINE K2
SCALE 1:1250H, 1:1250V



NZ TRANSPORT AGENCY
PETONE TO GRENADA LINK ROAD : CONTRACT No.448PN
EVALUATION WORKSHOP

POTENTIAL FILL AREAS
FILL K - VERSION 2

5-C2359.22 AS SHOWN (A1)

SKETCH

FK2 R0

Fill Disposal Site M (Version 2)

Fill Site M is located in Horokiwi, over two private properties, in the upper reaches of a deep gully within the Horokiwi Stream catchment.

This fill site was preferred by specialists at Workshop 3 held on 24 June 2015 for the following reasons:

- Low ecological values with the stream running through the Horokiwi Quarry;
- Potential from a landscape perspective of widening the ridge at the upper reaches of the gully to create a flatter section to create more useable land;
- Potential to extend the site into the contaminated site to the west known as Cottles Landfill.

The refinements to the original version of this site included increasing the fill in this area by providing a relatively flat surface at the eastern end adjacent to Horokiwi Road in the vicinity of the residential dwelling to maximise the useable area of land on this property.

The revised fill site is approximately 250m long and approximately 200m wide at its widest point. The fill site follows the upper reaches of the valley and slopes downwards from east to west. The longitudinal profile of the outer face varies from approximately 2% (1V to 50H) along the eastern section, 15% (1V:6H) along the middle section and 30% (1V:3H) along the western section. The relatively flat eastern section is approximately 200m long. The maximum fill depth is approximately 30m. The site is located on two properties but avoids impacting directly on any residential dwellings.

Extending the fill into the contaminated site (identified as Cottles Landfill) was considered but not pursued as anecdotal evidence suggested that the refuse placed at this site was uncontrolled and unlikely to physically support additional fill. As a result this site was further refined by removing a portion of the original version of this site which extended into the area identified as contaminated land. Further preliminary site assessment work would be required to determine the potential to extend this site into the neighbouring contaminated site.

Lincolnshire Farm 1 (Version 2)

Lincolnshire Farm 1 (Version 2) is located between Grenada and Horokiwi in the Porirua Stream catchment over the majority of the area identified as Lincolnshire Farm.

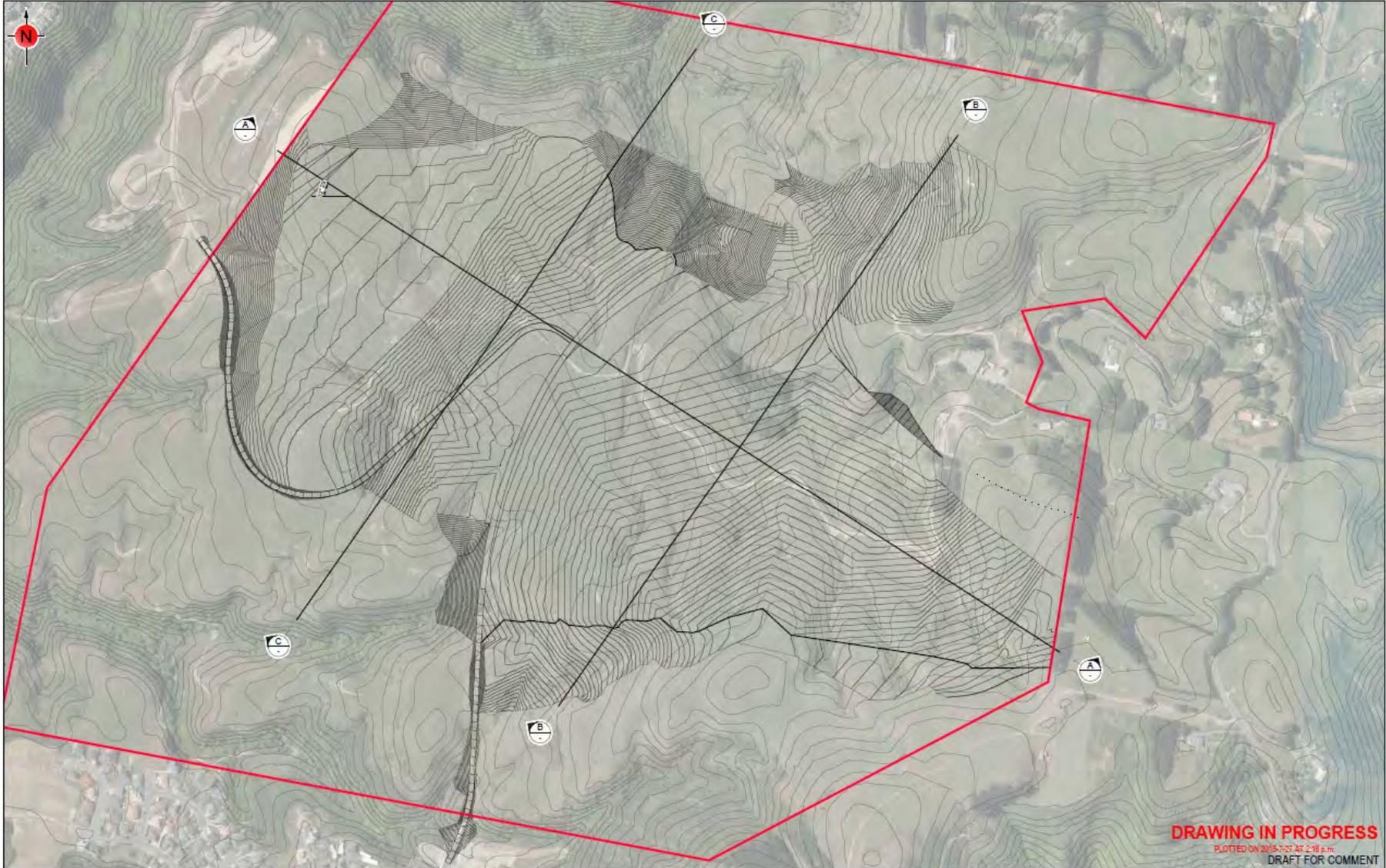
This fill site was preferred by specialists at Workshop 3 held on 24 June 2015 for the following reasons:

