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**NZ Transport Agency**

SH1 Taupō - Waiouru  
Programme Business Case

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# Executive Summary

## Introduction

The purpose of this programme business case is to identify an optimal mix of alternatives and options for investing in the State Highway 1 (SH1) transport corridor between Taupō and Waiouru over the next 30 years.

This programme business case has been developed concurrently with the State Highway 1 Piarere - Taupō programme business case, recognising that end-to-end journeys between Wellington and the upper North Island (see Figure 1) travel along both parts of this route and that issues and opportunities facing one part can have impacts on the other.



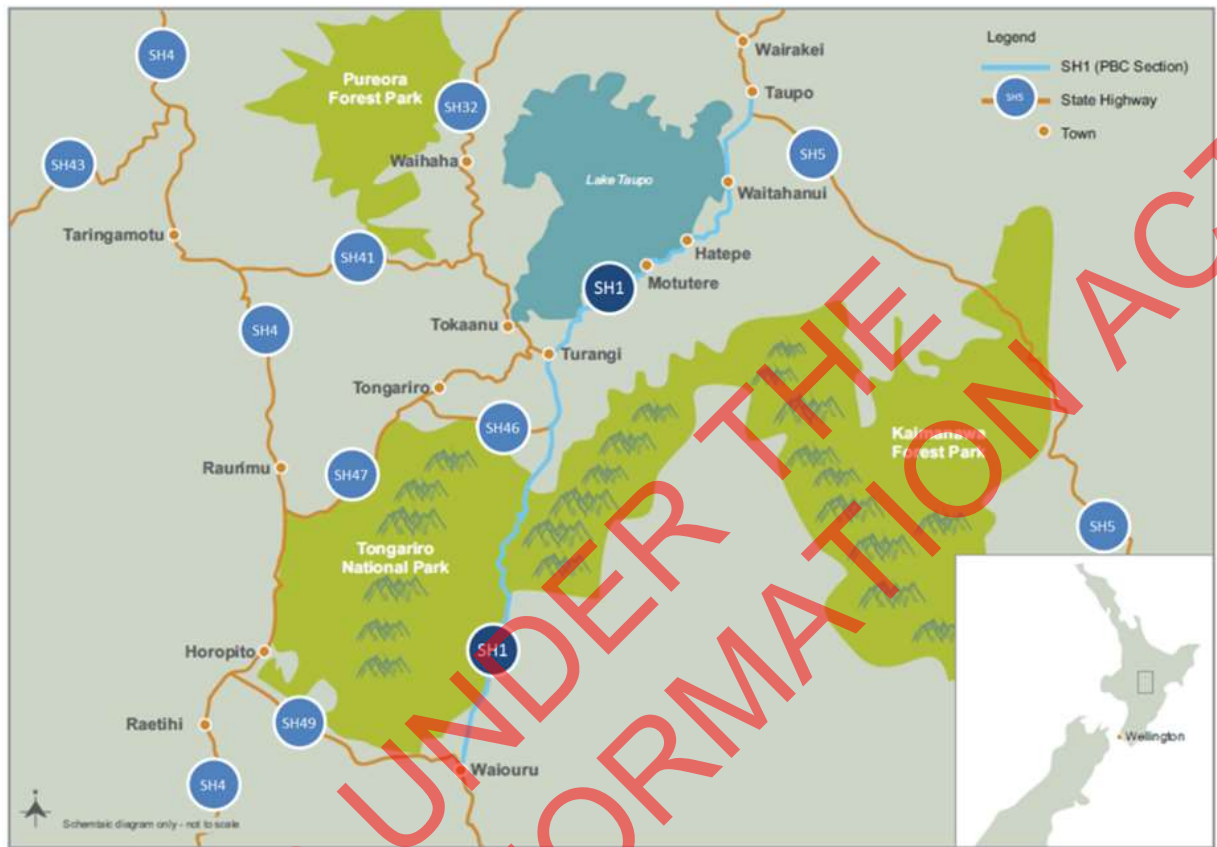
**Figure 1: National and local context**

## Context

The programme business case focusses on a transport corridor defined as being between Taupō and Waiouru. The programme business case also considers parallel transport routes (i.e. SH32 and 41) and modes such as rail. The section of SH1 for this corridor is a 107 km stretch of highway commencing at Taupō at the intersection of SH1 and SH5 (Napier-Taupō Road) and traversing along the south eastern shoreline of Lake Taupō, through Turangi before reaching the boundary of the Tongariro National Park (also the boundary between Waikato and Manawatu-Wanganui district councils). From this point, SH1 traverses through Tongariro National Park.

Despite the volumes of traffic being significantly less than further north, SH1 from Taupō to Waiouru, is classified as a national route. Its current form is generally undivided two lanes with some passing opportunities, bendy and windy where it runs alongside Lake Taupō foreshore but then straightens out through the Rangipo Desert. The highway between Rangipo and the Desert Road summit alongside Tongariro National Park is very windy through the Three Sisters and then has a large number of

curved and undulating sections in what is known as the Desert Road curves. It passes through a number of small settlements alongside the lake including a campground that straddles SH1. The town of Turangi is located just south of the Lake where the SH1 runs through the eastern side of the town. Further south, SH1 rises gradually to become the highest state highway in New Zealand at around 1000 metres above sea level.



**Figure 2: Local context**

### **Current situation**

This section of SH1 has been underinvested in over a number of decades for upgrades and improvement and as a result is limited in its form and its ability to perform its function as well as being one of the most expensive sections of the highway network to operate and maintain. These additional costs, in some areas five times greater per kilometre than the average highway maintenance costs, relate to the poor condition of the underlying asset as well as difficulty to maintain some remote and constrained sections such as the Desert Road Curves and the Three Sisters.

The main issues (described in the Problem Statements below) for this section of SH1 are road user safety, consistent travel time speeds (particularly for freight), travel time reliability and network resilience. A more specific issue for this section of SH1 is that there are conflicts at various points along SH1 between the corridors role as the main north-south transport link in the North Island, local network users and the interaction with high levels of tourism and recreation activity. These conflicts occur primarily along Lake Taupō, through the towns and at various points on the route where people slow or stop at recreational areas (i.e. Bulli Point) or areas of interest (viewing and photo taking opportunities) such as along the Desert Road.

This section of highway carries between 3,000 and 5,700 vehicles per day, of which 15-25% are heavy vehicles. There has been a recent increase in traffic volumes the last two years, which may reflect increasing economic activity and tourism in the region. These growth patterns will need to be monitored as they will influence the potential investment timeframes and triggers.

Vehicles have a higher number of occupants per vehicle than average, reflected in the crash statistics. The route has extremes in its alignment from 100kph straights on the Desert Road to 25kph curves on the Lake Taupō foreshore. Narrow road width due to geological features results in variable journey speeds with freight averaging just 62kph between Rangipo and the Desert Road summit.

## Problem statements and key considerations

Four problem statements were developed and agreed with stakeholders that reflect the key areas to address through future investment. These problem statements are:

**Problem 1:** The unforgiving nature of the corridor contributes to a high number of crashes including deaths and serious injuries

**Problem 2:** There are specific sections (Three Sisters and along Lake Taupō) of the existing SH1 alignment that are environmentally / physically constrained resulting in unreliable and inefficient movement of goods and people

**Problem 3:** Weather, other natural events and crashes result in closures and delays

**Problem 4:** The route traverses a major tourism area and areas of significant recreational activity, coupled with competing functions (national, inter-regional and local) of the road corridor creating risk to different road users and impacting the amenity of the region

The following were key areas of consideration in the development of the programme options:

- SH1 is the key north-south spine for moving people and goods the length of the North Island and connecting to the South Island. It is the primary road-based transport route in the North Island and is a national route in the One Network Road Classification
- The route is susceptible to closures due to extreme weather, volcanic event risks from Mount Ruapehu and the geology of the route, particularly around Lake Taupō foreshore and near the Desert Road summit
- There are areas of cultural (iwi), tourist and recreational significance along the route including Lake Taupō and Tongariro National Park with traffic for these destinations and through traffic conflicting. Part of the route passes through a World Heritage Area
- The corridor is a primary tourist route linking attractions such as Mount Ruapehu, Lake Taupō and the Tongariro National Park
- The corridor is home to a local population, in townships such as Taupō, Waitahanui, Hatepe, Motutere, Tauranga Taupō, and Turangi
- Conflict between the transport role of the corridor and adjacent land uses and industries including tourism, agriculture, forestry and fishing, retail and construction is widely acknowledged
- Risks along the corridor are increasing with continual wear and tear in a harsh environment

## Programme option assessment

The programme options (ten) were developed and assessed with stakeholders. The programme options included a range of infrastructure and non-infrastructure alternatives. Programmes with short, medium and long-term delivery timeframes were considered. The alternatives considered major new infrastructure to provide route realignments, minor safety improvements, alternative procurement of resilience vehicles (snow related), improved coverage of radio and cell coverage, travel behaviour change, walking improvements, cycling improvements, education, enforcement and freight management.

The programmes were assessed against the following the Investment Objectives for the SH1 transport corridor between Taupō and Waiouru:

- Reduction in deaths and serious injuries
- Increased KiwiRap (safety) rating
- Improved average travel speeds for freight and all vehicles
- Improved travel times and travel time reliability
- Increased resilience by reducing the number and time (total and average hours) of closures
- Reducing conflicts between transport and other functions and uses along the corridor such as recreation and tourism

Other assessment criteria included risk levels, achievability, economic (benefit-cost ratio), social impacts and technical feasibility.

### **Recommended programme**

A mix of non-infrastructure and infrastructure activities were selected as the recommended programme including:

- Short term safety improvements
- Short to medium term resilience and reliability improvements
- Longer term improvements including a new realignment of SH1 between Hatepe Hill and Motuoapa, at the Three Sisters and on the Desert Road Curves
- Improved maintenance regimes
- Improved traveller information
- Improved emergency response and incident management

The recommended programme not only performs well against the investment objectives but also provides the opportunity for this national state highway to be performing well against the One Network Rooding Classification Customer Levels of Service.

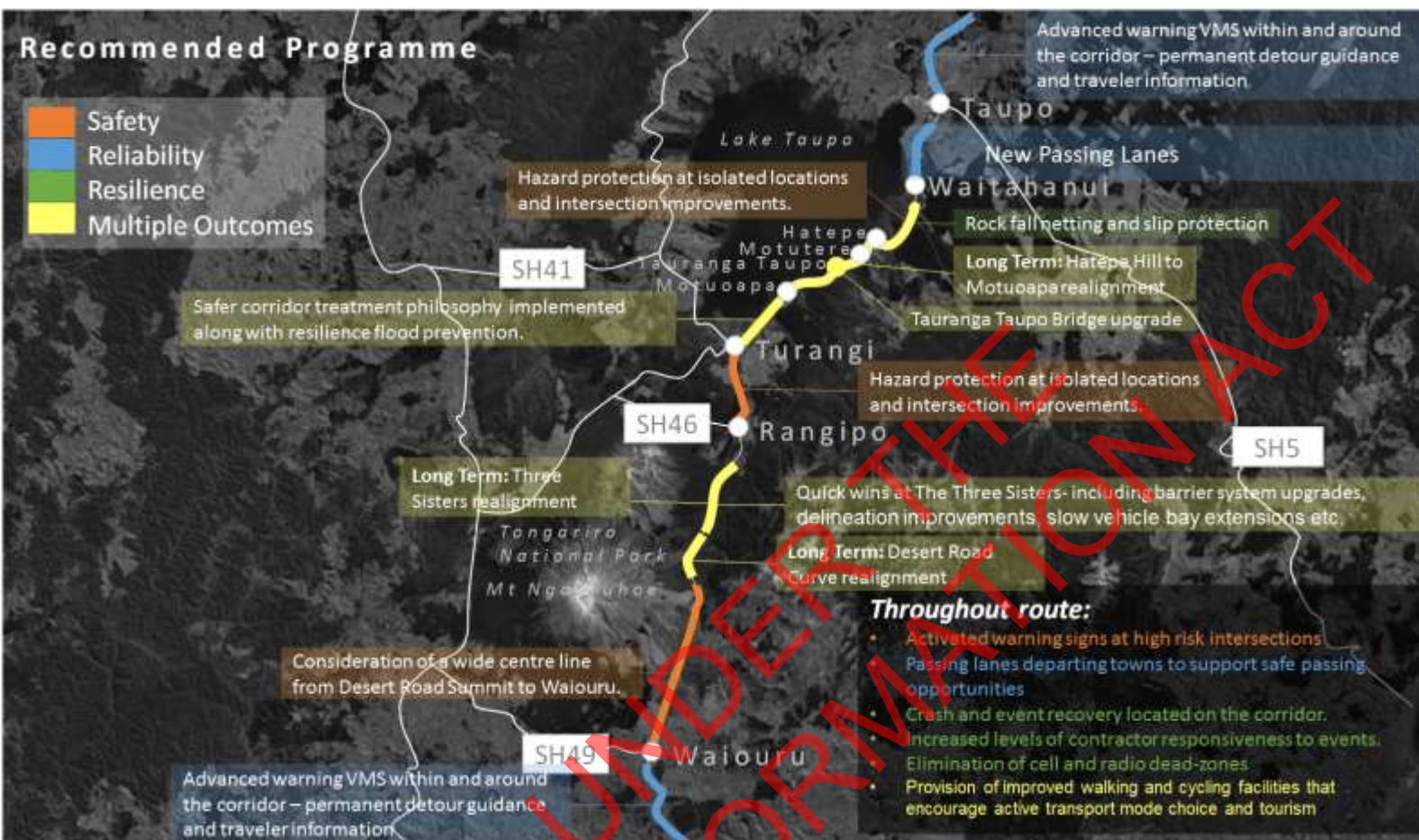
The recommended programme is estimated to cost \$750-950M and will provide a median divided, high 3/4 Star KiwiRap highway, possibly offline along sections of the corridor, with improved journey facilities, improved maintenance and operations regimes. Delivery is proposed in a staged manner over 30 years as funding permits. On this section of SH1 there are no triggers related to traffic growth that indicate timing of intervention but upon completion, the investment will:

- Reduce deaths and serious injuries by 35-45% (10-15 DSIs saved) over 5 year periods
- Improve the KiwiRap Star Rating to 92% above 3 star and 40-50% at 4 star
- Achieve more consistent travel speeds along Lake Taupō Foreshore and Desert Road/Three Sisters with average speeds increased from current 72kph to 86kph
- Reduce the impact of closures on customers with 16 less road closures and 158 less hours of road closure over a 5 year period

An additional and secondary benefit is a shorter journey time (14 minutes saving for freight in 2046 when compared with do nothing scenario).

The programme that delivers these outcomes consists of online safety and resilience investment plus a new alignment between Hatepe Hill to Motuoapa (or similar) and, realignments and/or viaduct(s) between Rangipo and Desert Road. The recommended programme incorporates a mix of both infrastructure and non-infrastructure improvements and is outlined below in Figure 3. Components of the programme will be bundled into a single project where they are geographically located or where it would result in greater efficiency in programme delivery.

The investment in the programme is required immediately to address the problem statements with the early years developing the detail of the new alignment and realignment components which will transform the route and provide consistency with the One Network Road Classification (ONRC).



**Figure 3: Recommended Programme**

#### *Online safety improvements*

**Year 1:** speed limit assessments, isolated hazard protection, and improved delineation at high risk locations

**Year 2:** Barrier system upgrades, carriageway camber improvements and surfacing enhancements, consideration of median treatments between Desert Road summit and Waiouru, shoulder widening, and minor intersection improvements

**Year 5:** consideration of median treatments between Turangi and Rangipo

#### *Online – multi-faceted (safety, resilience and reliability) improvements*

Replacement of the Tauranga Taupō Bridge on the existing location or on a new alignment with investigation, design and construction being completed between year 1 and year 4.

Resilience and reliability interventions may include:

**Year 1:** Activated warning signs, detour route signage upgrade, rock-fall netting and slip protection

**Year 2:** Resilience flood prevention between Motuoapa and Turangi including safer corridor treatments, extensions of existing passing lanes and slow vehicle bays, Advanced warning Variable Messaging Signs (VMS) within and around the corridor, permanent detour guidance and traveller information systems

**Year 3:** Passing lanes departing townships, to support safe passing opportunities, and corridor safety improvements between Turangi and Rangipo, Elimination of cell and radio dead-zones, Rapid response emergency landing sites and the provision of improved walking and cycling facilities that encourage active transport mode choice and tourism

Other investments that could occur in the short term include maintenance and operations activities

- Crash and event recovery equipment located on the corridor (e.g. snow clearing equipment)
- Increased levels of contractor responsiveness to events (contractual changes)

#### ***Major realignment improvements***

Major realignment improvements focus on the realignment and improvement of two sections of the SH1 corridor. These realignments would be approximately located between Hatepe Hill and south of Motuoapa, and a section of the highway known as the Three Sisters and the Desert Road summit.

Further feasibility work to deliver these realignments including consultation with iwi, Department of Conservation and landholder engagement is required. Following this there would be geotechnical and geometric work undertaken to assess the impacts of potential re-alignments, with these being undertaken as part of the detailed business case.

#### **Assessment profile**

The project has been assessed as high strategic fit, high effectiveness and low benefit cost appraisal (HHL).

