

Released under the Official Information Act 1982

NZ Transport Agency
SH1 Christchurch - Dunedin
Programme Business Case

April 2017

Released under the Official Information Act 1982

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 Christchurch and Dunedin. These options and alternatives are developed, and then assessed as part of the process to find a range of programmes that can meet the agreed outcomes and investment objectives. The recommended programme that will aim to address the problems identified on this transport corridor as well as achieve a range of benefits for transport and the community. In developing the programme options and recommended programme, it is important to consider the following:

- SH1 is of national significance with this corridor for moving people and goods critical to the country, region and local communities. It is the primary road-based transport route in the South Island and is a national strategic route in the One Network Road Classification (ONRC);
- The road alignment on the northern section of this journey is generally flat and straight, and becomes more rolling and curved south of Timaru. South of Oamaru the road alignment becomes more undulating and curved towards Dunedin;
- The South Island's two largest population centres, Christchurch and Dunedin, lie at either end of this section of State Highway 1. These cities have major services including health, university, commercial centres, international airports and ports. Timaru also has a port (PrimePort), which along with Lyttelton (Christchurch) and Port Chalmers (Dunedin) provides freight connectivity to other centres and international markets;
- The main south rail line runs adjacent to the state highway for much of the route, and the close proximity can present safety issues for vehicle access to the state highway. The main south line is used mainly for freight purposes with key rail yards or sidings at Lyttelton Port, CityPort Woolston, Middleton, Sockburn, Rolleston, Ashburton, Temuka, Washdyke, Timaru, Oamaru and Dunedin.



Figure 1 Regional context

Context

This Programme Business Case is the State Highway 1 corridor between Christchurch and Dunedin. The corridor is a 320 km stretch between the northern abutment of the Selwyn River Bridge (35 km south-west of Christchurch in the north and the Pine Hill intersection (northern urban limit) in the south. The corridor has been divided into three segments, Mid Canterbury, South Canterbury and North Otago, with the Rangitata and Waitaki Rivers being the boundaries between the segments. The different segments have variances in traffic volumes and/or geographic terrain.

Corridor Segments

The Mid Canterbury segment between the Selwyn River and the Rangitata River is generally flat and straight. The state highway crosses several braided rivers along the corridor, and these bridges are important infrastructure assets due to the limited viable detours available in the event of an outage. Many of these bridges are narrower than bridges that are now constructed and can feel narrow to some drivers. While high productivity motor vehicle (HPMV) access is available, some bridges are being monitored for their suitability for heavier vehicles in the longer term. The corridor runs near the main south rail line for this segment of the corridor and includes three level rail crossings.



Figure 2: Mid Canterbury

This segment of the corridor has higher traffic volumes compared with the other segments of the corridor, including 23,000 vehicles per day through Tinwald in Ashburton.

The South Canterbury segment of the corridor is between the Rangitata River and the Waitaki River. North of Timaru the corridor is generally flat with few out-of-context curves. South of Timaru there are rolling sections with notable out-of-context curves. This segment has several segments of high traffic volumes, in particular between Temuka and Timaru and within Timaru urban.



Figure 3: South Canterbury

The surrounding area of Timaru is farmland with significant growth in this sector primarily driven by irrigation. There is a strong interaction between the Port, in the centre of Timaru and the industrial area in Washdyke to the north of the town. As a result, there is a significant volume of HCVs travelling between the Timaru Port and Washdyke along SH1 (also known as Evans Street).

North Otago

The North Otago segment of the corridor is from the Waitaki River and the Pine Hill intersection. The southern sections of the segment include the Leith Saddle and the Kilmog. There are out-of-context curves throughout this segment of the corridor.

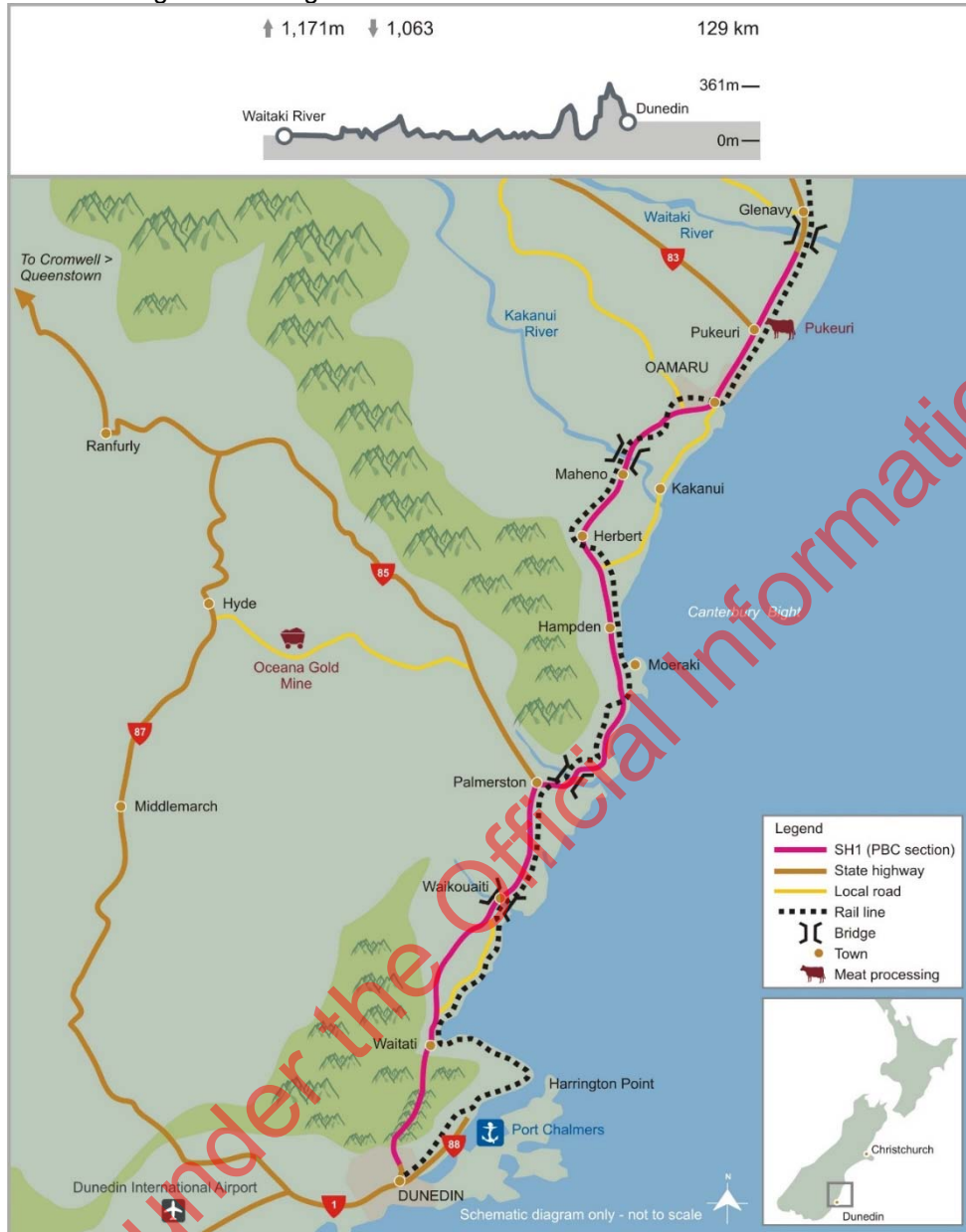


Figure 4 North Otago

This segment of the corridor has a significant safety issue, with a DSI rate substantially higher than the rest of the Christchurch to Dunedin corridor and the national average. There are several resilience issues throughout this segment including snow and ice, coastal erosion and flooding.

Concurrent Programme Business Cases

This programme business case has been developed concurrently with the State Highway 1/73/76 Greater Christchurch Programme Business Case, acknowledging the travel in south-west Christchurch and that issues facing one part of the transport network could impact on the other. This programme business case will also align with work activities currently being identified and to be implemented between Christchurch to Dunedin by the Safe Roads Alliance.

Current Situation and Future Considerations

The key issues for SH1 between Christchurch and Dunedin are road user safety, travel time reliability between Selwyn River and Timaru, and network resilience, which are common issues for State Highways in New Zealand. A more specific issue is the conflict in Ashburton and Timaru between the corridors role as the main north-south transport link in the South Island, and local network users access on to, across and turning off the state highway in these urban areas.

A summary of traffic volume data was presented in the strategic case which illustrates the decreasing traffic volumes travelling south on State Highway 1 from Christchurch to Dunedin.

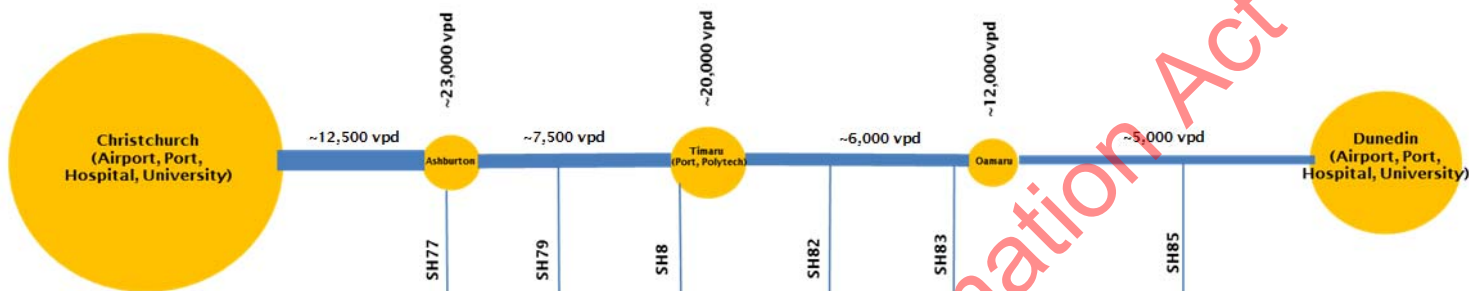


Figure 5 Traffic volumes between Christchurch to Dunedin

Figure 5 shows the average daily vehicle trips between major towns and cities along the corridor. It also shows the volumes within the towns and connections with other State Highways.

There are a number of current and important issues and constraints:

- Poor safety outcomes as a result of a large combination of factors including inconsistent road environment, is used by a diverse range of vehicles travelling at slower speeds, risk taking behaviour, out of context curves, fatigue, and unforgiving roads and roadsides;
- The speed limits through the urban areas of Ashburton, Timaru and Oamaru and some of the smaller townships along the corridor results in 'traffic bunching', which in turn is contributing to risk taking behaviour by drivers on the rural sections of the corridor;
- The state highway crosses several braided rivers along the corridor, and these bridges are important infrastructure assets due to the limited viable detours available in the event of an outage. The highway passes through, over and beside several natural environments such as low-lying flood plains, coastal marine areas with some parts experiencing coastal erosion issues and elevated snow-prone areas that can experience closures during certain weather events;
- State Highway 1 between Christchurch to Dunedin is performing and functioning more like a regional route than a national strategic route. These conditions coupled with minimal upgrades over recent decades has contributed to:
 - Uncertainty for industry in particular access to key freight hubs
 - Restraint of local and regional economies with flow on effects to the national economy
 - Poor access and safety for local communities particularly in Tinwald and northern Timaru.

There are a large number of future considerations, these include but are not limited to:

- Business as usual is not an option to effectively address the safety issues, potential network failure and closures expected;
- Some sections of the corridor would struggle with traffic volume increases, in particular for safety and access issues for communities along the corridor.

Problems and Benefits of Investment

The problem statements reflect the evidence that has been collected and analysed as well as through discussions and communication with stakeholders. The problem and benefit statements for each segment of the corridor are in the Figures below.

