Petone To Grenada Link Project - Transport Modelling Assessment Of Options For North Of Tawa

NZ Transport Agency

April 2015

VERSION 7

NZ TRANSPORT AGENCY WAKA KOTAHI

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More information

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1. BACKGROUND TO THE PETONE TO GRENADA PROJECT

1.1. Purpose

1.1.1. This Report documents the results of the transport modelling analysis undertaken since May 2014. This analysis was prepared by the NZ Transport Agency (**Transport Agency**), with assistance from Greater Wellington Regional Council (**GWRC**) following work with the Chief Executives' Forum on the options proposed to address the predicted congestion problem on State Highway 1 (**SH1**) north of the Tawa Interchange once the Petone to Grenada (**P2G**) Link Road is operational.

1.1.2. In particular, this Report responds to the Wellington Regional Transport Committee (**WRTC**) resolution of 9 March 2014:

> *"**Requests** that the NZ Transport Agency bring back to the Committee a detailed report on the results of the analysis undertaken over the last six months, focussing on the options north of the Tawa Interchange. This report should include information on the impact on public transport patronage, forecast levels of congestion and a comparison of the options."*

1.1.3. In preparing this Report, the Transport Agency has interpreted WRTC's resolution as a desire to better understand transport and traffic modelling in order that the WRTC can provide feedback on the north of Tawa part of the P2G Link Road project. Therefore, this Report includes detail on the transport and traffic modelling work undertaken since May 2014 including an analysis of the transport benefits of each option. It excludes any discussion of the pros and cons of the options regarding resilience, property, social impact, ecology, cost, and timing. More details on these aspects of the project are covered in the **Scoping Options Report**, available on the Transport Agency's website (http://www.nzta.govt.nz/projects/petone-grenada-link-road/publications.html), and in the summary presentation given to the affected Councils which is attached at **Appendix 1**.

1.1.4. This Report has been prepared by the Transport Agency. GWRC officers have reviewed the Report and lead the public transport modelling in the report.

1.1.5. In order to document the transport modelling analysis undertaken over the past six months, this Report has been structured as follows:

- Background;
- The Congestion Problem;
- Modelling Alternative Options North of Tawa;
- Other Transport Modelling (Freight);
- SH58 as an Alternative to North of Tawa; and
- Economic Evaluation of Options

1.1.6. For clarification purposes, all references to 'north of Tawa' means the section of SH1 between the Tawa Interchange and the future Transmission Gully Kenepuru Interchange to be located near Linden.

1.2. Background

1.1.1 The P2G Link Road has been identified by the Wellington Region as being an important transport connection since the mid 1970s (it was first identified by the Wellington Region Land Use and Transport Study (1975)).

1.1.2 Since the 1970s there have been various high level strategic transport studies undertaken to further identify the need for a new link road between Petone and Grenada and when it should be built. In more recent times, the Ngauranga Triangle Study (2009) identified that a link road may provide a solution to increasing congestion on both SH1 in the Ngauranga Gorge and on SH2 between the Petone Overhead Bridge and Ngauranga Interchange. **Figure 1** illustrates the alignment identified in this Ngauranga Triangle Study for the P2G Link Road.

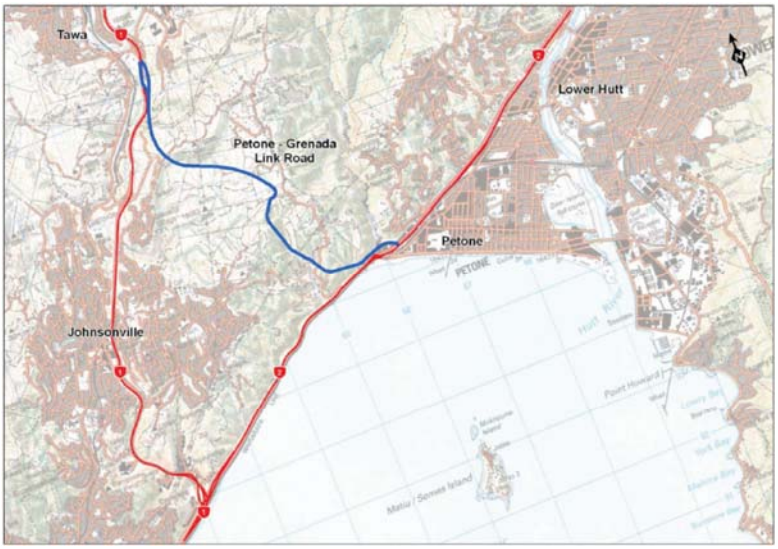


Figure 1 - Possible alignment for a P2G Link Road as identified in the Ngauranga Triangle Strategy Study (2009)

1.1.3 The above alignment shows a road between Petone and SH1, including north facing ramps onto SH1 between Grenada and Tawa and a connection to the Churton Park interchange.

1.1.4 It is noted that the Ngauranga Triangle Study also identified a number of safety improvements to be investigated as part of any future P2G Link Road investigations as follows:

- SH1 curve north of Tawa Interchange,
- Second SH1 curve south of Tawa Interchange, and
- Tawa Interchange area.

1.1.5 In 2011, the Wellington Regional Land Transport Strategy's Hutt Corridor Plan was updated. It detailed a number of packages, including:

- the P2G Link Road (to improve east-west connections, reduce congestion, enhance resilience, provide potential for an east-west bus link, and support proposed development at Lincolnshire Farm, Petone West and Seaview / Gracefield);
- the "Gracefield package" (addressing access between SH2 and the Seaview / Gracefield industrial and logistics hub),

- the rail enhancement package (to ensure that rail runs reliably and effectively, improve existing railway stations, upgrade park and ride provision, and to implement real time and integrated ticketing systems); and
- the Ngauranga to Petone cycleway / walkway (to provide a good quality walkway and cycleway along the entire stretch between Ngauranga and Petone).

1.1.6 The Hutt Corridor Plan also included a timetable for key packages of work. For the P2G Link Road, the Plan identified that construction should take place between 2015-2018.

1.1.7 It is also noted that the P2G Link Road is identified as a project that would support and optimise the delivery of the Wellington Northern Corridor Road of National Significance.

1.3. Scope of the Investigation and Reporting Phase

1.3.1. The Transport Agency commenced the Investigation and Reporting Phase for the P2G Link Road in early 2013. The first key deliverable of this Phase is a Scoping Options Report and the ultimate deliverable is a Scheme Assessment Report (**SAR**).

1.3.2. The purpose of the Scoping Options Report is to identify options for further investigation. The Scoping Options Report was completed in December 2013 and was published on the Transport Agency website (http://www.nzta.govt.nz/projects/petone-grenada-link-road/publications.html) in February 2014. In order to progress to the next phase of the SAR, public consultation needed to be undertaken so a preferred alignment could be determined and then further analysed. This analysis enables the SAR requirements to be met, and advanced through the Transport Agency internal approval process system.

1.3.3. The key purpose of a SAR is to identify a preferred option for a scheme and enable Resource Management Act (**RMA**) consent applications and Notices of Requirement (**NoR**) to be lodged. It is currently anticipated that the RMA applications and the NoR for the P2G Link Road will be lodged in mid to late 2016, with a scheduled construction start date of 2019, subject to all approvals being gained.

1.3.4. The scope for the SAR was set out in the Request for Tenders (**RfT**), released in October 2012. This included consideration of the possible safety improvements to SH1 north of the Tawa Interchange that had been previously identified in the Ngauranga Triangle Study. Relevant sections of the RfT are as follows:

4.4.1 in the Scope of Services:

"In addition to the requirements of the NZTA's Standard Specifications, the consultant will be required to:

- *Consider the impact of P2G on SH1, SH2, the Esplanade and other key routes and incorporate into the design for the route improvements required as a result of the project on adjacent routes, including, but not limited to, improving the alignment of SH1 at the Tawa bends, any necessary upgrade of the Grenada interchange and upgrades of the Petone Interchange."*

Notice to Tenderers (NTT) No. 2

"The scope of the Petone to Grenada Link Road investigation includes consideration of any improvements to the section of SH1 between Tawa and Linden as required following the implementation of Transmission Gully, in order to maintain a good level of service on SH1

between the southern terminus of Transmission Gully and the western connection of Petone to Grenada to SH1."

1.4. Project Objectives

1.4.1. Project objectives can be revised throughout the life of a project. Accordingly, following consideration by the Project Team and stakeholders, the objectives in the Scoping Options Report were altered from those set out in the RfT. Changes were made to align them better with RMA considerations, enable greater consideration of connectivity and freight efficiency and to make the objectives more specific to the P2G Link Road project.

1.4.2. The objectives for the Investigation and Reporting Phase, as set out in the Scoping Options Report, are to:

- Improve safety and efficiency of the transport network including efficiency of HCVs[1] travelling between Seaview and SH1 to the north and maximise value for money,
- Support the economic growth and development of the region by improving connectivity within the region,
- Enhance resilience of the state highway network within the region, and
- Minimise adverse environmental impacts.

1.5. Scoping Options Report – Summary of Key Recommendations

1.5.1. The Scoping Options Report identified a number of options to be taken forward for public consultation in early 2014 prior to commencing the final SAR analysis.

1.5.2. **Figure 2** sets out the four options for a route from the Petone Interchange to the Crest of the Wellington Escarpment, known as Options P1, P2, P3 and P4, and four options from the Crest of the Wellington Escarpment to SH1, known as Options A, B, C and D. All options included a new interchange at Petone, while options for connections onto SH1 varied.

[1] HCVs = Heavy Commercial Vehicle, or Heavy Trucks.

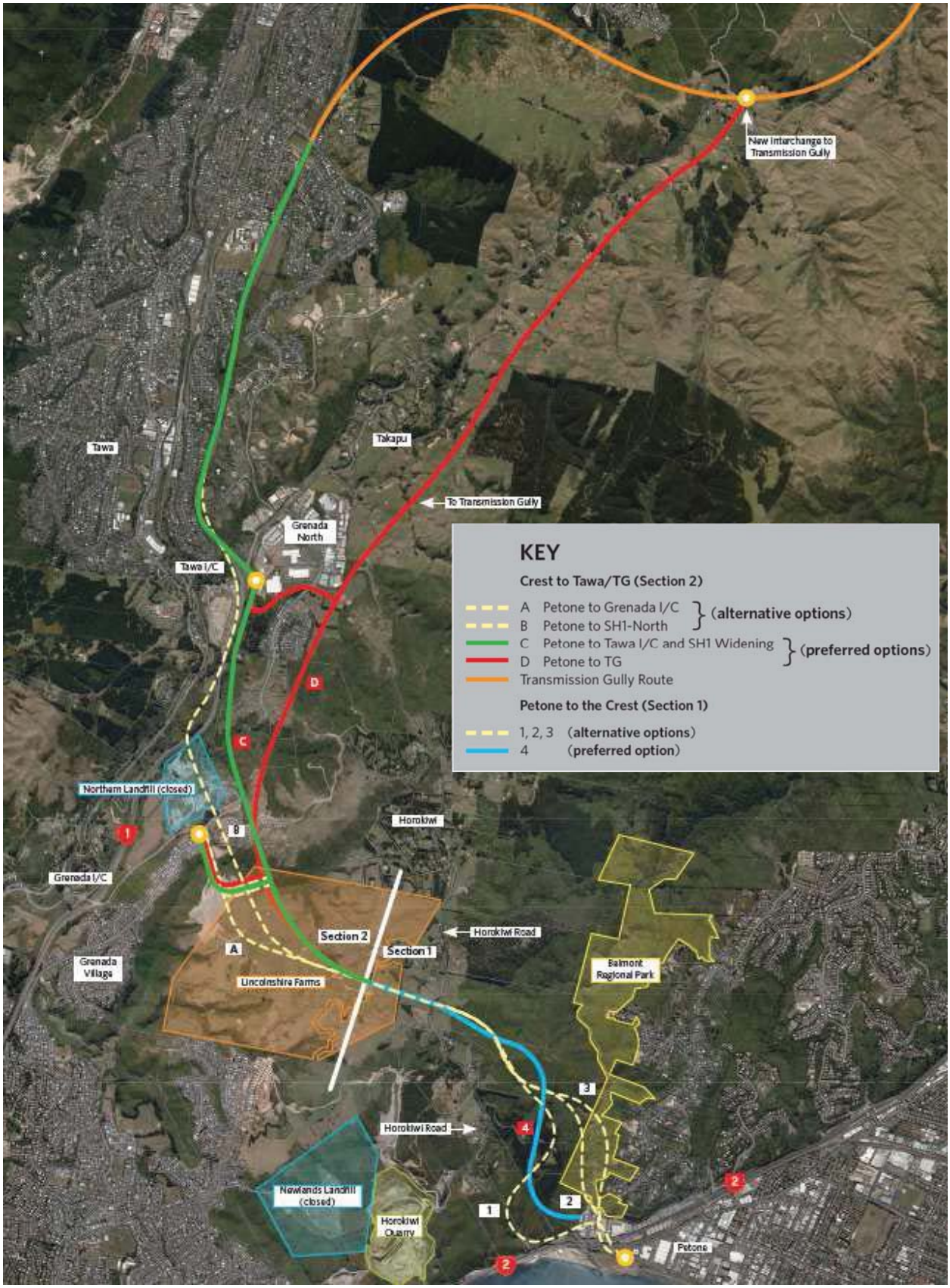


Figure 2 - P2G Link Road Options identified in the Petone to Grenada Scoping Options Report (February 2014)

1.5.3. During the development of the Scoping Options Report, Option P4 was identified as the preferred option for the section from the Petone Interchange to the Crest because it was superior from an environmental and resilience perspective. This was primarily because the other options either directly affected the Korokoro Valley (Options P2 and P3), or affected the stability of the Wellington Escarpment (Option P1).

1.5.4. The four options for the section from the Crest of the Wellington Escarpment to SH1 can be summarised as follows:

- Option A - includes a connection to the Grenada Interchange, widening of SH1 between Grenada and Linden and straightening of the Tawa curves,
- Option B - is broadly analogous to the P2G Link Road alignment identified in the Ngauranga Triangle Study (see **Figure 1**), but also includes widening of SH1 between the new northbound connection to SH1 and Linden, straightening of the northern Tawa curve and a connection to the Grenada Interchange,
- Option C - includes a connection to the Grenada Interchange, a new connection to the Tawa Interchange, widening of SH1 between Tawa and Linden and straightening of the northern Tawa curve, and
- Option D- includes a connection to the Grenada Interchange, a new connection to the Tawa Interchange and a new two lane road along the Takapu Valley connecting with Transmission Gully near the Takapu substation

1.5.5. The Scoping Options Report identified the need for capacity upgrades on SH1 to the north of Tawa in order to manage predicted congestion problems in 2031 as part of its proposals for the section of the P2G Link Road between the Crest of the Wellington escarpment to SH1. This is discussed further below (see section 2.3).

1.5.6. The options for the P2G Link Road from the Crest of the Wellington Escarpment to SH1 were identified in the Scoping Options Report and evaluated against one another. All options were found to be viable, and the two best options were identified to be Options C and D for resilience and connectivity purposes. On the basis of the Scoping Options Report's findings, Options C and D were taken forward for public consultation in early 2014.

1.5.7. It was noted that public consultation material in 2014 did not identify a preferred option for the western part of the P2G Link Road; rather feedback was sought on the pros and cons of each option.

1.6. Public Consultation (February – April 2014)

1.6.1. Between February and April 2014 the Transport Agency consulted on alignment options for the P2G Link Road (that is, the options identified in the Scoping Options Report). The feedback from the consultation was detailed in the **P2G Link Road Engagement Report**, which was published on the Transport Agency's website in September 2014 (http://www.nzta.govt.nz/projects/petone-grenada-link-road/docs/p2g-engagement-report-201408.pdf). Some key findings from the consultation period were:

- A large proportion of the comments came from the Tawa Community.
- For the Petone to the crest area there is a preference for Option 4.
- Most submitters were supportive of using the excess fill for the Petone to Ngauranga Cycleway.
- There is a concern that the P2G Link Road will increase traffic on Petone Esplanade.

- There is a general requirement that suitable access to the Horokiwi community should be provided. The Horokiwi Community also clearly stated their desire to work closely with the NZ Transport Agency to find the best workable access solution.
- Submitters were concerned about the capacity of the Tawa Interchange once the P2G Link Road is 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.
- There is a clear indication that network resilience is an important consideration for many of the submitters.
- There is 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 is 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 P2G Link Road and the P2G Link Road should not undermine current use of Public Transport.
- There is a concern that the steep gradient between Petone and the crest (option 4) will discourage heavy vehicles from using it.
- A similar number of people support tolling as oppose it.

1.7. Wellington Regional Transport Committee (May 2014)

1.7.1. In early May 2014[2] the WRTC recommended the following:

- *The NZ Transport Agency, Greater Wellington Regional Council, Wellington City Council, Hutt City Council, Upper Hutt City Council, Porirua City Council and Kapiti Coast District Council agree to collaborate on a whole of network approach to resolving strategic network issues arising from the Hutt Valley – Porirua Links.*

- *A new steering group be established, comprising the chief executives (or their senior delegates) of the territorial authorities and Greater Wellington Regional Council and the Regional Director (or delegate) of the NZ Transport Agency. This group will provide direction to the project managers, resolve conflicts and ensure that elected officials from individual councils are kept fully informed to enable them to participate in any discussion at the Regional Transport Committee. A joint officer Working Group will continue to provide operational oversight of the project.*

- *Further investigation will be undertaken of options to manage forecast traffic volume increases on SH1 north of Grenada. This will include considering alternative measures to shift trips towards the rail network and manage demand on the network to avoid the need for an increase in roading capacity as well as the option of a 'managed motorway' (ie hard shoulder running).*

- *This next stage of investigation will be completed before the end of 2014, and reported back to this Committee to enable the preferred option to feed into the Regional Land Transport Plan process (if required).*

The recommendations were endorsed in the meeting as minuted below:

- *That the Committee endorses the process outlined to consider and resolve the further investigation of issues relating to the Hutt Valley – Porirua Links, including a review of*

[2] Meeting Dated 9 May 2014. Minutes of that meeting available at http://www.gw.govt.nz/assets/council-reports/Meeting_Documents/7163_Minutes_Minutes%202014.245.pdf

Petone to Grenada and an upgrade of State Highway 58 to decide details, rather than revisiting the inclusion of Petone to Grenada in the Regional Land Transport Plan.

1.7.2. Following receipt of this recommendation, the Transport Agency commenced work with the relevant Chief Executives from the existing **Chief Executives' Forum** on further modelling of Options C and D, and on alternative options (e.g. 'managed motorways', whether demand could be shifted onto the passenger rail network through network upgrades and/or implementing travel demand measures).

1.8. Further transport analysis – (May 2014 to March 2015)

1.8.1. Between May and November 2014, the Transport Agency, GWRC and the Chief Executives' Forum identified a list of possible options for further assessment, and in particular further transport modelling assessment. The short list of options to investigate further included:

- Testing a "do minimum" option, excluding any improvements north of Tawa. This was not previously included in the Scoping Options Report since the initial modelling indicated that the increase in capacity was needed for mitigation,
- Option C improvements including hard shoulder running,
- Option D improvements to minimise impact on property,
- Public Transport Improvements including potential for public transport improvements to offset the need for capacity improvements north of Tawa,
- Impacts of tolling and the potential for tolling to offset the need for capacity improvements north of Tawa, and
- Calculation of incremental benefit cost ratios of the options for north of Tawa to indicate the value of these improvements as stand-alone projects.

1.8.2. The transport modelling and various transport models used to undertake the further assessment work is described in more detail in the "Transport Modelling" text box below.