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## Indicative programme cost and cash flow

The total indicative programme cost is assessed at the programme business case stage to be \$794M and is outlined in Table 1.

**Table 1: Indicative programme cost and cash flow (unescalated)**

Year Number	Years 1-3	Years 4-7	Years 8-10	Years 11-30	Total
Activities	Hatepe Hill to Motuoapa IBC & DBC Rangipo to Desert Road Summit IBC & DBC. Tauranga Taupō Bridge replacement. Online safety reliability and resilience activities	Hatepe Hill to Motuoapa Pre-Implementation and construction start. Rangipo to Desert Road Summit pre-implementation and Construction. Tauranga Taupō Bridge construction. Online safety (Turangi to Rangipo), and resilience activities	Hatepe Hill to Motuoapa pre-implementation and construction.	Operations and maintenance	
Capex	\$42M	\$442M	\$310M	\$-	\$794M
Operations and maintenance	\$50,000 p/a additional operations	\$50,000 p/a additional operations	\$50,000 p/a additional operations	\$50,000 p/a additional operations	\$1.5

The cash flow is to be confirmed by the Transport Agency during the indicative and detailed business cases.

## Benefit-cost ratio and sensitivity analysis

The preliminary benefit cost ratio is 0.59.

This is based on a NPV benefit of \$280M and a NPV cost of \$480 M.

Low levels of investment into this section of SH1 have resulted in a high cost to rectify the problems being experienced and which will continue to worsen over time. The costs associated with improving the form is increased by the remoteness of the highway, geography and geotechnical constraints. Additionally the existing highway and proposed realignments also traverse a World Heritage Area, areas of cultural significance and high value recreation and tourism.

Full or partial failure of the highway was not factored into the assessment but would be considerable and is outlined in the sensitivity testing below. Undertaking investment as soon as possible will reduce this risk and associated economic costs and if delivered earlier, in full or staged, than outlined in the recommended programme will improve the benefit-cost ratio.

Travel Time Savings and Vehicle Operating Costs (approximate and likely underestimated) from the detour Taupō to Turangi are \$318,506 per day (compared with the Manawatu Gorge closure which was reported at \$62,000 per day). These costs are less than what the complete cost to the economy would be and did not factor in a wide range of costs including repair costs for SH1 or cost of new alignment, other economic impacts, increased costs to the network from redirected traffic flows.

## **Next steps**

The following are the key areas for further investigation and activities to deliver the programme:

### ***Tauranga Taupō bridge replacement indicative business case***

This project consists of improvements on the connecting sections of SH1.

#### ***Safety only improvements:***

There would be sections that only require safety improvements and do not have resilience issues or specific needs (i.e. Desert Road – snow). This could be delivered by the Safe Roads Alliance.

#### ***Online– multi-faceted (safety, resilience and reliability) improvements:***

This is a series of improvements along the corridor that could be undertaken in the short to medium term. These could be delivered through minor improvements and / or maintenance and minor capital works.

#### ***Realignments (Northern section) from Hatepe Hill to Motuoapa indicative business case:***

This requires initial work to be undertaken specifically iwi and landholder engagement to confirm feasibility of realignments to the east of Lake Taupō and also, to assess the geotechnical and geometric impacts of potential re-alignments.

#### ***Realignments (Southern section) Three Sisters to Desert Road summit indicative business case:***

This also requires initial work including iwi and Department of Conservation engagement to confirm feasibility of realignments through the Three Sisters and to the Desert Road Summit and also to assess the geotechnical and geometric impacts of potential re-alignments. This may require viaducts or bridges due to environmental constraints (including a World Heritage Area) and animal migration that would be impacted from 'cut and fill' options. The realignment could be constructed in progressive stages to enable faster realisation of benefits.

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# SH1 TAUPO TO WAIOURU RECOMMENDED PROGRAMME



TAUPO TO WAIOURU

Taupo      Hatepe      Motuoapa      Turangi      Rangipo      Desert Road (region boundary)      Waiouru

## KEY PROBLEMS

The unforgiving nature of the corridor contributes to a high number of crashes including deaths and serious injuries  
Reduction in deaths and serious injuries

There are specific sections (Three Sisters and along Lake Taupo) of the existing SH1 alignment that are environmentally / physically constrained resulting in unreliable and inefficient movement of goods and people  
Maintained or improved efficiency

Weather, other natural events and crashes result in closures and delay  
Reduced closures in a year  
Reduced average closure time periods

The route traverses a major tourism area and areas of significant recreational activity, creating risk to different road users

Current (2015)  
Do minimum (2046)  
Recommended programme (2046)  
**PROPORTION OF LENGTH 3 STAR OR BETTER (%)**  
**COLLECTIVE RISK**

Median speed (do minimum) (2046)  
Median speed (realigned corridor) (2046)

Flooding  
Rockfall  
Strong winds  
Snow / ice  
Volcanic activity

Current (2015)  
Do minimum (2046)  
Recommended programme (2046)



## RECOMMENDED PROGRAMME

### Outcomes

- 32 DSIs saved (10 yr period)
- 90% Three Star or better
- 16 less road closures (5 yr)
- 160 less hours of road closures (5 yr)
- Average travel speed for freight will be 84 km/h (an 11 km/h improvement)
- 10mins average travel time saving in 2046

Programme investment profile  
**H/H/0.5-0.8**  
Programme cost range **\$700-\$900m**

	Taupo - Hatepe	Hatepe - Motuoapa	Motuoapa - Turangi	Turangi - Rangipo	Rangipo - Desert Road Three Sisters & Desert Road curves	Desert Road - Waiouru Desert Road straights
<b>Activity</b>	Short Term - Passing and overtaking investigation, safety management, walking and cycling improvements	Short Term - Hazard protection, intersection safety improvements, minor ice warning improvements, walking and cycling improvements Medium Term - Replacement of Tauranga-Taupo bridge Medium-Long Term - Realignment between Hatepe Hill and Motuoapa	Short Term - Safer speed consideration and flood resiliency improvements Short-Medium Term - Passing/overtaking with safer corridors improvements	Short term - Isolated hazard protection, shoulder widening, passing/overtaking improvements and safer corridors improvements	Short-Medium Term - Snow/ice activated warning signs/pavement markers, barrier system upgrades, delineation improvements, slow vehicle bay extensions, camber improvements, surfacing enhancements Medium-Long Term - Safe system transformation, realignment between Three Sisters and the Desert Road Summit	Short Term - Delineation improvements, surfacing enhancements, median and delineation improvements, snow/ice activated warning signs/pavement markers Medium Term - Passing/overtaking improvements
<b>Capital cost (\$m)</b>	11-16	450-540	4-6	4-6	225-320	6-10
<b>Operational &amp; Maintenance cost (\$m)</b>	0.25-0.35	0.5-0.7	0.4-0.6	0.15-0.25	1.7-2.3	1.2-1.6
<b>BCR</b>	1-3	<1	>5	1-3	<1	>5
<b>Corridor wide activities</b>	Short Term - Improved contractor responsiveness through NOC, new crash and event recovery equipment purchased and located along the corridor Short Term - Traveller information improvements, permanent detour guidance, variable messaging signs, telco dead-zone elimination					

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# SH1 TAUPO TO WAIOURU

State Highway 1 (SH1) is of national significance for moving people and goods critical to the country, region and local communities, is the primary north-south road-based transport route in the North Island and is a national route in the one network road classification (ONRC).

This journey connects the upper North Island, central regions, lower North Island and the South Island.

From a customer perspective the journey between Taupo and Waiouru is one of the most variable and least approachable sections of SH1. It provides an inconsistent level of service with significant out-of-context curves around Lake Taupo and in parts of Desert Road. The corridor is characterised by high value/volume freight and high occupancy vehicles due to the heavy freight and tourism function of the journey. This section of SH1 experiences substantial variation in traffic demands and peaks associated with weekends, holidays and events (eg multi sports and cyclists). The mix of traffic and recreational activity along the lake foreshore creates significant conflict between local activity and through traffic.

Travel speeds are inconsistent with tight bends, some with advisory speeds of 25km/h. Conversely low traffic volumes on parts of Desert Road are high speed environments where road users can be distracted by the scenery. Journeys are affected by closures resulting from crashes or due to adverse alpine weather conditions on Desert Road. The average duration of closure on Desert Road is 11 hours and, depending on location, alternative routes can add 40 - 120 minutes to the journey.

The geology of the area, particularly around Lake Taupo foreshore and section between the Desert Road summit and Rangipo, result in high levels of land slips and land falls closures and delays compared with national and regional levels. Consequently this part of the network is one of the most expensive sections of the highway network to operate and maintain, in some areas five times greater per kilometre than the average highway maintenance costs. Not only is this due to geology but the increasing deterioration of the underlying asset as well as difficulty to maintain some remote and constrained sections such as the Desert Road and Three Sisters.

A major concern for this section of SH1 is the possible failure of SH1 along Lake Taupo and in the Three Sisters due to a high impact low probability (HILP) event which would have a significant impact on customers.

The recommended programme aims to address road user safety, and provide a reliable and efficient corridor commensurate with the route classification and wide range of users (freight, general and high level of tourism/ recreational activity).

There is no evidence to suggest a major shift in goods transported by the Main Trunk rail line between Hamilton and Palmerston North to road, which would significantly affect the programme or its outcomes. We have, however, considered the viability of encouraging a greater uptake of freight on the alternative route (SH32) around Lake Taupo to Turangi. This option has been discounted due to the cost to upgrade the route to an appropriate level of service and the ongoing requirement to provide a strategic connection to Napier (SH5) and Taupo which remains on the existing alignment.

There are potentially significant wider national and regional economic development benefits associated with the future role and purpose of land adjacent to the existing corridor alongside Lake Taupo, were SH1 to move inland, that need to be explored further as we work with local communities and Taupo District Council through the next phase of development. The recommended programme is also inherently risky due to the world heritage status of the national park. The Lake Taupo foreshore and the Central Plateau are also significant to Iwi. We have involved the Department of Conservation and Iwi representatives in developing this programme and recognise the importance of developing strong partnerships/ collaborative approaches as we consider the options, and wider opportunities, in more detail.

## PROGRAMME MULTI-CRITERIA ASSESSMENT

The programmes are different combinations of activities. Alternative programmes were developed and assessed against the investment objectives and other criteria.

	Programme 1 Current operating LoS & levels of investment	Programme 2 Shift freight corridor to west of Lake Taupo (SH32 & SH41)	Programme 3 Low cost safety & improved driver information	Programme 4 Tourists, active modes & community connectivity	Programme 5 Corridor wide safety improvements & speed management	Programme 6 Improved Desert Road resilience & Lake Taupo foreshore reliability	Programme 7 Freight shift to rail	Programme 8 Major realignment Hatape Hill - Rangipo & realignments through Three Sisters and Desert Road (curves)	Programme 9 Major realignment Hatape Hill - Motuoapa & realignments through Three Sisters and Desert Road (curves)	Programme 10 SH1 realignments plus improved maintenance & network management	
<b>INVESTMENT OBJECTIVES</b> KPI/OUTCOMES	Reduction in deaths and serious injuries * (Proportion of reduction of DSI from current levels) * (Estimated reduction in deaths and serious injuries per 10 year period)	5% - 10% 5 - 9	1	1	-2	2	1	1	40% - 50% 36 - 55	35% - 45% 32 - 48	25% - 35% 23 - 38
	Improved road safety risk assessment rating * (KiwiRAP) (Proportion of length 3 star or better) * (KiwiRAP) (Proportion of length 4 star or better)	82% - 88% 11% - 16%	-1	1	0	1	1	1	91% - 97% 59% - 65%	90% - 96% 39% - 45%	85% - 90% 15% - 21%
	Improved travel time reliability (minutes of variance between the median and 85th percentile corridor travel times)	71 - 91	2	1	1	1	1	1	4.6 - 6.6	5.2 - 7.2	6.5 - 8.5
	Maintained or improved efficiency (median corridor travel time in minutes)	82 - 88	-2	1	-2	1	1	1	68 - 74	72 - 78	80 - 86
	Median freight travel speed between Taupo and Waiouru	73 - 77kph	0	0	-1	0	1	0	85 - 89kph	84 - 88kph	76 - 80kph
	Reduced closures in a year (number of closure events per five year period)	52 - 62	-1	0	-2	0	0	0	25 - 35	36 - 46	39 - 49
	Reduced average closure periods (duration of road closure events per five year period in hours)	410 - 510	-1	-1	-1	0	1	+1/0	150 - 250	160 - 260	250 - 350
<b>OTHER FACTORS</b>	Effectiveness	--	--	--	0	0	--	+++	+++	+	
	Risk	--	+	+	++	--	--	--	--	+	
	Public and stakeholders	--	+	+	+	--	--	--	+	+	
	Inter/ dependencies	++	++	++	++	+	--	--	--	+++	
	Feasibility	+++	+++	+++	+++	++	--	--	--	+	
	Affordability	+++	---	+++	++	++	++	--	--	+	
	Costs - including operations and maintenance	\$95 - \$115 m	\$1.4 - \$2.4 b	\$1.5 - \$1.6 b	\$160 - \$180 m	\$190 - \$220 m	\$190 - \$220 m	TBD	\$1.1 - \$1.3 b	\$700 - \$900 m	\$325 - \$425 m
Benefit cost ratio		0.2 - 0.4	1.5 - 2.5	0.4 - 0.7	1.5 - 2.5	1 - 2	0.1 - 0.2	0.3 - 0.5	0.5 - 0.8	0.8 - 1.1	

The recommended programme is Programme Option 9 - short term safety, short to medium term resilience investment (as shown in the figures below) plus new alignment Hatape Hill to Motuoapa (or similar) and, realignments and/or viaduct(s) between Rangipo and the Desert Road summit. The recommended programme incorporates a mix of both infrastructure and non-infrastructure improvements.

**Recommended programme**

## STAKEHOLDERS INVOLVED IN THE PBC



## TRIGGER POINTS, RISKS AND UNCERTAINTIES

Trigger, risk and/or uncertainty	Time	Impact level	Impact on programme	Comments
Land acquisition: Engagement will need to occur with the land holders including the Department of Conservation, Iwi and others to identify the potential land available for re-alignments of SH1	2016-2020	High	The proposed realignments of SH1 are predicated on the ability to acquire the required land to the east of Lake Taupo and between Rangipo and Desert Road summit	Engagement with land holders has commenced and will likely require a number of years continued consultation to confirm the feasibility of the land acquisitions and the various alignments (ie reconnecting to SH1 either north or south of Motuoapa)
Consenting for re-alignments: There will be a requirement for consenting for sections of the SH1 that are proposed to be realigned, in particular through the Tongariro National Park	2020-2025	High	Consenting for the programme is not expected to impact programme delivery if successful but will impact the type of engineering and environmental design and implementation	Due to the environmental importance of the region as well as areas of cultural significance it is expected that there will be a focus on minimising impacts (ie migration of animals in the Tongariro National Park as a world heritage area)
Full or partial failure of SH1: There is a considerable risk that due to deterioration or an event that SH1 along Lake Taupo may fail	Ongoing	High	This would result in full or partial closure of the highway and major impact on the local communities through severance	This is a serious and imminent risk, there have been no detailed studies to identify the probable occurrence and impacts
Revocation: If the realignments occur there will be a need to revoke the existing sections of the highway to Taupo District Council	10-15 years	Low	The impact will be timing and financial and dependent on discussions with Taupo District Council	This should not impact the programme with regards to timing but may impact the level of funding and investment prior to the revocation

## IMPLEMENTATION PARTNERS



The Transport Agency is the primary funding partner for the delivery of the programme. Taupo District Council will be a co-investor and implementation partner for some improvements along the corridor or in providing new transport infrastructure for walking and cycling and

potentially a bike trail. Local Iwi groups, land owners and the Department of Conservation are important implementation partners and will need to be critical to the successful planning and delivery of the programme, in particular the proposed realignments of the highway corridor.

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## Appendices

Appendix A – Uncertainty Log

Appendix B – Risk Assessment

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# Part A – The Strategic Case

## 1. Introduction

Part A summarises the strategic case for SH1 Taupō to Waiouru following further evidence collection and analysis that reconfirmed and refined the problems and benefits or conversely, discounted them. The problems have then been further developed and shaped into SMART investment objectives that form a line of sight between the problem statements and measureable outcomes.

The strategic case for investment in the transport corridor between Hamilton and Waiouru was developed and approved in 2014. Facilitated investment logic mapping workshops were held on 5th and 6th of December 2013 with key stakeholders to gain a better understanding of issues. At that time, stakeholders agreed upon four problems that would drive and influence future investment on State Highway 1 (SH1).

During the development of the programme business case, the strategic case has been reconfirmed to refresh stakeholder understanding, account for any changes since it was completed, confirm the geographic extents of the problems and benefits, and understand the areas of overlap with other relevant programme business cases that are being developed at the same time.

A workshop held with key stakeholders on Tuesday 23 February 2016 focused on confirming the problems and benefits and examining the evidence base that supports the problems. This workshop also examined stakeholders' desired outcomes and relevant Investment Objectives for the proposed programme. As a result of this process and further evaluation the programme development and assessment reflects the main problems which include road user safety, travel time reliability and network resilience. A more specific issue for this section of SH1 there is a major conflict between the corridors role as the main north-south transport link in the North Island, local transport movements and its role as a recreation and tourism destination in its own right. This has led to a refinement of the problem and benefits statements.