Mid Canterbury

Figure 6 below outlines the problems and benefit statements for the Mid Canterbury segment of the corridor.




Themes	The Problems	Benefit Statement
 <p>Safety</p>	<p>Problem 1: State Highway 1 has some unforgiving sections, combined with driver mistakes contributes to fatal and serious injury crashes.</p>	<p>Improved road user safety</p>
 <p>Reliability</p>	<p>Problem 2: State Highway 1 has a diverse range of vehicles with varying speeds, combined with increasing traffic volumes contributes to travel time reliability issues.</p>	<p>A reliable corridor allowing the movement of people and goods</p>
 <p>State Highway Access</p>	<p>Problem 3: Corridor layout and existing land use, combined with increasing traffic volumes constrains access on to, across and off the state highway for all modes of travel.</p>	<p>Improved access on to, across and off the state highway</p>

Figure 6 Mid Canterbury problem and benefit statements

South Canterbury

The South Canterbury segment has been split into Timaru Urban (between the 100/70 speed change sign at the racecourse and the 100/50 speed change at Saltwater Creek, 9 km) and the rural section (north and south of Timaru). There are different problem statements for the rural sections and Timaru urban as shown in Figure 7.

	Themes	The Problems	Benefit Statement
Rural	Safety	Problem 1: State Highway 1 has some unforgiving sections, combined with driver mistakes contributes to fatal and serious injury crashes.	Improved road user safety
	Reliability	Problem 2: State Highway 1 has a diverse range of vehicles with varying speeds, which contributes to travel time reliability issues.	A reliable corridor allowing the movement of people and goods
	State Highway Access	Problem 3: Corridor layout and existing land use constrains access on to, across and off the state highway for all modes of travel.	Improved access on to, across and off the State Highway
Urban	Reliability	Problem 1: Future growth of industry increases the number of HCVs on State Highway 1, contributing to travel time reliability issues.	A reliable corridor allowing the movement of people and goods
	State Highway Access	Problem 2: Corridor layout and existing land use constrains access on to, across and off the state highway for all modes of travel.	Improved ability to access, cross and off the State Highway

Figure 7: South Canterbury and Timaru urban problem and benefit statements

North Otago

North Otago is the only segment that includes a resilience problem area. The traffic volume is comparatively low that reliability is not evidenced as an issue. The problem and benefit statements are outlined in Figure 8 below.




Themes	The Problems	Benefit Statement
 Safety	Problem 1: State Highway 1 has a diverse terrain and some unforgiving sections, combined with driver mistakes contributes to fatal and serious injury crashes.	Improved road user safety
 Resilience	Problem 2: Sections of State Highway 1 have resilience issues which results in road closures.	A resilient corridor allowing the movement of people and goods
 State Highway Access	Problem 3: Corridor layout and existing land use, combined with increasing traffic volumes constrains access on to, across and off the state highway for all modes of travel.	Improved access on to, across and off the State Highway

Figure 8: North Otago problem and benefit statements

Investment Objectives

The Investment Objectives outlined below as well other criteria have been as the key assessment criteria for the programmes which are shown in the following sections:



Programme Options – Long List Assessment

The long list of programme options was developed in conjunction with the stakeholders, with the short list of programme options agreed for further development and assessment. The long-list was assessed at a high level against the Investment Objectives as well as the other criteria outlined in the short-list assessment overleaf.

Programme Options Assessment

Mid Canterbury

Programme Multi - Criteria Assessment at 2046		Programme 1 Business as Usual	Programme 2 Target Safety and some Access Improvements	Programme 3 Corridor Safety (3 1/2 - 4 star safety)	Programme 4 Balanced Mid-Level Investment (Safety, Travel Time Reliability, Access)	Programme 5a Balanced High-Level Investment (Safety, Travel Time Reliability, Access)	Programme 5b Balanced High Level Investment with Second Ashburton River Bridge	Programme 6 Maximum Travel Time Reliability and 4 Star Safety (Do Max)
Investment Objectives KPI Outcomes	Reduction in deaths and serious injuries	20% increase on 2011-2015			45%-55% decrease on BAU		55%-65% decrease on BAU	
	Expected deaths and serious injuries in 2042-2046	45-55 DSI --	35-40 DSI +	25-35 DSI ++	20-25 DSI ++	20-25 DSI ++	15-20 DSI ++	10-15 DSI +++
	Improved road safety risk assessment rating (KiwiRAP) (Proportion of length 3 star or better)	86% - 89%	88%-92% 0	95% - 98% ++	95% - 98% ++	95% - 98% ++	97+% ++	98%+ ++
	Median travel time	60-63 mins --	60-63 mins --	65-70 mins ---	55-58 mins ++	55-57 mins ++	55-57 mins ++	53-55 mins ++
	Open road median speed North of Ashburton South of Ashburton	80 90 -	80 90 -	75 85 --	93 92 ++	93 95 +++	93 95 +++	95 95 +++
	Maintain travel time reliability (Difference between programme 85th percentile and 2015 median travel times)	7 min --	7 min --	8½ min --	4½ min +	4½ min +	4 min ++	3½ min +++
	Intersection level of service	--	0	-	0	+	++	+++
Pedestrian and cyclist access	--	+	0	+	++	+++	+++	
Other factors	Effectiveness	--	-	-	++	++	+	+++
	Risk	-	-	0	0	0	0	0
	Public & Stakeholders	-	-	-	0	0	-	--
	Inter/ dependencies	++	0	0	-	-	--	--
	Feasibility	+++	+	0	-	--	--	--
	Affordability	+++	+	0	-	--	-	--
	Costs	\$5 - \$15 M	\$20- \$50 M	\$75 - \$120 M	\$200 - \$350 M	\$300 - \$500 M	\$350 - \$550 M	\$450 - \$750 M
	Benefit Cost Ratio	High	Medium	Medium	Medium	Low / Medium	Low / Medium	Low
	Programme Consideration	Short Listed	Not Short Listed	Not Short Listed	Recommended Programme	Not Short Listed	Short Listed	Not Short Listed

Programme Multi - Criteria Assessment in 2046		Programme 1 Business as Usual / Do Minimum	Programme 2 Targetted Safety and Minor Access Improvements	Programme 3 Corridor Safety (3 1/2 - 4 stars)	Programme 4a Mixed Programme (Safety, Travel Time Reliability, Access and Timaru Road Optimisation)	Programme 4b Mixed Programme (Safety, Travel Time Reliability and Access) with extra Timaru Capacity (4 lane)	Programme 5 Consistent and Higher Standard (ONRC) State Highway Corridor (Safety, Travel Time Reliability, and Access)	Programme 6 Balanced High Level (Safety, Travel Time Reliability and Access)
Investment Objectives KPI Outcomes	Reduction in deaths and serious injuries	20% reduction on 2011-2015			40% reduction on BAU	40% reduction on BAU		
	Expected deaths and serious injuries in 2042-2046	35-40 DSI +	35-40 DSI +	20-25 DSI ++	20-25 DSI ++	20-25 DSI ++	15-20 DSI ++	10-15 DSI +++
	Road safety risk assessment rating (KiwiRAP) (Proportion of length 3 star or better)	82% -	82%-85% 0	93% ++	93% ++	93% ++	93-97% ++	98%+ +++
	Median travel time	82 min -	82-85 min -	82-85 min -	78 min -	75-77 min ++	74-76 min ++	74-76 min ++
	Open road median speed	88 km/h -	85-88 km/h -	85-88 km/h -	92-94 km/h +	92-94 km/h ++	93-95 km/h ++	93-95 km/h ++
	Improve travel time reliability (Difference between programme 85th percentile and 2015 median travel times)	7¼ min -	7¼ min -	7½ min -	6½ min +	6 min ++	6½ min +	5½ min +++
	Intersections level of service	--	0	-	-	--	+	0
Other factors	Pedestrian and cyclist access	--	+	+	+	0	+	+
	Effectiveness	--	-	-	+	-	++	+
	Risk	++	+	-	0	-	-	--
	Public & Stakeholders	+	+	-	++	-	+	0
	Inter/ dependencies	++	+	0	0	-	-	-
	Feasibility	+++	+	-	0	-	-	--
	Affordability	+++	++	+	+	--	-	--
	Costs - including operations and maintenance	\$5 - \$15 M	\$20- \$40 M	\$40 - \$70 M	\$150- \$190 M	\$260 - \$320 M	\$250 - \$500 M	\$350 - \$650 M
	Benefit Cost Ratio	High	Medium / High	Medium	Medium	Low	Low	Low
	Programme Consideration	Short Listed	Not Short Listed	Not Short Listed	Recommended Programme	Short Listed	Not Short Listed	Not Short Listed

Programme Multi - Criteria Assessment in 2046		Programme 1 Business as Usual	Programme 2 Targeted Safety and Minor Access Improvements	Programme 3 Targeted Safety with Resilience for Low Impact High Probability events	Programme 4 Corridor Safety with Resilience from Low Impact High Probability Events	Programme 5 Corridor Safety, Resilience, Access and Active Mod. Connectivity	Programme 6 Highly Safe, Accessible, Connected and Resilient Coastal Corridor at Katiki Straight	Programme 7 Highly Safe, Accessible, Connected and Resilient Inland Realignment at Katiki Straight
Investment Objectives KPI Outcomes	Reduction in deaths and serious injuries	20% reduction on 2011-2015			15-25% reduction on BAU	15-25% reduction on BAU	25-35% reduction on BAU	
	Expected deaths and serious injuries in 2042-2046	55-60 DSI 0	50-55 DSI +	50-55 DSI +	45-50 DSI ++	45-50 DSI ++	40-45 DSI ++	35-45 DSI ++
	Road safety risk assessment rating (KiwiRAP) (Proportion of length 3 star or better)	73% -	80%-85% +	80%-85% +	87%-90% ++	87%-90% ++	91% ++	95%+ +++
	Average closure duration	11 hrs -	11 hrs -	8-10 hours +	6-7 hours ++	6 - 7 hours ++	6 - 7 hours ++	6 - 7 hours ++
	Number of road closures (per 5 year period)	29 events -	29 events -	20-25 events 0	17-20 events +	17 events ++	17 events ++	17 events ++
	Intersection level of service	-	+	+	+	++	++	+
Other factors	Pedestrian and cyclist access	0	+	+	+	++	+++	+++
	Effectiveness	--	-	+	++	++	++	+++
	Risk	--	-	-	-	--	--	---
	Public & Stakeholders	-	0	0	+	-	--	--
	Inter/ dependencies	++	++	++	+	+	0	-
	Feasibility	++	+++	+	+	-	--	--
	Affordability	+++	++	+	+	++	--	---
	Costs - including operations and maintenance	\$10 - \$25 M	\$30 - \$60 M	\$40 - \$70 M	\$50 - \$130 M	\$80 - \$170 M	\$140 - \$190 M	\$150 - \$325 M
	Benefit Cost Ratio	Low / Medium	Medium	Medium	Low	Low	Low	Low
Programme Consideration	Short Listed	Not Short Listed	Not Short Listed	Not Short Listed	Short Listed	Recommended Programme	Not Short Listed	

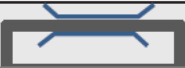
Recommended Programme

The Recommended Programmes for each segment:

- Mid Canterbury - Programme Option 4
- South Canterbury – Programme Option 4a
- North Otago – Programme Option 6.