1.8.3. All transport modelling assessment work was undertaken within a framework agreed with GWRC. A key feature of this assessment framework was the use of a revised Wellington Transport and Strategy Model (**WTSM**). This revision enabled improved representation of land use in Aotea block and Lincolnshire Farms when compared with the modelling undertaken in the Scoping Options Report, enabling the short listed options to be more accurately compared. Public transport modelling was undertaken by GWRC using their Public Transport Model (**WPTM**). All transport model testing in this report undertaken since May 2014 is for the year 2031 in order to align with the WTSM model forecast year.

1.8.4. Other features of the assessment work undertaken included further refinement of the design for Option D to minimise property take. Namely, on the basis of public consultation feedback, the Option D alignment was shifted further to the east to avoid impacting properties in the Hunter's Hill area. This also meant that the Option D alignment moved further east of the alignment illustrated in the Scoping Options Report and further away from the majority of properties in Takapu Valley. It was concluded that this skewing of the alignment to the east to avoid Hunter's Hill is preferred, should Option D proceed. This variation increases the estimated cost of Option D from $26M-$55M to $30-$60M.

1.8.5. For Option C, a variant described as hard shoulder running was investigated (this option would be managed under the "managed motorway concept"). In order to achieve two additional lanes, it would be necessary to widen into the existing SH1 median and also take

some additional land outside the existing carriageway because the existing SH1 shoulders would not be wide enough to accommodate hard shoulder running. A hard shoulder option would result in a higher construction cost ($40M-$85M) as compared to the lower cost option of widening on both sides of the SH1 ($25-$54m). This is because the hard shoulder running option would also incur significant traffic management costs during construction and ongoing maintenance/operational costs. It should also be noted that widening into the median would still require property acquisition. Also, should either variant of Option C proceed (either with or without SH1 widening), it may be necessary to acquire property at the Tawa curves in order to resolve safety concerns at that location.

1.8.6. As noted above, GWRC lead the modelling of the public transport options using WPTM. The purpose of this modelling assessment was to better understand the ability of the current public transport network to accommodate predicted additional travel demand north of Tawa. The results of this analysis are discussed below in Section 3.2.

1.8.7. In early November 2014, the results of the additional assessment work, particularly the transport modelling work, were presented to the Chief Executives at a workshop.

1.8.8. The attendees at the workshop agreed that the transport modelling assessment work confirmed there would be a potential congestion problem north of Tawa in 2031 as a consequence of the P2G Link Road. However, the attendees also recognised that the transport modelling was only a prediction of a potential congestion problem in the future. On this basis it was agreed that three options should be presented to each individual council and then to the WRTC. The options were as follows:

- No improvements north of Tawa,
- Widening of SH1 between Tawa and Transmission Gully, and
- A new Takapu Link.

1.8.9. Alongside these three options, three timing options were agreed:

- Build now (ie implement one of the north of Tawa options as part of the wider P2G Link Road options),
- Build later (ie designate one of the north of Tawa options now, but not build now), and
- Wait and see (do nothing north of Tawa until evidence is presented about the need to construct any improvements).

1.8.10. In February 2015, and in accordance with the WRTC resolution from May 2014, the Transport Agency presented the above options (and the timing of the options) along with key pros and cons to each option (from a Transport Agency perspective) to the relevant councils. The purpose of the presentations to the councils was to help inform the Chief Executives' report back to the WRTC in March 2015. The presentation given to the Councils is attached to this report at **Appendix 1**.

1.8.11. The predicted congestion problem is discussed below in Section 2.3. This is then followed by the key findings of the Project Team's modelling of freight efficiency.

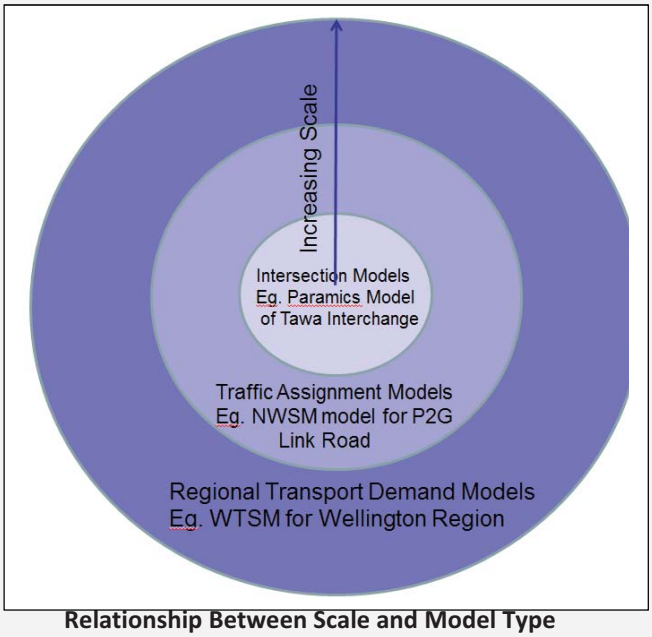
Transport Modelling

Transportation modelling is a tool used by planners and engineers to help understand future transport requirements. There are many types of model*;

Higher level Regional Transport Demand Models.

These models use mathematical relationships derived from Household Travel Surveys and other information (land use / census and other survey data) to predict regional travel demands in current and future years. Demand means demand for travel, and therefore does not only represent vehicle flows. Demand models are particularly useful to understand travel patterns between areas and provide a broad overview of flows between sectors. They can also help describe the role of various modes.

In the Wellington Region the WTSM is the regional travel demand model on which most other modelling is based. WTSM covers the entire Greater Wellington area. It is owned and operated by GWRC and its inputs are agreed through discussion with local territorial authorities and the Transport Agency. GWRC also maintains a public transport model (WPTM). This model is used to help analyse public transport network investment. Future transport demand growth in WTSM can be demonstrated to be linked strongly to changes (growth) in regional population. Historically, regional population growth has closely matched Statistics New Zealand medium projections, and is consistent with the analysis contained in this report.



Relationship Between Scale and Model Type

Mid-level Strategic Network / Project Traffic Assignment Models

These models use demand data (in the Wellington Region from WTSM) and other data to model a smaller area. The models use driver value of time to represent the economic concept that drivers are rational individuals and choose the lowest cost route for their journeys. Because factors such as intersection design, lane configurations and gradients can be programmed into them, these models give a more accurate picture of traffic flows on routes than Regional Transport Demand Models.

For the P2G Link Road Project, the North Wellington SATURN model (**NWSM**) is used to model the study area. Its area includes the Ngauranga Interchange, SH1 including Transmission Gully, SH2, and SH58. Traffic inputs are derived from WTSM and checked against actual traffic counts. All traffic modelling in this report comes from the NWSM.

The process for developing the model for the P2G Link Road has been externally peer reviewed by Quality Transport Planning (QTP). It is standard practice to undertake peer reviews. The purpose of such reviews is to validate and confirm the rigour of the underlying model and resolve any identified issues before being used for analysis.

Micro simulation models for intersections and corridors

These models simulate the behaviour of drivers and vehicles on the network. They can be developed for current or future intersection designs. For the P2G Link Road Project Paramics micro-simulation models are currently under development for the Tawa and Petone interchanges to better understand how those interchanges will work if built. These are not discussed further in this paper as they are not relevant to the decision on north of Tawa options.

* Transport Model Data Comparison Guidelines NZMUGS/ NZTA see https://www.ipenz.org.nz/ipenztg/Subgroups/NZMUGS/Documents/March%202014%20NZTA%20NZMUGS-Transport%20Model%20Data%20Comparison%20Guideline_Draft.pdf

2. DEFINING THE PREDICTED CONGESTION PROBLEM

2.1. Travel Demand

2.1.1. In order to understand the predicted congestion problem the GWRC WTSM model was used to model travel demand. Demand means demand for **all** travel, and therefore does not only represent vehicle flows. Travellers can be accommodated on a range of modes of transport, including cars, buses, trains, walking and cycling.

2.1.2. Key daily traveller demand flows in the "P2G Link Road project area" in 2031 without the P2G Link Road in place are set out in **Figure 3**. It is noted that this "Do Minimum" situation would include Transmission Gully and other programmed network improvements, ie improvements between Ngauranga and Aotea Quay, at grade improvements at the Melling intersection and the grade separation of State Highway 2 and 58 (Haywards). Demand flows once the P2G Link Road is in place in 2031 are set out in **Figure 4**.

Figure 3 - Daily Traveller Demand Numbers 2031, Without P2G Link Road

Figure 4 - Daily Traveller Demand Numbers 2031, With P2G Link Road

2.1.3. Both **Figure 3** and **Figure 4** demonstrate the largest travel demands are those along the SH1 Corridor to and from Wellington and along the SH2 corridor to and from Wellington.

2.1.4. **Figure 3** (without the P2G Link Road) shows there is significant travel demand (ie 27,300 travellers) in 2031 between the SH1 Corridor and the SH2 Corridor. This demand is currently met by travelling down SH1 to the Ngauranga Interchange and returning north via SH2, or using SH1, then SH58 and then SH2. There is a significantly smaller demand (ie 11,000 travellers) between the SH1 Corridor north of Porirua, including Kapiti and Upper Hutt, who are likely to exclusively use the SH58 corridor.

2.1.5. **Figure 4** shows with the P2G Link Road in place in 2031 that there will be increased traveller demand between the southern part of the SH1 Corridor and the SH2 Corridor. This is because the creation of the new road stimulates travel demand as it effectively brings two disparate areas of the region closer together. This increased demand is a reflection of the agglomeration benefits of the P2G Link Road (that is, because parts of the region are closer together, it will be easier to do business and find jobs in the future which results in economic growth. The agglomeration benefits (which are a conventional benefit calculated in

accordance with the Transport Agency's Economic Evaluation Manual (**EEM**)) for the region from the implementation of the P2G Link Road have been assessed at around $440m.

2.1.6. The increased traveller demand is reflected in the changes in Level of Service predicted for north of Tawa, discussed further in Section 2.3.

2.1.7. **Figure 5** and **Figure 6** show the main origins and destinations for vehicles (cars, heavy commercial vehicles (heavy trucks) (**HCVs**) and total vehicles) moving through the P2G Link Road project during peak hours. Results are shown for the peak direction, ie eastbound in the AM peak and westbound in the PM peak and the numbers are for a one hour peak. Because the volumes are very similar between Options C and D and for clarity, the Figures show the average of both options.

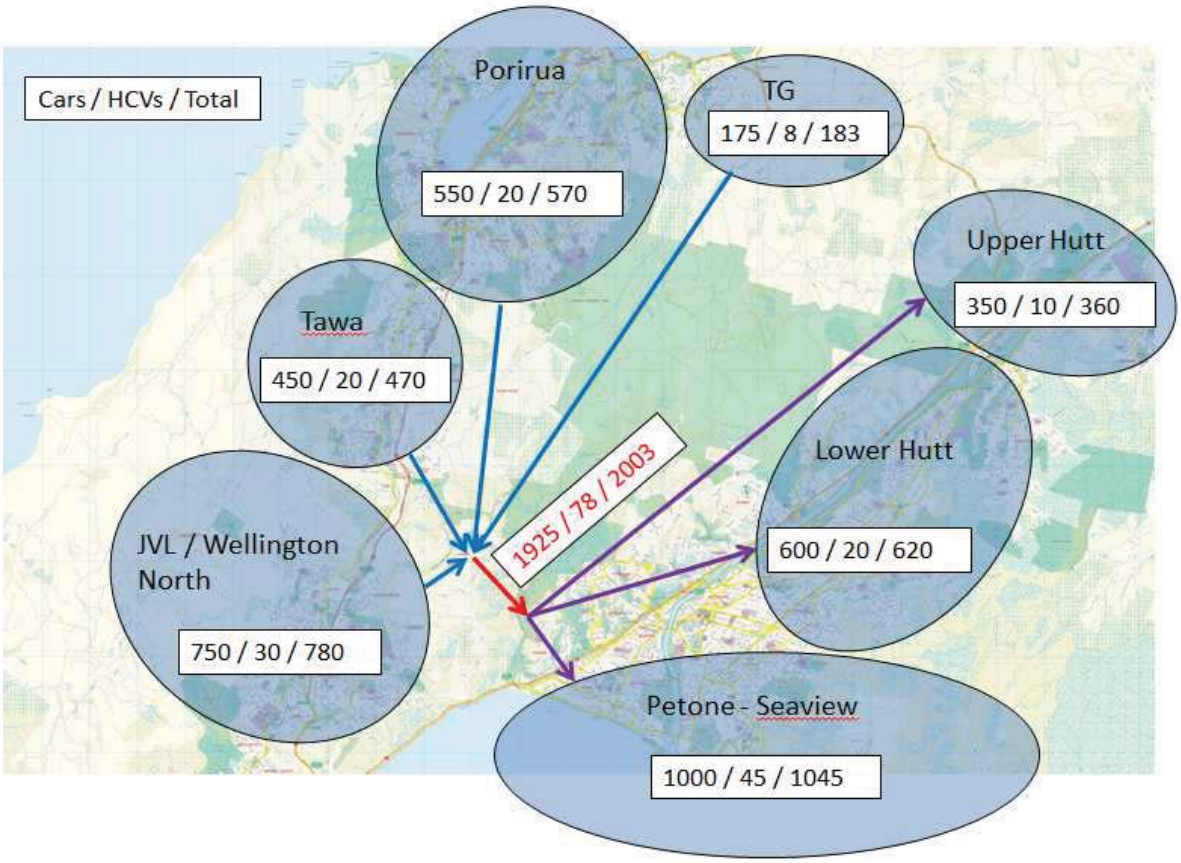


Figure 5 Origin and Destination Demand Flows AM Peak Eastbound

2.1.8. A summary of observations from **Figure 5** are as follows:

- For cars and other light vehicles, most of the demand comes from Johnsonville and other Northern Wellington suburbs (except Tawa), representing about 40% of the total demand.
- Porirua and Tawa represent respectively 29% and 23% of the demand. Trips from further north (ie trips from Transmission Gully), transiting either through SH1 in Option C or the Takapu link in Option D, represent the remaining 9%.
- In the Hutt Valley, half of the demand is heading to Petone and Seaview, with 30% going to Lower Hutt and the remaining 20% to Upper Hutt.

- For freight vehicles the proportions are very similar to car, with 40% of the demand coming from Johnsonville and the Northern suburbs, 26% both for Porirua and Tawa, and the remaining 10% from TG and the north.
- In terms of freight destinations, the proportions are again quite similar except for Petone / Seaview which attracts about 60% of total demand.

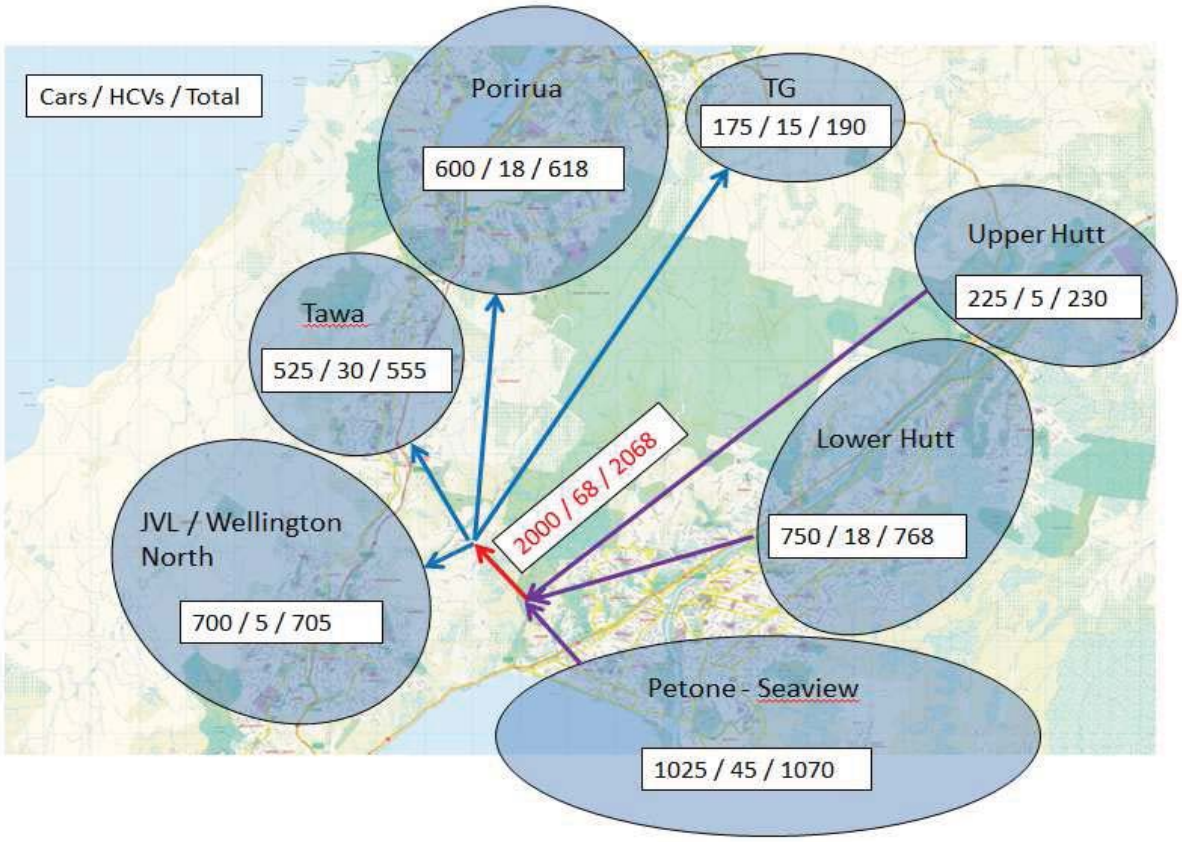


Figure 6 Origin and Destination Demand Flows PM Peak Westbound

2.1.9. A summary of observations from **Figure 6** are as follows:

- For light vehicles, the AM peak patterns are largely reversed in the PM Peak direction.
- In terms of origin, half of the demand comes from Petone / Seaview, 40% from Lower Hutt and 10% from Upper Hutt.
- Johnsonville is still the main destination at 35%, followed by Porirua and Tawa (about 30% each) and the North / TG with the remaining 9%.
- For HCV demand, the main difference is that Johnsonville and the Northern suburbs represent only 7% of the destination, whereas Tawa increases to 44%. Porirua stays at 26%, and TG / North increases to 22%, amounting to 15 vehicles.

2.2. Traffic Flows on the P2G Link Road

2.2.1. Two-way vehicular Flows on the P2G Link Road and surrounding road network in the AM and PM peaks in 2031 are presented below for both the Do Minimum and with and without the P2G Link Road, plus daily flows showing HCV numbers.