This programme business case was developed concurrently with the SH1 Piarere - Taupō programme business case, recognising that end-to-end journeys between Wellington and the upper North Island travel along both parts of this route and that issues and opportunities facing one part can have impacts on the other.

It should be noted that the programme also considers changes to technology in transportation over time including electric and autonomous vehicles and associated infrastructure. The programme options and recommendations do not have specific investments identified but will be capable of accommodating these developments either by policy through Transport Agency national initiatives or private enterprise (i.e. charging stations within service centres).

## 2. Programme Context

This programme business case focusses on a transport corridor defined as being between Taupō and Waiouru (see Figure 4). The programme business case also considers parallel transport routes (such as SH32 and SH41) and modes such as rail. The section of SH1 for this corridor is a 107km stretch of highway commencing at Taupō at the intersection of SH1 and SH5 (Napier-Taupō Road) and traversing along the south eastern shoreline of Lake Taupō, through Turangi before reaching the boundary of the Tongariro National Park (also the boundary between Waikato and Manawatu-Wanganui district councils). From this point, SH1 traverses through the Tongariro National Park.



**Figure 4: Local context**

### 2.1 Partners and key stakeholders

This programme business case has been developed as a collaborative exercise between the New Zealand Transport Agency (NZTA) and a number of stakeholders, including:

- Taupō District Council
- Waikato Regional Council
- Freight and Logistics Action Group
- Automobile Association
- Department of Conservation
- Road Transport Association New Zealand
- Horizons Regional Council
- Ruapehu District Council
- NZ Police

In the programme business case process, the investors are identified early and are involved closely and collaboratively in the development of the programme business case to ensure there is the maximum buy-in to the programme resulting from the process.

KiwiRail provided some information and data at the commencement of the process but had no further involvement as requested by them (due to lower level of relevance compared to other programme business cases).

Early engagement with Iwi has commenced and confirmed their desire to be involved early in the planning process. They understand the need to consider improvements along the route and that specific solutions will need to be worked through in the coming stages.

### **2.1.1 Customer perspective**

Whilst no specific customer research has been undertaken for this transport corridor it is used by a wide variety of customers including but not limited to the following:

- Freight (truck) drivers
- Local commuters including school buses
- Regional and international tourists
- Commercial commuters
- Emergency services

Other organisations such as Destination Great Lake Taupō provided valuable input as to the customer experience for this corridor, for example, the issues experienced with on road cyclists leading up to and during events that use SH1.

The Upper North Island Customer Insight work has been used to inform the development of the programme options. Specifically, this includes the freighting industries' need for consistent travel speeds and travel time predictability.

The road freight sector identified that with Taupō being centrally located between Auckland (3.5 hrs) and Wellington (4.5 hrs), it is the main overnight stopping location for truck drivers making the full journey. Turangi fulfils a similar role providing drivers the option of splitting their journey more equally. The freight and logistics industry have facilities and infrastructure located in Taupō. Furthermore, a number of drivers reside in Taupō and the surrounding areas.

The North Island Main Trunk also runs to the west of Lake Taupō, providing freight connectivity. Alternative freight routes include SH32 and SH41 which are used less frequently than SH1 but provide a viable alternative when SH1 is closed and sufficient advice of closure is provided.

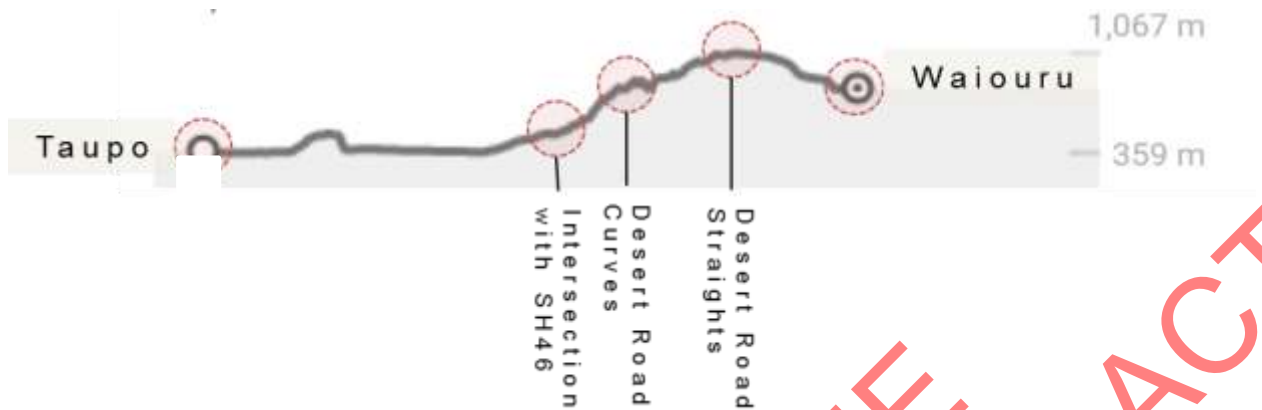
## **2.2 Geographic and environmental context**

One section of the route passes through the Tongariro National Park, acknowledged as a cultural and natural World Heritage Site. There are active volcanic mountains; Ruapehu, Ngauruhoe, and Tongariro along with a number of culturally significant Maori sites. The route also runs adjacent to Lake Taupō and a number of other recreation and tourism areas of significance.

The likely remaining lifespan of SH1 is highly variable as a result of a number of factors including erosion, geotechnical conditions, physical constraints (i.e. lakes, rivers and cliffs) and other environmental factors impacting the existing SH1 corridor. Due to these conditions there is an ongoing and real risk of failure and / or closure of the SH1 corridor which would have adverse impacts on the network, local and interregional transport movements.

The weather along this section of SH1 can be harsh and unpredictable. The route is impacted by snow and ice, resulting in closures, warnings and changing conditions, especially in winter. The alternative

routes within the region are also likely to be impacted by similar conditions. This route rises deceptively south of Taupō and reaches around 1,000m above sea level at the Desert Road summit.



**Figure 5: Route profile: Taupō to Waiouru**

The highway form is generally undivided two lanes with some passing opportunities. It winds around the geographic features where it runs alongside Lake Taupō foreshore but then straightens out through the Rangipo Desert. The highway between Rangipo and the Desert Road summit alongside Tongariro National Park is windy through the Three Sisters and then has a number of curved and undulating sections in what is known as the Desert Road curves. It passes through a number of small settlements alongside the lake including a campground which straddles SH1. The town of Turangi is located just south of the Lake with SH1 running along the eastern side of the town. Further south, SH1 rises gradually to become the highest state highway in New Zealand.

## 2.3 Social and economic context

### Population

Transport links are vital for economic activity and critical for regions which rely on primary industries, tourism, and connections with markets and ports. The Taupō and Ruapehu districts have experienced constrained economic and population growth for an extended period. Comparisons with population growth indexed to 1996 in the two districts relative to New Zealand as a whole demonstrated that the Ruapehu district has experienced a net reduction in population since 1996 whereas Taupō has experienced modest growth since 1996.

### Industries and employment

The most common employment category in the Taupō district is in the accommodation and food services industries- indicating the importance of tourism in the area. In contrast, there is a reliance on the industries of agriculture, forestry, and fishing in Ruapehu district, with 23% of employed people engaged in these industries. By comparison employment is more varied in Taupō district - while the most common employment category is accommodation and food services, the agriculture, forestry and fishing industries, retail industry, and construction industry also employ large numbers of people.

Ruapehu has a higher than average unemployment rate and lower than average per capita GDP. The Manawatū-Whanganui Growth Study (2015) identified Ruapehu as having major growth potential from increased tourism activity. There have been recent investments in the Ruapehu district in cycle trails and other tourism related infrastructure. The study stated 'if the level of international visitors was raised to that of domestic visitors, \$460m pa would be added to the regional economy, together with 520 jobs. This would boost regional employment by 0.5% and subregional employment, if concentrated in a place like Ruapehu district, by 11%.' These opportunities as well as the Tongariro

Crossing which is rated the best 1-day walk in New Zealand and in the 'Top 10' one day walks in the world by National Geographic.

## 2.4 Transport context

Traffic volume data has been obtained from the NZTA State highway traffic data booklet (2011 to 2015) and is summarised in Table 2: State highway 1 Taupō to Waiouru traffic volumes below.

**Table 2: State highway 1 Taupō to Waiouru traffic volumes**


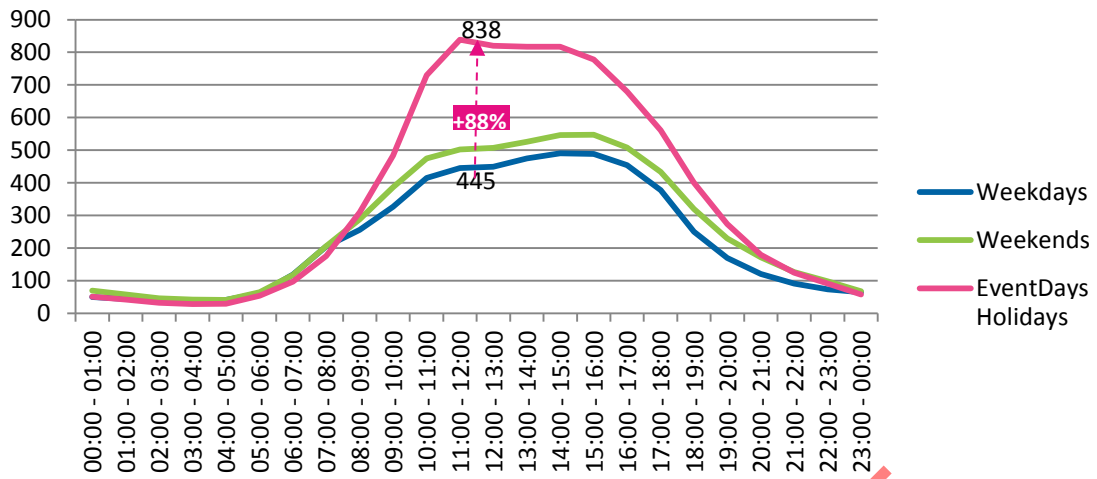
Reference station number	Average Annual Daily Traffic (AADT)					% Heavy	
	Both directions						
	2011	2012	2013	2014	2015		
	Halletts Bay	5,300	5,200	5,200	5,500	5,700	15%
	South of Turangi	3,600	3,600	3,700	3,600	3,900	23%
	Rangipo	3,300	3,300	3,100	3,200	3,600	22%
	Desert Road	3,000	3,000	3,100	3,200	3,500	25%

Table 2: State highway 1 Taupō to Waiouru traffic volumes shows that between Turangi and Waiouru traffic volumes are fairly consistent and have changed little between 2011 and 2015. There has been an increase between 2013 and 2015 which may reflect increasing in economic activity and tourism in the region. These traffic patterns should be monitored as they influence the potential investment timeframes and triggers.

There are variances in the volumes along the route due to vehicles redirecting to SH41 or SH46 as well as people who live along the route, particularly at Turangi. The percentage of heavy vehicles increases as overall vehicle numbers drop but are consistent in volumes along the route, typically between 8am – 9am.

Growth of approximately 10% in the past two years for vehicle numbers as well as declining use of the highway between 2008 and 2010 reflect the variable nature of its use and the economic activity across the country and is therefore difficult to provide an accurate long-term prediction of traffic volumes.

Whilst SH1 performs the role of the key north-south spine, its use by tourists and visitors is evidenced by the fluctuation in traffic flows at weekends and holiday periods. Figure 6 shows that there is a difference in the number of vehicles during holiday periods. At 11 am -12 noon during holiday periods there were 88% more vehicles counted at the Hallett Bay site than the average weekday.



Source: NZTA, Traffic Monitoring System, 2015

**Figure 6: Hourly traffic volumes at Halletts Bay traffic count site, 2015**

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### 3. Strategic assessment – Outlining the need for investment

The following section outlines the Strategic Assessment following further evidence collection and analysis which reconfirmed and refined the strategic case problems and benefits. More detail can be found in the ‘State Highway 1 Taupō – Waiouru: Confirming the Context for the Programme Report’ (Context Report).

#### 3.1 Defining the problems

The evidence provided in the Context Report and summarised below support the problem statements, as well as reflecting the discussions and communication with stakeholders. The problem statements relate to safety, reliability, resilience, and land use and transport conflict and are shown in Figure 7 below.





Themes	Problems Statements
 <p>Safety</p>	<p><b>Problem 1:</b> The unforgiving nature of the corridor contributes to a high number of crashes including deaths and serious injuries</p>
 <p>Reliability</p>	<p><b>Problem 2:</b> There are specific sections (Three Sisters and along Lake Taupo) of the existing SH1 alignment that are environmentally / physically constrained resulting in unreliable and inefficient movement of goods and people</p>
 <p>Resilience</p>	<p><b>Problem 3:</b> Weather, other natural events and crashes results in closures and delays</p>
 <p>Land Use and Transport Conflict</p>	<p><b>Problem 4:</b> The route traverses a major tourism area and areas of significant recreational activity, coupled with competing functions (national, inter-regional and local) of the road corridor creating risk to different road users and impacting the amenity of the region</p>

Figure 7: Problem statements

### 3.2 Problem one: Safety

*The unforgiving nature of the corridor contributes to a high number of crashes including deaths and serious injuries*

#### 3.2.1 The evidence (NZ Transport Agency's Crash Analysis System)

There were 345 reported crashes on SH1 between Taupō and Waiouru (107 km) from 2010 to 2014 within the NZ Transport Agency's Crash Analysis System, which resulted in 14 deaths and 39 serious injuries. In 2015, there were 59 reported crashes and 12 deaths and serious injuries.

Over the entire route, there are approximately 0.07 fatal and serious injury crashes per kilometre, and 4.7 fatal and serious injury crashes per 100 million vehicle kilometres travelled. According to the High Risk Rural Road Guide methodology, this route has a medium-high collective risk, and a low-medium personal risk.

Table 3 below outlines the route's personal and collective risk ratings identified through applying KiwiRap. KiwiRAP is the New Zealand Road Assessment Programme. It provides a process to systematically assess risk and identify safety shortcomings that can be addressed with practical road improvement measures.

**Table 3: Route personal and collective risk (2010-2014)**

Location	F+S/km/year	Collective risk	F+S/100Mvkt	Personal risk	Treatment Philosophy
SH1 Taupō to Waiouru	0.07	Medium-high	4.7	Low-medium	Safety Management
Wairahanui to Halletts Bay	0.08	Medium-high	3.9	Low-medium	Safety Management
Motuoapa to Turangi	0.09	Medium-high	4.4	Medium	Safer Corridors
Turangi (80km/h zone)	0.08	Medium	4.0	Medium	Safety Maintenance
Three Sisters	0.14	High	12.1	High	Safe System Transformation
Desert Road Curves	0.16	High	13.2	High	Safe System Transformation

The major findings for crash types and safety issues on the route were:

- There are significantly more run-off-road crashes on this route
- Death and serious injury predominantly comes from head-on crashes. Head-on crashes typically have higher impact speed and involve multiple vehicles and are more likely to result in multiple deaths and serious injuries
- Bend lost control / head on crashes occurred in a greater proportion on this route compared with the Taupō District and all State Highways, conversely crossing / turning crashes occurred in a smaller proportion
- There has been no pedestrian or miscellaneous injury crashes on this route between 2011 and 2015

Some stakeholders were of the opinion that fatigue is likely to be an under-reported crash factor in the official data. Fatigue is difficult to accurately account for after a crash as drivers can be hyper-alert (due to adrenaline) or unresponsive after an accident. Some of the reasons why fatigue was considered to be a factor by these stakeholders related to:

- The distance of this stretch of SH1 being within the 3-5 hour mark of major origins such as Auckland and Wellington, which is when fatigue begins to be a major factor,
- Many people come to the area for a weekend of physical activity (hiking, skiing etc.) and are tired when they start the ride home.

Further there are other inherent safety concerns for this section of SH1 specifically related to the increased promotion and use of the lakeside at key locations including Bulli Point (renowned swimming hole). Access to Bulli Point is limited and often cars are parked on the carriageway and blind corners. These safety issues are also experienced at each of the settlements along the highway including Motutere Bay Holiday Park which straddles SH1.