Released under the Official Information Act 1982

Mid Canterbury

PBC Outcomes	Activity	2+1	2+1			
48-58 DSIs saved (10 yr period) 96% three star or better 57-60 min journey time (2015) 55 - 58 min journey time (Recommended 2046) Programme investment profile H/H/1-1.5	Short term 2017-2026	Selwyn River to Rakaia Safe Roads Alliance improvements	Rakaia to Ashburton Safe Roads Alliance improvements (BAU funded)	Ashburton South St traffic signals (BAU funded), Walnut Avenue traffic signals and Moore/Kermode/Park St improvements and four-lane to Havelock Signals at Laghmor/Agnes, Tinwald corridor improvements	Ashburton to Hinds Speed activated warning signs and thresholds at Hinds	Hinds to Rangitata River Safety 'hotspot' improvements
	Medium term 2027-2036	Implementation of alternating 2+1 configuration; Local road connections	Implementation of alternating 2+1 configuration (while keeping existing 2+2s)	Second river bridge across Ashburton River	Passing lane and intersection improvements	Intersection improvements
	Long term 2037-2046		Rural intersection improvements			
	Capital Cost (\$M)	\$80-90M	\$130-150M	\$45-55M	\$20M	\$10M
	Additional Operations and Maintenance Cost (\$k)	\$800k	\$1,200k	\$400k	\$200k	\$200k
	BCR	1 - 3	<1	1 - 3	1 - 3	3 - 5
	Corridor Wide Activities	Short to medium term - Education and behaviour change improvements, speed management, driver information incident response plans and detour route planning, and high impact low probability response plans.				

South Canterbury

PBC Outcomes	Activity		2+1	2+2 Washdyke to Port			
29-37 DSIs saved (10 yr period) 93% three star or better 79-82 min average travel time (2015) 77-80 min travel time (recommended 2046) Programme investment profile H/H/1.4-1.8	Short term 2017-2026	Rangitata River - Temuka Safe Roads Alliance improvements (BAU funded)	Temuka - Washdyke Centreline Barrier installation and widening Intersection improvements and rationalisation	Washdyke & Timaru Localised Road Optimisation (including lengthening merges beyond signals)	Timaru - Pareora Activated warning signs	Pareora - SH82 Activated warning signs	SH82 - Waitaki River Activated warning signs
	Medium term 2027-2036	Safer corridors Treatments		Grants St Signalisation following Show Grounds development	Isolated hazard protection, shoulder widening, curve easing	Safer corridors treatment (wide centreline, sealed shoulder widening and roadside hazard removal)	Safer corridors treatment (wide centreline, sealed shoulder widening and roadside hazard removal)
	Long term 2037-2046		Implementation of 2+1 configuration	Monitor travel time and travel time reliability, and HCVs through Timaru for Four Lane timing	Passing/overtaking improvements and safer corridors improvements		
	Capital Cost (\$M)	\$20M	\$50-60M	\$55-65M	\$10M	\$15M	\$15M
	Additional Operations and Maintenance Cost (\$k)	\$400k	\$650k	\$400k	\$100k	\$450k	\$250k
	BCR	1 - 3	1 - 3	1 - 3	1 - 3	<1	1 - 3
	Corridor Wide Activities	Short Term - Incident response planning and detour planning, promote use of rail with connections to Rolleston Inland Port					
	Medium and long term - rural intersection improvements						

North Otago

PBC Outcomes		Activity					
<p>29-37 DSIs saved (10 yr period) 91% three star or better</p> <p>Programme investment profile H/H/0.3-0.8</p>	Short term 2017-2026	Waitaki - Oamaru Stock underpasses and RIAWs at SH83 intersection	Oamaru North Oamaru corridor improvements	Oamaru - Hampden Level rail crossing improvements at Maheno	Hampden - Palmerston Passing lane north of Palmerston, R1 WS and vertical realignment at Moeraki Boulders. Coastal erosion protection at Katiki Straight	Palmerston - Waikouaiti Corridor safety improvements	Waikouaiti - Dunedin Delineation improvements, surfacing enhancements, median and delineation improvements, snow/ice activated warning signs/pavement markers Waikouaiti flooding improvements and safer corridors treatment
	Medium term 2027-2026	Hilderthorpe Straight flood improvements and corridor safety improvements	Oamaru safety and access improvements Deborah Underpass improvements	Centreline wire-rope barriers (Herbert - Hampden) and corridor safety improvements Vertical and horizontal realignment south of Herbert	Corridor safety improvements Additional coastal erosion protection at Katiki Straight	Out-of-context curve easing	Centreline barriers through 2+2 passing lanes Out-of-context curve easing
	Long term 2037-2046						
	Capital Cost (\$M)	\$15M	\$25-30M	\$25-30M	\$50-60M	\$12M	\$35-40M
	Additional Operations and Maintenance Cost (\$k)	\$200k	\$400k	\$500k	\$300k	\$200k	\$1200k
	BCR	<1	<1	<1	<1	<1	<1
	Corridor Wide Activities	<p>Short term - Traveller information improvements, Incident response planning and tour planning, variable messaging signs, telco dead-zone elimination, behaviour improvements and pedestrian crossing improvements in small towns</p> <p>Medium to long term - roadside hazard removal (including roadside power poles)</p>					

Released under the Official Information Act 1982

Programme Assessment

When evaluating strategies, programmes, packages and projects, the Government Policy Statement requires both local government and the NZ 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; and
- Economic efficiency of the proposed solution.

The project was assessed against the New Zealand Transport Agency Investment Assessment Framework (IAF) resulting in an indicative assessment profile of **H/H/L** with benefit cost analysis 1.0-1.2.

Programme Cash Flow

The indicative programme cash flow is shown in Table 1. This cash flow is indicative and is to be confirmed with the NZ Transport Agency during the subsequent Indicative and Detailed Business Case. The costs and cashflow below do not include escalation or discounting.

Table 1 Indicative programme cashflow

Estimated Costs	Short Term (1-10)	Medium Term (11-20)	Long Term (21-30)
Mid Canterbury	\$64 M	\$233 M	\$0 M
South Canterbury	\$32 M	\$39 M	\$94 M
North Otago	\$60 M	\$71 M	\$8 M

Table of contents

Executive Summary	i
Introduction.....	i
Context.....	ii
Corridor Segments	iii
Concurrent Programme Business Cases.....	v
Current Situation and Future Considerations.....	vi
Problems and Benefits of Investment	vii
Investment Objectives.....	ix
Programme Options – Long List Assessment.....	ix
Programme Options Assessment	x
Recommended Programme	xiii
Programme Assessment.....	xvi
Programme Cash Flow	xvi
Part A – The Strategic Case.....	1
1. Introduction.....	1
2. Programme Context.....	2
2.1 Geographic and Environmental Context	2
2.2 Partners and Key Stakeholders.....	5
2.3 Social and Economic Context	6
2.4 Transport Context	7
3. Strategic Assessment – Outlining the Need for Investment	9
3.1 Mid Canterbury	9
3.2 South Canterbury.....	17
3.3 North Otago	27
4. Investment Objectives.....	34
4.1 Mid Canterbury	34
4.2 South Canterbury.....	35
4.3 North Otago	35
Part B – Developing the Programme	37
5. Alternatives and Options.....	37
6. Programme Options Development and Assessment.....	40
6.1 Programme options development and refinement.....	40
6.2 Long list to draft short list.....	40
6.3 Short list refinement.....	43
6.4 Short list programme options summary	47
6.5 Short list programme option assessment	49
7. Recommended Programme – Description and Assessment.....	53

7.1	The Recommended Programme	53
7.2	Recommended Programme Assessment	58
7.3	Assessment Profile	59
7.4	Programme Risk and Opportunity	61
8.	Programme Financial Case.....	63
8.1	Funding Arrangements	63
8.1	Indicative Cost and Programme Cash Flow	63
Part C – Delivering and Monitoring the Programme		64
9.	Planning and Delivery Overview	64
10.	Management Case.....	67
10.1	Programme Performance and Review.....	67
10.2	Governance and Reporting.....	67
10.3	Stakeholder Engagement and Communications Plan.....	67
11.	Commercial Case.....	68

Table index

Table 1	Indicative programme cashflow.....	xvi
Table 2:	Projected population of territorial authority areas	6
Table 3	State Highway 1 / Main South rail line crossings	7
Table 4	Collective and personal risk for Mid Canterbury	11
Table 5	Collective and Personal Risk for South Canterbury	19
Table 6	Collective and personal risk for North Otago	29
Table 7	Assessment of the long list (Mid Canterbury)	40
Table 8:	Assessment of the long list (South Canterbury).....	41
Table 9	Assessment of the long list (North Otago)	42
Table 10:	Short list refinements (Mid Canterbury)	44
Table 11:	Short list refinement (South Canterbury).....	45
Table 12:	Short list refinement (North Otago)	46
Table 13	Mid Canterbury short list and indicative timeframes	47
Table 14	South Canterbury short list and indicative timeframes.....	48
Table 15	North Otago short list and indicative timeframes	48
Table 16	Short list programme options assessment summary	50
Table 17	Summary of Identified Key Risks	62
Table 18	Indicative Programme Cash Flow (un-escalated)	63
Table 19	Recommended Activities for Early Development.....	65

Figure index

Figure 1 Regional context	ii
Figure 2: Mid Canterbury.....	iii
Figure 3: South Canterbury	iv
Figure 4 North Otago.....	v
Figure 5 Traffic volumes between Christchurch to Dunedin	vi
Figure 6 Mid Canterbury problem and benefit statements.....	vii
Figure 7: South Canterbury and Timaru urban problem and benefit statements.....	viii
Figure 8: North Otago problem and benefit statements.....	ix
Figure 9: Mid Canterbury.....	3
Figure 10 South Canterbury	4
Figure 11 North Otago.....	5
Figure 12 Traffic volumes between Christchurch and Dunedin	7
Figure 13 Mid Canterbury problem and benefit statements.....	9
Figure 14: Mid Canterbury crash type and severity	10
Figure 15: Mid Canterbury crash location and severity.....	10
Figure 16 Speed profile between Selwyn River and Ashburton southbound.....	12
Figure 17 Speed profile between Selwyn River and Ashburton northbound	12
Figure 18 Speed Profile through Ashburton urban southbound.....	13
Figure 19 Speed profile through Ashburton urban northbound.....	13
Figure 20 Traffic volumes on State Highway 1 (Tinwald) compared to truck volumes from 2011 to 2015	14
Figure 21: Ashburton pedestrian crossing facilities.....	15
Figure 22: Existing township pedestrian crossing facilities	16
Figure 23: South Canterbury and Timaru urban problem and benefit statements.....	17
Figure 24: South Canterbury crash type and severity.....	18
Figure 25: South Canterbury crash location and severity	19
Figure 26 Speed profile between Ashburton and Timaru southbound.....	21
Figure 27 Speed profile between Ashburton and Timaru northbound	21
Figure 28 Speed profile in urban Timaru southbound.....	22
Figure 29 Speed profile in Timaru urban northbound	23
Figure 30 Traffic volumes on state highway 1 (Evans Street) compared to truck volumes from 2011 to 2015.....	24
Figure 31: Timaru pedestrian crossing facilities.....	25
Figure 32: Existing township pedestrian crossing facilities	26
Figure 33 North Otago problem and benefit statements	27

Figure 34: North Otago crash type and severity	28
Figure 35: North Otago crash location and severity.....	28
Figure 36 Road closure locations in North Otago	30
Figure 37 Maximum (all hazards) disruption state levels North Otago	31
Figure 38: Oamaru pedestrian crossing points	32
Figure 39: North Otago pedestrian crossing facilities	33
Figure 40 Tiered assessment criteria.....	49
Figure 41 Mid Canterbury recommended programme.....	53
Figure 42: Ashburton intersection improvements.....	54
Figure 43: Tinwald corridor improvements.....	54
Figure 44: South Canterbury recommended programme	55
Figure 45: North Otago recommended programme.....	57
Figure 46 Recommended programme effectiveness assessment.....	60

Appendices

- Appendix A – Investment Logic Map
- Appendix B – Benefits Map
- Appendix C – Christchurch to Dunedin stakeholders
- Appendix D – Uncertainty Log
- Appendix E – Risk Assessment

Part A – The Strategic Case

1. Introduction

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

Facilitated Investment Logic Mapping (ILM) workshops were held on 9th (Selwyn River to Waitaki River) and 4th of November 2015 (Waitaki River to Dunedin) with key stakeholders to gain a better understanding of current issues. At this time, stakeholders agreed upon three problem areas that would drive and influence future investment on State Highway 1 (SH1). These problem areas were safety, resilience/reliability and accessibility. The strategic case for investment in the transport corridor between Christchurch and Dunedin was developed and approved in February 2016.