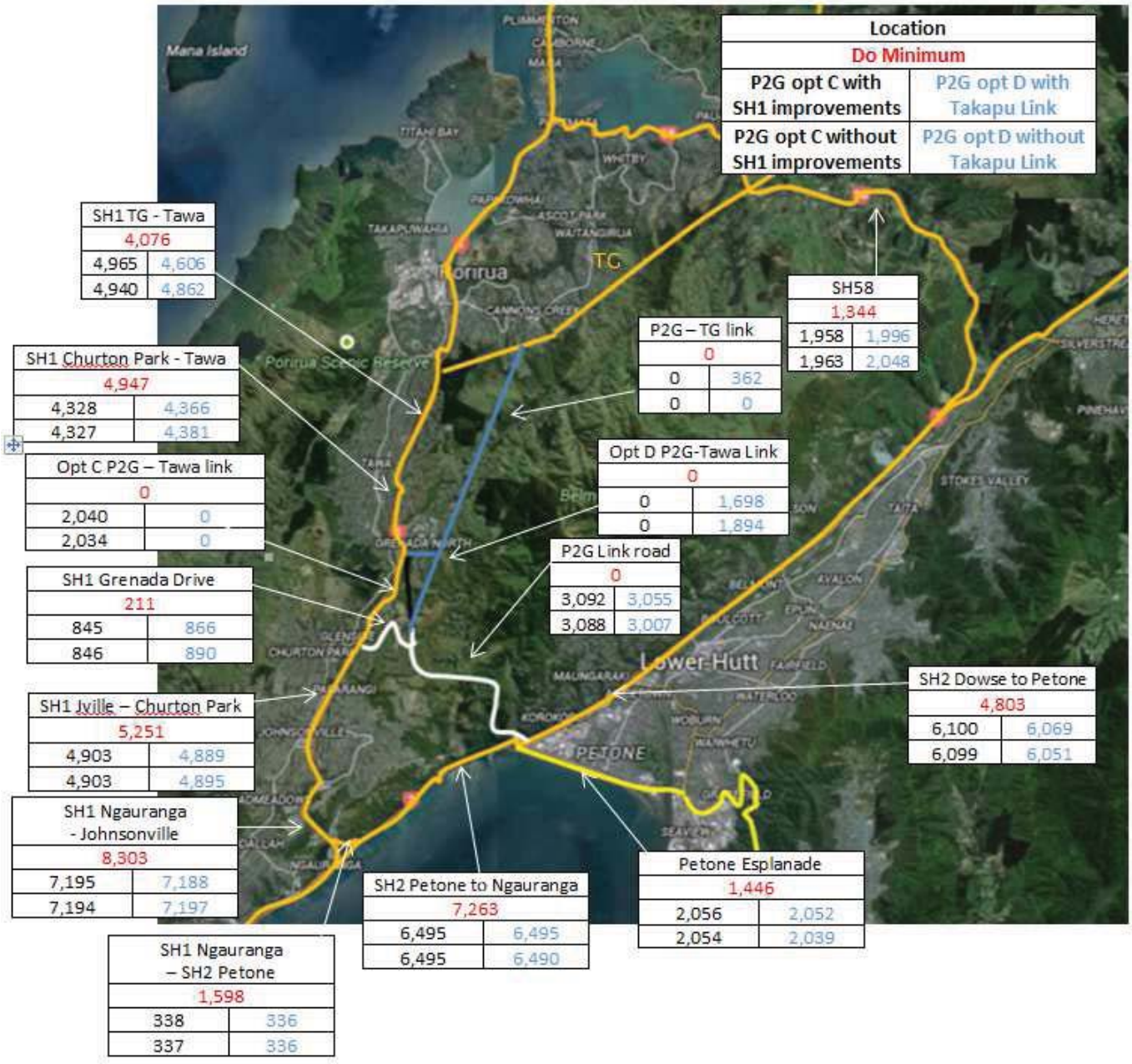


Figure 7 2031 AM Peak Hourly Traffic Flows

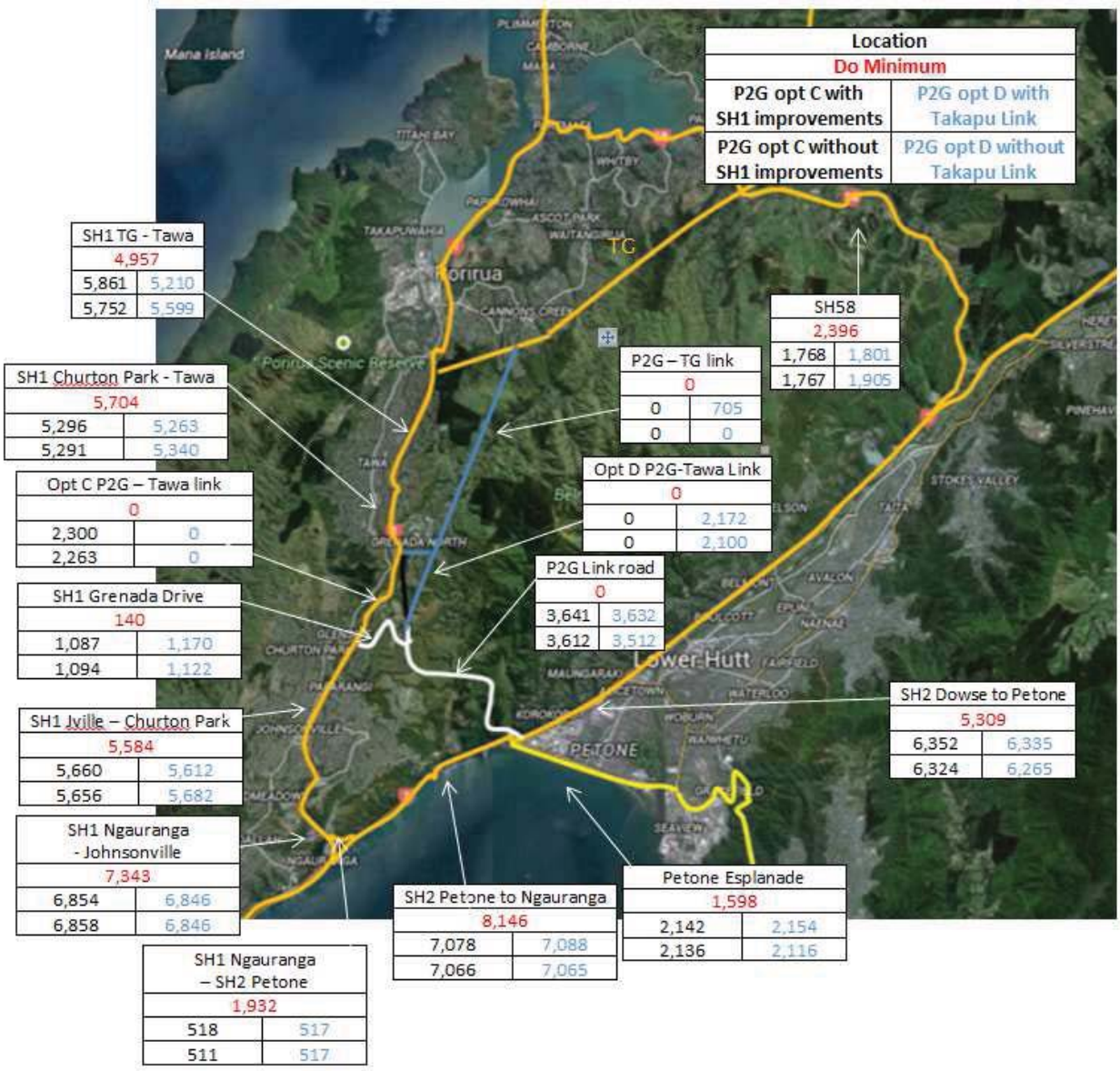


Figure 8 2031 PM Peak Hourly Traffic Flows

2.2.2. **Figure 7** and **Figure 8** illustrate how flows will change in the future with either Option C or D in place. There is significant movement away from the Ngauranga to Petone turn-around and reductions in flow south of Petone on SH2 and south of Churton Park on SH1 towards the P2G Link Road. Other roads in the surrounding network demonstrate increases in traffic flow due to the increased demand in the region.

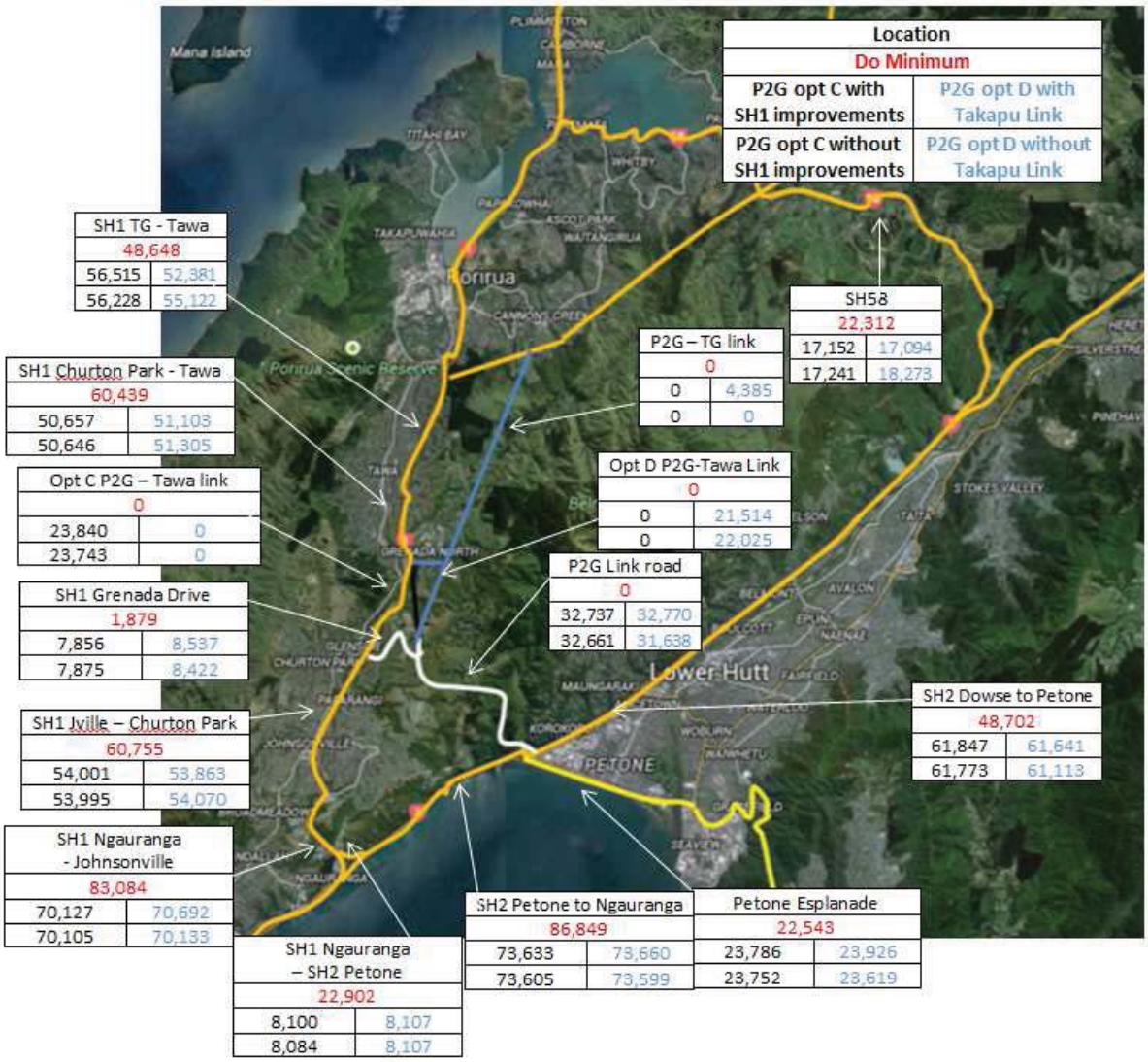


Figure 9 2031 Daily Traffic Flows

2.2.3. **Figure 9** shows the daily traffic flows with and without the P2G Link Road. A key point is the significant shift in traffic away from the Ngauranga Gorge, regardless of which option is developed.

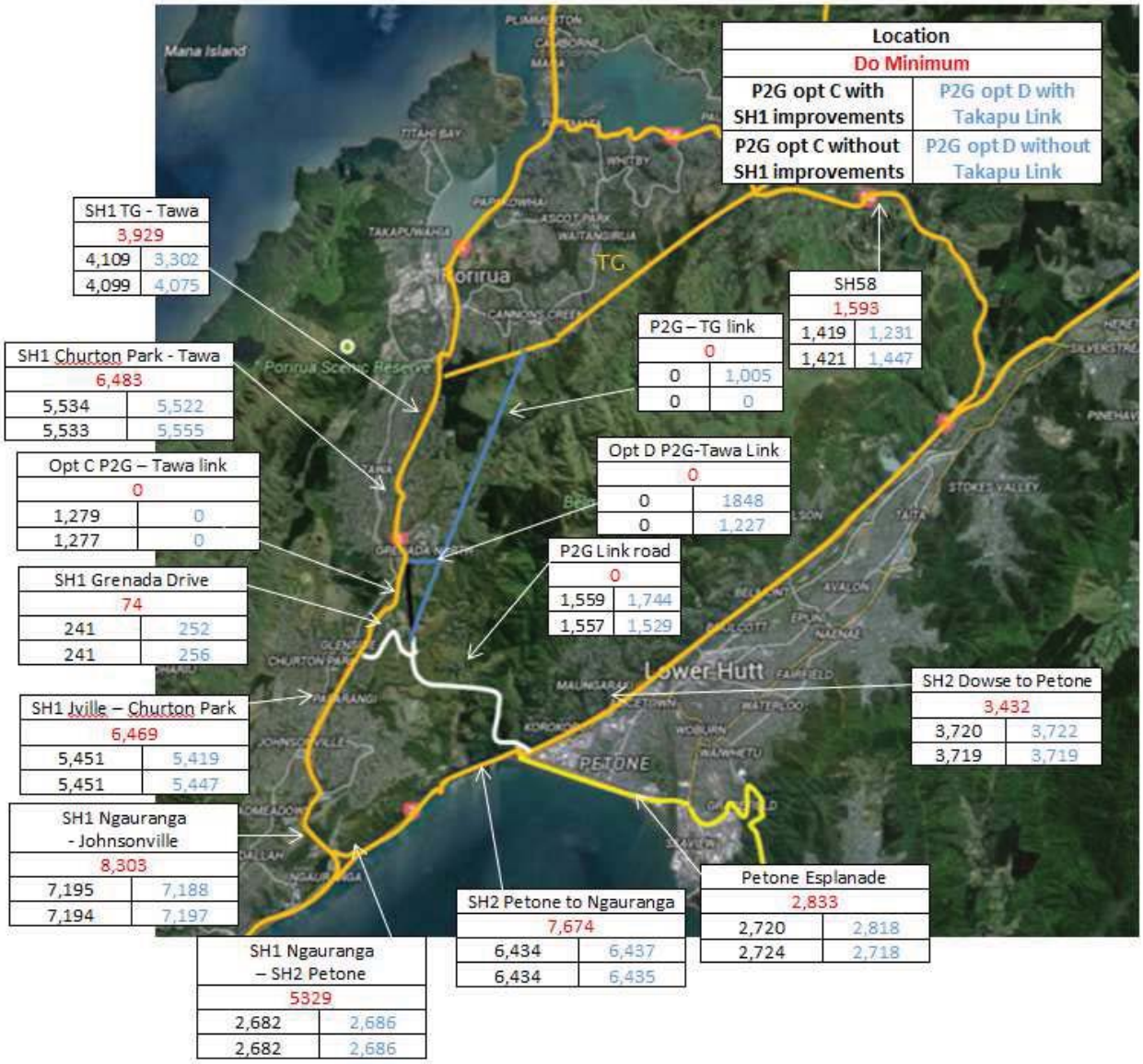


Figure 10 2031 Daily Heavy Vehicle Traffic Flows

2.2.4. **Figure 10** shows the daily HCV flows. Comparison with **Figure 5** and **Figure 6** shows that the majority of HCVs travel outside of peak hours. It is clear again that there is a significant movement of HCVs away from the Ngauranga to Petone turn-around towards the P2G Link Road. These heavy vehicle flows on the P2G Link Road could be considered to be conservative because although a gradient factor was added to the P2G Link Road to represent its steepness, equivalent gradient factors were not applied to the existing SH network, so for example, the steep section of SH1 through Ngauranga Gorge is modelled as flat.

2.3. Predicting the congestion impacts north of Tawa

2.3.1. To help understand the changes and the impact of increased traveller demand as a consequence of the P2G Link Road on north of Tawa, the following two traffic assessment measures were used:

- Level of Service (**LoS**), and

- Journey Time Modelling.

Level of Service

2.3.2. One key measure of congestion is Level of Service (**LoS**). The theory of traffic LoS is summarised in ***Table 1***. The colour coding is reflected in **Figures 11-22** below.

LOS	Traffic Flow				
	Description		Operating Speed	Volume/ Capacity	Density (pc/mi/ln)*
F	Gridlock		≤ 10% Free Flow Speed	100%	40
E	Significant Delays		10% - 20% Free Flow Speed	88%	35
D	Moderate to Significant Delays		20% - 30% Free Flow Speed	65%	26
C	Stable Operating Conditions		30% - 50% Free Flow Speed	45%	18
B	Relatively Unimpeded Flow		50% - 80% Free Flow Speed	28%	11
A	Free Flow		≥ 80% Free Flow Speed	0%	0
* Exhibit 14-4, HCM 2010 - (pc/mi/ln = passenger carrier/mile/lane)					

Table 1 - Theory of Traffic Level of Service

2.3.3. Transport Agency officers and GWRC agree that a LoS of E or above generally constitutes severe congestion. Typically, in these situations the Transport Agency would seek to manage such congestion.

2.3.4. It is also noted that where a project causes the deterioration of the Level of Service on the surrounding road network, the NZ Transport Agency would look to mitigate that effect. The nature of this mitigation could include capacity improvements.

2.3.5. To model LoS the NWSM was used. All figures show traffic flows in the peak direction (ie towards Wellington in the AM peak and away from Wellington in the PM peak). This is because the peak direction represents the worst case scenario. As noted above the future model year was determined to be 2031 to align with WSTM. The do-minimum model assumes that Transmission Gully will be in place, but not the P2G Link Road[3].

2.3.6. As a base case LoS has been modelled in 2011 (the nearest available model year to represent the current situation). This is illustrated below in **Figure 11** and **Figure 12**.

[3] The Do Minimum Model in 2031 includes all programmed works in the Wellington region, including Transmission Gully, improvements between Ngauranga and Aotea Quay, at grade improvements at the Melling intersection and the grade separation of State Highway 2 and 58 (Haywards).

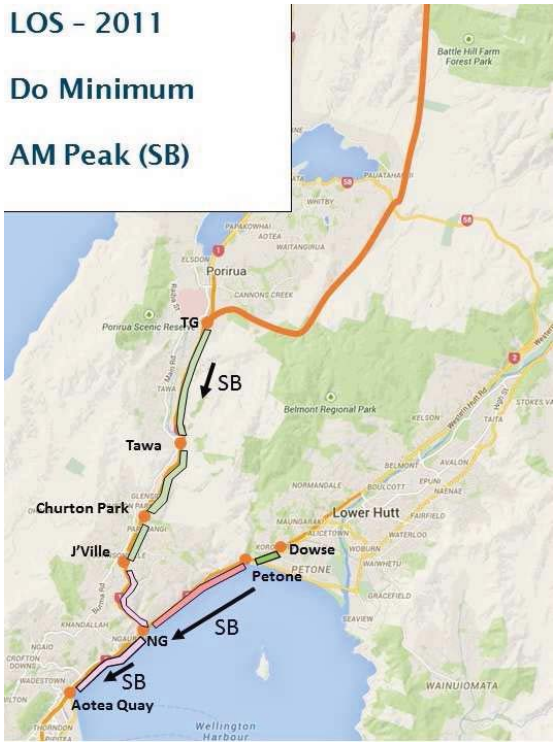
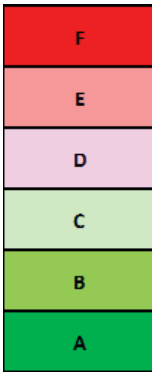


Figure 11 - 2011 AM southbound LoS



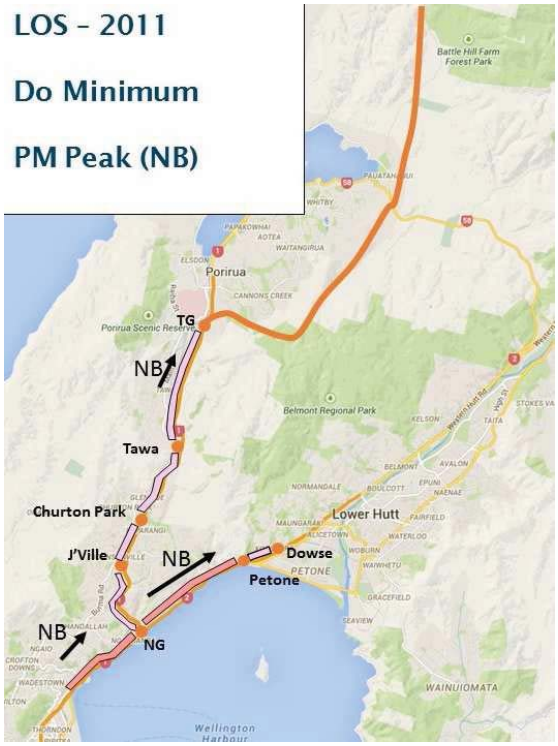


Figure 12- 2011 PM northbound LoS

2.3.7. **Figure 11** and **Figure 12** show that currently the worst LoS on the SH network is south of Ngauranga northbound in the PM peak, and between Ngauranga and Petone on SH2 in both AM and PM peaks. These sections of the SH network currently experience LoS E.