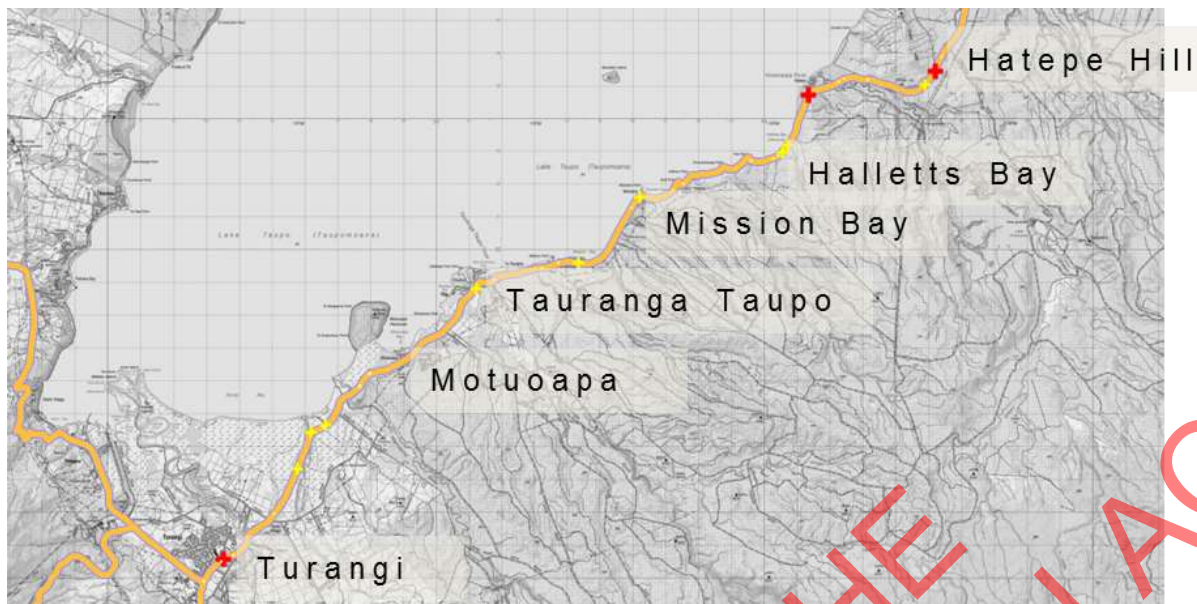
### 3.2.2 Detailed crash analysis – Four geographic areas of concern

In addition to the personal and collective risk it was identified that there were some outcomes and trends that were of concern to stakeholders including a high rate of deaths and serious injuries per crash and multiple fatalities per crash. A review of average travel speed allowed identification of stretches of the highway where drivers speed up after having travelled at slower speeds through windy sections.

The figures below (Figure 8 and Figure 9) show the deaths (red markers) and serious injuries (yellow markers) within four key geographic areas. These are discussed below in more detail with specific accident information in the Confirming the Context report.



**Figure 8: Fatal and serious injury crashes on Desert Road 2010-2014**



**Figure 9: Fatal and serious injury crash locations on Taupō lakefront 2010-2014**

Over 90% of this section of SH1 is 3 star rated KiwiRap and 10% is 4 star rated KiwiRap. For a national route, the KiwiRap rating should be a high 3 star but it should be noted that the star ratings are linked to traffic volumes so these percentages will decrease with any traffic volume increases. In addition, KiwiRap does not take into account vehicle composition, therefore the larger proportion of heavy vehicles on this route presents an additional safety risk and increased likelihood of deaths and serious injuries if there is a crash.

#### **SH1 Three Sisters and Desert Road Curves**

The Three Sisters is a section of SH1 with many bends and tight curves. It has constrained road widths and roadsides and a history of crashes at some of the tighter corners. The Desert Road curves are the section of SH1 directly to the north of the summit and are a stretch of road that has narrow bridges, out of context curves, corners with limited sight lines and is undulating. The injury crash numbers, distribution of deaths and serious injuries and crash factors for this route from 2010 to 2014 show a number of run-off-road crashes and head-on crashes. The head on crashes on this route typically occur where a road user is cutting the corner, or loses control and hits another vehicle rather than a roadside object. Most of these crashes are attributed to slippery surface conditions that can be addressed through driving to conditions, reduced speed limits or infrastructure responses.

#### **SH1 Desert Road Straights**

Along this section there have been a high number of deaths and serious injuries, which have resulted from head-on crashes which may be because of the higher impact speeds involved. Crash factors identify overtaking, incorrect lane/position, fatigue, and truck involvement higher than average for Taupō compared with all State highways.

#### **SH1 Hatepe Hill - Toki Point**

While run-off-road crashes are the most prevalent, deaths and serious injuries are distributed across head-on, intersection, and run-off-road. The intersection crash, which resulted in two serious injuries, occurred when a car suddenly stopped where there is a narrow sealed shoulder and two motorcyclists travelling behind were unable to avoid collision. There were a number of crashes during wet and icy conditions. Drivers travelling too fast or who had poor handling of their vehicle were identified higher than normal in the crash data.

This section of highway has a better alignment than the area to the south, but wet and icy conditions coupled with higher speeds result in more and higher impact crashes.

## SH1 Motuoapa - Turangi

On this section, injury crash numbers are mostly run-off-road, the head-on crash recorded resulted in two serious injuries. Wet and icy conditions were present in most of the injury crashes. This section of highway has a higher speed environment than the surrounding parts of the route. Two of the serious injury crashes occurred over the 500 m length between Frethey Road and Waiotaka Flood Stream No.2, directly to the south of Motuoapa.

### 3.2.3 Implications of the evidence (treatment options)

Table 3: Route personal and collective risk (2010-2014) identifies the recommend treatment philosophy. The Context Report also provides additional and specific interventions for these sections of SH1. The recommended programme will identify targeted and specific interventions as well as a more consistent road environment for the whole corridor to reduce crashes that result from out of context curves or variances in the road environment.

There is a high rate of crashes and very high proportion of deaths and serious injuries per crash along this section of SH1. The roading environment changes along this sections of highway, has sections that are very unforgiving and when added to the weather conditions and associated impacts such as ice result in harm for road users.

## 3.3 Problem two: Travel time reliability and efficiency

*There are specific sections (Three Sisters and along Lake Taupō) of the existing SH1 alignment that are environmentally / physically constrained resulting in unreliable and inefficient movement of goods and people*

### 3.3.1 The Evidence

The problem being experienced on this section of SH1 is both an unreliable and inefficient movement of all vehicles due to the physical and geometric characteristics of the highway for particular sections. Travel speeds are not consistent, decreasing significantly at specific locations (Lake Taupō foreshore and at the Three Sisters) due to bends and also through towns/settlements. Braking and accelerating is an operational issue for trucks resulting in higher costs. The average speed for the journey is approximately 72kph (and less for trucks) which is slow given less than 10km of the 107kms is at posted speed less than 100kph. There are specific sections which perform poorly such as between Rangipo and the Desert Road summit where the average speed for trucks is currently 62kph.

Figure 10 highlights the variance in travel speeds for the average vehicle travelling on SH1 between Taupō and Waiouru. The speed differential between the faster (85% of traffic) and the average is a bigger gap than the average and the slower (15% of traffic). This is not the norm for state highways and is due to the constrained nature of the highway, limited overtaking opportunities, a high proportion of trucks and tourist vehicles such as campers, towing boats etc. As traffic volumes increase, particularly trucks, the journey time will increase as will travel time variability. At holiday and during major events traffic volumes on the highway increase that results in larger travel time variances and unreliable journey times as highlighted previously in Figure 6.



**Figure 10: Travel speed variances (15<sup>th</sup>, 50<sup>th</sup> and 85<sup>th</sup> percentile travel speeds)**

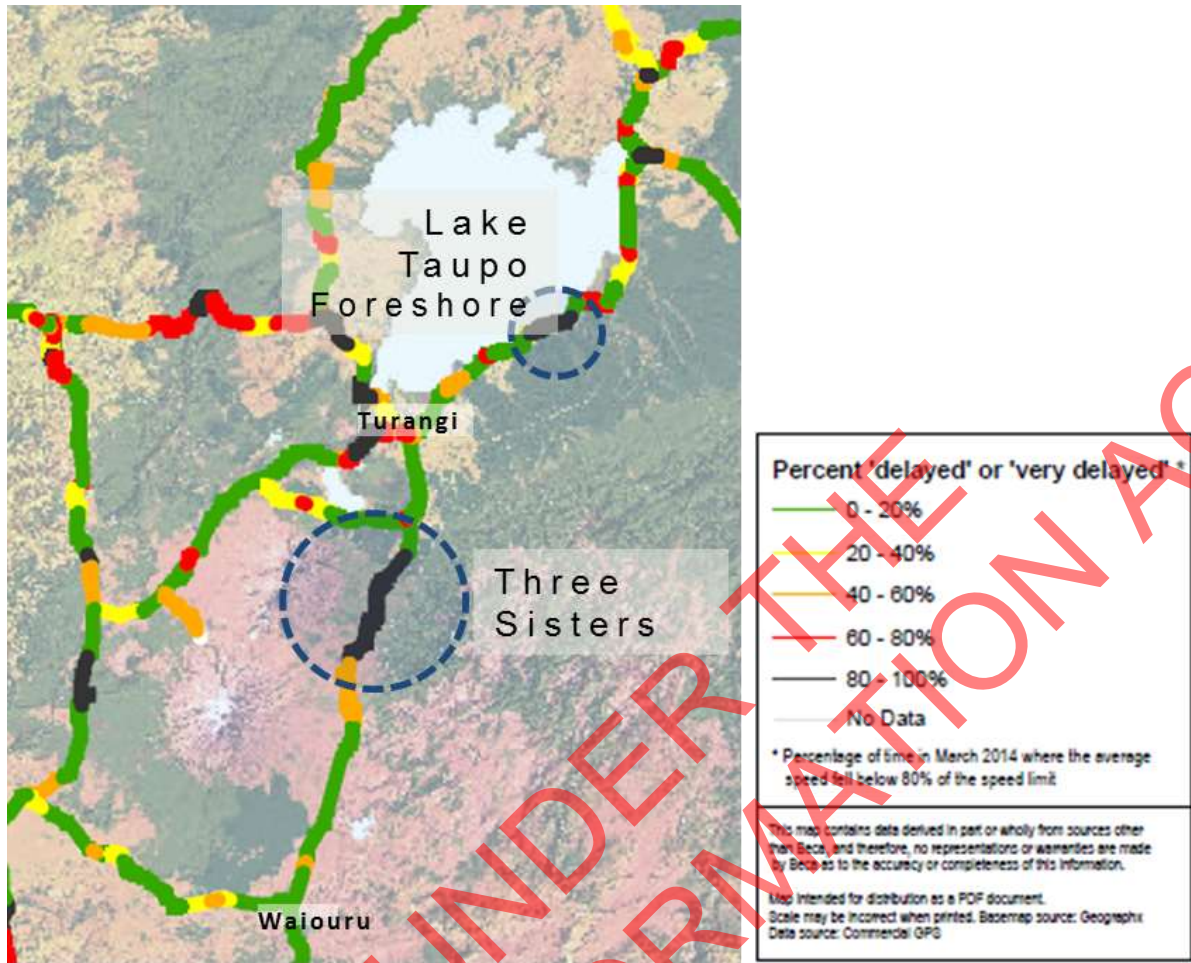
### 3.3.2 Freight vehicles are delayed, which impacts other vehicles also

Travel speeds vary along the route significantly because of the geometry of the road, environmental factors and townships (where there are lower speed limits). The improvement in the reliability of journey times are the areas outside townships is an issue where there are significant differences in travel speeds between some vehicle classes. Specifically, HPMV vehicles needing to reduce speeds because of the condition of the road (gradients or corners), which then impacts all vehicles due to limited safe overtaking opportunities.

Travel speeds between Taupō and Waiouru indicate that the corridor does not have consistent speeds along its length. There are considerable variances at some points along the route between the slower (15th percentile) and higher average (85th percentile), which indicates travel speed variances for trucks and larger vehicles or travel speeds during higher volume periods such as long weekends and holidays.

A 2014 study undertaken by the Ministry of Transport<sup>1</sup> indicated two areas of significance where freight vehicles are delayed – at Lake Taupō shore and Three Sisters as shown below in Figure 11.

<sup>1</sup> Freight, delayed or very delayed trips, 2014, Ministry of Transport



Source: MOT, Freight Congestion Study, 2014

**Figure 11: Freight, delayed or very delayed trips, 2014<sup>2</sup>**

There is an increased demand for freight to deliver 'just in time' deliveries, with an increase in fresh produce being moved by freight hubs to their customers. Currently the bulk of the freight task is carried out by road (not rail). Unreliable journey outcomes can also be attributed to network resilience issues.

### 3.3.3 Implications of the evidence

Inefficient journeys result on SH1 between Taupō and Waiouru primarily due to physical constraints (topography and road geometry) affecting freight and other mainly tourist vehicles which has a flow on effect to following vehicles. Delays and occasional crashes occur due to HCVs crossing the centre line to navigate tight corners.

Growth in traffic volumes will continue to deteriorate the efficiency and reliability for all journeys and particularly freight efficiency, if the current alignment is retained and the form of the road is not improved. It is anticipated that in 30 years the volume of traffic on an average day will be greater than an event day currently experienced. These outcomes will be inadequate for SH1 as the primary north south route for the country.

<sup>2</sup> MOT, Freight Congestion Study, 2014

### 3.4 Problem Three: Resilience

#### *Weather, other natural events and crashes result in closures and delay*

Network resilience relates to the ability for the road to withstand events and the duration of time it takes for the network to become operational after an event has occurred. The resilience of this part of SH1 is compromised by:

- Weather events (i.e. wind, snow and ice)
- Geology (events such as land slip, rock falls and drop-outs)
- Crashes (where there is no alternate route to detour traffic locally or major delays or closures occur due to remoteness and need to clear the highway)

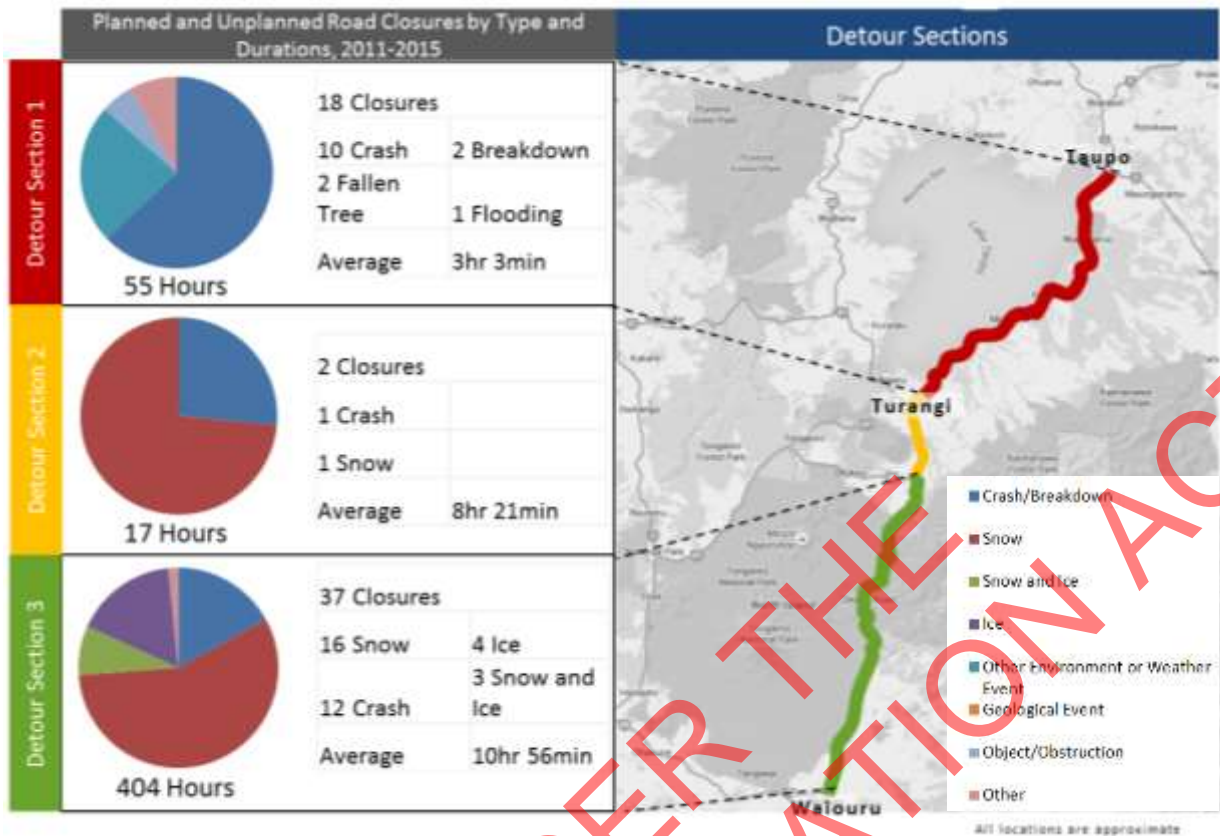
Crashes are recognised in this problem statement in regard to where a crash occurs and there is no other viable alternative. Crashes are also recorded in the safety problem statement as well as in the impact they have on travel time reliability. Crashes often occur on this section of SH1 and result in closures for several hours due to the need for incident response including removal of vehicles and investigations as a result of deaths.

#### **3.4.1 The evidence**

The main causes of delays, detours, and warnings differ along the route. For this analysis the route has been divided into the northern section, middle section and southern section (shown in Figure 12 in red, yellow and green). Events on each of these parts of road differ in nature, with the following trends identified:

- Most closures occur on the southern section, south of Rangipo and are mainly as a result of snow and ice, followed by the northern section, Lake Taupo foreshore
- The main cause of events on the northern section is crashes
- Most geological events (slips) occur in the northern section of the corridor, along the lake
- Environmental (i.e. flooding) and weather events are most prominent in southern section of the corridor
- SH1 is closed on average for 3 hours along the Lake but the closure duration increases significantly further south with it being nearly 11 hours on the Desert Road (compared to a regional average of 3 hours). Seventeen of these closures are due to snow with an average closure time of 14 hrs. Snow and ice has closed the highway three times (average of 10.8 hours) and ice four times (average of 16.7 hrs) in the past five years





**Figure 12: Planned and unplanned closures by type 2011-2015**

Due to the remoteness of this section of SH1 there are further consequences to those involved in crashes as it takes longer to be reached by emergency response teams and transferring to hospital if necessary. Limited availability of equipment and proximity to crews results in lengthier timeframes to clear crashes than is typical for state highways.