Before developing a programme business case for the SH1 Christchurch to Dunedin corridor, it was identified that there was a need to explore the problems associated with SH1 as they specifically relate to the Timaru urban area. This ILM workshop brought participants together for a “dep dive” into the problems for Timaru, and there was agreement at this time of following three problem statements with assigned weightings:

- Future growth of primary industry increases the number of heavy commercial vehicles on SH1 leading to inefficient traffic flow (50%)
- Volume and make-up of traffic on SH1 reduces community access and amenity (40%)
- Delays waiting to join or cross SH1 and at merges lead to crashes (10%).

During the development of the programme business case, the strategic case was reconfirmed to refresh stakeholder understanding, 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.

Workshops were held with key stakeholders from each segment in Ashburton (Mid Canterbury), Timaru (South Canterbury) and Oamaru (North Otago) in June 2016 as part of the programme business case process. These focused on confirming the problems and benefits, and examining the evidence base that supports the problems. This workshop also examined what stakeholders wanted to achieve from the programme business case and relevant Investment Objectives. As a result of this process, a more fine-grain understanding of the issues around safety, reliability, resilience and state highway access has led to a refinement of the problem statements.

It should be noted that the programme also considers changes to technology in transportation over time including electronic 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 NZ Transport Agency national initiatives or private enterprise (i.e. charging stations within service centres).

2. Programme Context

2.1 Geographic and Environmental Context

State Highway 1 between Christchurch and Dunedin is a national strategic road under the one network road classification. The journey from the Selwyn River to the northern boundary of Dunedin is about 320 kilometres.

The road alignment on the northern section of this journey is generally flat and straight, and becomes more rolling and curved south of Timaru. South of Oamaru the road alignment becomes more undulating and curved towards Dunedin where the highway traverses the Kilmog and Leith Saddle (approximately 370 m above sea level).

The state highway crosses several braided rivers along the corridor, and these bridges are important infrastructure assets due to the limited viable detours available in the event of an outage. Many were built some years ago and can feel narrow to some drivers. The highway passes through, over and beside several natural environments such as low-lying flood plains, coastal marine areas and elevated snow-prone areas that can experience closures during certain weather events. While high productivity motor vehicle (HPMV) access is available, some bridges are being monitored for their suitability for heavier vehicles in the longer term.

The South Island's two largest population centres, Christchurch and Dunedin, lie at either end of this section of State Highway 1. These cities have major services including health, university, commercial centres, international airports and ports. Timaru also has a port (PrimePort), which along with Lyttelton (Christchurch) and Port Chalmers (Dunedin) provides freight connectivity to other centres and international markets. The state highway corridor is the key strategic route linking Christchurch to Dunedin for the purposes of freight, tourism, inter-regional, and local movements.

The main south rail line runs adjacent to the state highway for much of the route, and the close proximity can present safety issues for vehicle access to the state highway. The main south line is used mainly for freight with key rail yards or sidings at Lyttelton Port, CityPort Woolston, Middleton, Sockburn, Rolleston, Ashburton, Temuka, Washdyke, Timaru, Oamaru and Dunedin.

The predominant land-use along the route is rural farmland, with intensive dairy and agriculture production facilitated through the Canterbury Water Management Strategy and various irrigation schemes including the expansion within Waitaki District. This activity is forecast to continue into the future.

Urban settlement on the corridor is generally evenly distributed amongst a number of towns servicing the rural communities. Timaru is located approximately halfway between Christchurch and Dunedin and is the largest urban area along the corridor. The towns of Ashburton and Oamaru are located approximately halfway between Timaru and Christchurch, and Timaru and Dunedin respectively. Smaller settlements are generally evenly interspersed between these main centres.

State Highway 1 from Christchurch to Dunedin is the most direct path for people traveling up and down the South Island. Between the two cities several state highways (from north to south: State Highways 77 79, 8, 82, 83, and 85) intersect on the western side of State Highway 1 and access tourism locations such as Lake Tekapo, Mt Cook and Queenstown. These state highway connections provide freight, tourism, and West Coast. State Highway 78 branches off to the east to access Prime Port Timaru.

The interface of State Highway 1 and the main south rail line, the route profile and integration with other transport network services is illustrated in the schematic diagrams for each of the three state highway segments for this programme business case:

- Mid Canterbury (Selwyn River to Rangitata River, including Ashburton urban);
- South Canterbury (Rangitata River to Waitaki River, including Timaru urban)
- North Otago (Waitaki River to Dunedin (Pine Hill intersection), including Oamaru urban).



Figure 9: Mid Canterbury



Figure 10 South Canterbury



Figure 11 North Otago

2.2 Partners and Key Stakeholders

This programme business case is being developed as a collaborative exercise between the New Zealand Transport Agency, Environment Canterbury and Otago Regional Council, KiwiRail and Selwyn, Ashburton, Timaru, Waimate, Waitaki and Dunedin District Councils.

These stakeholder partners were also all closely involved in the development of the strategic case. An overview of the team structure and lines of reporting and communication is provided in Appendix C, broken down into 'Responsible, Accountable, Consulted, and Informed (RACI)'. During the programme business case process, the investors were 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.

2.2.1 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:

- Ports and Container terminals;
- Freight (truck) operators;
- Local commuters;
- Tourism organisations; and
- Emergency services.

A number of stakeholders were involved in the development of this programme business case including councils, Automobile Association, NZ Police, and others who provided valuable input as to the customer experience for this corridor.

2.3 Social and Economic Context

Population

Transport links are vital for economic activity and critical for regions that rely on primary industries, tourism, and connections with markets and ports. Significant population growth for the territorial authority areas between Christchurch and Dunedin is not expected over the next 30 years with current population growth forecasts between zero and one percent annual average growth (calculated as a constant rate of population change over the 30 year period). The exception is the Selwyn district with s projected to have between one and three percent growth by 2043.

Table 2 below has the predicted populations of each of the territorial areas that the state highway goes through.

Table 2: Projected population of territorial authority areas

District	2013 population	2028 predicted	2043 predicted
Selwyn District	46,700	70,800	89,400
Ashburton District	32,300	38,400	42,600
Timaru District	45,400	48,400	48,600
Waimate District	7,810	8,400	8,500
Waitaki District	21,400	22,500	22,600
Dunedin City	123,500	129,700	130,700

Industries and Employment

Key sectors for the Canterbury economy are agriculture (dairy and sheep, beef cattle and grain farming) and manufacturing (transport and machinery equipment, and food and beverage). Christchurch is the manufacturing hub of the region, with particular strengths in machinery and equipment manufacturing and chemical, minerals and metal manufacturing. Following the 2010

and 2011 earthquakes, the construction industry has shown rapid growth, as workers moved in to rebuild the city. The increase in construction employment in Christchurch was also experienced in the neighbouring districts of Waimakariri and Selwyn.

The Otago economy has considerable diversity across its five territorial authorities. Education and health care are the main focus of Dunedin City's economy, with just over a quarter (26.4 per cent) of all employment being in one of those two industries. This reflects the importance of Dunedin's educational assets: The University of Otago alone has been estimated to contribute around 15 per cent of the city's GDP (University of Otago, 2015). Manufacturing employment has been declining in Dunedin, although this is being offset with gains in the tourism, education, high-tech and Information Communication and Technology (ICT) sectors.

The Waitaki District is relatively specialised in sheep, beef cattle and grain farming, and has seen increased levels of dairying and tourism activity over the past decade

2.4 Transport Context

2.4.1 Traffic volumes

A summary of traffic volume data was presented in the strategic case which illustrates the decreasing traffic volumes travelling south on State Highway 1 from Christchurch to Dunedin. Figure 12 shows that there was an average of approximately 12,500 vehicle trips per day for State Highway 1 between Christchurch to Ashburton, 7,500 vehicle trips per day between Ashburton to Timaru, 6,000 vehicle trips per day between Timaru and Oamaru and 5,000 vehicle trips per day between Oamaru to Dunedin.

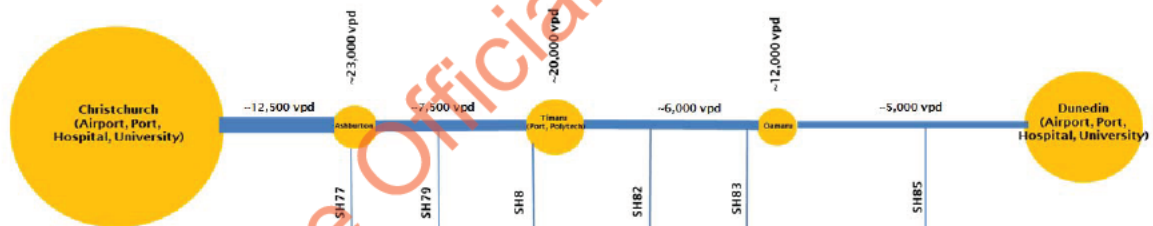


Figure 12 Traffic volumes between Christchurch and Dunedin

2.4.2 Main South Rail Line crossings

The Main South Rail Line crosses this section of State Highway 1 eleven times. The level rail crossings, overbridges and underpass are listed in Table 3.

Table 3 State Highway 1 / Main South rail line crossings

Type of Control	Road Name/ Location
Flashing lights and bells	Selwyn (south of river), Winchester (north of township, Maheno (north of township)
Half arm barriers	Chertsey, Ashburton (north side of river), Oamaru (Oamaru Public Gardens)
Grade separated crossings	Rakaia Rail Overpass (north of river), Deborah Underpass, Wainakarua Over Bridge (south of Herbert), Katiki Overbridge (northern end of Katiki Straight), Palmerston Overbridge,(eastern extent of urban area)

2.4.3 Cycle Network

For most of the rural sections of State Highway 1 between Christchurch to Dunedin, there are no dedicated cycle facilities, e.g. cycle lanes, road markings, signage and there is no parallel off-road path.

There are no dedicated cycle lanes on State Highway 1 in the urban area of Timaru. Cycling in Timaru is encouraged on the adjacent local road network and shared paths.

In north Oamaru there are cycle lanes along both sides of State Highway 1 and a shared path alongside the main south rail line.

2.4.4 Freight

It is estimated that freight movements will double over the next 30 years as New Zealand's population and economy grows¹ In July 2015, the draft South Island Freight Plan summarised the characteristics freight moved in the South Island. These characteristics include²:

- A majority of freight (by weight) travelling within the South Island's regions rather than across them;
- Canterbury accounting for approximately half of the total freight moved, and this will continue into the future;
- The majority of freight in the South Island being moved by road, with a small percentage moved by rail, coastal shipping or air; with this forecast to continue;
- Substantial projected freight growth with an extra 47.7 m tonnes of freight being carried in 2042 compared with 2012 (68 percent increase). This equates to an additional 1.7 m truck trips in 2042 compared with 2012. This means an additional 4,667 truck trips (based on 44 tonne trucks) per day across the network;
- Freight demand in the South Island being driven by a mix of primary sector and export growth, and population growth and change; and
- The greatest growth in freight demand is forecast for between 2012 and 2027, with the rate of growth then slowing

¹ National Freight Demand Study March 2014 (NFDS) Ministry of Transport

² Draft South Island Freight Plan, July 2015

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 Christchurch to Dunedin Confirming the Context for the Programme Report.