2.3.8. Using NWSM, the predicted LoS on SH1 and SH2 in 2031 without the P2G Link Road in place are shown in **Figure 13** and **Figure 14** (The Do Minimum situation). Notably both **Figure 13** and **Figure 14** indicate a LoS of E on SH1 between Johnsonville and the Ngauranga Interchange and on SH2 between the Petone Overhead Bridge and Ngauranga Interchange in the AM Peak, and a LoS of F on SH2 between the Ngauranga Interchange and Petone Overhead Bridge in the PM peak.

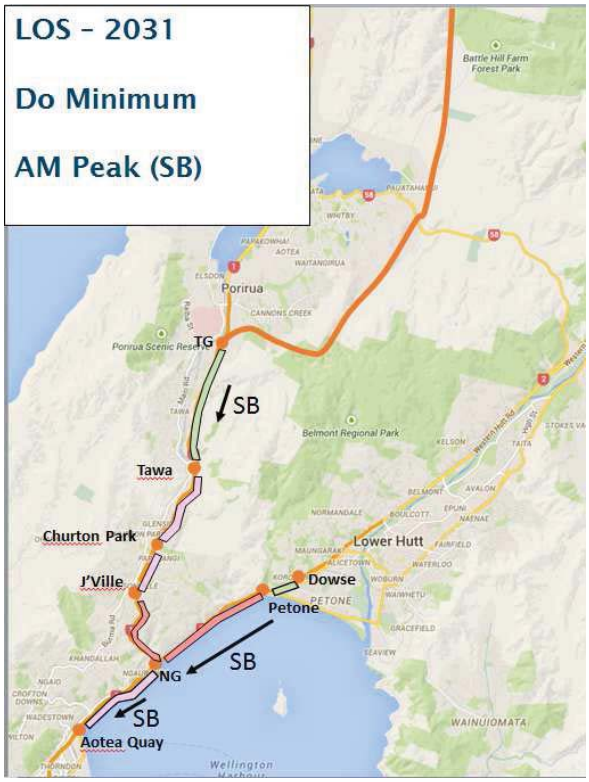


Figure 13 - 2031 AM southbound LoS

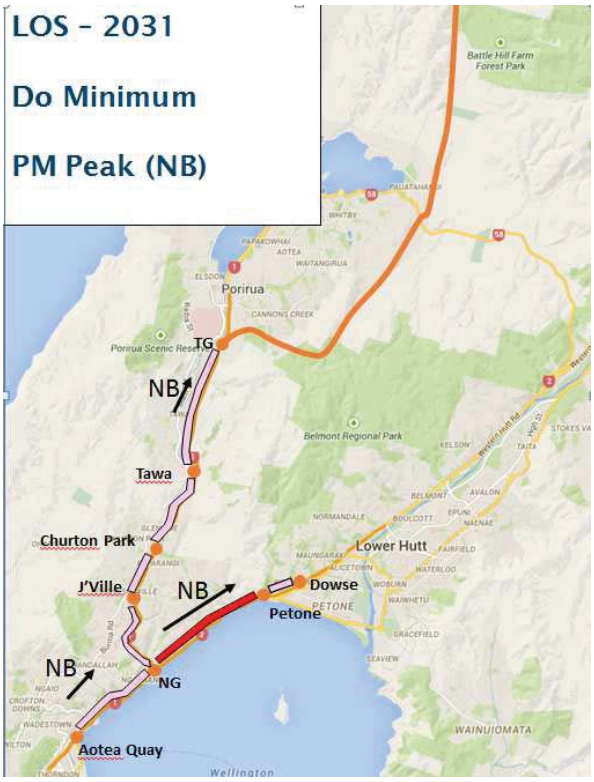


Figure 14- 2031 PM northbound LoS

2.3.9. **Figure 15** and **Figure 16** illustrate the LoS on SH1 and SH2 following the introduction of the P2G Link Road without any capacity upgrades north of Tawa.

Figure 15 - 2031 AM LoS southbound - (no improvements north of Tawa)

Figure 16 - 2031 PM LoS northbound (no improvements north of Tawa)

2.3.10. Both **Figure 15** and **Figure 16** indicate that as a consequence of implementing the P2G Link Road, LoS is predicted to improve or remain static throughout the network relative to the do-minimum, with the exception of the section of SH1 north of Tawa (which deteriorates from LoS D to LoS E in the northbound PM Peak. This predicted deterioration in LoS (and journey times as discussed further below) is due to significant increases in traveller demand once both Transmission Gully and the P2G Link Road are in place (as discussed in Section 2.1 above). In the AM Peak the deterioration is not as marked. It is believed that the improved route choice south of Tawa will permit more free flowing travel southbound (ie, with the creation of the P2G Link Road).

2.3.11. **Figure 16** also shows deterioration in LoS from D to E on SH1 between Johnsonville and Churton Park in the northbound direction with the P2G Link Road with and without north of Tawa options. It is noted that this deterioration does not impact significantly on journey times, whereas the deterioration in LoS north of Tawa is more marked and does have a significant impact on journey times. To further examine this result, **Figure 17** and **Figure 18** demonstrate the difference in LoS on SH1 between Johnsonville and Churton Park (in the northbound PM Peak) and the LoS on SH1 between Tawa and the Transmission Gully Interchange.

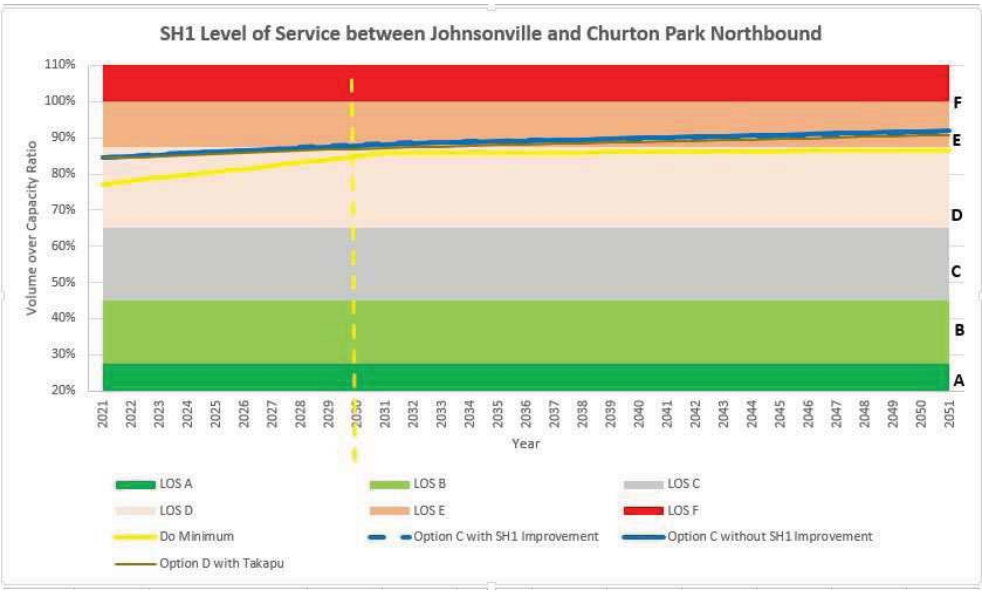


Figure 17 - Level of Service on SH1 (between Johnsonville and Churton Park)

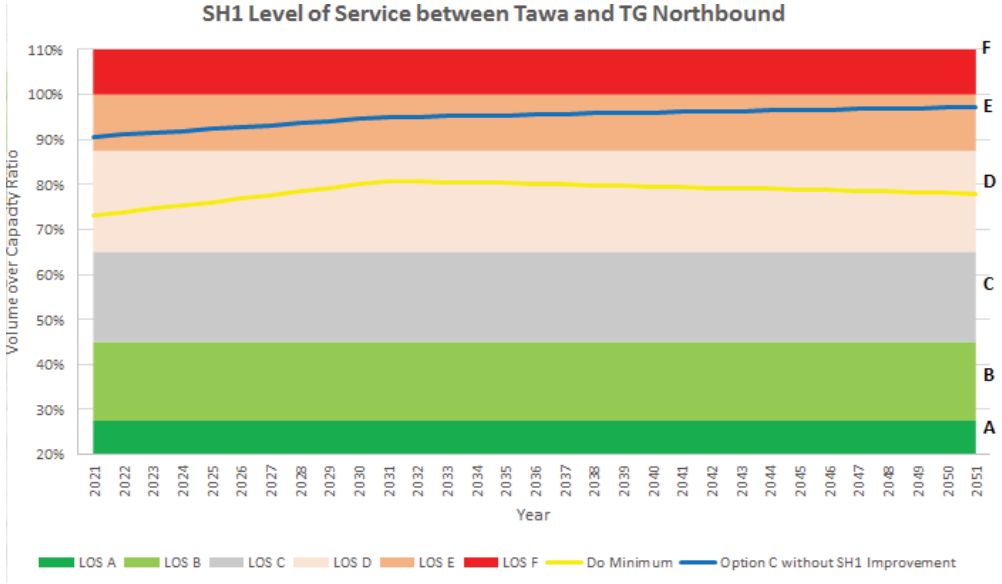


Figure 18 - Level of Service (between Tawa and Transmission Gully Interchange)

2.3.12. Both **Figure 17** and **Figure 18** show that the deterioration in LoS on SH1 between Johnsonville and Churton Park is relatively small. However, the deterioration in LoS on SH1 between Tawa and Transmission Gully is more marked.

2.3.13. **Figure 19** to **Figure 22** show the impacts on LoS on SH1 north of Tawa if capacity upgrades were to be implemented (that is, either Option C or D).

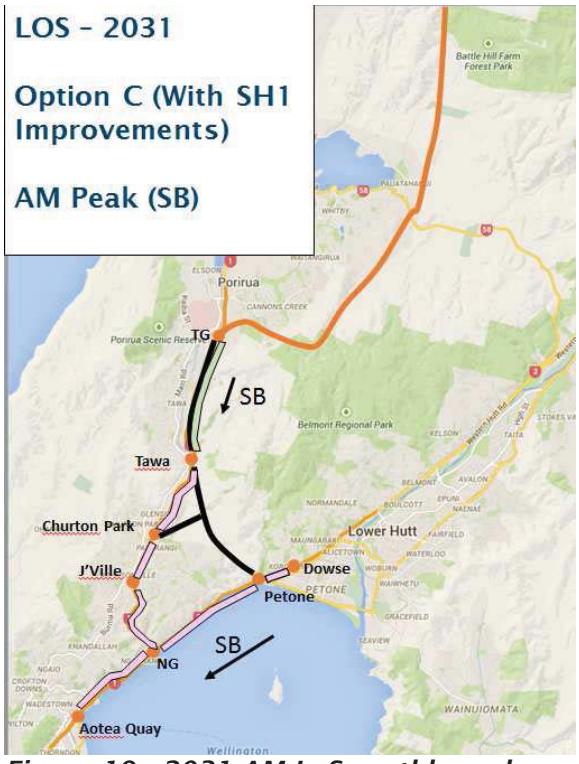


Figure 19 - 2031 AM LoS southbound with SH1 widening

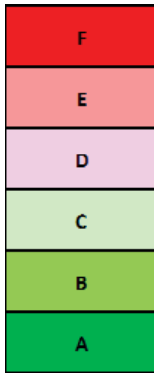


Figure 20- 2031 PM LoS northbound Option C with SH1 widening

2.3.14. **Figure 19** shows that implementation of Option C with SH1 widening in the 2031 AM southbound peak improves the predicted LoS on SH1 from D (that is, the do-minimum LoS outcome) to C.

2.3.15. **Figure 20** shows that implementation of Option C with SH1 widening in the 2031 PM northbound peak improves the predicted LoS on SH1 from E (that is, the do-minimum LoS outcome) to C. As described above, the LoS between Johnsonville and Churton Park deteriorates very slightly to a low LoS E (see **Figure 17**).

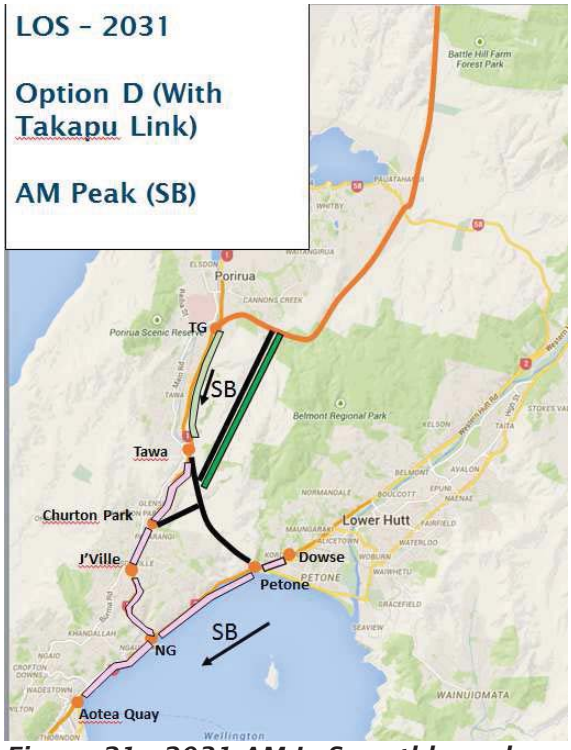
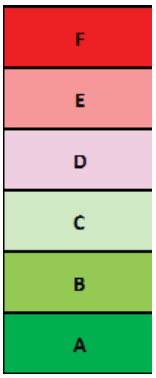


Figure 21 - 2031 AM LoS southbound Option D (Takapu Link)



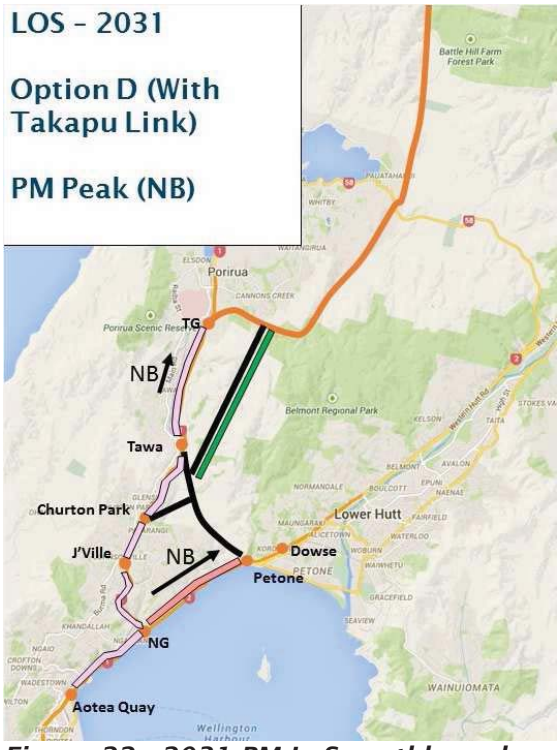


Figure 22 - 2031 PM LoS northbound Option D (Takapu Link)

2.3.16. **Figure 21** shows that the implementation of Option D in the 2031 AM southbound Peak is predicted to improve the LoS from D (that is, compared to the do-minimum outcome) on the existing SH1 (between Tawa and the Transmission Gully Interchange) to C.

2.3.17. **Figure 22** shows that the implementation of Option D in the 2031 PM northbound Peak is predicted to improve the LoS from E (that is, compared to the do-minimum outcome) on the existing SH1 (between Tawa and Transmission Gully Interchange) to D.

2.3.18. It is noted that the state highway customers using the new Takapu Link are likely to experience a LoS of A. It is also noted that state highway customers using the new P2G Link Road itself are likely to experience a LoS of A or B for both AM and PM peaks in both directions.

Summary

2.3.19. As noted above, a LoS of E or F is generally considered to represent Severe Congestion. The P2G Link Road improves, or has no impact, on LoS on the state highway network throughout

the Wellington Region with the exception of north of Tawa and to a much lesser extent between Johnsonville and Churton Park (where, with Option C, the LoS deteriorates to a very low LoS E). On the section of SH1 north of Tawa this LoS is predicted to deteriorate to a point of Severe Congestion without intervention which is why capacity improvements could be considered.

2.4. Travel Time Modelling

2.4.1. Another measure of congestion is travel time improvement and/or deterioration.

2.4.2. The NWSM has been used to measure the travel time for the P2G Link Road and for the options north of Tawa. To compare between options, four option scenarios have been tested as set out in **Table 2**.

Option	Colour Code	Description
Do Minimum		2031 Future year network, including Transmission Gully and SH2/58 upgrades but not P2G Link Road
Option C1		2031 Do Minimum plus P2G Link Road but no improvements north of Tawa.
Option C2		2031 Do Minimum plus P2G Link Road including SH1 widening north of Tawa.
Option D		2031 Do Minimum plus P2G Link Road including Takapu Link.

Table 2 - Journey Time Comparison between Options

2.5. Travel Time between Transmission Gully and Petone Overhead Bridge

2.5.1. The outputs of the transport modelling for travel time between Transmission Gully Interchange on SH1 and the Petone Overhead Bridge on SH2 are presented in **Figure 23** and **Figure 24**. Note that these travel times are for journeys via SH1 as illustrated.

2.5.2. **Figure 23** and **Figure 24** show that the travel time from the Petone Overhead Bridge and Transmission Gully Interchange is predicted to reduce by 10-15 minutes in both AM and PM peaks in 2031 through the implementation of the P2G Link Road (that is, whether or not Option C or D is implemented). This is because this route "cuts the corner" off the journey between SH1 and SH2.