- Alignment with the Lincolnshire Farm Structure Plan (LFSP) from an urban design perspective. Currently the LFSP appears infeasible with the existing topography and requires fill to realise the plan.
- Potential for good outcomes from a landscape perspective provided the fill was pulled back from the edges of the Belmont Gully, the site was not overfilled and the fill was shaped to fit in with the natural landscape.
- Potential for good outcomes from an ecological and water quality perspective provided the site included seepage areas, developed wetlands, green corridors, protection of ecological areas, a complete storm-water design and less fill.

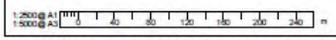
The refinements to the original version of this site included reducing the overall quantity of fill from approximately 9.5Mm³ to approximately 6.8Mm³ by reducing the overall height of the fill at the eastern end of the site and also pulling it back from the edge of Belmont Gully at the northeast section of the site.

The revised fill site is approximately 1.3km long from east to west, approximately 1km wide at its widest point and covers approximately 700,000m² (70ha). The existing area can be described as a broadly undulating hill top plateau which slopes downwards from east to west fill site at an average gradient of approximately 6% (1V:16H). The hill top plateau contains several depressions which from tributaries of the Belmont Stream. The concept of this fill site is to place fill over the majority of the hill top plateau to smooth the contours while maintaining an average gradient of 6% sloping downwards over the site from east to west. The maximum depth of fill is approximately 25m.

The fill site has been designed to avoid areas identified as “Areas of Protection” in the LFSP apart from a few narrow sections within the central area of the hilltop plateau. This can be seen on the plan below which overlays Map 3 of the LFSP (Pattern of Development). The fill site has also been designed to accommodate road links from Woodridge and Grenada as identified on Map 4 of the LFSP. These preliminary road links are illustrated on the plans below.