3.1 Mid Canterbury

The problem statements for Mid Canterbury shown in Figure 13 below, reflect the evidence that has been collected and analysed as well as through discussions and communication with stakeholders.




Themes	The Problems	Benefit Statement
 Safety	Problem 1: State Highway 1 has some unforgiving sections, combined with driver mistakes contributes to fatal and serious injury crashes.	Improved road user safety
 Reliability	Problem 2: State Highway 1 has a diverse range of vehicles with varying speeds, combined with increasing traffic volumes contributes to travel time reliability issues.	A reliable corridor allowing the movement of people and goods
 State Highway Access	Problem 3: Corridor layout and existing land use, combined with increasing traffic volumes constrains access on to, across and off the state highway for all modes of travel.	Improved access on to, across and off the state highway

Figure 13 Mid Canterbury problem and benefit statements

3.1.1 Problem One: Safety

Problem statement

State Highway 1 has some unforgiving sections that, combined with driver mistakes, contribute to fatal and serious injury crashes.

The evidence

In order to determine the actual crash risk for State Highway 1 for the Mid Canterbury segment from Selwyn River to Rangitata River, the most recent data in the NZ Transport Agency’s Crash Analysis System (CAS) has been analysed. A fatal crash is defined as injuries that result in death within 30 days of the crash. A serious injury crash is defined as an injury that involves removal to, and detention in, hospital.

Figure 14 and Figure 15 shows they type, severity and location of crashes that occurred in the Mid Canterbury segment from 2011 to 2015. There have been 28 fatal and serious injury crashes between the Selwyn River and the Rangitata River. It shows that the highest number of

fatal and serious injury crashes in Mid Canterbury is a result of head-on crashes, and crashes are occurring at a higher rate between Dunsandel and Rakaia.



Figure 14: Mid Canterbury crash type and severity

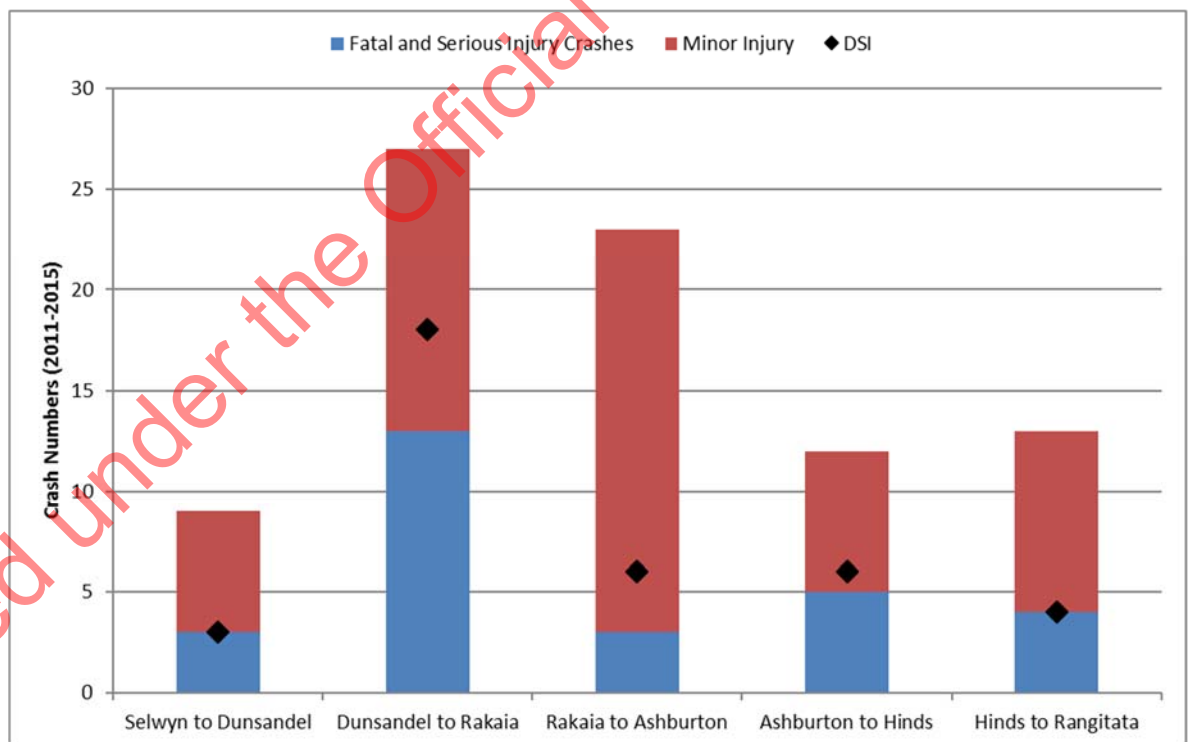


Figure 15: Mid Canterbury crash location and severity

The Mid Canterbury segment has an average crash rate of 0.068 fatal and serious injury crashes per kilometre each year. This compares to an average crash rate on of 0.070 on state highways in the Canterbury region, and a rate of 0.065 on all state highways nationally.

The collective and personal risk ratings have been classified using the NZ Transport Agency High Risk Rural Roads Guide for various locations along the Mid Canterbury segment. Table 4

shows that the section between Dunsandel to Rakaia has a high collective risk, and the Selwyn to Dunsandel and Ashburton to Hinds are classified with a medium-high collective risk. .

Table 4 Collective and personal risk for Mid Canterbury

Location	F+S/km/year	Collective risk	F+S/100Mvkt	Personal risk
Selwyn to Dunsandel (4.2 km)	0.145	Medium-high	0.5	Low-Medium
Dunsandel to Rakaia (17 km)	0.153	High	0.5	Low-Medium
Rakaia to Ashburton (25.5 km)	0.023	Low-medium	0.5	Low
Ashburton	Not Applicable to Urban Areas			
Ashburton to Hinds (13 km)	0.077	Medium-high	2.0	Low-Medium
Hinds to Rangitata (15.1 km)	0.053	Medium	2.0	Low

The personal risk from Selwyn River to Rangitata River has a low or low-medium personal risk.

It should be noted that in addition to the personal and collective risk it was identified that there were some outcomes and trends for the section between Selwyn River and Rakaia that were of concern and needs further investigation as part of the recommended programme option.

There was discussion by the stakeholders involved in this programme business case around the difficulties school children have in crossing the SH1 / Walnut Avenue intersection safely, providing access to Ashburton Intermediate and Ashburton High schools. During the development of this programme business case, the project team observed and confirmed that there is safety and access issues for pedestrians at this intersection.

3.1.2 Problem Two: Travel Time Reliability

Problem statement

State Highway 1 has a diverse range of vehicles with varying speeds, combined with increasing traffic volumes contributes to travel time reliability issues.

The evidence

The road alignment on the northern section of this journey is generally flat and straight. Travel time reliability issues on SH1 in Mid Canterbury is a result of the type of vehicles and the speed which they can travel, particularly over-dimension vehicles, agricultural vehicles of varying configurations HMPV's and HCV's (notably milk tankers and stock trucks). Encountering these type of vehicles is contributing to drivers taking unnecessary risks to pass resulting in DSIs. The speed limits through the urban area of Ashburton and some of the smaller townships along the corridor is also resulting in 'traffic bunching', which in turn is contributing to risk taking behaviour by drivers.

It has been expressed that the objective in resolving the problem of travel time reliability is not to increase travel speeds along the route, but rather to maintain reliable and consistent travel speeds. Maintaining travel speeds and journey times with increasing traffic volumes over the planning horizon was agreed to be an appropriate objectives, so that on any one day, customers can have a high degree of certainty about how long their journey will take.

Travel speeds along the Mid Canterbury segment of State Highway 1 in 2015 have been examined using data made available by TomTom. The southbound and northbound speed profiles for the rural section between Selwyn River and Ashburton are shown in Figure 16 and Figure 17 respectively. The graphs below show the variation between the 50th and the 15th percentile speeds is consistently around a 5 km/h difference that results in a 7-minute travel time difference across the segment.