Figure 23 - Travel Time between Transmission Gully Interchange and Petone Overhead Bridge

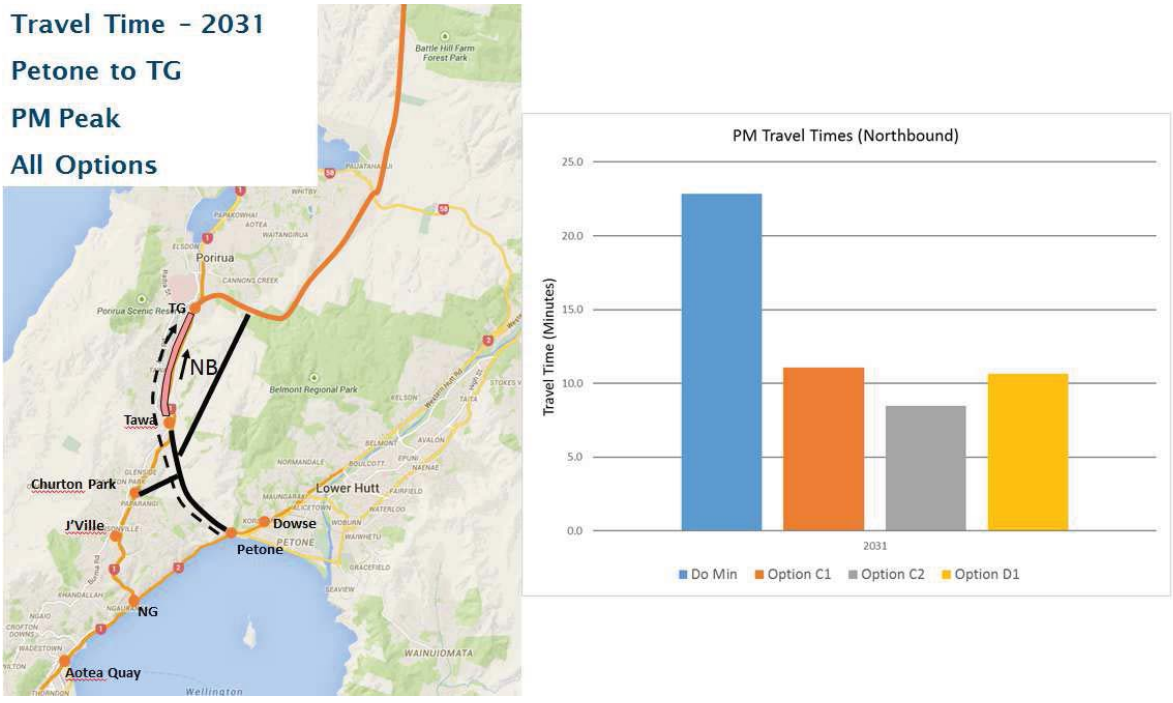


Figure 24 - Travel time between Petone Overhead Bridge and Transmission Gully Interchange

2.5.3. While all options indicate substantial journey time savings, journey times on SH1 with the C options are slightly faster than Option D1. This is because the Option D route introduces an additional interchange east of Grenada North which would result in a slight delay for traffic accessing the P2G Link Road from the existing SH1.

2.5.4. Traffic using the Takapu Link itself to access P2G would have significant travel time reductions for journeys to Petone and Seaview, and a travel time advantage over Option C. (See **Figure 25** and **Figure 26**).

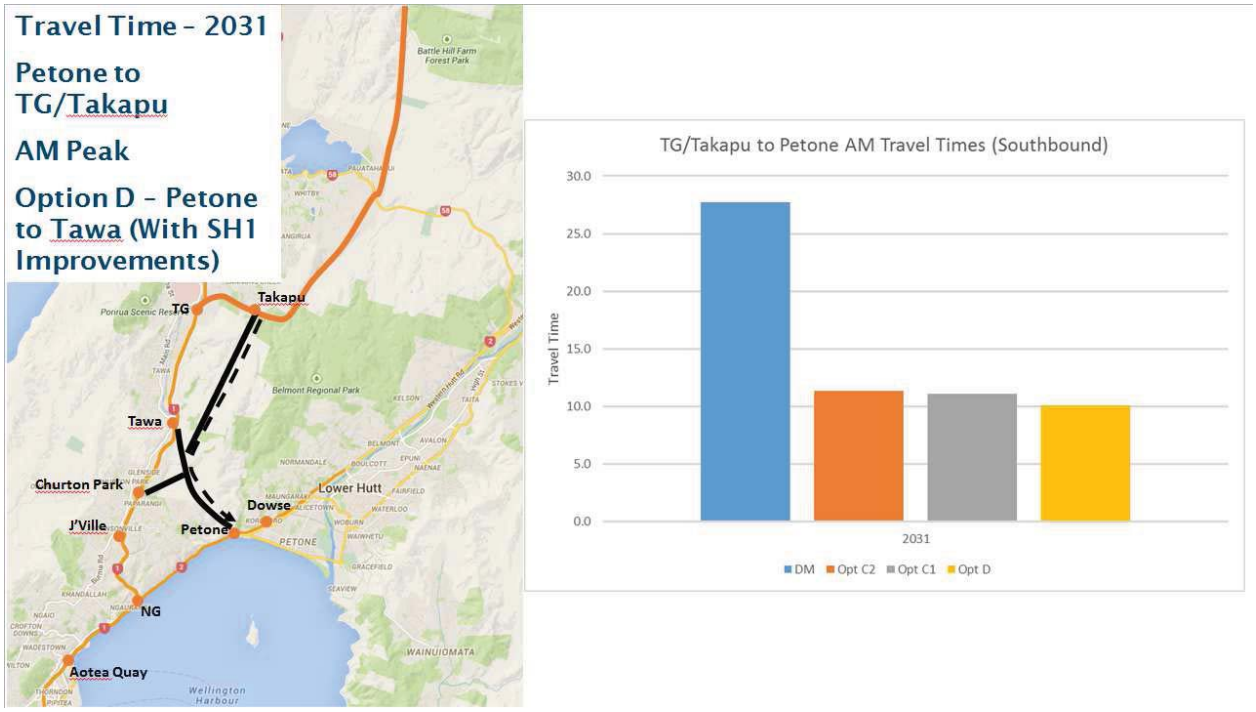


Figure 25 - Travel time between the Takapu Substation and Petone Overhead Bridge

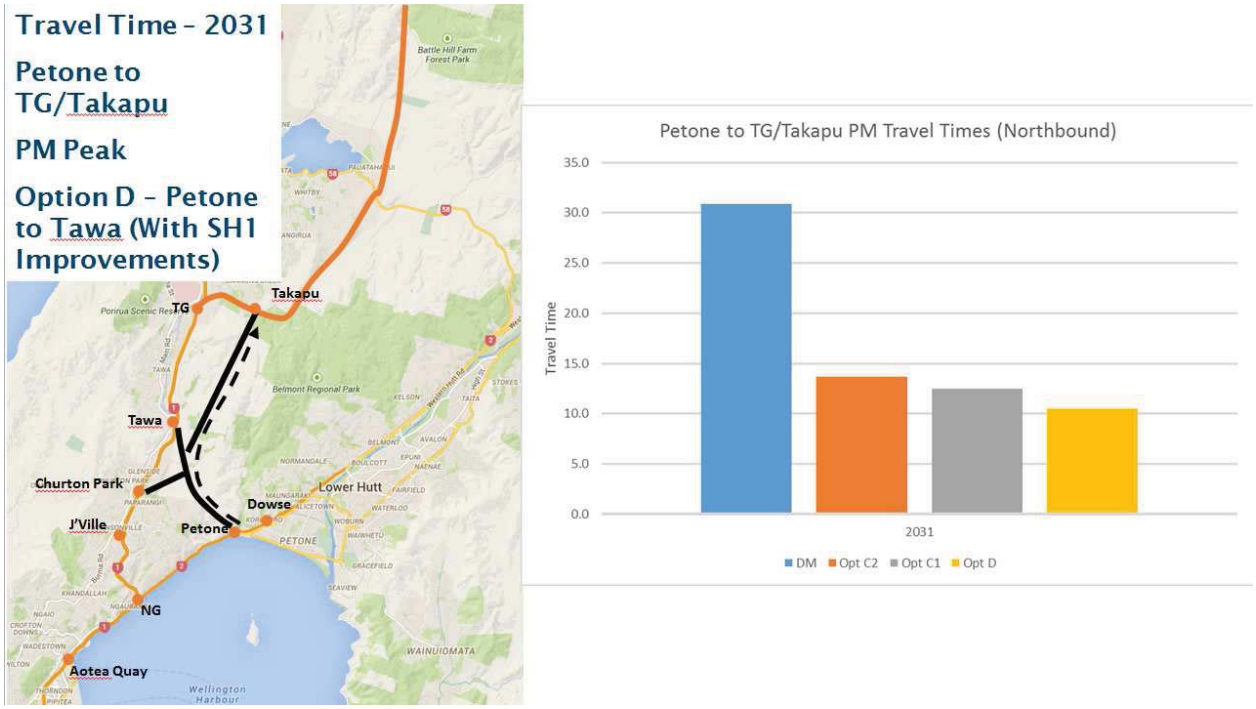


Figure 26 - Travel time between the Petone Overhead Bridge and the Takapu Substation using Option D 2031 northbound PM Peak

2.5.5. **Figure 25** and **Figure 26** show that travel times on the P2G Link Road between the Takapu substation and the Petone Overhead Bridge using Option D would be significantly faster in both peaks than using either the do-minimum route via Ngauranga, or Options C1 or C2. The travel time advantage for using Option D over either Option C1 or C2 for this journey is around 2 minutes in the AM peak or around 3 minutes in the PM peak.

2.5.6. The outputs of the transport modelling for travel time between the Ngauranga Interchange and the Transmission Gully Interchanges are presented in **Figure 27** and **Figure 28.**

Figure 27 - Travel time between Tawa and Transmission Gully Interchange 2031

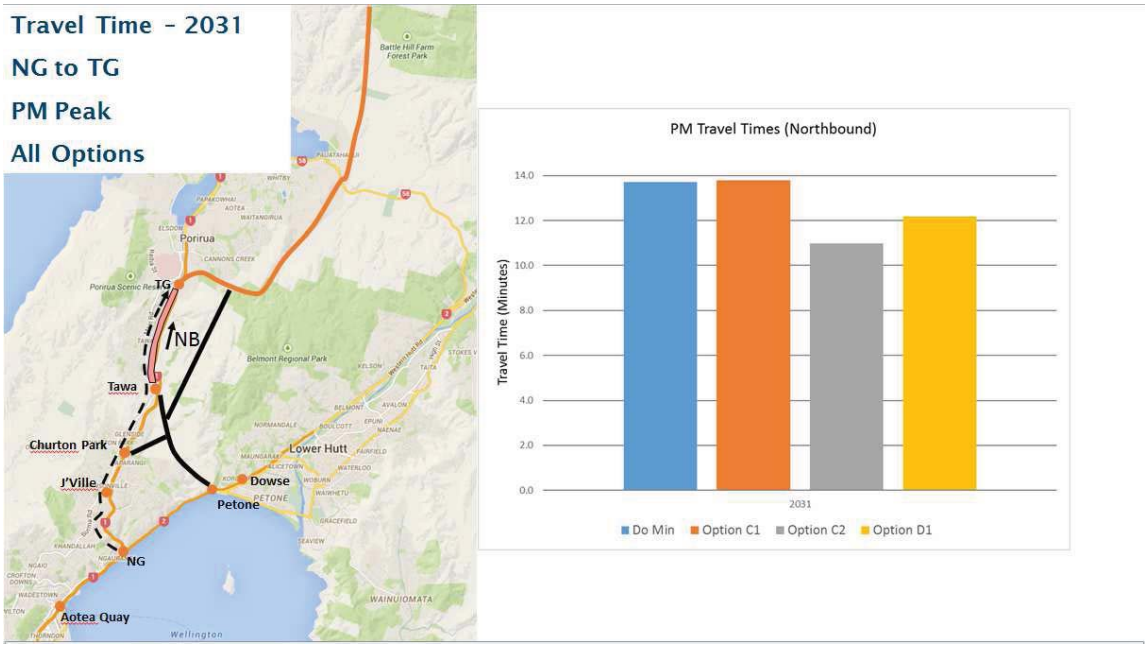


Figure 28 - Travel time between Ngauranga Interchange and Transmission Gully Interchange

2.5.7. **Figure 27** and **Figure 28** show that travel times in the northbound PM Peak on SH1 are predicted to deteriorate compared to the do-minimum if there are no capacity improvements north of Tawa (Option C1). This is because of the increased demand for travel in the region caused by the creation of the P2G Link Road.

2.5.8. The decrease in travel times is more marked for the discrete Tawa to Transmission Gully Interchange section (**Figure 27**) because of the balancing out of travel times over the longer distance between Ngauranga and Transmission Gully interchanges. The decrease in travel time would be most noticeable for local traffic travelling between Tawa and the Transmission Gully Interchange.

2.5.9. **Figure 27** shows that travel times between Tawa and the Transmission Gully Interchange are likely to deteriorate by around 90 seconds if the P2G Link Road is constructed without capacity improvements north of Tawa because of the increased traffic flows on this section causing delays. With the addition of either more capacity on SH1 (Option C2) or the Takapu Link (Option D1), travel times on SH1 improve relative to Option C1. Option C2 would result in travel time improvements for SH1 traffic between Tawa and the Transmission Gully Interchange relative to the do-minimum while travel times on SH1 would return to do-minimum levels with Option D1[4].

2.5.10. The travel times between the Ngauranga and Transmission Gully Interchanges in **Figure 28** reflect the same trends, ie overall travel times between the interchanges are similar or slightly worse than on the existing route if the P2G Link Road is constructed without capacity improvements. When capacity improvements are added, journey times reduce by around three minutes for Option C2 or around two minutes for the Option D1.

2.6. Travel time on SH2 between the Ngauranga and Dowse Interchanges

2.6.1. For completeness, the outputs of the transport modelling on travel times between Ngauranga and Dowse Interchanges on SH2 are presented and discussed in **Figure 29** to **Figure 32**. In these Figures, only Option D is illustrated.

[4] Note that travel times for traffic using the Takapu Link to travel to Lower Hutt and Seaview would be significantly reduced, as detailed in **Figure 25** and **Figure 26**.

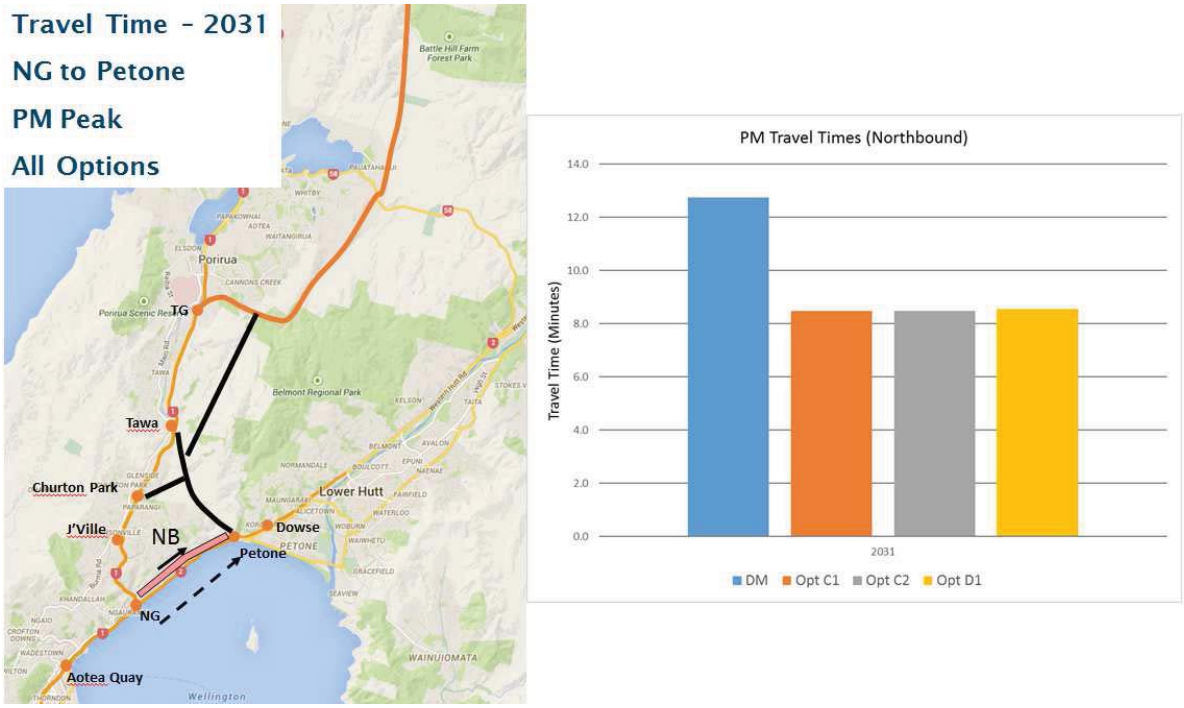


Figure 29 - Travel time between the Ngauranga Interchange and Petone Overhead Bridge 2031 Northbound PM Peak

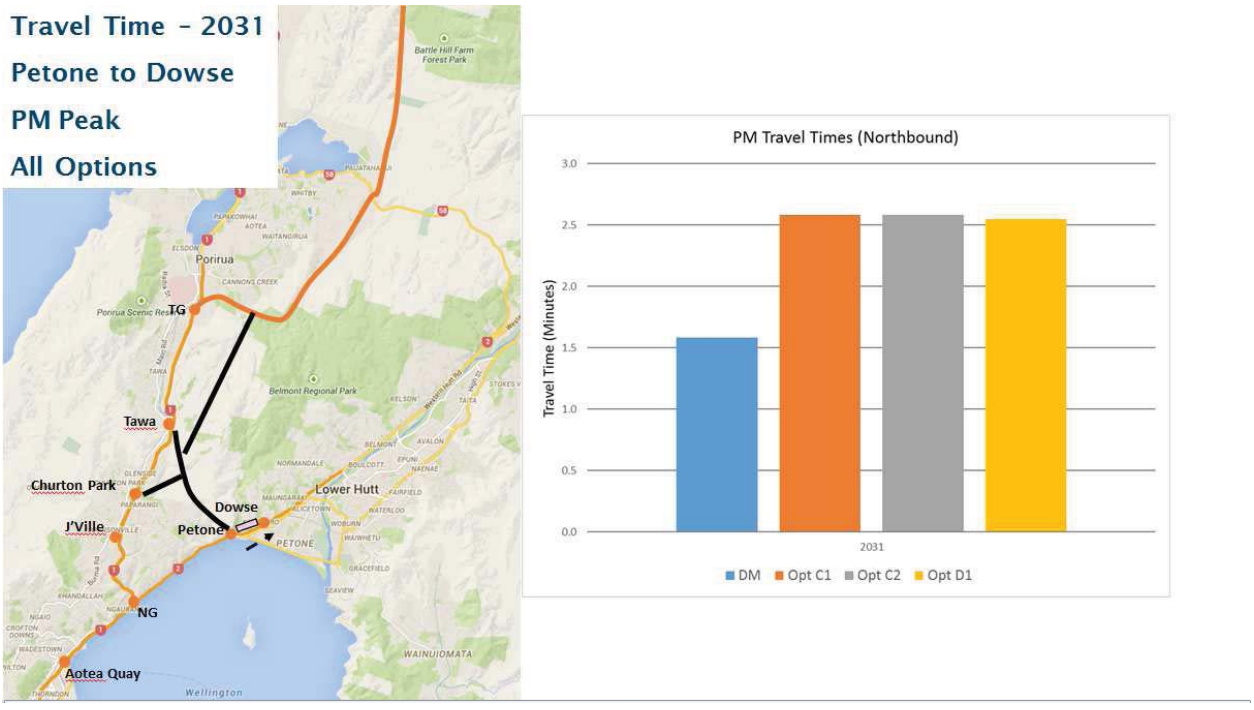


Figure 30 - Travel time between Petone Overhead Bridge and the Dowse Interchange 2031 northbound PM peak

2.6.2. It is noted from **Figure 29** and **Figure 30** that travel time in the northbound direction overall between the Ngauranga and Dowse Interchanges are likely to reduce by around three minutes. However, **Figure 30** (travel times on SH2 between the Petone Overhead Bridge and Dowse Interchange) shows that journey times are predicted to increase by around one minute in the

northbound PM Peak for this discrete section. This is due to the increased demand for travel as illustrated in Section 2.1. Measures to improve this localised travel time increase on this section of SH2 will be investigated during development of the SAR.

Figure 31 - Travel time between Petone Overhead Bridge and the Ngauranga Interchange

2.6.3. **Figure 29** and **Figure 31** show that the P2G Link Road improves travel times on SH2 between the Ngauranga Interchange and Petone Overhead Bridge in the northbound PM peak and southbound AM peak, but particularly in the PM peak, regardless of which north of Tawa option is selected, ie Options C and D are the same in this instance.

Figure 32 - Travel time between the Dowse Interchange and Petone Overhead Bridge 2031 southbound AM Peak

2.6.4. **Figure 32** shows that the predicted journey time southbound in the AM peak between Dowse and Petone will be reduced by around three minutes. This predicted travel time reduction reflects the replacement of the constraint of the Petone Overhead Bridge which is currently a bottleneck causing significant delays on the network.