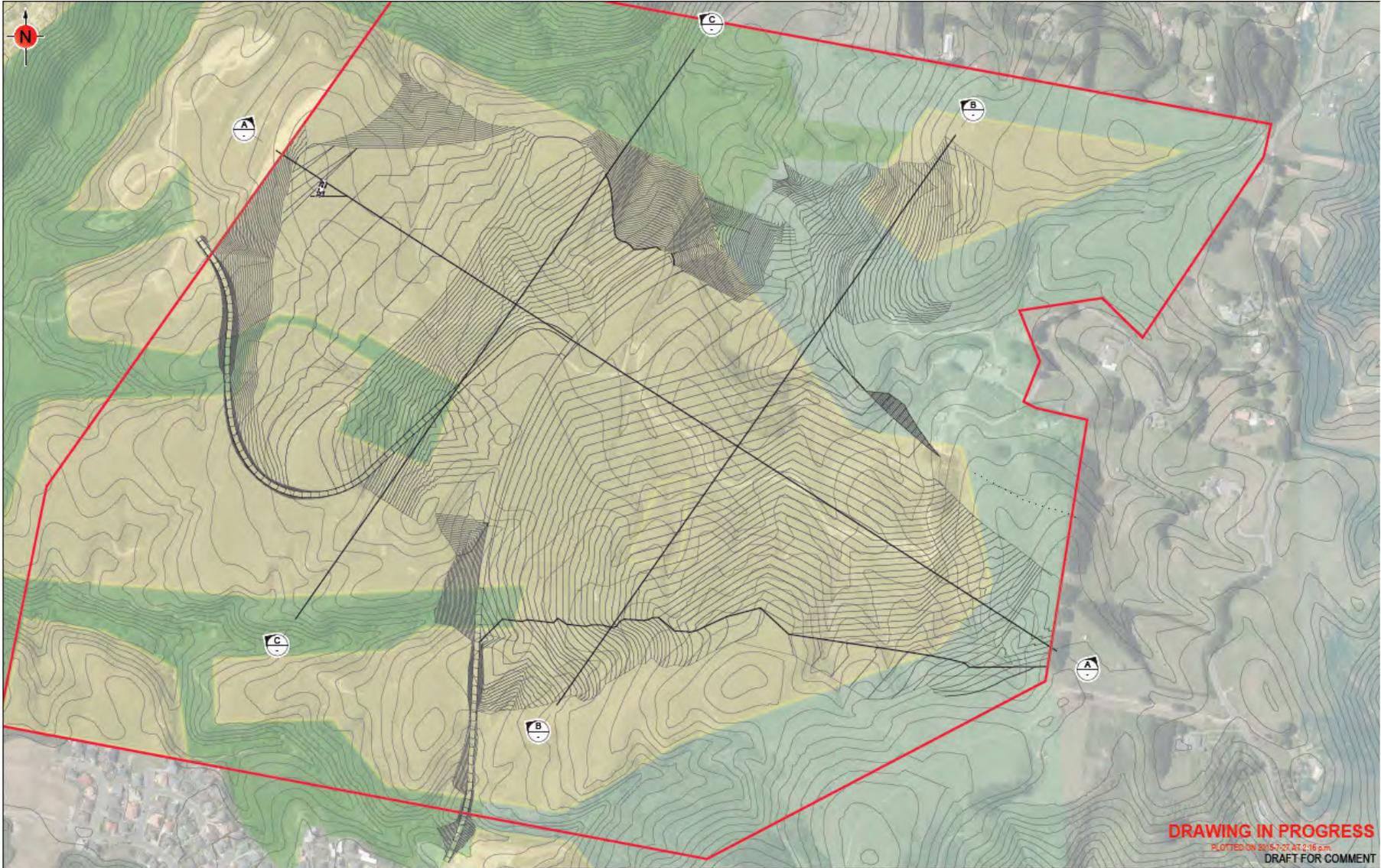


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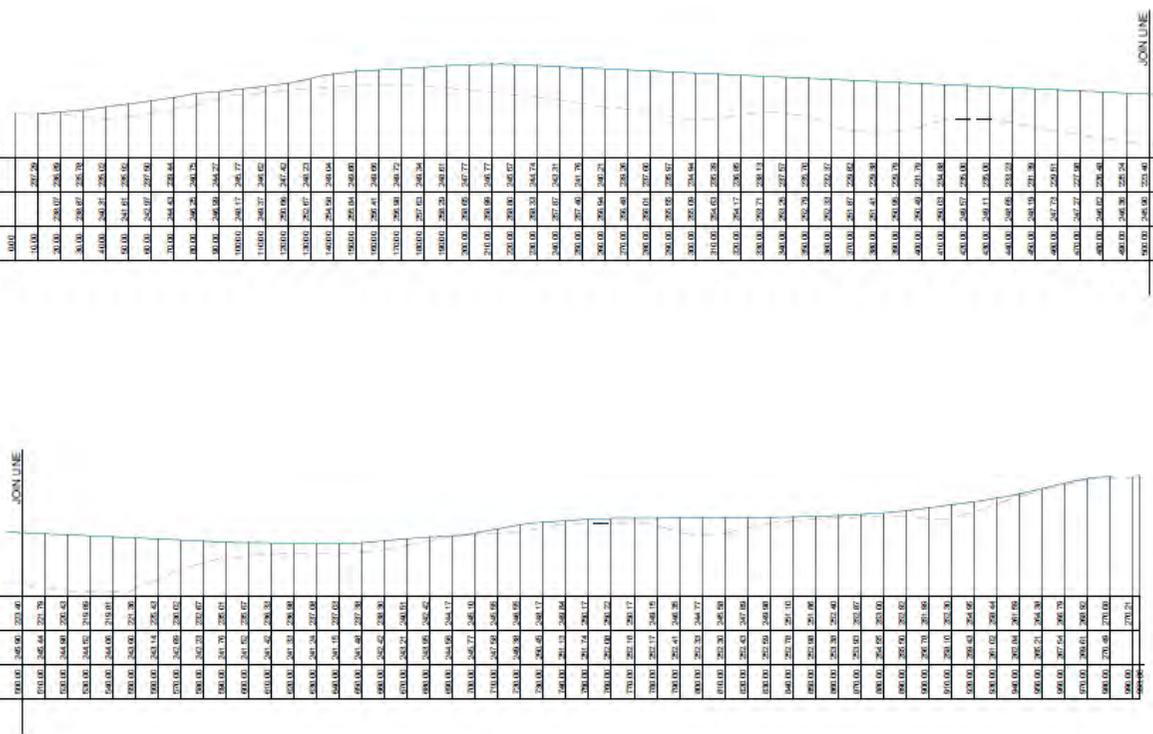


Name	Description	Quantity	Volume	Area

		PG No: 13-003 Wellington 0144 New Zealand		PETONE TO GRENADA LINCOLNSHIRE FARM PRELIMINARY FILL CONCEPTS	
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Drawn: JOHN PELL	Scale: 1:2000(A)	Title: S-C2359	Date: 1:2000(A)	Drawn By: 	Checked By:



1:1000 @ A1
1:2000 @ A2



Datum R.L. 218.00		
STATION	EXISTING LEVEL	PROPOSED LEVEL
000		
10.00	202.92	
20.00	203.07	208.00
30.00	203.67	208.70
40.00	204.71	209.00
50.00	204.91	209.50
60.00	204.97	209.90
70.00	204.93	209.64
80.00	204.79	209.78
90.00	204.69	209.77
100.00	204.57	209.67
110.00	204.37	209.65
120.00	203.96	207.62
130.00	203.47	206.73
140.00	202.92	206.01
150.00	202.59	205.04
160.00	202.54	204.00
170.00	202.59	204.00
180.00	202.67	204.34
190.00	202.70	204.61
200.00	202.69	204.77
210.00	202.69	204.77
220.00	202.69	204.67
230.00	202.53	204.74
240.00	202.07	202.71
250.00	201.46	201.70
260.00	200.94	200.71
270.00	200.40	200.30
280.00	200.01	200.00
290.00	200.00	200.07
300.00	200.00	200.04
310.00	200.00	200.30
320.00	200.00	200.30
330.00	200.00	200.30
340.00	200.00	200.30
350.00	200.00	200.30
360.00	200.00	200.30
370.00	200.00	200.30
380.00	200.00	200.30
390.00	200.00	200.30
400.00	200.00	200.30
410.00	200.00	200.30
420.00	200.00	200.30
430.00	200.00	200.30
440.00	200.00	200.30
450.00	200.00	200.30
460.00	200.00	200.30
470.00	200.00	200.30
480.00	200.00	200.30
490.00	200.00	200.30
500.00	200.00	200.30