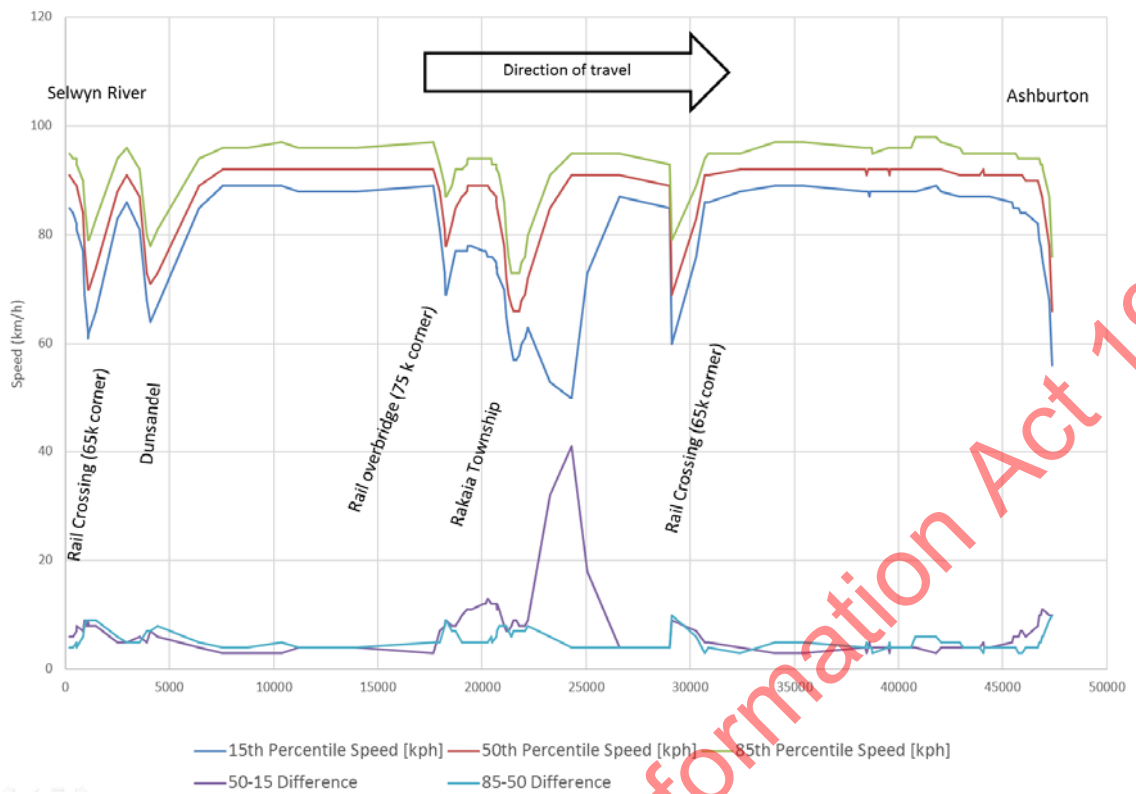


Figure 16 Speed profile between Selwyn River and Ashburton southbound

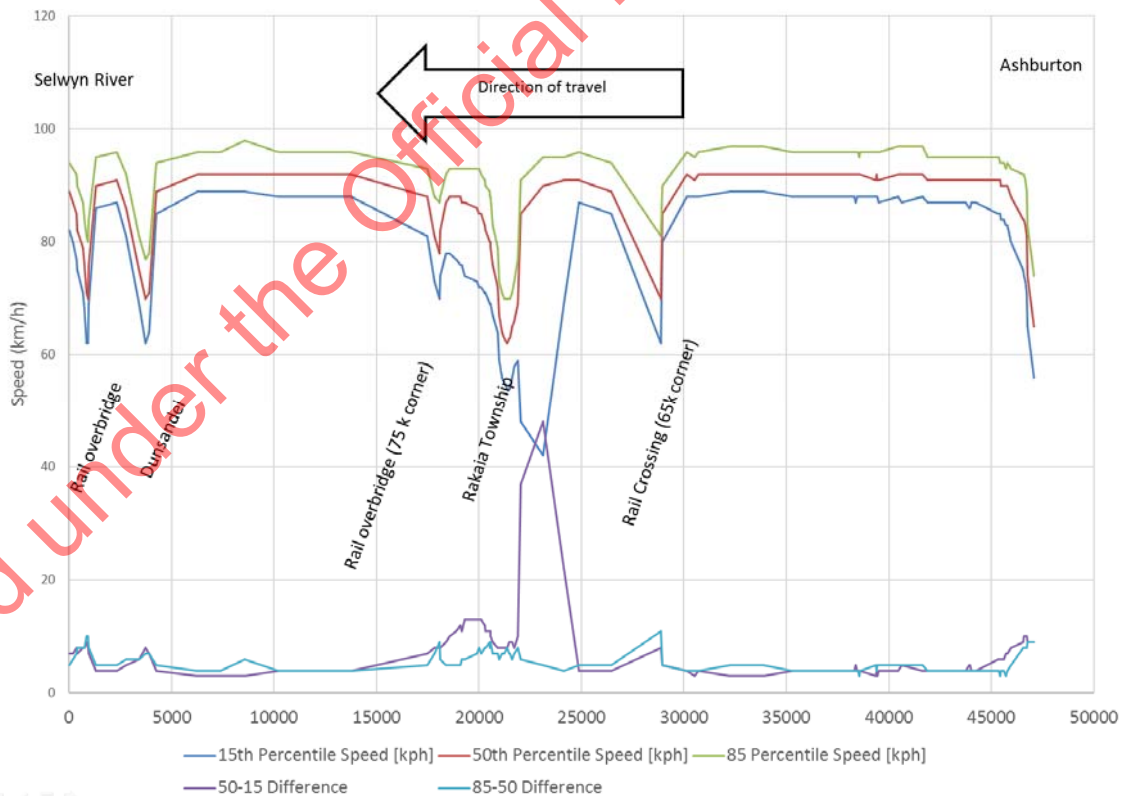


Figure 17 Speed profile between Selwyn River and Ashburton northbound

The median (50th percentile) travel speed on the rural section of State Highway One between Selwyn and Ashburton is around 90 km/h. The 15th and 85th percentile speeds are typically within 10 km/h of the median speed, indicating relatively reliable travel times. Journey times over this section of State Highway 1 are considered to be reliable.

The significant differential in speeds between the 50th and the 85th percentile is most likely due to roadworks that were in place in 2015 when the data was recorded.

The southbound and northbound speed profiles for Ashburton urban are shown in Figure 18 and Figure 19 respectively.

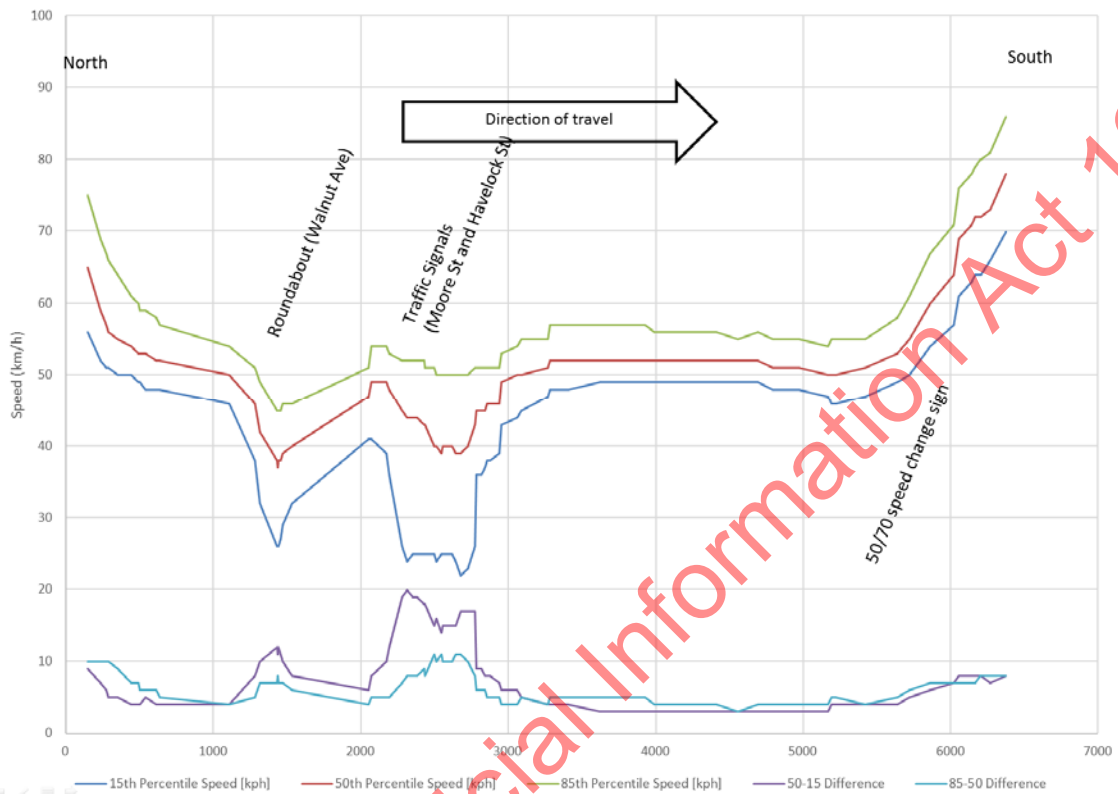


Figure 18 Speed Profile through Ashburton urban southbound

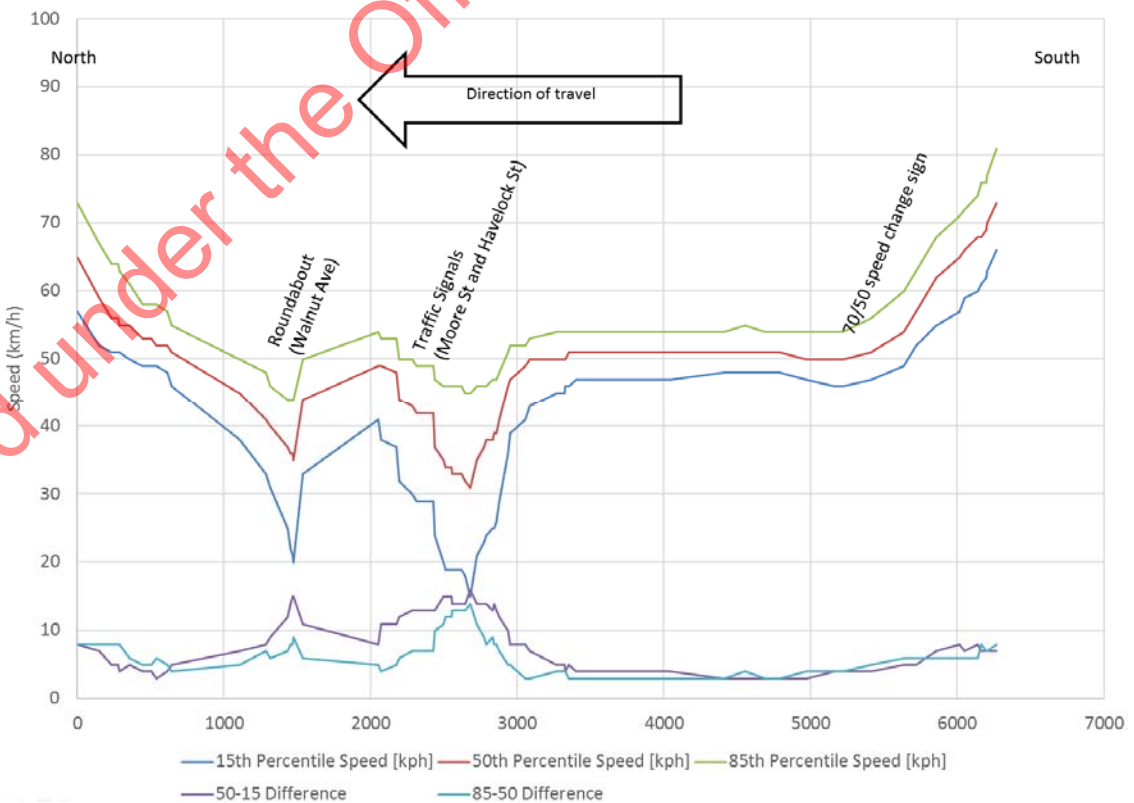


Figure 19 Speed profile through Ashburton urban northbound

The median (50th percentile) travel speed on the urban section of State Highway 1 through Ashburton is around 50 km/h except where vehicles are slowing for the roundabout the Walnut Ave intersection and the tow signalised intersections. The 15th and 85th percentile speeds are typically within 10 km/h of the median speed, indicating relatively reliable travel times. Journey times over this section of State Highway 1 are considered to be reliable.

Travel times along the Ashburton to Rangitata River section of the Mid Canterbury segment of State Highway 1 in 2015 shows that the median (50th percentile) travel speed around 90 km/h, except through Hinds which has a 70 km/h post speed limit. The speed profiles for this section of State Highway 1 are presented in in South Canterbury section of this report.

Traffic volumes

In urban Ashburton, there has been an approximate 2 percent annual growth in traffic volumes (Annual Average Daily Traffic (AADT)) from 2011 to 2015 as shown in Figure 20. During the same period there has been an approximate 2 percent decline in Heavy Commercial Vehicles (HCV's), likely to be due to the introduction of High Productivity Motor Vehicles (HMPVs) that can carry up to 62 tonnes with certain configurations. Increasing HMPV's volumes could be contributing to the diverse range of vehicles of varying size and speeds experienced along this segment of the corridor.



Figure 20 Traffic volumes on State Highway 1 (Tinwald) compared to truck volumes from 2011 to 2015

3.1.3 Problem Three: State highway access

Problem statement

Corridor layout and existing land use, combined with increasing traffic volumes constrains access on to, across and off the state highway for all modes of travel.

The evidence

Based on the traffic volume and the crossing distance, the average crossing delay time is 24 seconds, which equates to a LOS E₃ during the peak hour. This is based on the assumption that the peak hour traffic volume is 10% of the AADT and that pedestrians can stop in the flush median.

³ Guidelines for the selection of pedestrian facilities – Abley Transportation Consultants 2002

The following are the pedestrian crossing facilities in Ashburton as shown on Figure 21 below:

- One pedestrian crossing and one pedestrian refuge island south of the Ashburton River (approximately 3 km);
- Two signalised pedestrian crossings at Havelock St and SH77 intersections;
- Two mid-block pedestrian islands north of Ashburton River;
- Refuge islands at roundabout and rail crossing;
- Flush median throughout Ashburton, except over the bridge.