Summary

2.6.5. The key findings from the travel time modelling is as follows:

- The P2G Link Road delivers significant travel time benefits for commuting travellers. For example, the trip into Wellington on either SH2 or SH1 will decrease by three minutes in the AM peak,
- Travel time dis-benefits have been identified for the section of SH1 north of Tawa in the northbound PM Peak, and
- Minor travel time dis-benefits have been identified on SH2 for Petone to Dowse in the northbound PM Peak.

3. MODELLING ALTERNATIVE OPTIONS FOR NORTH OF TAWA

3.1. Alternative Options Considered

3.1.1. As noted above, a part of the Chief Executives' Forum remit was to consider alternative options to Options C and D. The options considered included:

- Upgrades to the Public Transport Network, and
- Demand Management (ie Tolling and Parking Fees).

3.2. Upgrades to the Public Transport Network

3.2.1. All public transport modelling on the P2G Link Road was undertaken by GWRC using WPTM for the year 2031. In particular, public transport modelling focused on the impacts that the P2G Link Road and Options C and D would have on public transport patronage, and also whether public transport upgrades could be an alternative to managing predicted traveller demand on SH1 north of Tawa.

3.2.2. It is noted that the public transport modelling indicated that the implementation of the P2G Link Road would generate increased demand for a public transport service between SH1 and SH2. Modelling showed that during peak periods there would be demand for up to 100 return bus trips per peak period. There would also be a strong inter peak demand leading to total demand of around 1000 bus users per day.

3.2.3. The public transport modelling also showed the following public transport impacts of the P2G Link Road:

- Reduced congestion and reduced travel times on SH1 and SH2 into Wellington (south of the P2G Link Road) has the effect of increasing the attractiveness of road travel into Wellington.
- Overall rail patronage reduces by 3% or around 400 passengers during the two hour AM peak period.
  - On the Kapiti Rail Line there is a 4% reduction in rail patronage (around 200 passengers in the AM peak period, mostly from the Tawa Basin);
  - On the Johnsonville Rail Line there is a 4% reduction in rail patronage (around 100 passengers per day in the AM peak period);
  - On the Hutt Rail Line there is a 1% reduction in rail patronage (around 100 passengers per day in the AM peak period).
- Because reduced congestion on SH2 leads to a decrease in journey times to Wellington, the P2G Link Road increases the attractiveness of bus services between Wellington and the Hutt Valley. The modelling indicates an increased demand for bus services between Hutt and Wellington of around 150 passengers in the AM peak. This increase in bus patronage offsets the decline in rail usage on the Hutt Line.

3.2.4. GWRC modelled a rail network improvement scenario to see if the fall in rail patronage as result of the introduction of the P2G Link Road can be mitigated. The scenario tested by GWRC

improved the speed and frequency of the rail service offering by implementing the following measures:

- A third track through the Tawa Basin (allowing express services to bypass stopping services);
- Track straightening between Petone and Ngauranga (to provide for rail operating speed increases);
- Park and Ride; and
- Service improvements to improve rail service levels and customer experience.

3.2.5. The modelling indicated that these measures, if implemented, would:

- Offset any public transport patronage decline associated with the P2G Link Road,
- Result in only limited decongestion on the section of SH1 north of Tawa, which would still experience a LoS E in the PM peak (see section 2.3). and have minimal impact on journey times. Therefore, such measures would not alleviate the need for capacity improvements north of Tawa.

3.3. Demand Management

3.3.1. GWRC have also undertaken modelling into the effect of demand management. Its analysis investigated the potential for tolling the P2G Link Road (from a demand management perspective) and measures to manage the state highway traffic entering Wellington City by retaining that "status quo" commuter parking capacity (the effect is to increase the future price of parking in Wellington City CBD). These measures could be used alongside public transport improvements.

3.3.2. In testing the tolled scenario for the P2G Link Road, GWRC noted that tolling has a limited impact on car travel demand as a whole in the Wellington Region as there was a tendency to divert away from the tolled road onto an alternative road rather than to switch to an alternative transport mode. GWRC did identify that a small decrease in flow on SH1 at Tawa was noticeable however, and could potentially result in an improved LoS for SH1 north of Tawa.

3.3.3. In relation to testing the future management of parking in Wellington City CBD, GWRC noted that there could be a marked increase in demand for public transport services if commuter parking charges were increased in Wellington City. Adopting such measures could help to delay or avoid the need to increase capacity north of Tawa.

4. OTHER TRANSPORT MODELLING UNDERTAKEN

4.1. Transport Modelling Impacts of Options

4.1.1. As detailed in Section 1.3, the P2G Link Road Project is still at Scoping Options Report stage. Therefore, the transport modelling results identified in this Report are at a "scoping stage". They will be developed further once the Project progresses through the SAR and RMA applications stages.

4.1.2. Modelling of freight efficiency using NWSM has been undertaken as part of the option assessment work for north of Tawa. This modelling is discussed further below.

4.2. Freight Efficiency Modelling

4.2.1. Freight efficiency of Options C and D has been modelled by Opus International Consultants (**Opus**).

4.2.2. Freight efficiency (in this context HCV efficiency) is a function of vehicle operating costs and journey times. Travel time and vehicle operating costs are determined by the design of a road; a shorter route would normally be faster, but it is also necessary to factor in elements such as congestion, traffic lights and gradients which all may have an impact on journey time and therefore vehicle operating costs.

4.2.3. The essential question considered is whether longer and flatter routes are preferred over shorter and steeper routes for HCVs. While steep grades have an impact on cars and light goods vehicles, they are still able to accelerate and maintain a reasonable average speed and therefore this is not likely to affect their routing decisions. In contrast, speed and fuel usage will play a significant factor in determining what routes HCVs take. HCV fuel usage is particularly sensitive to gradients and therefore a detailed modelling exercise has been undertaken to understand what impact the gradients of the P2G Link Road would have on HCV usage.

4.3. Scoping Options Report Freight Modelling

4.3.1. As identified in the Scoping Options Report, alignment options from Petone Overhead Bridge to the Takapu Substation on Transmission Gully were compared.

4.3.2. The modelling indicates that the P2G Link Road as a whole has significant travel time and vehicle operating cost benefits for freight over (and above) the existing routes. This results in (for the P2G Link Road route between Petone Overhead Bridge and Tawa Interchange) freight efficiencies of 20% over (and above) the existing routes. This is because the alternative routes all have steep sections, and while the P2G Link Road has a sustained steep climb, it is considerably shorter than the alternative route.

It is assumed that freight movements in this modelling are unconstrained. Crawler lanes have been proposed for the steep section of the P2G Link Road from Petone to the Crest of the Wellington Escarpment.

4.3.3. When comparing Options C and D, there are additional freight efficiencies associated with Option D for HCVs travelling north to join SH1 north of Porirua. This is because this route has a flatter gradient. The additional efficiency saving of Option D associated with a flatter gradient (when compared to Option C) is estimated to be 20%, resulting in total freight efficiency of Option C at 20% over existing or Option D at 39% over existing.

4.3.4. **Figure 33** below illustrates the relative efficiency and fuel savings of the three routes from Petone to the Takapu substation.

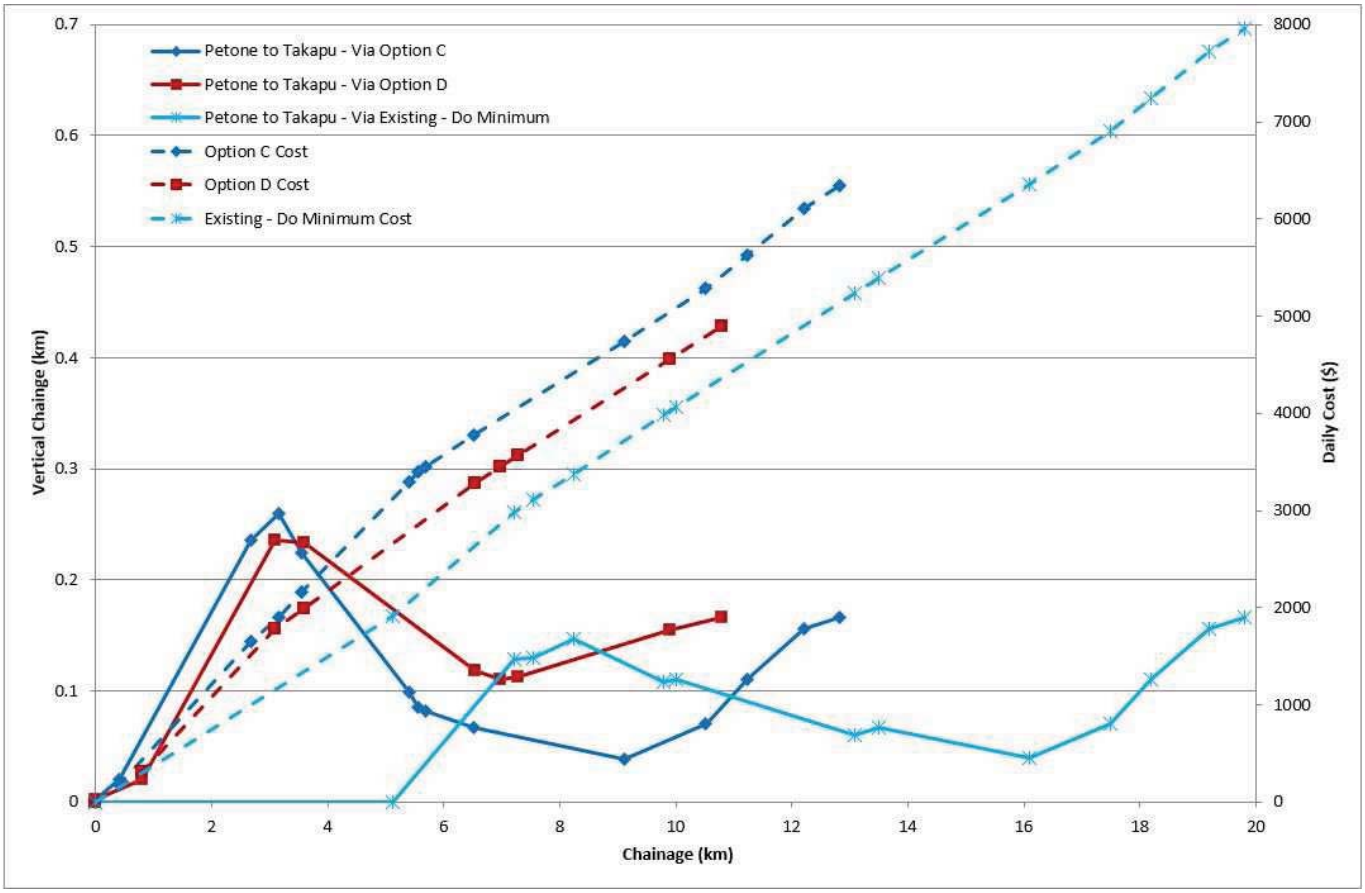


Figure 33 - Freight Efficiency Comparison for Routes between Petone

4.3.5. **Figure 33** shows the lower costs associated with the Option D compared with other options, such as Option C, due to the flatter gradient and shorter route compared to the other options. The red line, illustrating Option D, for example, illustrates a route length from Petone to the Takapu Substation of 11km which would equate to a collective daily cost of $5000, whereas the Option C is 13km long and would cost around $6500 collectively per day.

4.3.6. The NWSM has been used to determine the routes and demand for HCV routing on the P2G Link Road. Because of the steep gradient of the P2G Link Road, factors have been applied to the P2G Link Road route simulating steep gradients between Petone and Grenada. It should

be noted that equivalent factors have not been applied elsewhere in the network (noting that both the Ngauranga Gorge and SH58 routes have significant steep sections), so the HCV modelling demand for the P2G Link Road is likely to be conservative and further freight efficiency benefits could be realised once the road is in operation.

4.4. Longer Distance Freight Efficiency Comparison

4.4.1. Further freight efficiency modelling has been undertaken by Opus following completion of the Scoping Options Report. This modelling has used a longer distance for comparison, as opposed to the shorter distance used in the Scoping Options Report.

4.4.2. In this analysis the costs and times associated with a single HCV trip are modelled.

4.4.3. Three route options were assessed between the Petone Overhead Bridge on SH2 and MacKays Crossing at the junction of Transmission Gully (**TG**) and SH1:

- Route 1 – **Proposed SH1:** SH2 from Petone to Ngauranga, then TG to MacKays Crossing;
- Route 2 – **Option C:** P2G route from Petone to Tawa, SH1 to Kenepuru, and TG to MacKays Crossing; and
- Route 3 – **Option D:** P2G route from Petone to Takapu on TG, and TG to MacKays Crossing.

4.4.4. The three routes are shown in **Figure 34**.

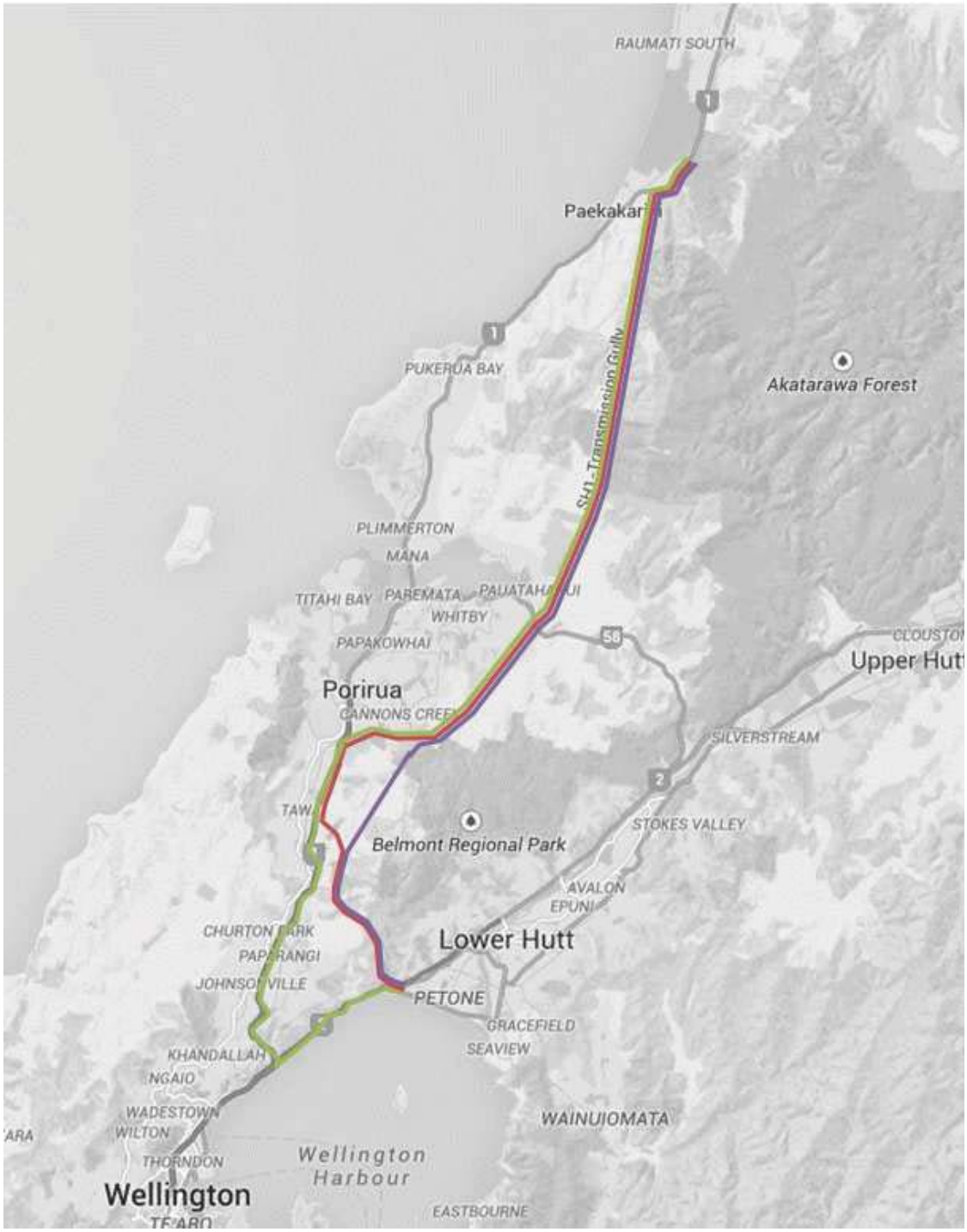


Figure 34 - Routes between Petone and MacKays Crossing

4.4.5. The elevation changes in metres for the three routes versus distance (km) are plotted on the primary axis in **Figure 35** and **Figure 36** for the southbound and northbound directions respectively. The average section speeds (km/h) are plotted on the secondary axis.