Datum R.L. 218.00		
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560.00	203.11	209.45
570.00	202.00	209.00
580.00	202.70	209.00
590.00	201.70	208.00
600.00	201.50	208.00
610.00	201.50	208.00
620.00	201.45	208.30
630.00	201.45	208.30
640.00	201.45	208.30
650.00	201.45	208.30
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670.00	201.45	208.30
680.00	201.45	208.30
690.00	201.45	208.30
700.00	201.45	208.30
710.00	201.45	208.30
720.00	201.45	208.30
730.00	201.45	208.30
740.00	201.45	208.30
750.00	201.45	208.30
760.00	201.45	208.30
770.00	201.45	208.30
780.00	201.45	208.30
790.00	201.45	208.30
800.00	201.45	208.30
810.00	201.45	208.30
820.00	201.45	208.30
830.00	201.45	208.30
840.00	201.45	208.30
850.00	201.45	208.30
860.00	201.45	208.30
870.00	201.45	208.30
880.00	201.45	208.30
890.00	201.45	208.30
900.00	201.45	208.30
910.00	201.45	208.30
920.00	201.45	208.30
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940.00	201.45	208.30
950.00	201.45	208.30
960.00	201.45	208.30
970.00	201.45	208.30
980.00	201.45	208.30
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SECTION B
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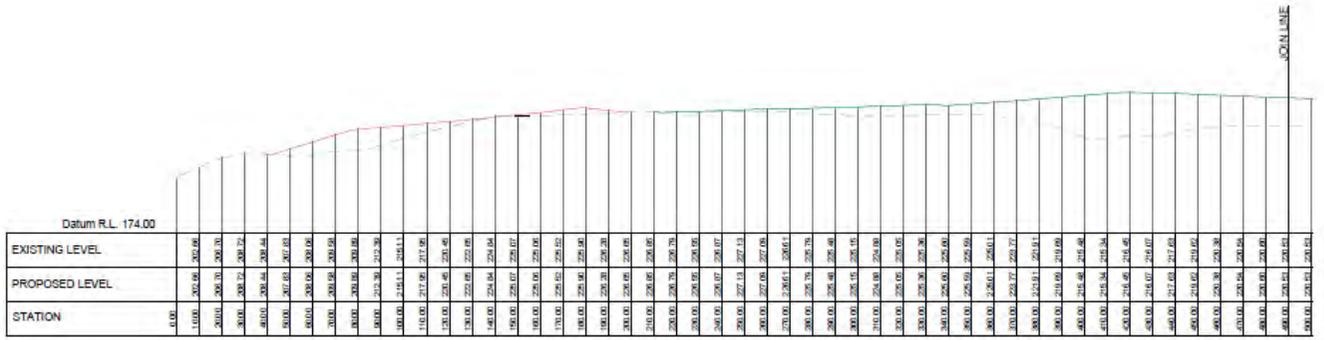
OPUS
Wellington Office
46-4 H.T. ROAD
110 Box 1670
Wellington 0144
New Zealand

PETONE TO GRENADA
LINCOLNSHIRE FARM
PRELIMINARY FILL CONCEPTS

MAIN FILL - LONG SECTION B

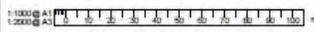
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SECTION C
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4+10	1.00	1.00
4+15	1.00	1.00
4+20	1.00	1.00
4+25	1.00	1.00
4+30	1.00	1.00
4+35	1.00	1.00
4+40	1.00	1.00
4+45	1.00	1.00
4+50	1.00	1.00
4+55	1.00	1.00
4+60	1.00	1.00
4+65	1.00	1.00
4+70	1.00	1.00
4+75	1.00	1.00
4+80	1.00	1.00
4+85	1.00	1.00
4+90.00	1.00	1.00

 Wellington Office 454 47 330		101 Box 9320 Wellington 6144 New Zealand	
		Project: PETONE TO GRENADA LINCOLNSHIRE FARM PRELIMINARY FILL CONCEPTS	
Drawing No: 5-C2359		Date: 1:1000 (A3)	