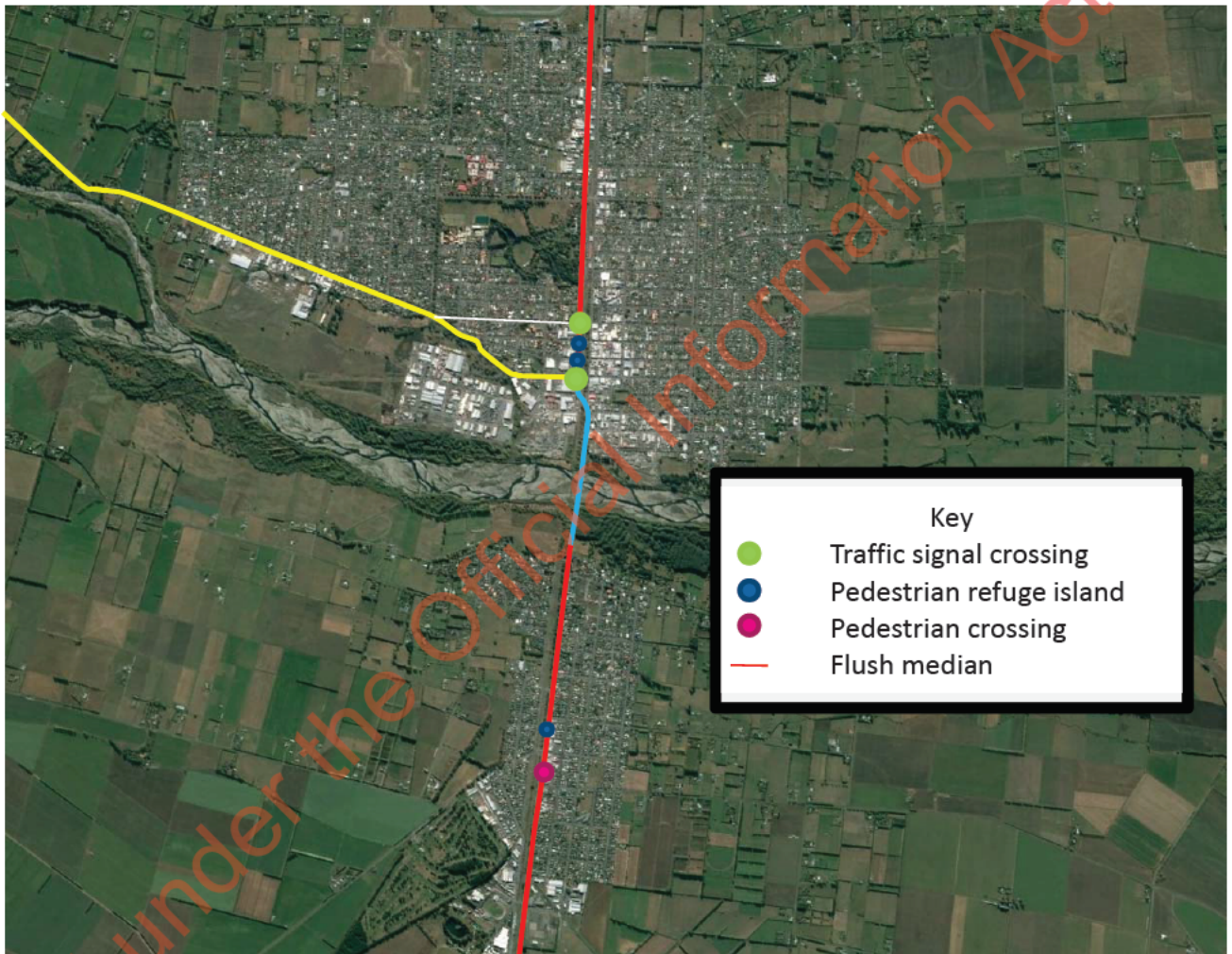
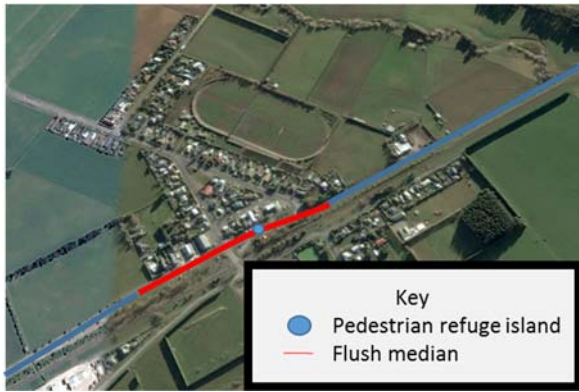


Figure 21: Ashburton pedestrian crossing facilities

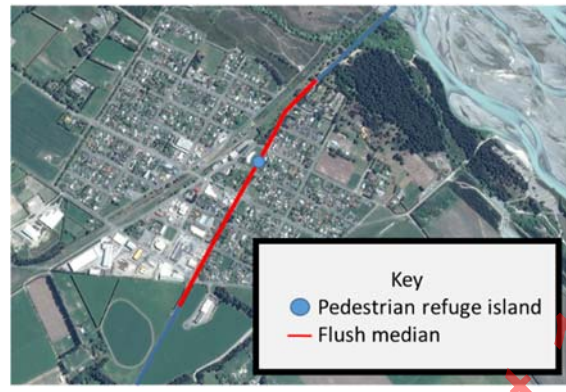
There was discussion by the stakeholders involved in this programme business case around the difficulties school children have in crossing the SH1 / Walnut Avenue intersection safely, providing access to Ashburton Intermediate and Ashburton High schools. During the development of this programme business case, the project team observed and confirmed that there is safety and access issues for pedestrians at this intersection.

Figure 23 below shows the pedestrian crossing facilities in the small towns of Mid Canterbury. The facilities include:

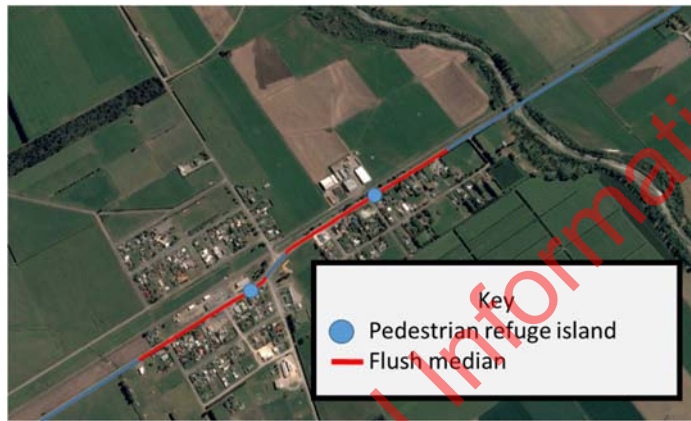
- Flush median and one pedestrian refuge island in Dunsandel;
- Flush median and one pedestrian refuge island in Rakaia;
- Flush median and two pedestrian refuge islands in Hinds.



Dunsandel



Rakaia



Hinds

Figure 22: Existing township pedestrian crossing facilities

3.2 South Canterbury

The South Canterbury segment has been split into Timaru Urban (between the 100/70 speed change sign at the racecourse and the 100/50 speed change at Saltwater Creek) and the rural section (north and south of Timaru).

3.2.1 South Canterbury

	Themes	The Problems	Benefit Statement
Rural	Safety	Problem 1: State Highway 1 has some unforgiving sections, combined with driver mistakes contributes to fatal and serious injury crashes.	Improved road user safety
	Reliability	Problem 2: State Highway 1 has a diverse range of vehicles with varying speeds, which contributes to travel time reliability issues.	A reliable corridor allowing the movement of people and goods
	State Highway Access	Problem 3: Corridor layout and existing land use constrains access on to, across and off the state highway for all modes of travel.	Improved access on to, across and off the State Highway
Urban	Reliability	Problem 1: Future growth of industry increases the number of HCVs on State Highway 1, contributing to travel time reliability issues.	A reliable corridor allowing the movement of people and goods
	State Highway Access	Problem 2: Corridor layout and existing land use constrains access on to, across and off the state highway for all modes of travel.	Improved ability to access, cross and off the State Highway

Figure 23: South Canterbury and Timaru urban problem and benefit statements

Problem statement (Rural)

State Highway 1 has some unforgiving sections that, combined with driver mistakes, contribute to fatal and serious injury crashes. (Safety)

The evidence

In order to determine the actual crash risk for State Highway 1 for the South Canterbury segment from Rangitata River to Waitaki River, data from the NZ Transport Agency's Crash Analysis System (CAS) has been analysed.

Figure 24 and Figure 25 shows they type, severity and location of crashes that occurred in the South Canterbury segment from 2011 to 2015. There have been 34 fatal and serious injury crashes in rural areas of State Highway 1 between the Rangitata River and the Waitaki River. It shows that the highest number of fatal and serious injury crashes in South Canterbury is a result of head-on and intersection crashes. Crashes occur at a higher rate between Temuka and Timaru.