Figure 35 - Southbound Distance vs Speed

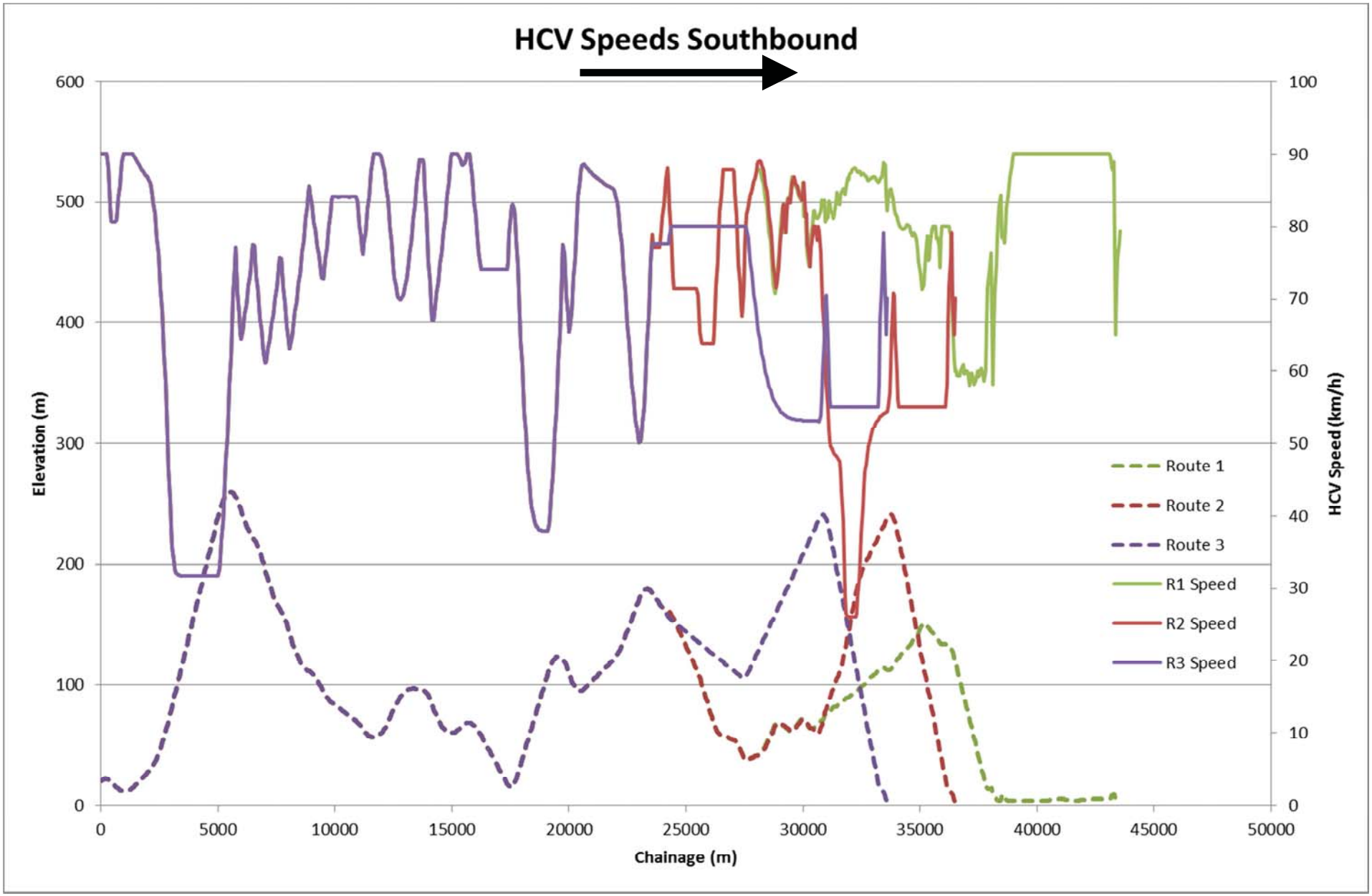
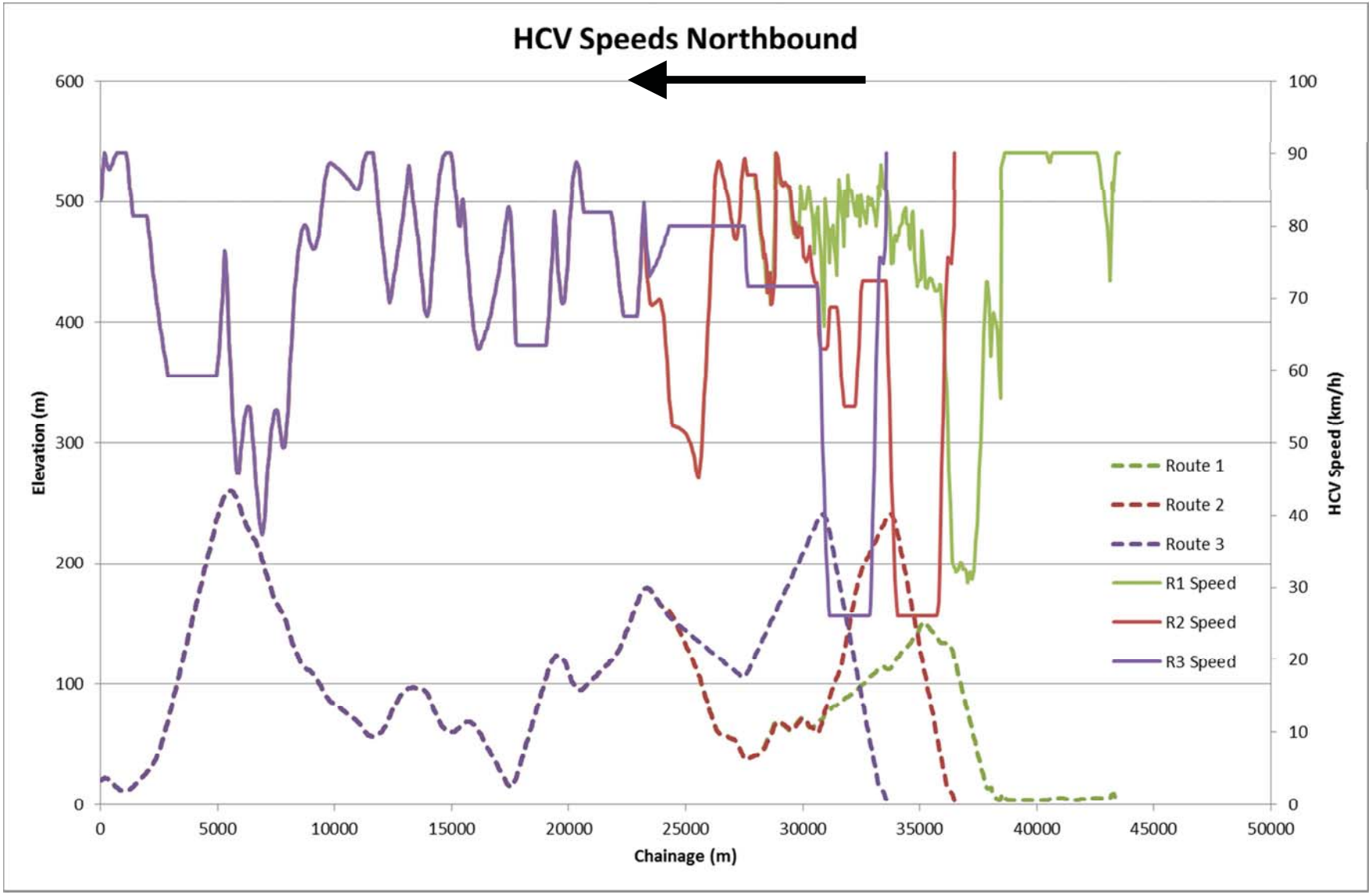


Figure 36 - Northbound Distance vs Speed



4.4.6. Summary statistics for average speed and travel time for the southbound and northbound directions are shown in **Table 3** and **Table 4** respectively. Free flow travel at the speed limit was assumed, since long haul HCVs tend to schedule trips away from the peaks to avoid loss of productivity. Percentage comparisons are made with Route 1, representing the new SH1 via Transmission Gully.

Route	Distance (km)	Travel Time (min)	Average Speed (km/h)
Route 1	43.6	37.1	70
Route 2	36.5 (-16%)	34.7 (-7%)	63 (-10%)
Route 3	33.6 (-23%)	31.3 (-16%)	64 (-9%)

Table 3 - Southbound Average Speed and Travel Time

Route	Distance (km)	Travel Time (min)	Average Speed (km/h)
Route 1	43.6	37.1	71
Route 2	36.5 (-16%)	34.3 (-7%)	64 (-9%)
Route 3	33.6 (-23%)	31.2 (-16%)	65 (-8%)

Table 4 - Northbound Average Speed and Travel Time

4.4.7. **Table 3** and **Table 4** show that the proposed SH1 Route 1 is the longest at 43.6km, followed by Route 2 with P2G Link Road at 36.5km. Route 3 with P2G Link Road and the Takapu Link is the shortest at 33.6km. Route 3 has a distance saving of 23% over Route 1.

4.4.8. **Table 3** and **Table 4** show that Route 3 is the fastest in terms of travel time, with almost a six minute (16%) time saving over Route 1. Route 2 is the next fastest, with a 2.4 minute (7%) travel time saving over Route 1.

4.4.9. The slowest routes in terms of average speed are Routes 2 and 3, as shown in **Table 3** and **Table 4**, as a result of the steep gradients to traverse, with Route 1 maintaining the highest average velocity, albeit over a longer length. This is also reflected in **Figure 35** and **Figure 36**.

4.4.10. The speeds and section lengths were used to generate travel time and vehicle operating costs for the three routes in accordance with the Transport Agency's EEM. The evaluation has been based on the following assumptions:

- NZTA Rural Strategic road classifications apply, and
- NZTA January 2014 update factors apply.

4.4.11. The resulting average travel time and Vehicle Operating Cost (**VOC**) costs for the three routes are shown in **Table 5**.

Route	Travel Time Cost	Vehicle Operating Cost	Total Cost ($
Route 1	35.7	81.4	117.0
Route 2	33.2 (-7%)	72.7 (-11%)	105.9 (-10%)
Route 3	30.0 (-16%)	65.8 (-19%)	95.9 (-18%)

Table 5 - Single HCV Travel Time and VOC Costs (2014$) – Average Both Directions

4.4.12. **Table 5** shows that Route 3 is 16% cheaper than Route 1 in terms of travel time cost, and 19% cheaper in terms of VOC, resulting in an overall 18% saving in costs for HCVs travelling the route. Similarly Route 2 is 10% cheaper than Route 1 in overall cost savings.

4.4.13. The results indicate that analysis of costs using the Transport Agency's EEM values favours a shorter and steeper trip (Routes 2 and 3) over a longer and shallower journey (Route 1).

4.4.14. The analysis has shown that both Routes 2 and 3 are far shorter than Route 1.

4.4.15. Route 3 is the fastest in terms of travel time, with almost a six minute (16%) time saving over Route 1. Route 2 is the next fastest, with a 2.4 minute (7%) travel time saving over Route 1.

4.4.16. Route 3 is 18% cheaper than Route 1 for HCVs travelling the route. Similarly Route 2 is 10% cheaper than Route 1 in overall cost savings. The results indicate that analysis of costs using the EEM values favours a shorter and steeper trip (Routes 2 and 3) over a longer and shallower journey (Route 1).

5. SH58 AS AN ALTERNATIVE

5.1. Modelling SH58 Upgrade as an Alternative to the P2G Link Road

5.1.1. During public consultation in 2014, a question was asked whether upgrading SH58 would be an alternative to the P2G Link Road and capacity improvements north of Tawa. A modelling exercise took place using the model version current at that time. This section summarises the results of that exercise. No new work has been undertaken on this question since mid 2014. The flows illustrated in the Figures in this section of the report are therefore slightly different to those illustrated in Section 2.2 which, along with all other sections of this report, uses the updated model. Although the NWSM has since been updated, those updates were to assist with measuring LoS on the scheme options and do not change the macro-level conclusions drawn in this section regarding SH58.

5.1.2. The starting position for this question is considering what the problem that the P2G Link Road is trying to address. Two of the key project objectives for the P2G Link Road (See Section 1.4) are to improve the safety and efficiency of the transport network including efficiency of HCVs travelling between Seaview and SH1 to the north and maximise value for money, and to support the economic growth and development of the region by improving connectivity within the region, The Hutt Corridor Plan also seeks the P2G Link Road to reduce congestion and to improve east-west connectivity on SH2. An upgrade of the SH58 would not achieve these objectives as well as the P2G Link road will.

5.1.3. The demand modelling (see Section 2.1) also indicates why the upgrade of SH58 is not an alternative to the P2G Link Road.

5.1.4. Modelling from the earlier version of NWSM indicates that four laning of SH58 would not improve journey times on SH58 enough to attract travellers off the alternative route on SH1 in the Ngauranga Gorge and SH2 between the Petone Overhead Bridge and the Ngauranga Interchange. **Figure 37** and **Figure 38** below illustrate the relative impacts of four laning SH58 and the P2G Link Road on traffic flows.

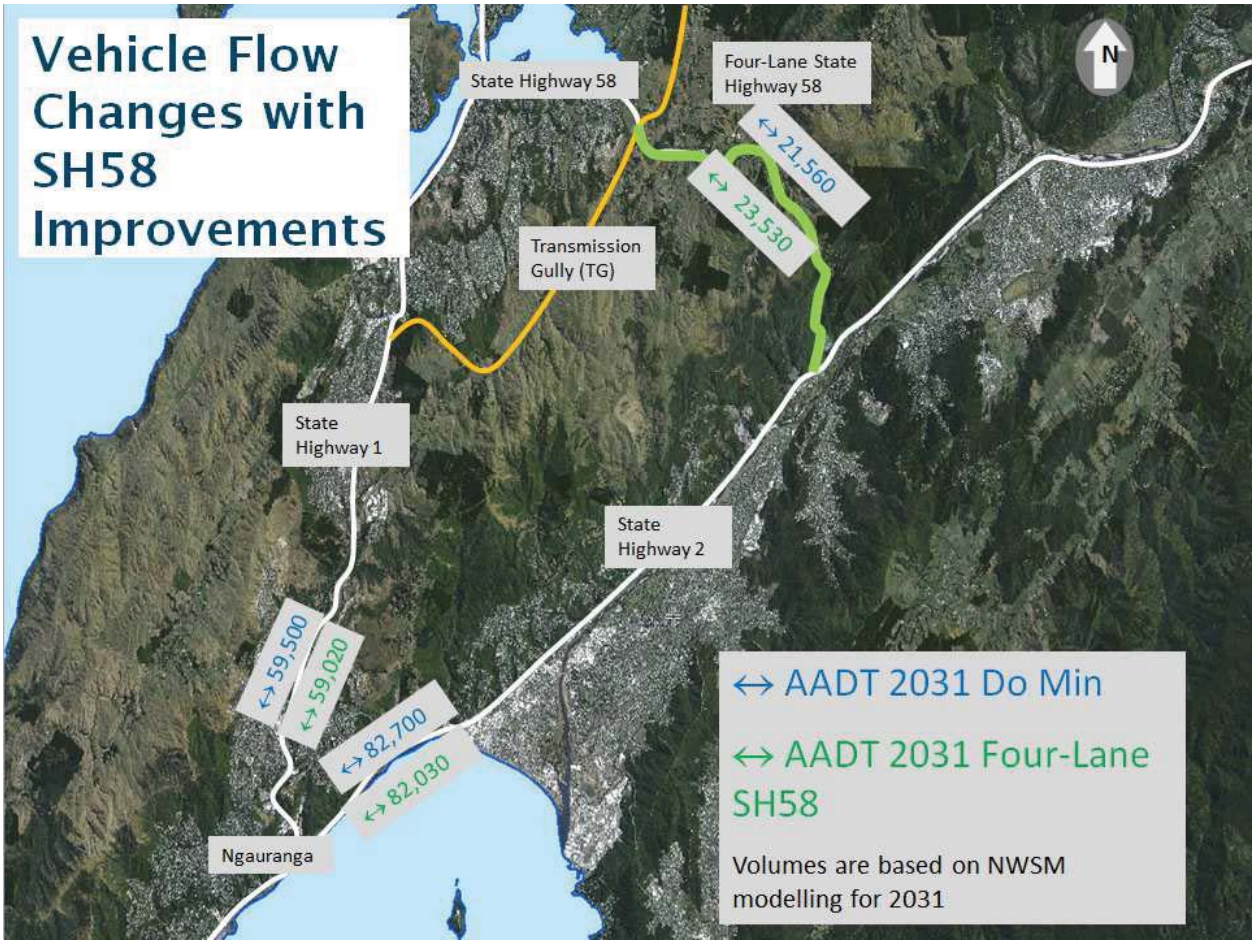


Figure 37 - Impact of SH58 Four Laning on Average Annual Daily Traffic (AADT) Flows in 2031

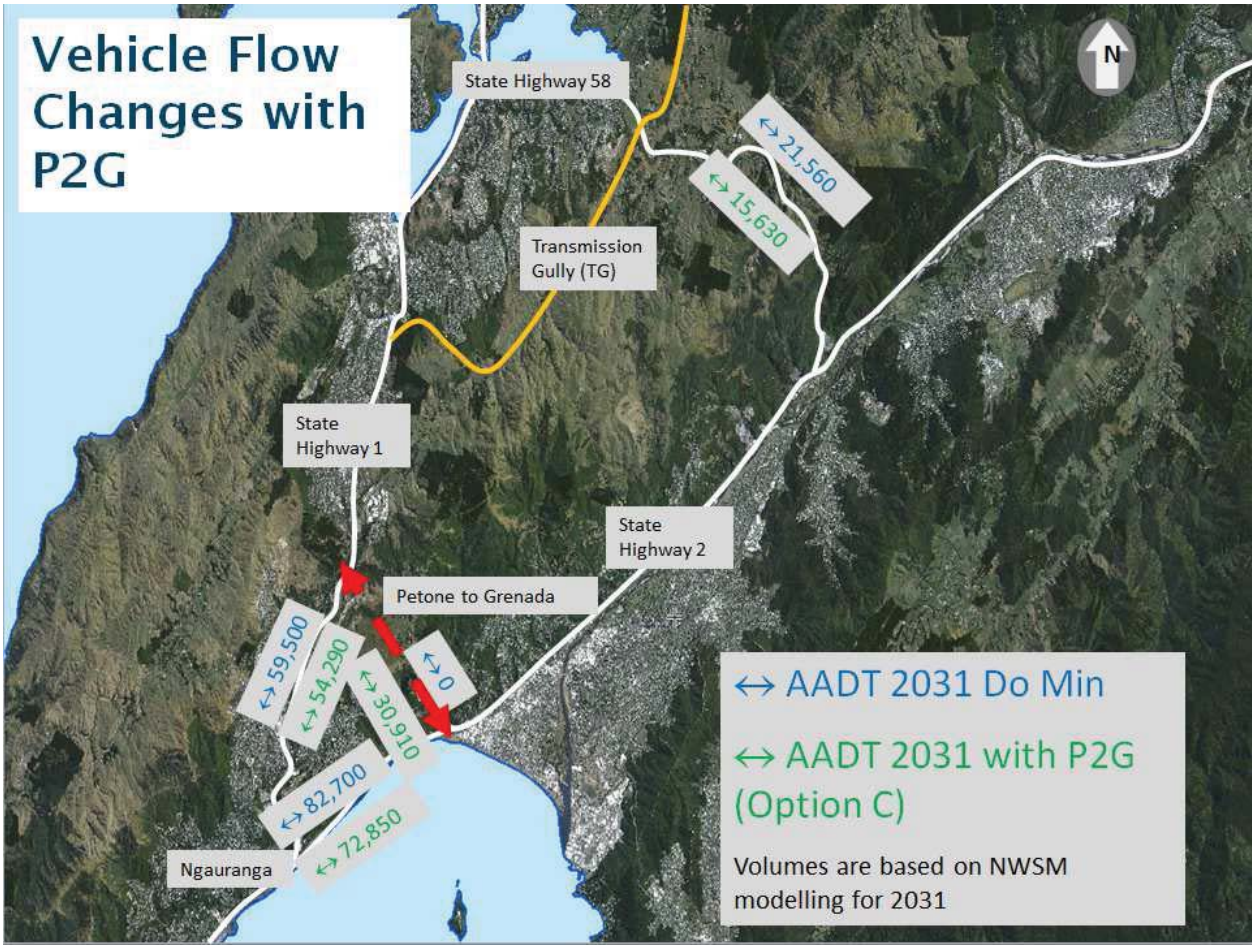


Figure 38 - Impact of P2G on Average Annual Daily Traffic (AADT) Flows in 2031

5.1.5. **Figure 37** illustrates that while four laning SH58 would have the impact of attracting a small number of travellers to SH58, it would not significantly reduce the traffic flows on SH1 south of Grenada and SH2 south of Petone. In contrast, **Figure 38** illustrates that the creation of the P2G Link Road (Option C with SH1 widening is illustrated, though the flows would be similar for Option D, or for Option C without SH1 widening) would significantly decrease traffic flows on both SH1 south of Grenada and SH2 south of Petone.

5.1.6. SH58 is an important connection for those travelling from Upper Hutt or the northern parts of Lower Hutt towards Porirua, Kapiti or areas further north, and for these travellers, SH58 will continue to be a preferred route. However, for the majority of the demand in the Wellington Region the P2G Link Road will serve those travellers better by providing a direct link between SH1 and SH2 in close proximity to the Ngauranga Gorge.

5.1.7. The North of Tawa Options, C and D are proposed to mitigate the congestion on SH1 and four laning SH58 is not an alternative to these options, because it would not be capable of mitigating congestion on SH1.

6. ECONOMIC EVALUATION OF NORTH OF TAWA OPTIONS

6.1. Incremental Benefit Cost Ratios for Options C and D north of Tawa

6.1.1. Benefit Cost Analysis is used for economic profiling of projects for funding assessment purposes. Overall Project Benefit Cost Ratios (**BCRs**) are used to understand how beneficial a project is over time.

6.1.2. A useful way of comparing sub project options, such as Options C and D is to calculate an incremental BCR. An incremental BCR indicates the benefit that would accrue over and above a base situation, so that it is possible to determine if a further improvement would be worth pursuing. A BCR can be derived from journey time and vehicle operating cost benefits as against the project costs.

6.1.3. Following feedback from the Chief Executives' Forum in late 2014, an incremental BCR analysis of Options C and D has been undertaken. This analysis seeks to determine whether either option would deliver more benefits than they cost as standalone projects.