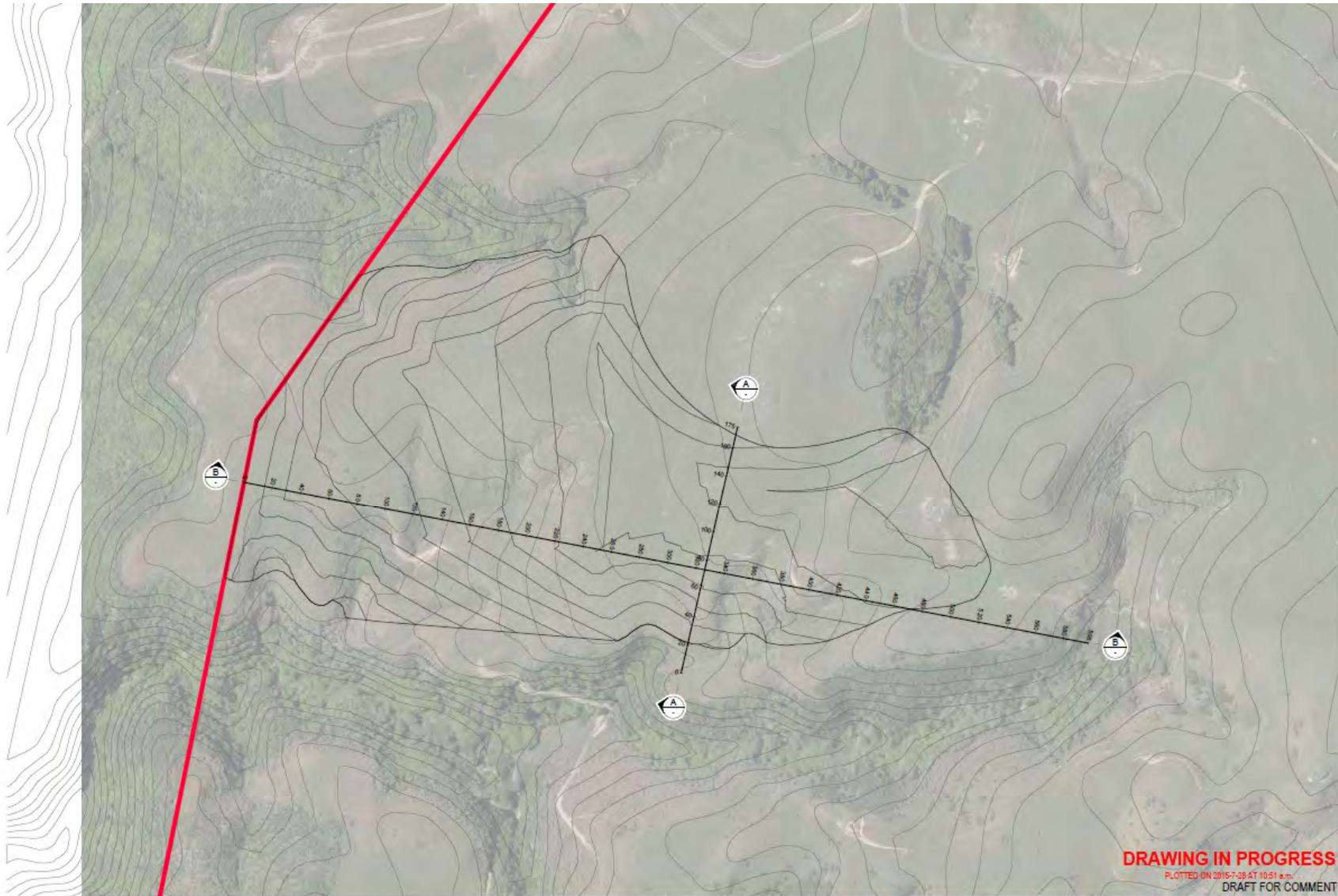
Lincolnshire Farm 2 (Version 2)

Lincolnshire Farm 2 (Version 2) is located in the Porirua Stream catchment over the southwest corner of the Lincolnshire Farm Area.

The original version filled a large tributary of the Belmont Stream which is identified as “Areas of Protection” in the LFSP. As a result the original version was not favoured by the specialists at Workshop 3 held on 24 June 2015. Consequently refinements were made based on feedback from the specialists which involved completely avoiding the large tributary of the Belmont Stream. This reduced the capacity of the fill area from approximately 3Mm³ to 840,000m³.

The revised fill site is approximately 470m long from east to west and 150m wide at its widest point and covers approximately 100,000m² (10ha). The existing area can be also be described as a broadly undulating hill top plateau but slopes from east to west more steeply than Lincolnshire Farm 1 (Version 2). This site slopes downwards from east to west at an average gradient of approximately 10% (1V:10H). The concept of this fill site is to place fill over the majority of this area to smooth the contours and create a relatively flat section from the eastern boundary for a length of approximately 220m followed by a steeper section of site at a gradient of approximately 16% (1V:6H) for approximately 250m to the western boundary. The maximum depth of fill is approximately 25m.

The fill site has been designed to avoid areas identified as “Areas of Protection” in the LFSP. This can be seen on the plan below which overlays Map 3 of the LFSP (Pattern of Development).