### 3.4.2 Parts of the route are susceptible to extreme weather

Ensuring SH1 from Taupō to Waiouru is operational under severe weather conditions through winter requires enactment of the Central Waikato Winter Maintenance Operations Strategy. This operation is a 24/7 undertaking, where decisions on the operational planning of the network are based on weather data received from the National Weather Services Contract (operated through NZ Transport Agency). This source includes Ice Prediction Services and Snow and Weather Forecast Services. The Desert Road corridor and wider area is also covered by strategically placed road weather information stations which have road sensors placed in the pavement. These weather stations provide real-time data at specific locations (including factors such as road surface temperature, wind speed, ice on road and many others).

Notwithstanding this operational strategy, weather events still occur through most of the corridor but are particularly prevalent in the vicinity of the 'Three Sisters' on the Desert Road (in Reference Station #777), where ice and snow are problematic. Due to environmental factors and the geometry of the road this portion of SH1 is prone to ice and suffers from significant snowfall events.

The availability of snow clearing equipment is paramount to opening the route quickly in extreme weather events. The current contract arrangements and specifically the procurement approach for this equipment are thought to contribute to some of the delays in reopening the route. Alternative procurement arrangement for this equipment will be considered as part of the programme implementation.

### **3.4.3 Geological events are particularly prevalent on Taupō foreshore**

Geological events are particularly experienced near the Taupō Foreshore between Hatepe and Motuoapa, where two thirds of all slips occur for this section of SH1. In the past five years these have not resulted in full closures, only as delays and cautionary messages to drivers.

There have been some events in the past decade where sections of the road were washed into the lake resulting in a partial closure of SH1 for more than three months until the road was repaired.

This section of SH1 has been underinvested in over a number of decades for upgrades and improvement and as a result is limited in its form and its ability to perform its function.

It is one of the most expensive sections of the highway network to operate and maintain. The additional costs, in some areas five times greater per kilometre than the average highway maintenance costs, relate to the poor condition of the underlying asset as well as difficulty to maintain.

The National Resilience Business Case has identified this section of SH1 as being at a high risk of impact from an earthquake or other seismic activity in the region.

### **3.4.4 Closures: the impact is significant**

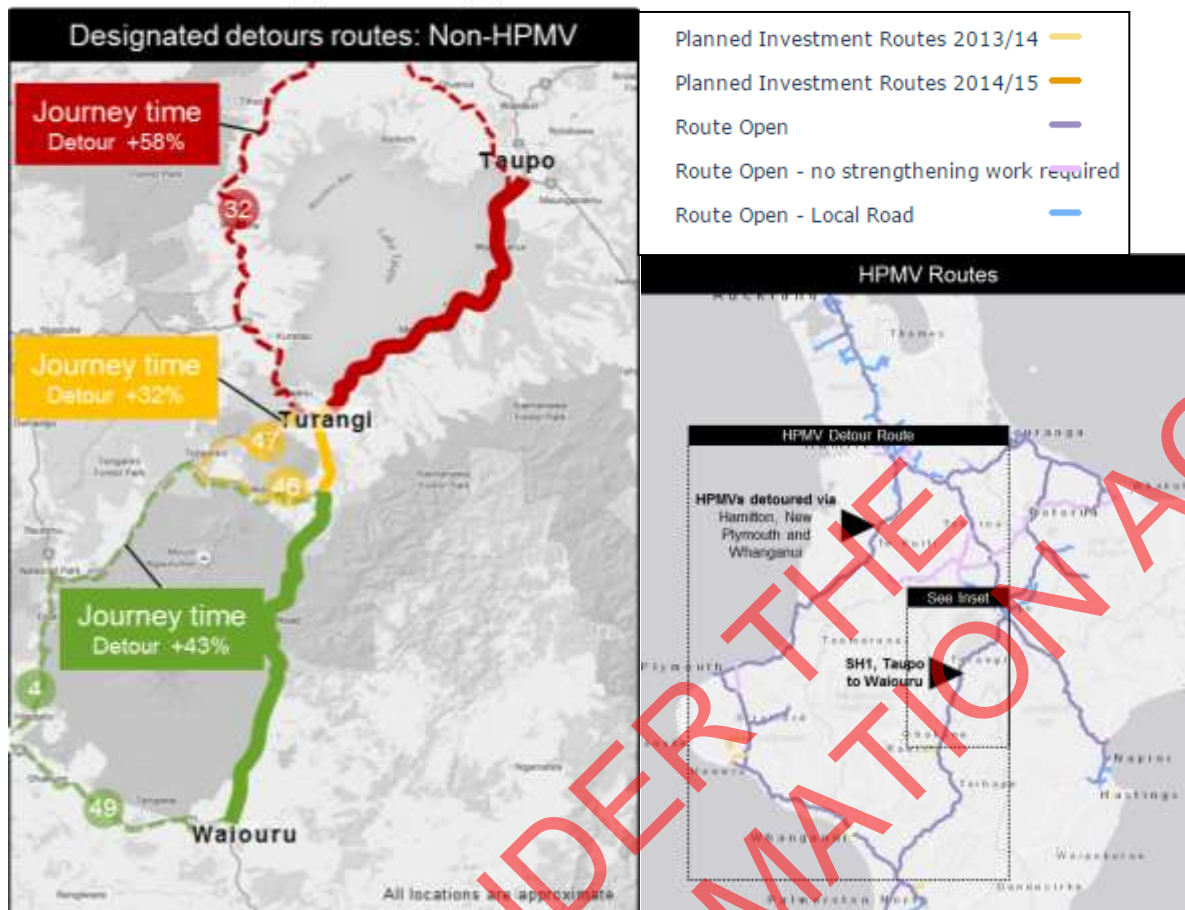
Road closures create a high level of inconvenience, with longer travel times resulting from:

- Travelers being required to detour around SH1
- Late notice as to closures resulting in additional travel time and distance for detours
- Some vehicle classes (particularly some freight vehicles) having to wait for roads to reopen due to being unable to turn in some sections of SH1

The main cause of road closure is events that are weather related. Snow events on the route result in the longest closures times.

When events occur, there are designated detour routes for non-High Productivity Motor Vehicles (HPMV) (Figure 13) and HPMVs. It is also noted, that when SH1 is closed due to weather events SH4 is often also closed as it has similar weather conditions and so the detour route in this case is much longer.

Stakeholders identified that often information was not provided to drivers in a timely way.



**Figure 13: Designated detour routes - non-HPMV (left) and HPMV (right)**

### 3.4.5 Implications of the Evidence

There is a need to improve the ability to withstand weather, geological and crash events through investment in improve infrastructure. There is also a need to provide improved operations using better maintenance or recovery equipment to enable quicker recover times, from events is necessary. This may require changes in the way the Transport Agency procures equipment and or contractors for this section of the network.

## 3.5 Problem Four: Land use and transport conflict

*The route traverses a major tourism area and areas of significant recreational activity, creating risk to different road users*

### 3.5.1 The evidence

SH1 from Taupō to Waiouru is part of the main north/south route through the North Island. It is also home to some of the North Island's most frequented tourist attractions including Tongariro National Park, Mount Ruapehu ski fields, the Desert Road itself, and Lake Taupō.

Ministry of Business, Innovation, and Employment estimate that the tourism industry is worth \$22 billion to the NZ economy. The Regional Tourism Organisations (RTO) of Lake Taupō and Ruapehu comprise around 3% of market share, generating close to \$600 million in tourism expenditure in the year ending March 2015. Discussions with Destination Great Lake Taupō suggest that the impact of tourism on the local and regional economy is greater than MBIE figures.

Figure 14 maps some of the key recreation and tourist destinations on the route.



**Figure 14: Tourist attractions on the route**

### 3.5.2 Lake Taupō tourism demand is growing creating new conflicts

Over recent years the growing popularity of Lake Taupō as a tourist destination has created increasing tension between those who want to travel through or get from A to B (such as freight traffic and local traffic) and those who see the route as a destination in itself or who want to experience the natural beauty of the surrounds.

Between 2009 and 2015 tourism expenditure in New Zealand grew by 15% and over this same period, tourism expenditure in Lake Taupō RTO grew by a modest 5% and dropped in the Ruapehu RTO by 16%. Over the last reported 4-year period, the Lake Taupō RTO has kept pace with the strong growth in New Zealand as a whole. During the period (2012-2015) tourism expenditure has grown in Lake Taupō RTO by 17%, which is roughly on par with the growth in tourism expenditure in New Zealand over the same period (18%).

The growth in tourism to Lake Taupō has been across both international and domestic tourist markets, which is consistent with New Zealand as a whole. The increasing number of international tourists particularly, results in a greater number of campervans and drivers on the route who are unfamiliar with the road conditions.

The growth in tourist numbers has resulted in anecdotal evidence becoming known through conversations with stakeholders and review of news articles. This qualitative evidence identifies the

tensions between the dual role of the route as a destination and a transport route. Specific issues identified and to be addressed are as follows:

- Conflicts and increased risk of incidents around Bulli Point, where swimmers in Lake Taupō park their cars adjacent to SH1 (and sometime partially on SH1) and have caused problems for trucks and other roads users having to navigate these obstacles
- Number of major sporting events including cycling and triathlons that use sections of this SH1 route and have people using the highway for weeks in advance for training which affect safety and travel time reliability for other road users. Taupō has become a hub for multi-sports
- Domestic tourism comprises the largest share' of tourism expenditure in New Zealand. international visitor expenditure is projected to increase 48.5 per cent to from \$8 billion in 2015 to \$11 billion by 2021
- Hiking the 20 km Tongariro Alpine Crossing (which is not reflected specifically in the Ministry of Business Innovation and Employment figures quoted in this sub-chapter), has been growing in popularity with approximately 6,000 people a day walking the hiking the trail over the summer 2015/16 period

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## 4. Investment Objectives

The investment objectives for this project relate specifically to the four problems and benefit areas identified developed with stakeholders and key relevant NZ Transport Agency staff.

Key performance indicators (KPIs) have been developed for each of these Investment objectives. The KPIs are used to set targets (in this case a base and stretch target) for what the Programme options should achieve. Baseline data analysis from which to measure the base and stretch targets has also been developed. These are set out in the following sub-chapters.

### 4.1.1 Investment objective 1: Improve safety outcomes

Baseline	48 deaths and serious injuries for the five years 2011 to 2015 (annual average DSI of 9.6)
KPI 1.1	Reduction in deaths and serious injuries
Baseline	85% of SH1 between Taupō and Waiouru has a Star Rating of 3 or higher 14% of SH1 between Taupō and Waiouru has a Star Rating of 4 or higher
KPI 1.2	Improved road safety risk assessment rating (KiwiRAP)

### 4.1.2 Investment objective #2: Improved reliability outcomes

Baseline	6.8 minutes of variance between the median and 85 <sup>th</sup> percentile corridor travel times
KPI 2.1	Improved travel time reliability
Baseline	1 hour 24 minute median travel time between Taupō and Waiouru in both directions
KPI 2.2	Maintain or decrease median travel time for all vehicles
Baseline	76 km/h median freight travel speed Taupō and Waiouru in both directions.
KPI 2.3	Improve median freight travel speed

### 4.1.3 Investment objective #3: Ability of the corridor to withstand and recover as quickly as practical from events

Baseline	57 Events resulting in closure of the road in 2011-2015
KPI 3.1	Reduced closures in a year
Baseline	456 hrs of road closure in 2011-2015 (resulting in an average duration of closure of 8hrs per event)
KPI 3.2	Reduced average closure time period

### 4.1.4 Investment objective #4: Safe and appropriate access to amenities

Investment Objective 4 is to provide safe and appropriate access to amenities to support tourism and recreational activities as well as locations and services along the corridor. This investment objective

does not have KPIs and measures at this point in time, but has been included to allow for potential funding partners to agree to investment objectives that allow the development of safe and appropriate access to amenities.

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# Part B – Developing the Programme

## 5. Alternatives and Options

The project team prepared the following alternatives with specific options identified, developed and assessed alongside, stakeholders and using previous studies. Key to developing the programmes was undertaking a review of previous Regional Land Transport submissions, studies for the corridor and testing these with the stakeholders. This approach identified more than 200 possible options within the alternative areas outlined below. These were then assessed for their effectiveness in addressing the problems for the corridor.

### *Existing SH1 road corridor improvements*

Improvements to the existing SH1 road corridor for specific areas along the corridor would achieve moderate to small benefits overall. Improvement works are an important element in maintaining the safe and efficient operation of the existing transport corridor. These improvement options are unlikely to provide significant contributions to the investment objectives of safety, reliability, and resilience.

### *SH1 new road corridor (major and minor realignments)*

Construction of new road corridor sections along the route would generally achieve moderate to medium benefits or positive impacts for each specific realignment option. Other benefits likely to be achieved are improved access and safety for local road users, visitors and the community. The existing sections of SH1 would be revoked to local road status (following discussion regarding the level of pre-revocation investment and ongoing maintenance requirements) and operated and maintained by local authorities.

Construction of new road corridors from Taupō to Turangi and Rangipo to the Desert Road are likely to deliver major benefits or positive impacts. The new alignments would provide improved safety outcomes along the transport corridor, improves reliability and freight efficiency, and resilience. These options present high risk however around attainability (affordability) and their likely environmental impact and Iwi significance and land ownership considerations.

### *Rail improvements*

Major rail infrastructure improvements such as new rail lines or improvements to rail operations, including rail line duplication would largely achieve minor to moderate benefits which should be noted when developing programme options. The exception is a new rail corridor along the SH1 route, which provides an alternative north-south route and contributes to the resilience investment objective. This option presents high risk and high investment for minimal return due to existing capacity within the rail network. There are also likely to be major constraints regarding environmental impacts and Iwi (cultural) considerations. There are also higher needs in the rail network at the northern and southern sections.

### *Public transport (road)*

On-road public transport in the corridor can provide benefits when used for specific outcomes, i.e. better location of school bus stops and use of tourist shuttles to remove excess vehicle trips. Such ideas have particular merit when considering management of peaks and journey time reliability on event days.



### ***Freight management***

Implementation of measures to manage freight movements, such as incentives or disincentives for use of SH1 would likely realise minor to moderate benefits overall. There are a number of risks, dependencies, and interdependencies which, need to be considered for freight management, in particular for Intelligent Transport Systems (ITS), enforcement and rail improvement options.

### ***Intelligent transport systems (ITS)***

Two broad types of ITS have been proposed, those that give general messages about conditions on the corridor, such as Variable Messaging Signs (VMS) and those that are location specific, such as at high risk sites and triggered when certain conditions are met. It is considered ITS can provide some minor benefits for the Taupō to Waiouru transport corridor, particularly for weather events, crashes and at high risk locations. This investment also supports travel time reliability allowing the customer to make an informed choice early on in their journey if there is an incident or event.

### ***Education***

Education is a crucial element to support many of the other alternatives in the corridor. Relative to other built infrastructure options it can have value for money outcomes with targeted campaigns such as driver behaviour and can achieve major safety and reliability gains as people are able to make more informed choices about their journeys, especially when used with ITS. Better information and education can help all drivers chose alternative routes if practicable and the drivers of heavy vehicles cope better with driving on the specific weather and tight road conditions on the route.

### ***Enforcement***

Enforcement is crucial element of the safe and efficient operation of any transport corridor. Enforcement is best used within a coordinated approach to safer road use which, is currently occurring across the region and specifically for this corridor. Development of new technologies will enable better enforcement and compliance with speeds including point to point speed cameras.

### ***Policy, Land use planning and travel demand management***

Policy options put forward were wide-ranging – speed management policy, safety funding and road pricing. Overall, their impact was mainly on safety and had no impact on the other investment areas of resilience and reliability.

This included a land use option regarding relocating campsites to safe locations and an option recommending cross-organisation collaboration.

A further option on road pricing was not considered to have any impact on investment objectives and so was not considered further.

### ***Travel planning and behaviour change***

Travel planning and behaviour change programmes are significantly related to a range of interventions. They are also relatively low-cost to implement and have the ability to improve safety and reliability of the corridor. Being better informed about current and potential closures and delays) before making journeys such as where to stop can make a big difference to the customer experience, as such better journey planning tools are to be included in the programme.

### ***Operations and maintenance***

There are a range of minor and moderate benefits which can be realised through improvements to the operations of the corridor. Particular impacts are around the benefits regarding safety with the addition of new technologies to respond to safety problems, but largely around 'more' of the measures which are already implemented along the route to a degree. Improved and incentivised incident management

and responses such as better located depot will improve resilience of the corridor. Improvements in pavement other road and roadside assets should improve resilience and safety outcomes.

Operational improvement options to differing degrees will be part of all programme options.

### ***Walking improvements***

Walking is a crucial element to support active travel in townships and to allow tourists travelling the corridor the ability to stop at key locations and safely access their destinations. Walking improvements are best used within a coordinated approach including cycling improvements and behaviour change alternatives. Walking improvements will be part of all programme options. In the short-term there will need to be minor improvements such as additional opportunities for crossing SH1 in urban areas and additional opportunities for off-road walking through paths and clip-on structures where necessary.