6.1.4. An analysis of the BCR of separating out the parts of Options C (widening of SH1) and D (Takapu Link) from the rest of the P2G Link Road has been undertaken and the results are illustrated in **Table 6** below.

Base Option	Next Highest Cost Option	Incremental Costs ($M)	Incremental Benefits ($M)	Incremental BCR	Base Option for Next Step
C without SH1 widening	D	27.1	37.0	1.4	D
C without SH1 widening	C with SH1 widening	30.9	30.9	1.0	C with SH1

Table 6 - Incremental BCR Analysis of Options C and D[5]

6.1.5. This analysis assumes that the projects are progressed separately from the main P2G Link Road. Based on this analysis **Table 6** shows that on a strictly incremental basis, Option D is the highest value for money route option for the P2G Link Road. Option C with SH1 improvements is slightly worse incrementally than Option D, but shown to be economically justified over Option C (without SH1 widening), with an incremental BCR of 1.0. These calculations exclude the wider economic benefits and any enabling land use change effects.

6.1.6. In summary, the incremental BCR analysis indicates that both Option C *with* SH1 improvements or Option D (Takapu Link) are economically viable standalone projects and would be economically justified over Option C *without* SH1 improvements.

[5] Both of these BCRs have been calculated using most recent modelling outputs generated since the update of the NWSM model in late 2014.

7. SUMMARY OF KEY FINDINGS

7.1. The Congestion Problem

7.1.1. Demand for travel will increase in the region when the P2G Link Road becomes operational. This is because it will become easier for people to travel around the region and do business. There will be significant demand growth on the route of the P2G Link Road because it will be a new connection which will generate the significant growth in demand for travel.

7.1.2. Parts of the SH network already experience LoS E or F, which is considered to be severe congestion. Future modelling, using GWRC's medium growth scenario indicates that when the P2G Link Road is built, LoS will improve or stay the same on the surrounding State Highway network, except for a few isolated sections of the SH network. The only section of state highway which is predicted to experience a significant deterioration in LoS is the section of SH1 between Tawa and the Transmission Gully Interchange which is predicted to deteriorate from LoS D to LoS E northbound in the PM peak.

7.1.3. Either the widening of SH1 or the creation of a new Takapu Link would mitigate this expected decrease in LoS on the existing SH1.

7.1.4. Journey times on the SH network will generally improve with the creation of the P2G Link Road, particularly all routes between SH1 and SH2. The exceptions to this rule are expected to be the section north of Tawa which is predicted to result in an increase in journey time by around 3 minutes in the PM peak, and a section of SH2 north of Petone where a small increase in journey time of 1 minute is predicted and for which long intersection merges are being investigated to mitigate this.

7.1.5. Either the widening of SH1 or the creation of a new Takapu Link would mitigate this reduction in journey time north of Tawa.

7.2. Modelling Alternative Options North of Tawa

7.2.1. Public transport modelling indicates that increased public transport provision would not be an alternative to improving LoS or journey time between Tawa and the Transmission Gully interchange to the same degree as Options C or D. Tolling the P2G Link Road also would not be capable of improving LoS or journey time between Tawa and Transmission Gully to the same degree as Options C or D, but could assist in reducing demand for travel on this section of the state highway. It is noted that tolling is being considered from a construction and operational funding perspective in any event.

7.2.2. Increasing commuter parking charges in Wellington City's CBD could however significantly reduce demand for travel into Wellington City, and could improve LoS and journey time between Tawa and the Transmission Gully Interchange to the same degree as Options C and D.

7.3. Freight Transport Modelling

7.3.1. The P2G Link Road represents a significant improvement in freight efficiency due to the reduced travel times. The modelling indicates that HCVs using the P2G Link Road are likely to experience

20% greater efficiency relative to the existing route via SH2 and SH1 because of the reduced journey time. For north of Tawa, Option D is significantly more efficient than Option C, because it is flatter and therefore represents a significantly more efficient route for freight than Option C.

7.4. SH58 as an Alternative

7.4.1. Upgrading SH58 is not a suitable alternative to either the P2G Link Road or to improving capacity north of Tawa. Two key objectives of the P2G Link Road are to improve journey times and improve connectivity. Four laning SH58 would not achieve these objectives because it is far too remote from the main demand flows between Johnsonville/Tawa/Porirua to Seaview/Lower Hutt (that is, through the Ngauranga Gorge on SH1 and between the Ngauranga Interchange and the Petone Overhead Bridge on SH2). The north of Tawa Options, C and D are proposed to manage the congestion on SH1 resulting from the P2G Link Road, and four laning SH58 is not an alternative to these options, because it would not be capable of mitigating congestion on SH1.

Appendix 1- Presentation to Councils February 2015

A CHANCE TO TALK ABOUT THE

OPTIONS NORTH OF TAWA

AND WHAT THEY MEAN FOR YOU.

NZ TRANSPORT AGENCY
WAKA KOTAHI

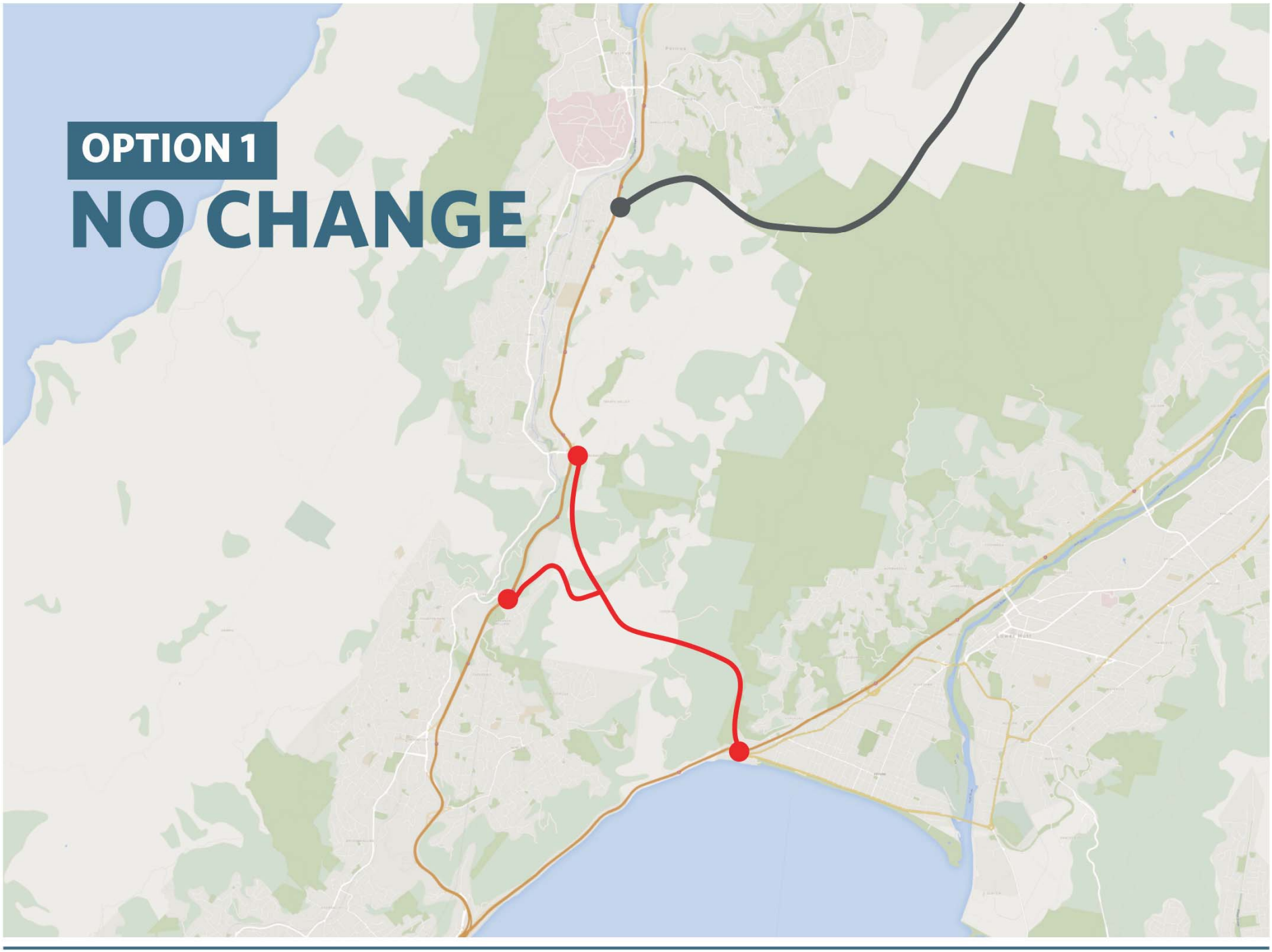
WHY WE NEED TO CONSIDER NORTH OF TAWA

3 OPTIONS

OPTION 1
NO CHANGE

OPTION 2
WIDEN SH1

OPTION 3
TAKAPU LINK


OPTION 1
NO CHANGE

OPTION 1

NO CHANGE

FREIGHT EFFICIENCY

NO EFFICIENCY GAIN

RESILIENCE

NO IMPROVEMENT

SOCIAL IMPACT

NO DIRECT IMPACT

PROPERTY IMPACT

NO IMPACT

ECOLOGY

NO DIRECT IMPACT

COST

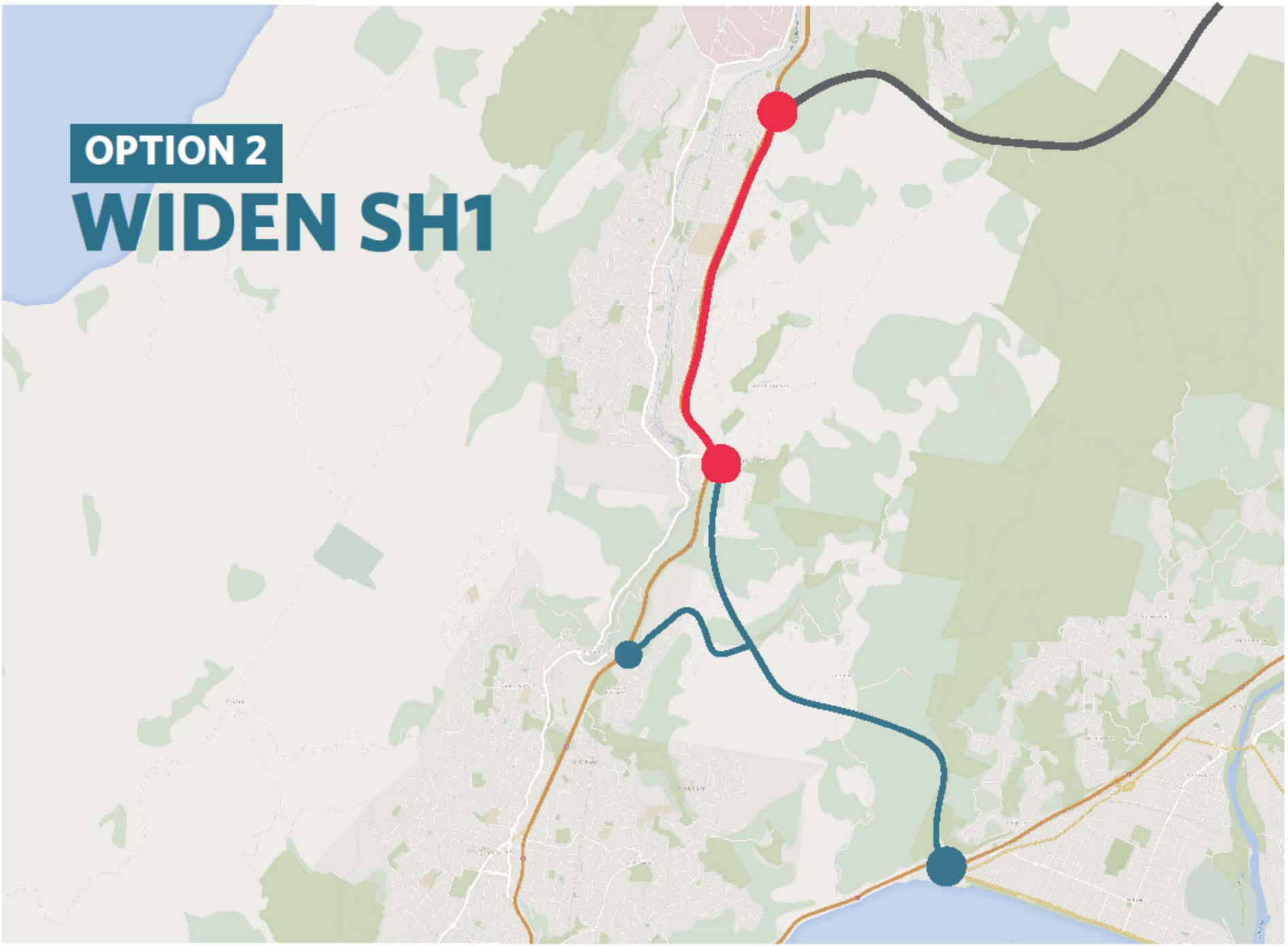
$0M

PUBLIC TRANSPORT

NO IMPACT ON PATRONAGE

NETWORK

MODEL SUGGESTS SIGNIFICANT CONGESTION BETWEEN TAWA & TRANSMISSION GULLY BY 2031


OPTION 2
WIDEN SH1

OPTION 2

WIDEN SH1

FREIGHT EFFICIENCY

NO EFFICIENCY GAIN

RESILIENCE

MINOR IMPROVEMENT DUE TO ADDITIONAL LANES ON SH1

PROPERTY IMPACT

6 HOUSES AFFECTED

30 LAND PARCELS AFFECTED

COST

$25M - $50M

SOCIAL IMPACT

CONSTRUCTION IMPACT ON PROPERTIES ALONGSIDE SH1

ECOLOGY

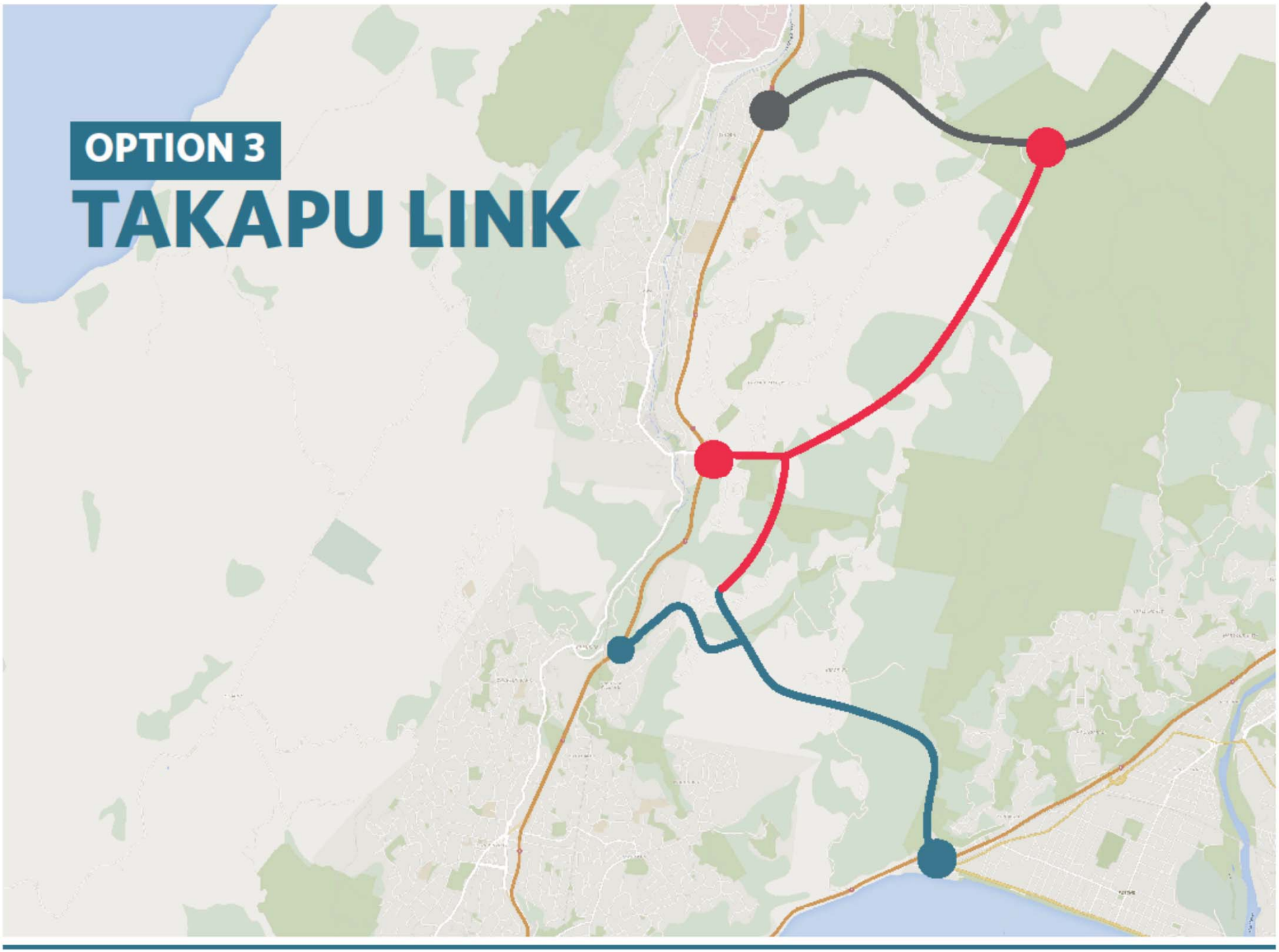
MODERATE IMPACT

NETWORK

MANAGES PREDICTED CONGESTION

PUBLIC TRANSPORT

NO IMPACT ON PATRONAGE


OPTION 3
TAKAPU LINK

OPTION 3

TAKAPU LINK

FREIGHT EFFICIENCY

20%

EFFICIENCY GAIN

RESILIENCE

SIGNIFICANT IMPROVEMENT DUE TO THE ALTERNATIVE ROUTE PROVISION

PROPERTY IMPACT

1

HOUSE AFFECTED

21

LAND PARCELS AFFECTED

COST

$30M – $60M

SOCIAL IMPACT

CONSTRUCTION IMPACT ON PROPERTIES

ECOLOGY

SIGNIFICANT IMPACT

NETWORK

MANAGES PREDICTED CONGESTION

PUBLIC TRANSPORT

NO IMPACT ON PATRONAGE

BUILD NOW, BUILD LATER OR WAIT & SEE?

LET'S DISCUSS.

BUILD NOW

PROS

COST EFFICIENCY

MANAGES PREDICTED CONGESTION

IMPROVED RESILIENCE

CERTAINTY FOR PROPERTY OWNERS

CONS

IMMEDIATE COST

AFFECTS PROPERTIES

BUILD LATER

PROS

FUTURE PROOF

COST EFFICIENCY

CERTAINTY FOR PROPERTY OWNERS

CONS

REMOBILISATION COST

FUNDING UNCERTAINTY

WAIT & SEE

PROS

NO IMPACT ON PROPERTIES

LOWER IMMEDIATE COST

EVIDENCE OF CONGESTION

CONS

FUNDING UNCERTAINTY

UNCERTAINTY FOR PROPERTY OWNERS

NEXT STEPS

- Council briefings concluded by end of February
- Regional Transport Committee meets in March and will then advise us
- We expect to announce the preferred north of Tawa option mid-late 2015

Petone to Grenada Project Process

- Seek RMA approvals 2016
- Detailed design 2017 – 2018
- Construction 2019 – 2023 (subject to funding)

IN SUMMARY

- Three options to consider for north of Tawa
  - No change (Option 1)
  - Widen SH1 (Option 2)
  - Takapu Link (Option 3)
- Build now, build later, or wait and see?
- Today is a great opportunity to give us and your CE feedback
- Your feedback will help your CE report back to the Regional Transport Committee in March