DRAWING IN PROGRESS
 PLOTTED ON 2015-07-28 AT 10:51 a.m.
 DRAFT FOR COMMENT



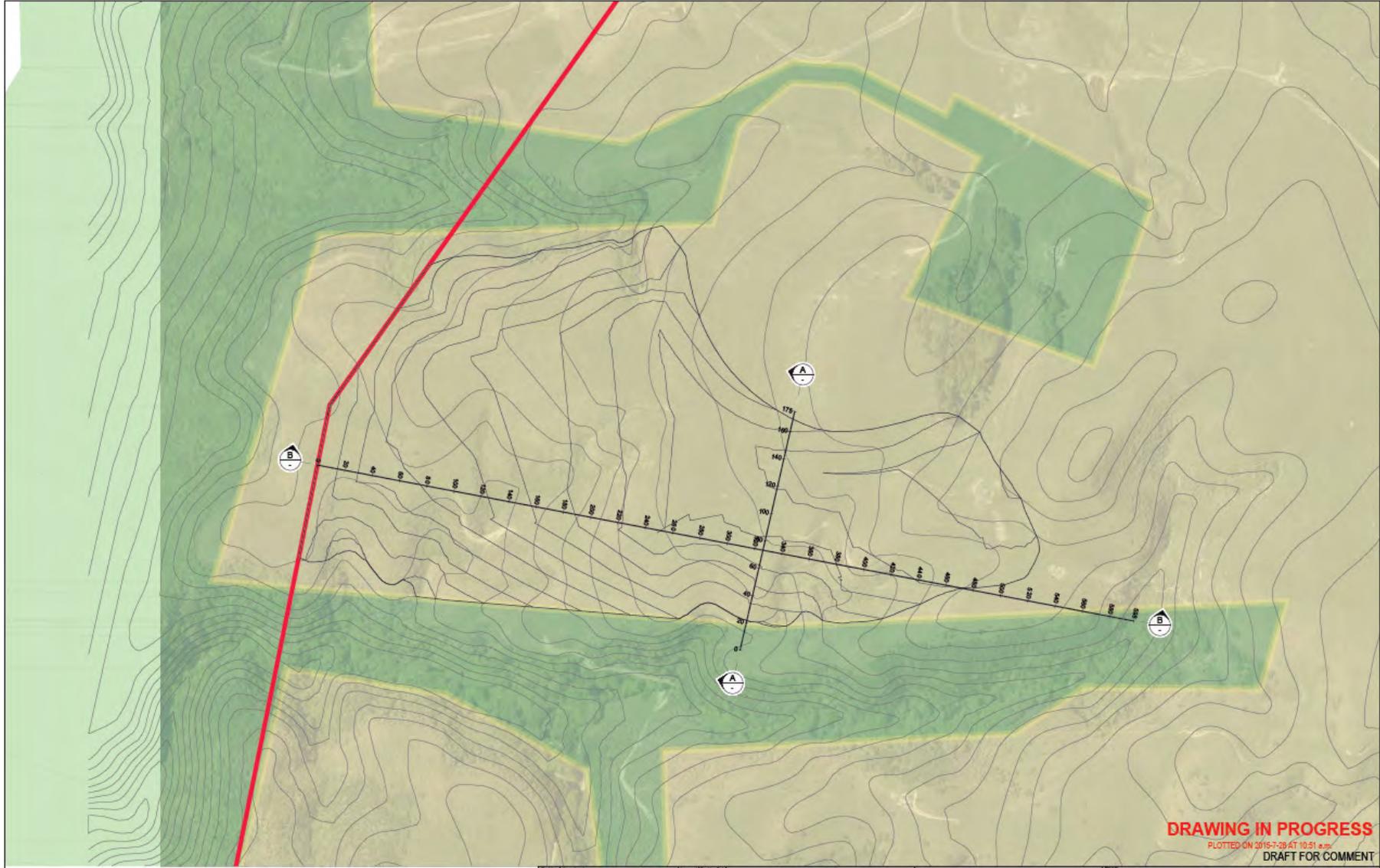
REV	DATE	BY	CHKD	DESCRIPTION

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 Wellington Office
 464 47 533

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 Wellington 6144
 New Zealand

Client: J PELL
 Date: J PELL
 Scale: 1:250(A1)

Project:	NEW ZEALAND TRANSPORT AGENCY PETONE TO GRENADA LINCOLNSHIRE FILL OPTION
Sheet:	PLAN
Project No.:	SC2359
Sheet No.:	###
Revision:	A



Fill Disposal Site L

Fill Site L is located within the former WCC Newlands landfill site, currently known as Waihinahina Park and covers an area of approximately 130,000m² (13ha). This site is within the Horokiwi Stream catchment. The current site is well contained in a deep greywacke valley. This potential fill site was introduced at the at Workshop 3 held on 24 June 2015 and preferred by specialists as there was potential for good urban design, ecological and landscape outcomes.

The concept of this fill site is to place additional fill on this site which matches its existing profile and gradient. The profile of this site is generally flat and slopes gently from south to north. In addition to adding more fill to the site it is also proposed to extend the fill site into the upper reaches of the gullies at the northern end of this site. The upper reaches of these gullies extend into the southern section of property owned by Woodridge Holdings which is within the southern section of the Lincolnshire Farm Structure Plan (LFSP).

The southern section of the site, which builds on the original fill site, is relatively flat with a gradient of approximately 5% (1V:20H). The maximum depth of fill within this site is approximately 20m.

The northern section of this site comprises fill in the upper reaches of two gullies. The profile of this section gently slopes downwards from north to south at approximately 5% (1V:20H) then steepens to a gradient of approximately 30% (1V:3H) until it meets the southern section of this site. The maximum depth of fill in the northern section is approximately 20m.

At this stage it is assumed access to this site would be from the north across the property owned by Woodridge Holdings Ltd.