### ***Cycling improvements***

Cycling is a crucial element to supporting active travel for both local residents and ensuring the tourism role of the corridor is supported both for the existing market and growing the cycle-tourism market. Cycling improvements are best used within a coordinated approach including walking improvements and behaviour change alternatives. It should be noted that there is a current investigation into an off road cycle trail in the Lake Taupō area and adjacent to SH1. All cycling improvements should be considered in the context of how to connect to the national cycle network including National Cycle Trail and Great Rides as well as regional and local cycle networks.

### ***Non-transport***

There are a range of non-transport options which sit under alternative areas. This separate alternative area is for those non-transport options (coordination, technology, and policy/by-laws) which do not correspond with other alternative areas. As such, it is difficult to provide a summary of their assessment other than to say that they are likely to have minor benefits.

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# 6. Programme Options Development and Assessment

## 6.1 Programme options development and refinement

A set of programme options were initially developed by the project team compiling sets of alternatives in differing areas of focus. These ranged from 'Business as Usual' through to low cost safety focus, freight focus and major capital investment focus. The programme options were presented, discussed and refined during a workshop with stakeholders and investment partners.

## 6.2 Programme options assessment

Stakeholders reviewed the long list of ten programme options (option 11 was combined with option 2) and identified those that were to be short listed, together with those that they thought were pragmatic responses to the problems that could be implemented in the short to medium term. For the purposes of this assessment, the timeframes are short term (1 to 5 years), medium term (6 to 10 years) and long term 11 to 30 years.

This process resulted in the short list shown in Table 4.

**Table 4: Long-list to short-list of programme options**

No.	Description	Short Listing	Short List
1	Business as Usual (Do Minimum)	▶ Short Listed	This programme option was short-listed as the Business as Usual option is always included as a comparator
2	Shift Freight Corridor	× Not short listed	This programme option was not short-listed due to affordability and feasibility
3	Low cost safety and Improved Driver Information	× Not short listed	It was considered that this resulted in only minor improvements against KPIs
4	Tourist and activity modes	× Not short listed	It was considered that this did not address the core problems identified for the corridor and was not a balanced programme
5	Corridor wide safety plus specific interventions	▶ Short Listed	These two options were seen as short term (Programme Option 5) and medium term (Programme Option 6) pragmatic responses which could be undertaken while planning major improvements in the preferred (long-term) programme option
6	Resilience and Reliability	▶ Short Listed	
7	Freight mode shift to rail	× Not short listed	Implementation of a road pricing scheme would be integral but would be technically difficult to implement. Would require significant investment in rail infrastructure – not suitable for just in time deliveries
8	Short term safety and resilience investment including new alignments from Hatepe Hill to Rangipo and realignments/new infrastructure between Rangipo and Desert Road summit	▶ Short Listed	Considered a good 'do maximum' option and a good idea to separate 'users' as much as possible in sections with safety, reliability and resilience issues
9	Short term safety and resilience investment plus new alignment Hatepe Hill to Motuoapa (or similar) and, realignments and between Rangipo and Desert Road summit	▶ Short Listed	Short-listed as similar to programme option 8 with the key differentiator being this route diverts traffic through Turangi and so would not suffer an economic loss
10	Short term safety and resilience investment including realignments within existing corridor	▶ Short Listed	As this programme option is within the existing corridor (largely) it performs well against environmental, social and cultural (Iwi) considerations

Note: Additional detail with regard the short listing process is contained in the SH1, Taupō to Waiouru, Post- Workshop 4 pack.

### 6.3 Short list programme options summary

Programme Option 1 is included in the Short List assessments as the comparator (including baselines for KPIs). It was agreed by project team members and stakeholders that the current alignment, operation and form of SH1 between Taupō and Waiouru is unacceptable for its function as the primary road in the region and main highway within the North Island. The evidence confirms that this section of SH1 and the transport corridor needs to be safer, more reliable, efficient and resilient for the movement of people and goods.

SH1 follows the eastern side of the Lake whilst SH32 & 41, run the other side connecting Turangi to Tokoroa, and SH4 via either SH41, SH46 or SH47, a regional route runs parallel but further west connecting Hamilton to Whanganui (via SH3). Whilst the west side of the Lake seems on plan to be a good routing option, SH1 via Taupō provides connections to Hawkes Bay via SH5 and northwards to Rotorua and the Port of Tauranga. The freight and logistics industry also have facilities and infrastructure located in Taupō as well as a number of their drivers who live in Taupō and surrounding areas. There is significantly less farming or agricultural land use and associated accesses along SH1 than on the SH32 and SH41 corridor which would result in safety and reliability issues should freight be transferred to the western side of the lake.

It should be noted that all programme options include non-infrastructure activities such as ITS, road safety education. The difference in the programme options is the level of investment. This is also the case for walking and cycling infrastructure which were greatest in the short listed options.





Programme options 5 and 6 were considered to be pragmatic programmes which address problems in the short -term but would not be 'stand-alone' solutions to address the corridor problems. The improvements in programme options 5 and 6 are considered to be lead programmes, for programme options 8, 9 and 10, as they do not provide enduring long term benefits for the corridor. It should be noted that some resilience and reliability investments such as ITS will be undertaken in the short term when practical and in conjunction with safety improvements.

The short listed programme options are summarised in Table 5 and Table 6.

**Table 5: Short list of programme options (short term)**

Short List		Alignment Scheme
<b>5</b>	<p><b>Corridor wide safety plus specific interventions</b></p> <p><i>This programme looks at improvements to the existing corridor to enhance safety and manage speed.</i></p> <p><i>There are no major alignment changes* but rather improvements focusing on making the safest corridor where it currently is.</i></p> <p><i>*minor alignment changes such as those to accommodate corner bash, Tauranga Taupō Bridge upgrade, and slight widening to accommodate safety improvements such as wider centerlines and median treatments</i></p>	<p>These two options were seen as being preferable to undertake in the short term and included pragmatic responses that could be undertaken while awaiting the ultimate (long-term) programme option.</p> <p>They have been used as stepping stones in the assessment of Programme Options 8, 9 and 10. As they do not involve significant alignment changes they have not been mapped in this table.</p>
<b>6</b>	<p><b>Resilience and Reliability</b></p> <p><i>This programme looks at reliability improvements between Taupō and Turangi, and resilience improvements from Turangi to Waiouru.</i></p> <p><i>There are no major alignment changes* but rather improvements focusing on making the most reliable and resilient corridor where it currently is.</i></p> <p><i>*minor alignment changes such as those to accommodate passing lanes and centre line treatment</i></p>	

**Table 6: Short-List of Programme Options (Longer Term)**

Short List	Alignment Scheme	Alignment Scheme
<p><b>1</b></p> <p><b>Business as Usual (Do Minimum)- The Comparator</b></p> <p><i>Note: The business as usual programme option is always carried forward as a 'comparator' for the assessment.</i></p>		
<p><b>8</b></p> <p><b>Short term safety and resilience investment plus new alignment from Hatepe Hill to Rangipo (with connection to Turangi) and, realignments between Rangipo and Desert Road</b></p> <p><i>Short Term: Undertaking programme option 5 and programme option 6.</i>  <i>New (mainly 4-star) primary corridor with an improved alignment between Hatepe Hill and Rangipo with a connection to Turangi (Form to be confirmed).</i>  <i>Rangipo to Waiouru to remain on existing alignment with some isolated realignments along sections.</i>  <i>The current SH1 route north of Rangipo would be retained for local connections and alternative modes or tourists, with a destination on the corridor.</i></p>		
<p><b>9</b></p> <p><b>Short term safety and resilience investment plus new alignment Hatepe Hill to Motuoapa (or similar) and, realignments between Rangipo and Desert Road</b></p> <p><i>Short Term: Undertaking programme option 5 and programme option 6.</i>  <i>In the northern section of the corridor realignment from Hatepe Hill to either Mission Bay or just south of Motuoapa – (feasibility and preferred alignment to be determined from consultation with Iwi and geotechnical assessments). In the southern section from Rangipo to Waiouru would be on existing alignment with isolated realignments (form to be determined).</i></p>		
<p><b>10</b></p> <p><b>Short term safety and resilience investment plus improvements within existing alignment</b></p> <p><i>Short Term: Undertaking programme option 5 and programme option 6.</i>  <i>Any other improvements possible within the corridor (online improvements) acknowledging constraints, i.e. Bulli Point and 3 sisters – minimal improvements to these specific sections)<sup>3</sup>(form of infrastructure improvements to be determined)</i></p>		

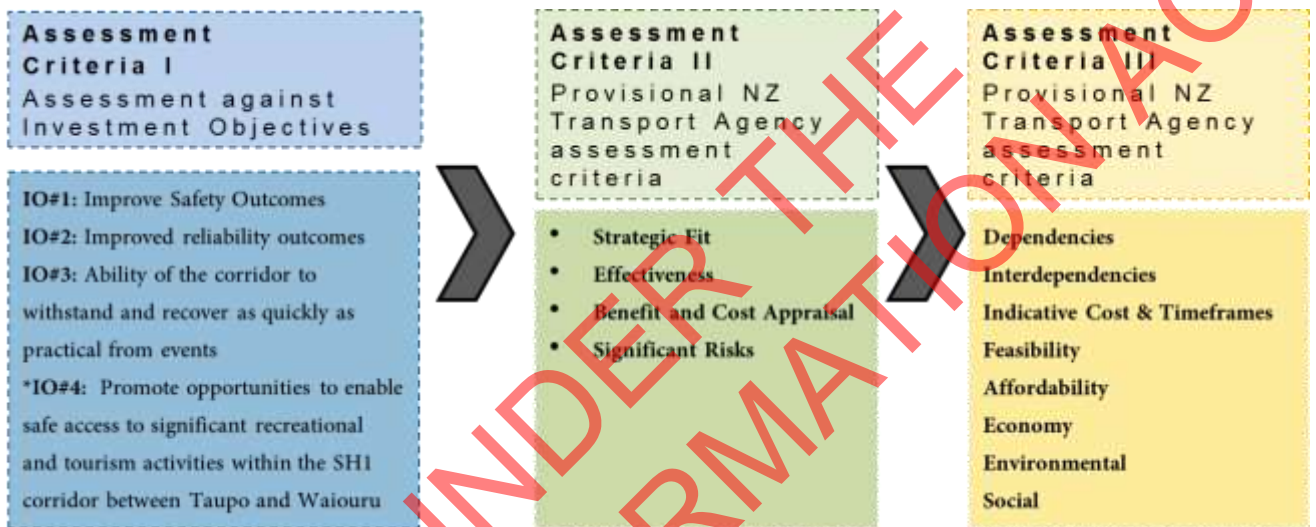
<sup>3</sup> Major cut and fill at 3 Sisters is unlikely due to environmental impacts and cultural significance. 'Curve easing' at Bulli Point is unlikely due to cultural importance of the area.

## 6.4 Short list programme options assessment

This section outlines the process utilised to assess programme short list and provides an assessment against of how each of the long list and then more detailed assessments of short listed programme options performs against the following criteria:

- **Assessment criteria 1:** Assessment against project investment objectives
- **Assessment criteria 2:** Assessment against strategic fit, effectiveness, benefit and cost appraisal, Significant risks
- **Assessment criteria 3:** Assessment against dependencies, interdependencies, indicative cost, indicative timeframes, feasibility, affordability, economy, environmental, social

The tiered nature of these assessment criteria are shown in Figure 15 below.



**Figure 15: Assessment criteria, tiers**

**\*Note: Investment Objective #4** is a consideration however does not have KPIs and measures by which different programme options are assessed.

Detailed assessments of the Long List and Short List programme options are contained the Programme Option Assessment Report.

### *Short-list assessment findings*

**The short list assessment is shown in**

Table 7 below and highlights the need for an improvement on the current situation and approach for this section of SH1. In addition to the assessments against the criteria outlined above it is important to note the following:

- There are inherent risks with Programme Option 1 and 10 which retain the current alignment and the risks associated with failure of the road at various points and in particular along Lake Taupō
- A bypass further away from Turangi than currently exists was not supported by the majority of the stakeholders and would likely require the retention by the Transport Agency of the current SH1 alignment due to the connections with the other state highways in and around Turangi

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**Table 7: Short list programme options assessment summary**

Programme Option		Investment Criteria 1							Investment Criteria 2				Investment Criteria 3				Summary		
		IO#1: Improve Safety Outcomes		IO#2 Improved reliability outcomes			IO#3 Ability of the corridor to withstand and recover as quickly as practical from events												
		Reduction in deaths and serious injuries	Improved road safety risk assessment rating (KiwiRAP)	Improved travel time reliability	Maintained or improved efficiency	Median Freight Travel Speed between Taupo and Waikare	Reduced closures in a year	Reduced average closure periods	Strategic Fit	Effectiveness	Risk	BCA	Inter/dependencies	Indicative cost and timeframe	Feasibility	Affordability			
		KPI 1.1	KPI 1.2	KPI 2.1	KPI 2.2	KPI 2.3	KPI 3.1	KPI 3.2											
Programme Option 1		Score	-2	-1	-2	-2	-2	-2	-2	-2	High	Low	Low	Low	High	Medium / High	High	Medium / High	The current condition of SH1 though this corridor is not reflective of the national significance and required function. The costs of maintenance is high with a poor Level of Service due to the nature of the road and associated constraints. There are significant problems on the corridor with major safety, resilience and reliability impacts.
	Measure	5 -10% reduction (5-9 DSI saved)	82 -88% <3star 11 -16% 4star KiwiRap rating	Indicative 7.1-9.1 minute difference	Predicted median travel time of 82 - 88 minutes	73 - 77 kph	Predicted 52 - 62 events per five year period	Predicted 410 - 510 hours closed per five year period	Does not address the problems	(High risk programme)			(Few if any interdependencies and/or dependencies)	(Medium cost)	(Technically feasible)	(Medium / High affordability)			
Programme Option 8		Score	3	3	2	3	2	3	3	High	Medium	Low	Low	Low	Low	Low	Low	Achieves the highest score against all investment objectives- but does not perform well with regard to other assessment tiers in Criteria 2 and 3. Fatal Flaws – Major bypass of Turangi and associated duplication of SH network between Rangipo and Motuoapa. Major delivery risk in land access/acquisition and consentability.	
	Measure	40 -50% reduction (36-55 DSI saved)	92 -98% <3star 59 -65% 4star KiwiRap rating	Indicative 4.6 - 6.6 minute difference	68 - 74 minutes	85 - 89 kph	Predicted 32-42 events per five year period	Predicted 250 - 350 hours closed per five year period	This corridor is a High Strategic Fit as it is a national route in the ONRC classification. The journeys along this route include a high volume of freight and inter regional movements. There are also sections of the highway which have high safety issues	(impacted by affordability)	(High risk programme)		(Significant interdependencies and/or dependencies)	(High cost, appropriate delivery timeframe)	(Technically difficult – land acquisition and consenting)	(Low affordability)			
Programme Option 9		Score	3	2	1	2	2	2	2	High	Medium	Low	Low	Low	Low / Medium	Low	Low	Performs strongly (but not the strongest) against all investment objectives. It also, achieves the highest strategic fit and effectiveness score, but is also high risk due to land access/acquisition and consentability. This option has a high level of effectiveness and will address issues associated with on-line improvements along Lake Taupo and adjacent to Tongariro National Park.	
	Measure	35 -45% reduction (32-48 DSI saved)	92 -98% <3star 39 -45% 4star KiwiRap rating	Indicative 5.2 - 7.2 minute difference	72 - 78 minutes	84 - 88 kph	Predicted 36 - 46 events per five year period	Predicted 260 - 360 hours closed per five year period	(more affordable than 8 and slightly less effective)	(High risk programme)		(Significant interdependencies and/or dependencies)	(High cost, appropriate delivery timeframe)	(Technically difficult – land acquisition and consenting)	(Medium / Low affordability)				
Programme Option 10		Score	1	1	0	0	-1	1	1	High	Medium	Medium	Low	High	Medium	Medium	Medium / High	Performs the weakest against KPIs and does not sufficiently address the problems. Only medium strategic fit and medium effectiveness ranking but may be considered to perform better with regard to criteria 2 as it is low risk (a key differentiator to Programme Options 8 and 9). Achieves the best against all Criteria 3.	
	Measure	25 -35% reduction (23-38 DSI saved)	85 -90% <3star 15 -21% 4star KiwiRap rating	Indicative 6.5 - 8.5 minute difference	80 - 86 minutes	76 - 80 kph	Predicted 39-49 events per five year period	Predicted 300 - 400 hours closed per five year period	(Option does not address key problems on the corridor)	(Medium risk programme)		(Few if any interdependencies and/or dependencies)	(Medium cost, appropriate delivery timeframe)	(Some technical challenges)	(Medium / High affordability)				



# 7. Recommended Programme – Description and Assessment

## 7.1 The Recommended Programme

The Recommended Programme is Option 9 - Online safety and resilience investment plus new alignment Hatepe Hill to Motuoapa (or similar) and, realignments and/or new infrastructure between Rangipo and Desert Road summit. The recommended programme incorporates a mix of both infrastructure and non-infrastructure improvements.

These improvements are in two main phases:

1. Safety, resilience and reliability (on-line) improvements
2. Long term improvements including major realignments, bridges and/or viaducts

Rationale for timing of any improvements through the recommended programme is not based on growth in traffic. Risks along the corridor, which is a nationally significant route, are increasing with continual wear and tear in a harsh environment requiring regular maintenance.

Other investments that could occur in the short term include maintenance and operations activities.

- Crash and event recovery equipment located on the corridor (e.g. snow clearing equipment)
- Increased levels of contractor responsiveness to events (contractual changes)

### *Online safety improvements*

Safety improvements should be undertaken to the existing highway (online) as soon as possible.

**Year 1:** Speed limit assessments, isolated hazard protection, and improved delineation at high risk locations

**Year 2:** Barrier system upgrades, carriageway camber improvements and surfacing enhancements, consideration of median treatments between Desert Road summit and Waiouru, shoulder widening, and minor intersection improvements

**Year 5:** consideration of median treatments between Turangi and Rangipo





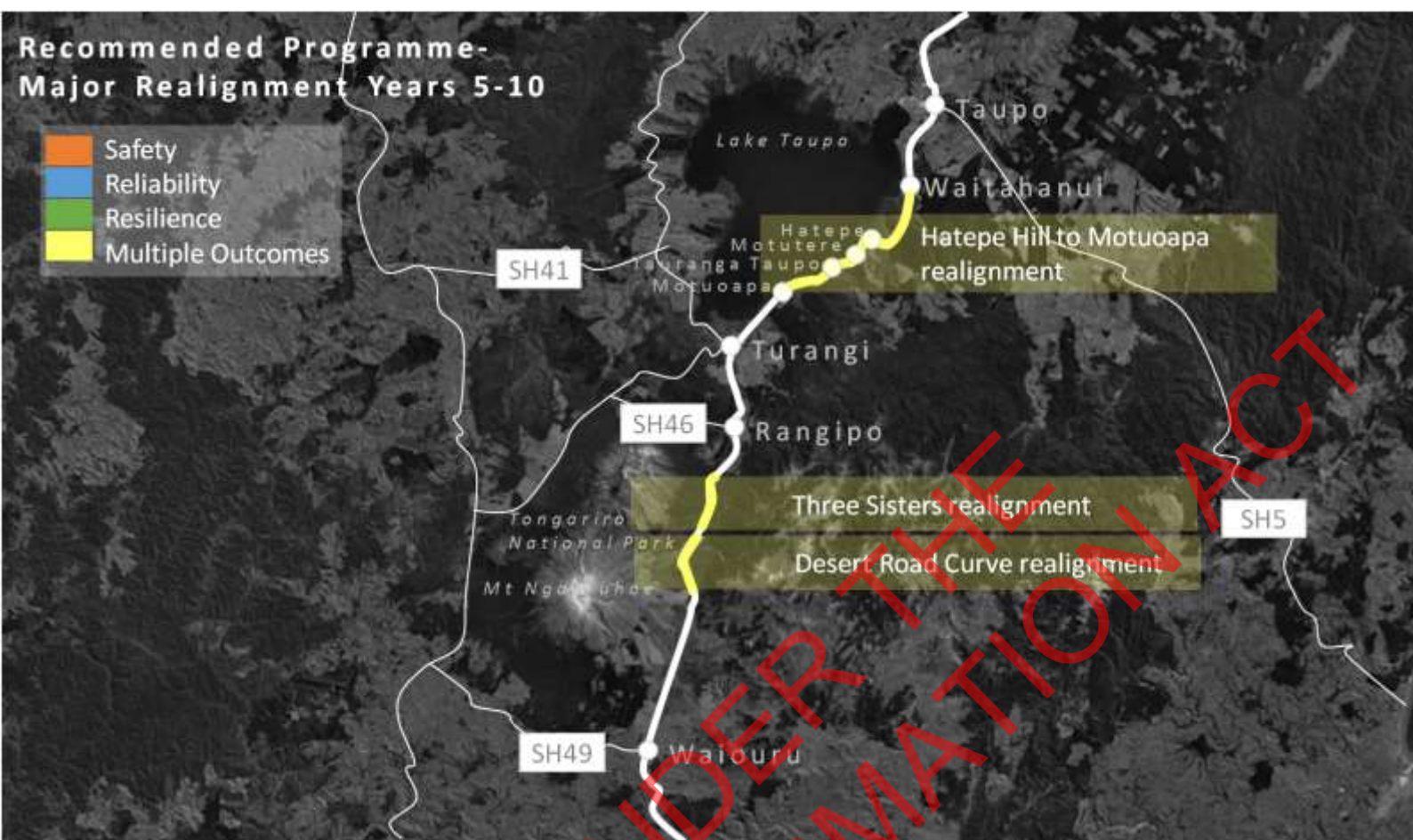
**Figure 17: Multi-Faceted Improvements**

**Major realignment improvements**

Major realignment improvements focus on the realignment and improvement of two sections of the SH1 corridor. These realignments would be approximately located between Hatape Hill and south of Motuoapa, and a section of the highway known as the Three Sisters and the Desert Road summit.

Further feasibility work to deliver these realignments including consultation with iwi, Department of Conservation and landholder engagement is required. Following this there would be geotechnical and geometric work undertaken to assess the impacts of potential re-alignments. This would be undertaken as part of the next stage of business case development.

These re-alignments as well as other improvements along the corridor will result in a high standard highway that is reflective of the One Network Road Classification (ONRC). Routes classified as National in the ONRC make the largest contribution to the social and economic wellbeing of New Zealand by connecting major population centres, major ports or international airports and have high volumes of heavy commercial vehicles or general traffic.



**Figure 18: Major Realignments**

Figure 19 below shows the indicative realignments for the sections of the Three Sisters and Desert Road curves located between Rangipo and Waiouru. These indicative alignments are based on previous studies and will need detailed planning and design to confirm the most appropriate design solution and consider the local environment as well as topography.

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**Figure 19: Sections identified for realignment - Three sisters & Desert Road**

Longer-term improvements consider a new highway alignment between Hatepe Hill and Motuoapa (white shading in Figure 20 below). This has an indicative construction commencement timeframe of eight to twelve years depending on funding availability and pre-implementation activities. The alignment, to be refined in future stages, bypasses the lakefront route for heavy traffic improving the safety and amenity of the local communities and vulnerable road users.

An alternative shorter route is represented by red shading in the Figure 20 between Hatepe Hill and south of Motutere. Options for a refined alignment route will be dependent on cultural and landowner considerations.

# Hatepe Hill – Motuoapa Realignment



**Figure 20: Sections identified for realignment – Hatepe Hill - Motuoapa**

## 7.2 Recommended programme assessment

When evaluating strategies, programmes, packages and projects, the Government Policy Statement requires both local government and the New Zealand Transport Agency to consider a number of matters, including achieving better value for money. Assessment using the Assessment Framework involves rating strategies, programmes, packages, projects and other activities across three factors, being the:

- Strategic fit of the problem, issue or opportunity that is being addressed
- Effectiveness of the proposed solution
- Economic efficiency of the proposed solution

The project was assessed using the New Zealand Transport Agency Investment Assessment Framework (IAF) resulting in an indicative assessment profile of H/H/L).

### 7.2.1 Assessment profile

In accordance with advice from the NZ Transport Agency Planning and Investment Knowledge Base, a road improvement activity must only be given a high or medium strategic fit rating if it successfully addresses a problem, issue, or opportunity. The recommended programme assessments are shown below in Table 8 and

Table 9.

**Table 8: Strategic Fit assessment against high rating requirements**

Criteria	Assessment
<p>A road improvement activity must only be given a high strategic fit rating if the problem, issue or opportunity involves Journeys for: employment access to economic opportunities, including activities identified in regional economic growth strategies and in support of special housing area orders tourism freight</p>	<p>Addressing the problems is considered to have a high strategic fit. The section of SH1 is a road of national significance. It is the main route for domestic, tourist and commercial road users between Auckland and Wellington.</p> <p>The corridor has high volumes of freight traffic and it is an important strategic haulage route. From a regional and national resilience perspective, the section through the Desert Road and Three Sisters as well as along Lake Taupō Lakeside is vulnerable to extreme weather events, slips and un-planned closures. Inconsistent travel speeds along corridor, poor travel time times and reliability on the route are a result of the constrained location of the alignment of the road (topography and road geometry) and environmental factors.</p> <p>Closures create inconvenience, with longer travel times resulting from: Travellers being required to detour around SH1; or Some vehicle classes (particularly some freight vehicles) having to wait for roads to reopen due to being unable to turn.</p> <p>The corridor provides connectivity through the Desert Road as a popular tourist route. The route is a primary tourist route in New Zealand and enables tourism movements, particularly into the Tongariro National Park.</p>
<p>There is a significant gap in the customer levels of service for: journey time reliability resilience (including lifelines) mismatched capacity and demand that results in severe congestion mismatched capacity and demand that results in capacity constraints</p>	<p>The transport corridor between Taupō and Waiouru has a constrained alignment due to topology and geometry which imposes travel time reliability and resilience limitations to road users.</p> <p>Reliability of freight movements on this corridor has knock-on effects to the economic performance of the district and surrounding regions. A 2014 study undertaken by the Ministry of Transport indicated two areas of significance where freight vehicles are delayed – at Lake Taupō Shore and Three Sisters.</p> <p>Weather and geometry constraints impose frequent 'low impact' events resulting in the closure of the corridor for significantly longer periods per kilometre than most national state highways. Local communities are also dependent on SH1 for access to work, education, and community amenities</p>
<p>A high crash risk</p>	<p>The SH1 corridor has a Medium-High collective risk overall (classifying it as a high risk rural road), with sections having High collective and personal risk. Most notably these High risk sections include the Three Sisters and other Curves on the Desert Road. Additionally other sections of the route have higher crash risk or deaths and serious injuries than their surrounding environment such a between Hatepe Hill and Mission Bay, Motuoapa and Turangi, or Desert Road Summit to Waiouru.</p>

The overall assessment rating for the 'Strategic Fit' of the programme of interventions is **High**.

### 7.2.2 Effectiveness

An indicative 'High' rating for Effectiveness is achieved on the basis the identified problems and potential investment meets the components of the criteria shown in

Table 9.

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**Table 9: Recommended Programme Effectiveness Assessment**

Rating	Assessment
High	<p><b>Outcomes Focussed</b></p> <p>Programme option 9 delivers strong outcomes when considering the investment objectives identified. It is anticipated that the following outcomes would occur in the long-term if this programme option is adopted including:</p> <ul style="list-style-type: none"> <li>• Reductions in deaths and serious injuries and significant improvements in road safety risk assessments.</li> <li>• Good improvements in travel time reliability and improvements in consistency of travel speeds and travel times.</li> <li>• Improvements on the corridor reduce conflict between transport functions and land uses</li> <li>• Good levels in reduction in the number of closures and the duration of closures.</li> </ul> <p>Programme option 9 also includes opportunities to provide safe access to significant recreational and tourism activities with the corridor between Taupo and Waiouru in line with the objectives of investment objective 4.</p>
High	<p><b>Integrated</b></p> <p>Programme option 9 delivers positive outcomes when considering integration with current network and future transport plans. The mixture of high outcomes (outlined above-Outcomes Focussed) reflect the corridor's role as the main north to south transport connection through the North Island, whilst there is some room for improvement when reconciling the role of the corridor with the merely moderate reliability and resilience outcomes.</p>
High	<p><b>Correctly scoped</b></p> <p>The degree of works and outcomes achieved for programme option 9 suggests a high rating against these criteria. The programme addresses the problem identified for the corridor, however it also provides infrastructure to decrease travel time for this corridor. The proposed investments are targeted at the areas of risk and problems. There are remaining challenges for this corridor that investment cannot fully address including snow and other weather related events. This programme does seek to minimize the impact of these problems.</p>
High	<p><b>Affordable</b></p> <p>At this stage of the programme business case a funding plan has not typically been identified. As such this is a preliminary comment on affordability based on limited information.</p> <p>This programme option is considered to High affordability, though there is a risk this could be lower if the existing SH1 alignment is not handed to the relevant local government authority following construction and NZTA had to continue to maintain both pieces of state highway long term.</p> <p>It is assumed a reasonable level of investment into SH1 would be required prior to and potentially ongoing for the revoked section of SH1.</p>
High	<p><b>Timely</b></p> <p>This programme option delivers outcomes in the short to long term.</p>
High	<p><b>Confidence</b></p> <p>There is high confidence that this programme option manages current and future risk for outcomes - Whilst the outcomes it delivers are high, the risks are also high.</p>
High	<p><b>Overall</b></p> <p>Risk - Delivery of the programme earlier carries a higher funding availability risk.</p>

### 7.2.3 Benefit Cost Appraisal

The preliminary benefit cost ratio is 0.59.

This is based on a NPV benefit of \$280M and a NPV cost of \$480 M.

Low levels of investment into this section of SH1 have resulted in a high cost to rectify the problems being experienced and which will continue to worsen over time. The costs associated with improving the form and function is increased by the remoteness of the highway, geography and geotechnical constraints. Additionally the existing highway and proposed realignments also traverse a World Heritage Area, areas of cultural significance and high value recreation and tourism.

Full or partial failure of the highway was not factored into the assessment but would be considerable and is outlined in the sensitivity testing below. Undertaking investment as soon as possible will reduce this risk and associated economic costs and if delivered earlier, in full or staged, than outlined in the recommended programme will improve the benefit-cost ratio.

Key Assumptions BCR are:

- 40 year analysis period with 6% discount rate
- Benefits are calculated based on the BAU costs of maintenance, travel time, vehicle operating costs and safety compared with the Recommended Programme
- Traffic growth rate range - 3% equal to the 25 year trend for the route
- Travel time used the 2015 update factor, 1.44
- Vehicle Operating Costs (VOC) and Safety used the updated 2016 values
- Heavy Vehicles considered proportionally (when using standard rural composition) for gradient and travel time when assessing VOC, more detailed investigations would likely identify greater VOC benefits
- Roughness was not included as a contributor
- Crashes considered social cost based on crashes being – all vehicles, all movements. These at a future point can be broken down into User Class and Movement Types
- Maintenance efficiency improvements are assumed based on making the road environment more resilient to Low Impact High Probability events such as slips, snow/icy and crash repairs (i.e. fixing guardrail after a crash), and annualised periodic events such as resurfacing
- Passing and overtaking is taken into account under safety and travel time calculations
- Resilience has been included within vehicle operating costs and travel time costs; this includes closures and delays from planned (roadworks)

### **Sensitivity Analysis**

Five sensitivity tests were carried out on the benefit cost ratio. These consisted of:

- 4% discount rate
- 8% discount rate
- 30% increase in capital cost
- 1% traffic growth, similar to last 10 years growth on the section of State highway
- Waikato Regional Traffic Model Growth – 3% growth per annum with a period of lower growth

Lowering the discount rate raised the BCR to 0.77 (4%) and raising the discount rate reduced the BCR to 0.47 (8%).

Capital costs for the programme will be refined at each stage of business case development with the variance in costs reducing. At the programme business case stage it is prudent due to limited

information to assess higher costs of delivery. A 30% increase in capital costs would lower the BCR to 0.45.

The benefits of the programme were calculated by adjusting the traffic growth rates. If traffic growth continues as for the previous 10 years at 1% per annum the BCR would reduce to 0.45. The Waikato Regional Traffic model growth figures would result in a slightly higher BCR of 0.63.

Travel Time Savings and Vehicle Operating Costs (approximate and likely underestimated) from the detour Taupō to Turangi are \$318,506 per day (compared with the Manawatu Gorge closure which was reported at \$62,000 per day). These costs are less than what the complete cost to the economy would be and did not factor in:

- Repair costs for SH1 or cost of new alignment
- Increased crash rate on lower standard road (resulting in more resilience events) (Safety)
- Speed change cycles for poor alignment (VOC)
- Gradient & speed profiles assumed to be equivalent to existing route (COV)
- Reduced passing and overtaking opportunities (Travel Time)
- Approximately 150 HPMV per day have additional detour length (currently via New Plymouth) (Travel Time)
- Wider economic impacts to townships
- Freight supply chain impacts
- Increased/advanced maintenance costs due to pavement deterioration. (Maintenance)
- Traffic management cost
- Reputational damage
- Tourism impacts (and Taupō “Round The Lake” events)
- Alternative route resilience – whether there was an impact to the alternate route and deterioration of the alternate route (approximately additional 120km route)

### 7.3 Programme risk and opportunity

There are a number of risks to this programme of works that are being assessed with the individual programme elements. These risks will need to continue to be managed and assessed during subsequent business case stages. It is recommended that ongoing risk assessment, including thorough risk identification, mitigation actions, and action owners, continue to be undertaken during the Indicative and Detailed Business Cases and other delivery mechanisms. The key risks are outlined in Table 10 below.