Number	Description	Author	Revision Date



Project No	5-C2359 22
Scale	1:2000 AT A1

NZ TRANSPORT AGENCY PETONE TO GRENADA LINK ROAD : CONTRACT No.448PN EVALUATION WORKSHOP	
Title POTENTIAL FILL AREAS FILL L - AERIALS & DEVELOPMENT AREAS	
Sheet No.	##
Format	RD

Appendix F: Mitigated and Unmitigated Raw Scores

No Weighting Applied	Individual MCA Criteria	C r i t e r i a	5. A		6. B		7. C		8. D		9. C(V1)		9a. C(V1)-Variant 1		10. C(V1) MM1		10a. C(V1)-Variant 1 MM1	
			Score		Score		Score		Score		Score		Score		Score		Score	
			Unmitigated	Mitigated	Unmitigated	Mitigated	Unmitigated	Mitigated	Unmitigated	Mitigated	Unmitigated	Mitigated	Unmitigated	Mitigated	Unmitigated	Mitigated	Unmitigated	Mitigated
			Raw	Raw	Raw	Raw	Raw	Raw	Raw	Raw	Raw	Raw	Raw	Raw	Raw	Raw	Raw	Raw
Business	Business	1.00	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	
Transport	Natural Hazards and Network Resilience	1.00	1	1	0	0	1	1	3	3	1	1	1	1	0	1	0	1
	Transport	1.00	1	2	1	2	2	2	1	2	2	2	1	2	1	2	1	2
Built and Human Environment	Noise	1.00	-2	-1	-1	-1	-1	-1	-2	-1	-2	-1	-2	-1	-1	-1	-1	-1
	Urban Design	1.00	-2	-2	-2	-2	-1	0	-3	-2	1	2	2	3	1	2	2	3
	Recreation	1.00	-1	0	-1	0	-2	-1	-3	-1	-2	-1	-1	0	-2	-1	-2	-1
Social	Social	1.00	-3	-2	-3	-2	-3	-2	-3	-2	-3	-2	-3	-2	-2	-1	-2	-1
Heritage and Culture	Archaeology	1.00	0	0	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
	Built Heritage	1.00	-1	0	-1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cultural	1.00	0	0	0	0	-1	2	-1	2	-1	2	-1	2	-1	2	-1	2
Natural Environment	Land Contamination (potential for)	1.00	0	0	F	F	0	0	-1	0	0	0	0	0	0	0	0	0
	Landscape/Visual	1.00	-2	-1	-2	-1	-2	-2	-3	-3	-3	-2	-3	-2	-3	-2	-3	-2
	Ecology	1.00	-1	0	-2	0	-2	0	-3	-3	-2	-1	-1	0	-2	-1	-1	0
	Water Quality	1.00	F	-1	F	-1	F	-1	F	-1	F	-1	F	-1	F	-1	F	-1
	Overall scores		F	-3	F	F	-8	-1	-14	-5	-8	0	-6	3	-8	1	-6	3
	Ranking												1=				1=	
	Notes:		All Criteria Score 1															

No Weighting Applied	Individual MCA Criteria	C r i t e r i a	11. C(V1) MM2		11a. C(V1)-Variant 1 MM2		12. C(V1) No SH1 Upgrade		12a. C(V1)-Variant 1 No SH1 Upgrade		13. C(V2)		14. C(V2) MM1		15. C(V2) MM2		16. C(V2) No SH1 Upgrade	
			Score		Score		Score		Score		Score		Score		Score		Score	
			Unmitigated	Mitigated	Unmitigated	Mitigated	Unmitigated	Mitigated	Unmitigated	Mitigated	Unmitigated	Mitigated	Unmitigated	Mitigated	Unmitigated	Mitigated	Unmitigated	Mitigated
			Raw	Raw	Raw	Raw	Raw	Raw	Raw	Raw	Raw	Raw	Raw	Raw	Raw	Raw	Raw	Raw
Business	Business	1.00	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
Transport	Natural Hazards and Network Resilience	1.00	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	
	Transport	1.00	1	2	1	2	1	1	1	1	1	2	1	2	1	2	1	1
Built and Human Environment	Noise	1.00	-1	-1	-1	-1	-2	-1	-2	-1	-2	-1	-2	-1	-2	-1	-2	-1
	Urban Design	1.00	1	2	2	3	1	2	2	3	-2	0	-2	0	-2	0	-2	0
	Recreation	1.00	-2	-1	-2	-1	-1	0	-1	0	-1	0	-1	0	-1	0	-1	0
Social	Social	1.00	-2	-1	-2	-1	-2	-1	-2	-1	-3	-2	-2	-1	-2	-1	-2	-1
Heritage and Culture	Archaeology	1.00	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
	Built Heritage	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cultural	1.00	-1	2	-1	2	-1	2	-1	2	-1	2	-1	2	-1	2	-1	2
Natural Environment	Land Contamination (potential for)	1.00	0	0	0	0	0	0	0	F	-3	F	-3	F	-3	F	-3	
	Landscape/Visual	1.00	-3	-2	-3	-2	-3	-2	-3	-2	-2	-1	-2	-1	-2	-1	-2	-1
	Ecology	1.00	-2	-1	-1	0	-2	-1	-1	0	-1	0	-1	0	-1	0	-1	0
	Water Quality	1.00	F	-1	F	-1	F	-1	F	-1	F	-1	F	-1	F	-1	F	-1
	Overall scores		-8	1	-6	3	-8	0	-6	2	-10	-3	-9	-2	-9	-2	-9	-3
	Ranking				1=													
	Notes:		All Criteria Score 1															