**Table 10: Summary of identified key risks**

Risk Area	Description	Treatment Strategy
<b>Land acquisitions</b>	There is a need for an unknown quantum of land acquisitions for the proposed option	Early consultation and engagement with potentially affected land owners
<b>Latent Ground Conditions</b>	The geotechnical and other potential factors influencing design, alignment and cost have not yet been confirmed	Undertake further consultation with potentially affected land owners and gain information at the earliest feasible time

<b>Operational</b>	Network impacts as a result of ongoing improvements to the existing SH1 alignment	Prepare detailed traffic management plans for the programme of short term improvement to obtain a balanced approach and minimise impacts to SH1 customers
<b>Financial</b>	Costs are difficult to accurately confirm due to the nature of the proposed major improvements	Undertaken enabling activities and Indicative Business cases as early as possible following consultation
<b>Environmental and social responsibility</b>	SH1 traverses areas of natural and cultural significance and all works including minor improvements can have an adverse impact on the environment	Planning and implementation within the corridor need to use high levels of design and construction focus on reducing actual and potential adverse impacts. Early engagement with affected landowners is essential.
<b>Economy</b>	The re-alignments near Lake Taupō may have an adverse impact on some aspects of the local economy due to reduced passing commuters and freight	During the planning stages of the proposed realignment there will be a need to understand the potential impacts at a greater level as well as work with the affected parties to identify solutions and / impact minimisation from the realignment of SH1
<b>Reputational Risk</b>	There would be considerable reputational risk to NZTA and impact to the local and regional economies from full or partial failure of SH1 in prone areas	Commence planning for realignments for long term outcomes and reduction in risk of failure and closure of SH1
<b>Cultural</b>	Programme interventions don't fully consider cultural implications	Clear and open consultation and engagement with local iwi

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## 8. Programme Financial Case

### 8.1 Funding arrangements

The proposed programme of works and associated costs are considerable. It is anticipated that the majority if not all major capital and operational costs will be incurred by the NZ Transport Agency for this programme. All major realignments or improvements to SH1 will be at the cost of NZ Transport Agency. There is anticipated to be some co-investment from others such as Taupō District Council for accessibility improvements for recreational and tourist use (such as the proposed Bike Trail between Taupō and Turangi).

There is potential co-investment or investments by other along the corridor that can improve the outcomes identified and assist in meeting our investment objectives. These co-investment opportunities are likely to be with the district and regional councils or other entities such as Destination Great Lake Taupō and would relate to improving safe access to SH1 or recreation and tourism destinations along the corridor. These opportunities will be explored in more detail following the completion of the programme business case. There are a number of improvements that can be made in this area, especially along Lake Taupō.

### 8.2 Indicative cost and Programme cash flow

An indicative, escalated programme cost has been estimated at approximately \$795 million. The breakdown by intervention type is shown in Table 11 below.

**Table 11: Indicative Programme cash flow**

Year Number	Years 1-3	Years 4-7	Years 8-10	Years 11-30	Total
Activities	Hatepe Hill to Motuoapa IBC & DBC Rangipo to Desert Road Summit IBC & DBC. Tauranga Taupō Bridge replacement. Online safety reliability and resilience activities	Hatepe Hill to Motuoapa Pre-Implementation and construction start. Rangipo to Desert Road Summit pre-implementation and Construction. Tauranga Taupō Bridge construction. Online safety (Turangi to Rangipo), and resilience activities.	Hatepe Hill to Motuoapa pre-implementation and construction.	Operations and maintenance	
Capex	\$42M	\$442M	\$310M	\$-	\$794M
Operations and maintenance	\$50,000 p/a additional operations	\$50,000 p/a additional operations	\$50,000 p/a additional operations	\$50,000 p/a additional operations	\$1.5

The specific projects are outlined in Section 9 of this report.

# Part C – Delivering and monitoring the Programme

## 9. Planning and delivery overview

The following are proposed approaches for the development of the programme and progression following the programme business case.

### *Safety improvements (Recommended 2016-2018)*

There are a number of short term safety improvements that have been identified. These could be implemented through a number of mechanisms including the Safe Roads Alliance, existing network operating contracts or through minor works packages. These will need to be assessed on a case by case basis and reflect the evidence provided in the Context Report. The proposed works include:

- Safer speed limit assessment and implementation between Halletts Bay and Motuoapa
- Education programmes targeted at improving safety outcomes and travel planning
- Sections of shoulder widening between Wairahanui and Halletts Bay
- Delineation and wide centreline improvements, followed by improved surfacing on Desert Road
- Wide centrelines and corridor safety improvements between Motuoapa and Turangi
- Minor intersection safety improvements at Rereahu Ave, Hinemalaia Access Road, and Te Heuheu Road and at other town and intersections
- Slow vehicle lanes/bays extensions or gradient reductions for steep sections on Desert Road and Hatepe Hill
- Wide centrelines and corridor safety improvements between Turangi and Rangipo
- Isolated hazard protection between Turangi and Desert Road curves

### *Multi-faceted (safety, resilience and reliability) improvements (Recommended 2016-2019)*

A number of improvements have been identified that can have an improvement to the current SH1 alignment and its operation. These improvements will be developed through a detailed business case then using existing network operating contracts or through minor works packages to deliver the improvements.

Some of the larger interventions that are multi-faceted such as the replacement of the Tauranga-Taupō bridge should be further developed through an indicative business case and consider a scope that include improvements to the north and south of the bridge with regard to accessibility, safety and amenity, especially through the town site areas.

There are a number of related programmes being undertaken by the Transport Agency that will influence or overlap with the implementation of the Recommended Programme. These include but are not limited to enhanced network resilience package, the National Resilience Programme Business Case and journey management work.

The proposed works include:

- Vehicle/weather/speed activated warning signage at Hatepe Hill, Bulli Point, Tauranga Taupō River, Three Sisters and Desert Road
- Isolated hazard protection between Wairahanui and Mission Bay

- Culvert upgrades and improvements between Motuoapa and Turangi
- Walking and cycling improvements between Taupō and Turangi (potentially in conjunction with proposed new trail around Turangi and in areas between Taupō and Turangi such as Bulli Point)
- Three sisters curve form (camber/superelevation) improvements – potentially not required if realignments can be undertaken before 2022-24
- Passing and overtaking improvements on town departures
- Helicopter and response landing sites

#### ***Enabling activities for major realignments and or improvements***

Prior to the commencement of the indicative business cases for the proposed major realignment areas in the north and southern sections of the corridor it is recommended that a number of activities are undertaken. These activities include but are not limited to:

- Preliminary consultation with potentially affected land owners for the re-alignments. This includes Iwi groups, Department of Conservation and others
- Preliminary geotechnical investigations (following discussions with affected land owners) to identify potential constraints that may impact potential alignments or costs of re-alignments
- Further discussion with other stakeholders including district and regional councils to identify constraints and opportunities that will need to be fully understood in the Indicative Business Case stage

#### ***Indicative (then detailed) business cases***

There are two potential major projects within the programme which will require indicative business cases if the enabling activities are progressed and resolved. These are the potential realignment of SH1 between Hatepe Hill and Motuoapa and realignments between Desert Rd and Rangipo. Implementation of works for these major realignments will be dependent on a number of time sensitive factors including land acquisitions, consenting processes, ground works and funding availability. The indicative timeframes for the implementation of these indicative business cases are:

##### **Rangipo to Desert Road summit**

1. Commencement: 2016
2. Engagement with Iwi and land holders: 2016
3. Geotechnical investigations: 2016
4. Finalise indicative business case: 2017
5. Detailed business case: 2016-2018
6. Funding approval: 2018
7. Consenting: 2018-2021
8. Procurement: 2019
9. Implementation: 2020-2023

##### **Hatepe Hill to Motuoapa**

1. Commencement: 2016
2. Engagement with Iwi and land holders: 2016/17
3. Geotechnical investigations: 2016/17

4. Finalise indicative business case: 2018
5. Detailed business case: 2018 – 2020
6. Funding approval: 2020
7. Land acquisitions: 2019-2022
8. Consenting: 2020-2022
9. Procurement: 2021
10. Implementation: 2022-2036

#### ***Operations and Maintenance***

- Improved contractor responsiveness and event/recovery plant availability
- Traveller information strategy, including VMS, radio coverage, and improved detour route signage

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# 10. Management Case

## 10.1 Programme performance and review

The investment objectives identified in the programme business case have been developed in a manner that they are attributable to investment on this corridor as well as can be easily assessed and monitored over time. This should be undertaken on an annual basis by the regional HNO team and other teams where relevant.

## 10.2 Governance and reporting

Governance and reporting of the programme will be dependent on the various methods of delivery, i.e. minor works or major projects. It is recommended that the HNO Waikato Regional office have ultimate responsibility for the outcomes of the planning, improvements and monitoring for the programme.

A delivery model is proposed below:



# Roles & Responsibilities to deliver the corridor programme effectively

## RESPONSIBLE

“The do-er”  
Person/s responsible for the completion of the task



## ACCOUNTABLE

“The buck stops here”  
Person/s ultimately answerable for the activity or decision



## CONSULTED

“In the loop”  
Person/s whose technical advice is necessary, typically a subject matter expert



## INFORMED

“Kept in the picture”  
Person/s who are kept up-to-date on progress



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## SH1 Taupo - Waiouru Programme Governance

A corridor-wide Steering Group is proposed – the Collaborative Oversight Group (COG) – which is responsible for delivery of the Taupō to Waiouru programme and ensuring individual activities collectively deliver the programme outcomes.

Group	Representatives	Primary role and scope
Collaborative Oversight	Will be confirmed through the COG Terms of Reference	<p>C) Ensure programme delivery aligns with other sub-regional strategies.</p> <p>C) Plot programme decisions sought through governance pathways</p>
Programme Steering Outcomes & Delivery)	<p>Transport Agency HNO Principal Transport Planner</p> <p>Transport Agency HNO Corridor Programme Manager</p> <p>Transport Agency Technical Advisor</p> <p>Transport Agency Communications</p> <p>Transport Agency P&amp;I Investment Planning</p> <p>Taupō District Council</p> <p>Ruapehu District Council</p> <p>Safe Roads Alliance (SRA)</p> <p>Transport Agency Outcome Planning</p>	<p>A) Ongoing programme requirement, scope &amp; technical direction</p> <p>R) Procurement, funding, engagement, finance, risk, reporting.</p> <p>R) Monitoring the programme across the multi-criteria framework</p> <p>R) Delivering the programme communications strategy</p> <p>C) Strategic context, alignment to PBC objectives</p> <p>C) Technical direction of activities</p> <p>C) BC guidance and quality assurance</p>

Individual activities within the programme will be managed separately and may require their own Project Steering Groups:

## SH1 T-W Programme – Activity Management

Group	Representatives	Primary role and scope
Indicative Business Case SH1 Realignment Desert Rd - Rangipo Form & Function Review Existing SH1 network Taupō - Waiouru	Transport Agency HNO Project Manager  Transport Agency HNO Transport Planner  Consultant Transport Planning  Taupō District Council  Ruapehu District Council  Other BOP Transport Agency Business Units  (Safety, Network and Journey Management)	A) Pre-Implementation, Implementation  A) SH1 Form & Function review, Revocation Plan  R) SH1 Form & Function review, Revocation plan  C) SH1 Form & Function review, Revocation plan

### 10.3 Stakeholder engagement and communications plan

The programme business case has been developed by working closely with a number of stakeholders over a six month period to gain a greater insight into the problems, constraints, investment needs and drivers, and opportunities for improvement of this section of SH1 and the transport needs of the wider region.

The stakeholder and communication strategy developed for this programme business case should be reviewed and updated acknowledging the recommended option and the need for specific strategies for the programme components identified.

## 11. Commercial Case

The Commercial Case will be developed during the Indicative Business Case stage of the programme's development. This will consider the current suite of procurement and commercial arrangements available to the NZ Transport Agency as well as the potential funding partners.

It is anticipated that due to the physical length of the corridor considered in this programme the business case as well as the large number of programme elements that a number of procurement and commercial arrangements will be required to successfully deliver the programme.

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## **Appendices**

**Appendix A** – Uncertainty Log

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## Uncertainty log

Area of Uncertainty	Uncertainty	Degree of uncertainty	Impact on programme	Comments
Financial	Ability to fund maintenance and operations for new infrastructure either major or minor	Low uncertainty	Negligible	Funding for Maintenance and operations is considered to be available and at sufficient levels
	Ability to fund a major infrastructure project	Some uncertainty	Moderate/ Major	Restricts likelihood of major infrastructure interventions or delays implementation timeframe
Stakeholder / Public	Stakeholder expectations for programme business case	Low uncertainty	Low	Good understanding of stakeholder expectations and communication of programme
	Local residents appetite for connectivity/separation to the adjacent regions	Some uncertainty	Low	Balancing improving accessibility along the corridor without impacting the unique nature of the region
	Customers level of service expectations	Some uncertainty	High	Increasing expectations of the Levels of Service for main north / south corridor for the North Island and is reflected in the recommended programme
	Land ownership (and land use) and consultation around potential future projects	Near certain	High	Inability to / restriction on the upgrade and improvement of the existing SH1 road corridor OR new alignments for SH1 requires high levels of engagement and communication for the programme
	Utilising adjacent environmentally sensitive land	Near certain	High	There are areas of high environmental and culturally sensitive land including (but not limited to) Tongariro National Park which is a world heritage site
Environmental	Environmental impacts of options and alternatives	Near certain	Medium	Some of the proposed options will have environmental impacts, these can be mitigated, minimised and/ or offset if necessary
	Likelihood of a major event impacting State Highway 1 and/or alternative routes	Near certain	High	This section of SH1 is impacted by weather and other events resulting in closures, warnings and changing conditions, especially in winter. The alternate routes within the region are also likely to be impacted by a major event such as volcanic eruption
	Impact of rail service / function as a result of a major environmental event	Low uncertainty	Medium	If a major event occurred that closed the rail service for a period there would be increased traffic levels on sections of SH1 which may have negative impacts such as road condition degradation
	Global demand for forestry and other	Some	Low	There are projections of significant growth in forestry across New

Area of Uncertainty	Uncertainty	Degree of uncertainty	Impact on programme	Comments
	primary industry resources varying freight volumes on State Highway 1 e.g. dairy, logs and pulp	uncertainty		Zealand in the period of 2020 – 2030. These may be impacted by world demand and prices for logs and therefore freight vehicle across the state highway network.
Economic	Impact of route on value of tourism i.e. routes role in tourist movements within the region	Near certain	Medium	The growth in tourism across New Zealand in recent years is expected to grow in future years. There is increasing local and regional activity at locations such as Tongariro Crossing, the Mt Ruapehu ski fields
	Growth in new industries or activities which significantly increase traffic volumes	Some uncertainty	Low	No major growth from new industries is expected for the region. There is expected increases in freight movements for the north south interregional movements as a result of overall economic activity in the country. There will be some increased movement along SH1 as a result of forestry along Lake Taupo, however this is likely to be lower than those experienced across the country. Tourism growth has resulted in increases in activity in the region and in traffic volume, this is expected to grow but not to a level that would require an increase in capacity on sections of the corridor
Technical	Limited / lack of detailed transport network modelling for transport to identify and understand the different users of the corridor.	Some uncertainty	Medium	There is data relating the volume and original and destination of some movements within the corridor. There would be benefits of having a greater understanding of the types and regularity of various drivers along the corridor (i.e. regular holiday makers, recreational users, international travellers)
	Ability to undertake any major (and in some constrained areas minor) civil works on SH1	Near certain	Medium	There are existing and ongoing issues to undertake asset management activities along the corridor, especially in constrained areas around the three sisters and the lake side areas
Other	That the main north-south rail corridor discontinues or significantly decreases function resulting in increased freight movements on SH1	Low uncertainty	Medium	The main north-south rail line has had consistent volumes and function for a number of years and is expected to continue in the future, there is a good level of confidence that this will continue

### Issues and Constraints

Area of Issue or Constraint	Issue or Constraint	Impact on programme	Comments
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Area of Issue or Constraint	Issue or Constraint	Impact on programme	Comments
Financial	Detailed analysis required and / or understood by stakeholders and community for the PBC stage	Low / Moderate	Levels of investigation and analysis is being communicated with stakeholders throughout the PBC process with good understanding of what can / should be achieved at each stage of the planning and delivery of the programme
Stakeholder / Public	The funding levels that can realistically be justified and used for investment rationale	Moderate	Stakeholders are being communicated to throughout the PBC with continual discussions about what is realistic and a good investment for NZTA and the community
	Ability for KiwiRail to participate as a stakeholder and contribute funding	Low / Moderate	It is not anticipated that there will be a major impact or change in programme due to changes in rail activity
Environmental	Bad weather, especially during winter, can impact delivery of works	Low / Moderate	Whilst difficult there is experience within the industry to deliver quality projects and outcomes in these environments
Economic	Capacity of existing road infrastructure	Moderate	The lane capacity (1 lane in each direction) is sufficient for the current and expected future volumes, however the geometry and width of the road corridor is constrained and impacts travel speeds, efficiency and travel time reliability
	Some viable alternative routes but due to unplanned closures (i.e. crashes) at certain points of the corridor it severs both local and inter-regional movements and causes significant detours.	Moderate	Travel management plans and other interventions are implemented and will continue
Technical	Rough terrain making infrastructure works difficult	High	Restricts ability of major infrastructure as choice
Policy	The statutory powers of local authority to promote change	Low / Moderate	The councils and other organisations will undertake activities that will have some impact on the function of SH1, i.e. increased tourism and traffic along the corridor
Social	Tertiary healthcare, education and other services can be cut off during crashes and other events	Moderate	This does occur on a regular basis there are arrangements to

Area of Issue or Constraint	Issue or Constraint	Impact on programme	Comments
			minimise the impacts of these events

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## **Appendix B** – Risk Assessment

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