No Weighting Applied	Individual MCA Criteria	C r i t e r i a	17. C Full Widening	18. C MM1	19. C MM2	20. C No SH1 Upgrade	21. D Update Tawa I/C	22. D(V1)	23. D(V2)	Criteria							
			Score		Score		Score		Score		Score						
			Unmitigated	Mitigated	Unmitigated	Mitigated	Unmitigated	Mitigated	Unmitigated		Mitigated	Unmitigated	Mitigated				
			Raw	Raw	Raw	Raw	Raw	Raw	Raw		Raw	Raw	Raw				
Business	Business	1.00	2	2	2	2	2	2	2	2	2	2	2	2	Business		
Transport	Natural Hazards and Network Resilience	1.00	1	1	0	1	0	1	0	0	3	3	3	3	3	Natural Hazards and Network Resilience	
	Transport	1.00	2	2	1	2	1	2	1	1	1	2	1	2	1	2	Transport
Built and Human Environment	Noise	1.00	-2	-1	-2	-1	-2	-1	-2	-1	-2	-1	-2	-1	-2	-1	Noise
	Urban Design	1.00	-1	0	-1	0	-1	0	-1	0	-3	-2	0	2	0	2	Urban Design
	Recreation	1.00	-2	-1	-2	-1	-2	-1	-1	0	-3	-2	-3	-2	-2	-1	Recreation
Social	Social	1.00	-3	-2	-2	-1	-2	-1	-2	-1	-3	-2	-3	-2	-3	-2	Social
Heritage and Culture	Archaeology	1.00	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	Archaeology
	Built Heritage	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Built Heritage
	Cultural	1.00	-2	2	-1	2	-1	2	-1	2	-1	2	-1	2	-1	2	Cultural
Natural Environment	Land Contamination (potential for)	1.00	0	0	0	0	0	0	0	-1	0	-1	0	-1	0	Land Contamination (potential for)	
	Landscape/Visual	1.00	-2	-1	-2	-1	-2	-1	-2	-1	-3	-3	-3	-3	-3	-3	Landscape/Visual
	Ecology	1.00	-1	0	-1	0	-1	0	-1	0	-3	-3	-3	-3	-3	-3	Ecology
	Water Quality	1.00	F	-1	F	-1	F	-1	F	-1	F	-1	F	-1	F	-1	Water Quality
Overall scores			-9	0	-9	1	-9	1	-8	0	-14	-6	-11	-2	-10	-1	Overall scores
Notes: All Criteria Score 1			Ranking													Ranking	

No Weighting Applied (all individual criteria score equally at 10)	Individual MCA Criteria	C r i t e r i a	1. P1	1a. P1-Variant 1	1b. P1-Variant 2	2. P2	3. P3	4. P4	Individual MCA Criteria						
			Score		Score		Score			Score		Score			
			Unmitigated	Mitigated	Unmitigated	Mitigated	Unmitigated	Mitigated		Unmitigated	Mitigated	Unmitigated	Mitigated	Unmitigated	Mitigated
			Raw	Raw	Raw	Raw	Raw	Raw		Raw	Raw	Raw	Raw	Raw	Raw
Business	Business	1.00	-3	-1	-3	-1	-3	-1	-3	-1	-3	-1	-3	-1	Business
Transport	Resilience	1.00	-3	-3	F	F	F	-3	0	0	3	3	1	2	Natural Hazards and Network Resilience
	Transport	1.00	-1	2	-1	-1	-1	0	2	2	2	2	2	2	Transport
Built-Human Environment	Noise	1.00	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	Noise
	Urban Design	1.00	1	2	-3	-2	-1	2	-1	0	-1	0	0	1	Urban Design
	Recreation	1.00	-1	-1	-2	-2	-3	-3	-2	-1	-3	-2	0	0	Recreation
Social	Social	1.00	-3	-2	-3	-2	-3	-2	-3	-2	-3	-2	-3	-2	Social
Culture and Heritage	Archaeology	1.00	-3	-2	-3	-2	-3	-2	-3	-2	-3	-2	-3	-2	Archaeology
	Built Heritage	1.00	-2	0	-2	0	-2	0	-2	0	-2	0	-2	0	Built Heritage
	Cultural	1.00	-3	-1	-3	-3	-3	-3	-1	-3	-1	-3	-1	-1	Cultural
Natural Environment and Contamination	Land Contamination	1.00	0	0	0	0	0	0	0	0	0	0	0	0	Land Contamination (potential for)
	Landscape and Visual	1.00	-3	-3	-3	-2	-2	-2	-3	-3	-3	-3	-3	-3	Landscape/Visual
	Ecology	1.00	-1	0	-1	0	-1	0	-2	-1	-3	-2	-1	0	Ecology
	Water Quality	1.00	F	-1	F	-1	F	-1	F	-1	F	-1	F	-1	Water Quality
Overall scores			-23	-11	F	F	-23	-16	-21	-11	-20	-10	-14	-6	Overall scores
Notes: All Criteria Score 1			Ranking											Ranking	



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