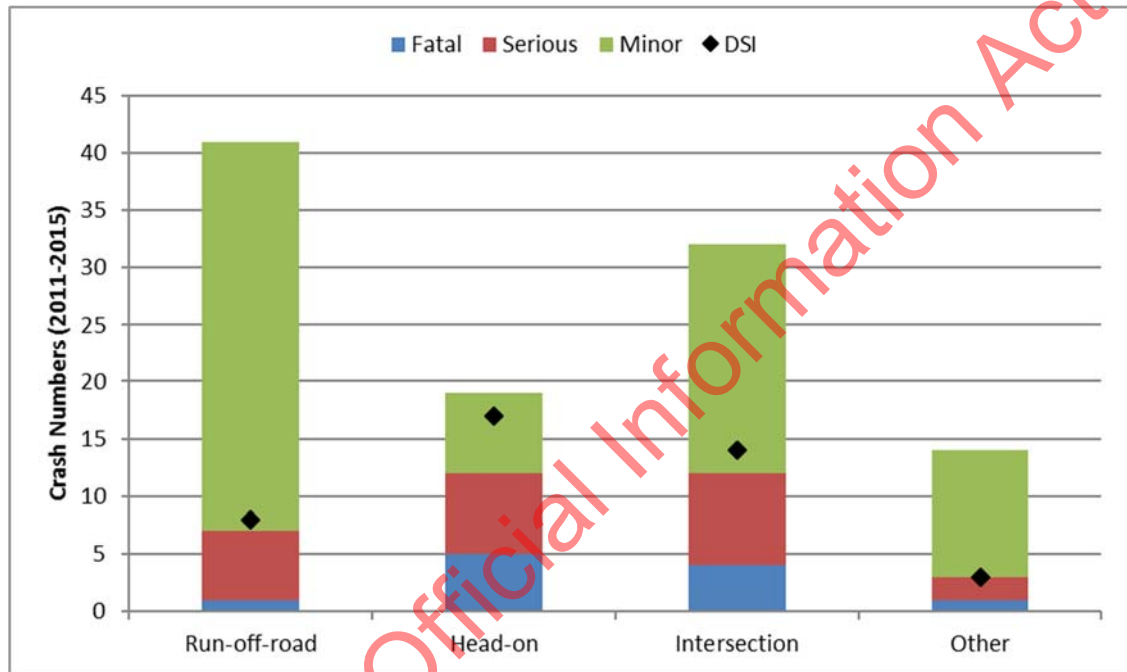


Figure 24: South Canterbury crash type and severity

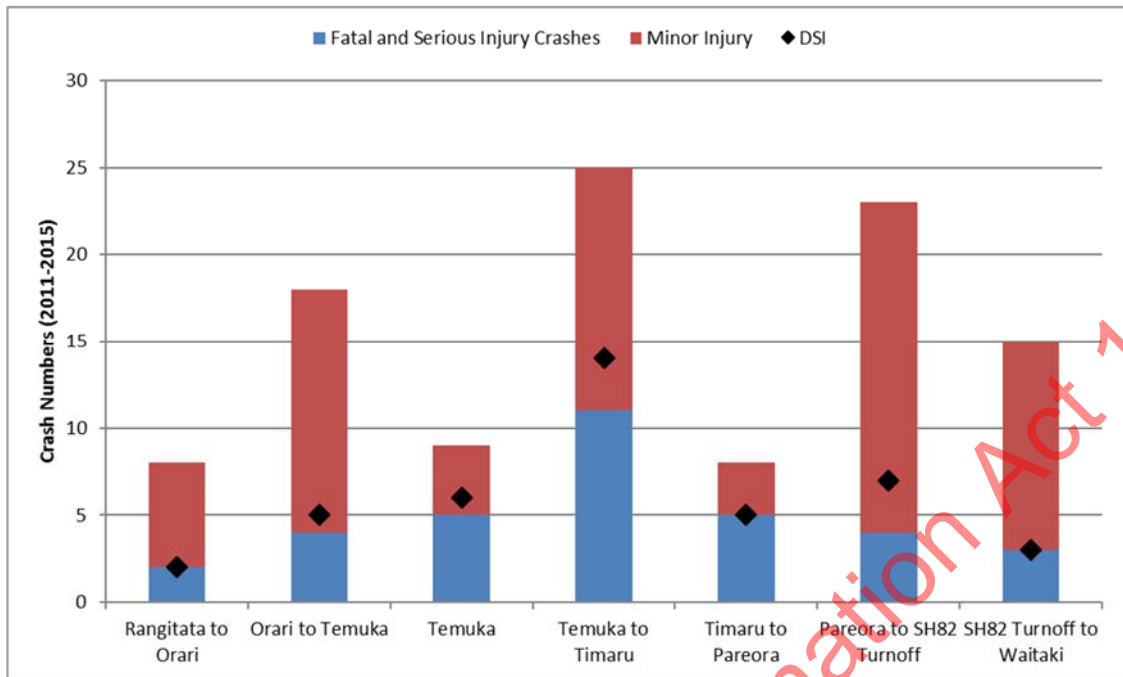


Figure 25: South Canterbury crash location and severity

The South Canterbury section has an average crash rate of 0.063 fatal and serious injury crashes per kilometre each year. This compares to state highways in the Canterbury region, and all New Zealand state highways of 0.070 and 0.065 respectively.

The collective and personal risk ratings have been classified using the NZ Transport Agency High Risk Rural Roads Guide for various locations along the South Canterbury segment.

Table 5 shows that the section between Temuka and Timaru has a high collective risk and a medium personal risk, whilst the Timaru to Pareora section is classified as a medium-high collective risk and a low-medium personal risk. The personal risk for the remaining sections has a low personal risk.

Table 5 Collective and Personal Risk for South Canterbury

Section	FS/km/year	Collective risk	FS/100MVKT	Personal Risk
Rangitata to Orari	0.03	Low-medium	1.34	Low
Orari to Temuka	0.06	Medium	2.17	Low
Temuka to Timaru	0.24	High	5.37	Medium
Timaru to Pareora	0.12	Medium-high	3.99	Low-Medium
Pareora to SH82 Turnoff	0.03	Low-medium	1.33	Low
SH82 Turnoff to Waitaki	0.02	Low-medium	1.40	Low

3.2.2 Problem Two: Travel Time Reliability

Problem statement (Rural)

State Highway 1 has a diverse range of vehicles with varying speeds, which contributes to travel time reliability issues.

The evidence

The road alignment on the northern section of this journey is generally flat and straight, and becomes more rolling and curved south of Timaru. Travel time reliability issues on SH1 in South Canterbury is a result of the type of vehicles and the speed which they can travel, particularly over-dimension vehicles, agricultural vehicles of varying configurations, HMPV's and HCV's (notably milk tankers and stock trucks). Encountering these type of vehicles is contributing to drivers taking unnecessary risks to pass resulting in DSIs. The speed limits through the urban area of Timaru and some of the smaller townships along the corridor is also resulting in 'traffic bunching', which in turn is contributing to risk taking behaviour by drivers.

It has been expressed that the objective in resolving the problem of travel time reliability is not to increase travel speeds along the route, but rather to maintain reliable and consistent travel speeds, even with increasing traffic volumes over the planning horizon, so that on any one day customers can have a high degree of certainty about how long their journey will take

Travel time

Travel speeds along the South Canterbury segment of State Highway 1 in 2015 have been examined using data made available by TomTom. The southbound and northbound speed profiles for the rural section between Ashburton and Timaru are shown in Figure 26 and Figure 27 respectively.

These show that the median (50th percentile) travel speed on the rural section of State Highway 1 between Ashburton and Timaru is around 90 km/h. Travel speeds are lower in this South Canterbury segment where there are reduced speeds, including the level rail crossing north of Winchester with an advisory speed of 65 km/h, and 50 km/h speed limits for the townships of Winchester and Temuka.

Journey times over this section of State Highway 1 are considered to be reliable.

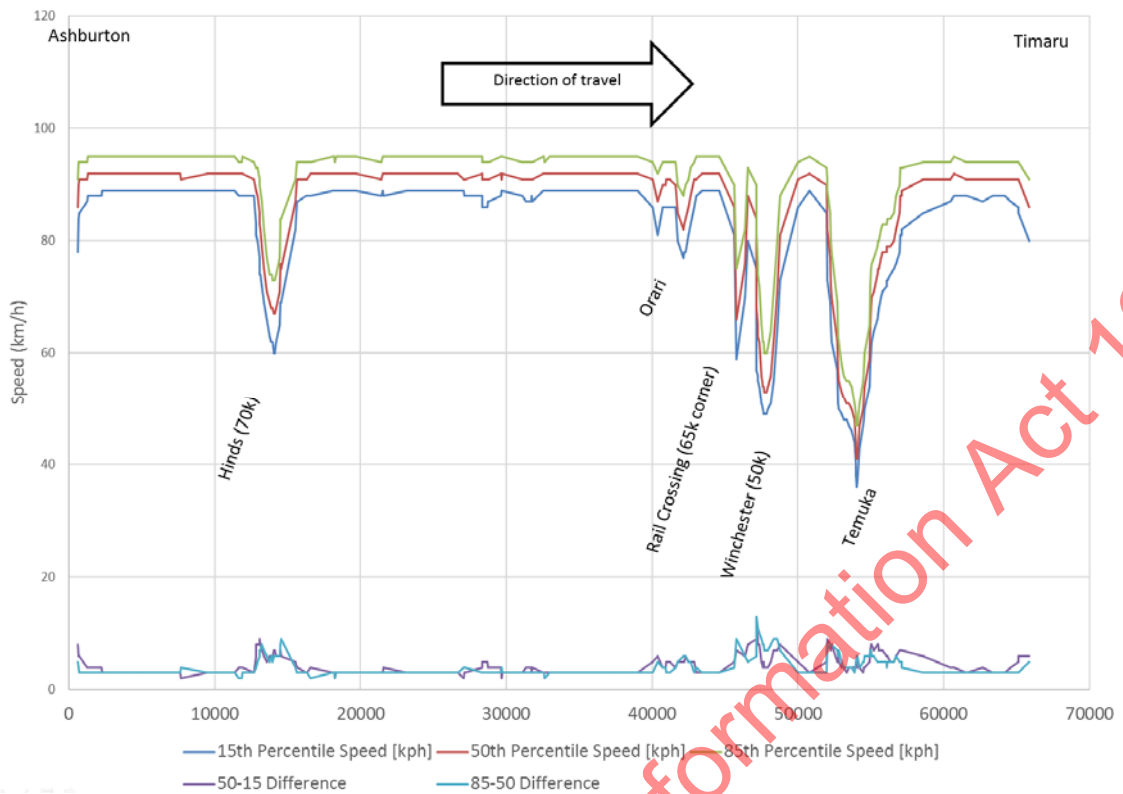


Figure 26 Speed profile between Ashburton and Timaru southbound

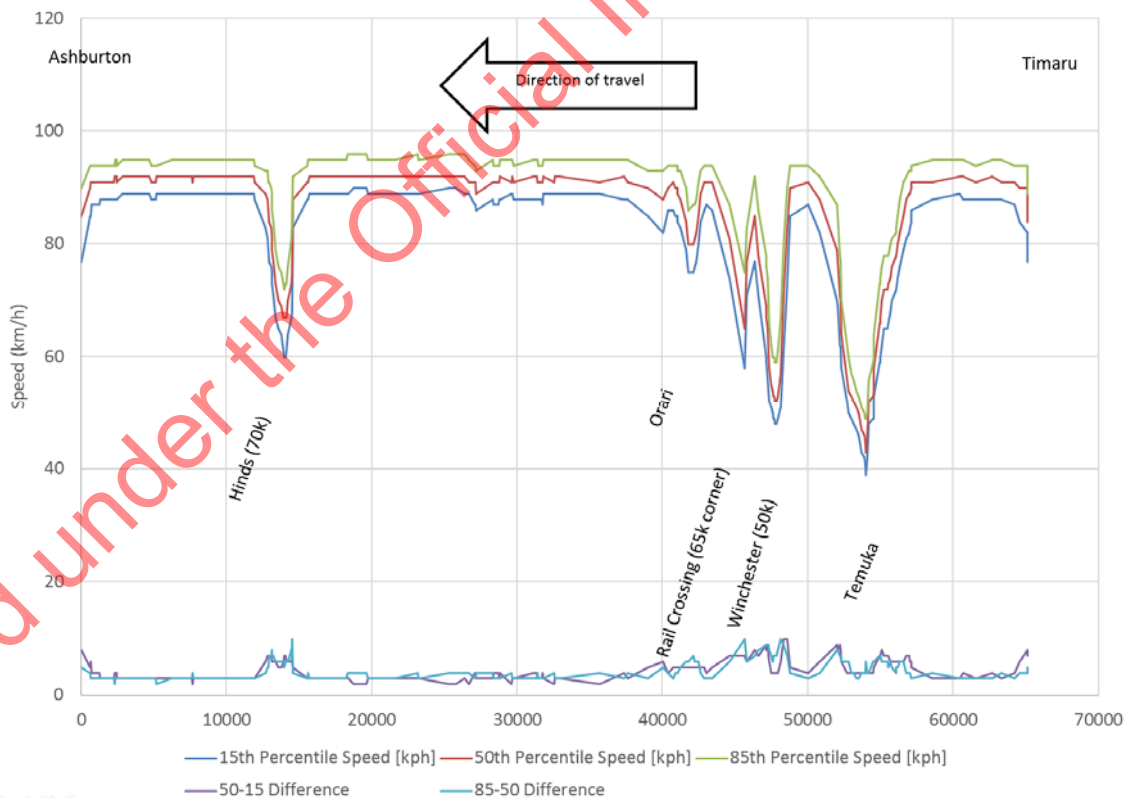


Figure 27 Speed profile between Ashburton and Timaru northbound

Travel speeds along the Timaru to Waitaki rural section for the South Canterbury segment of State Highway 1 in 2015 shows that the median (50th percentile) travel speed around 90 km/h, except through the following sections:

- Normanby (due to undulating topography);
- St Andrews (70 km/h posted speed limit);

- Makikihi (70 km/h posted speed limit);
- Glenavy (70 km/h posted speed limit).

Journey times over this section of State Highway 1 are considered to be reliable.

Problem statement (urban)

The future growth of industry increases the number of HCV's on State Highway 1, contributing to travel time reliability issues.

The evidence

The southbound and northbound speed profiles for Timaru urban between Washdyke and Saltwater Creek are shown in Figure 28 and Figure 29 respectively.

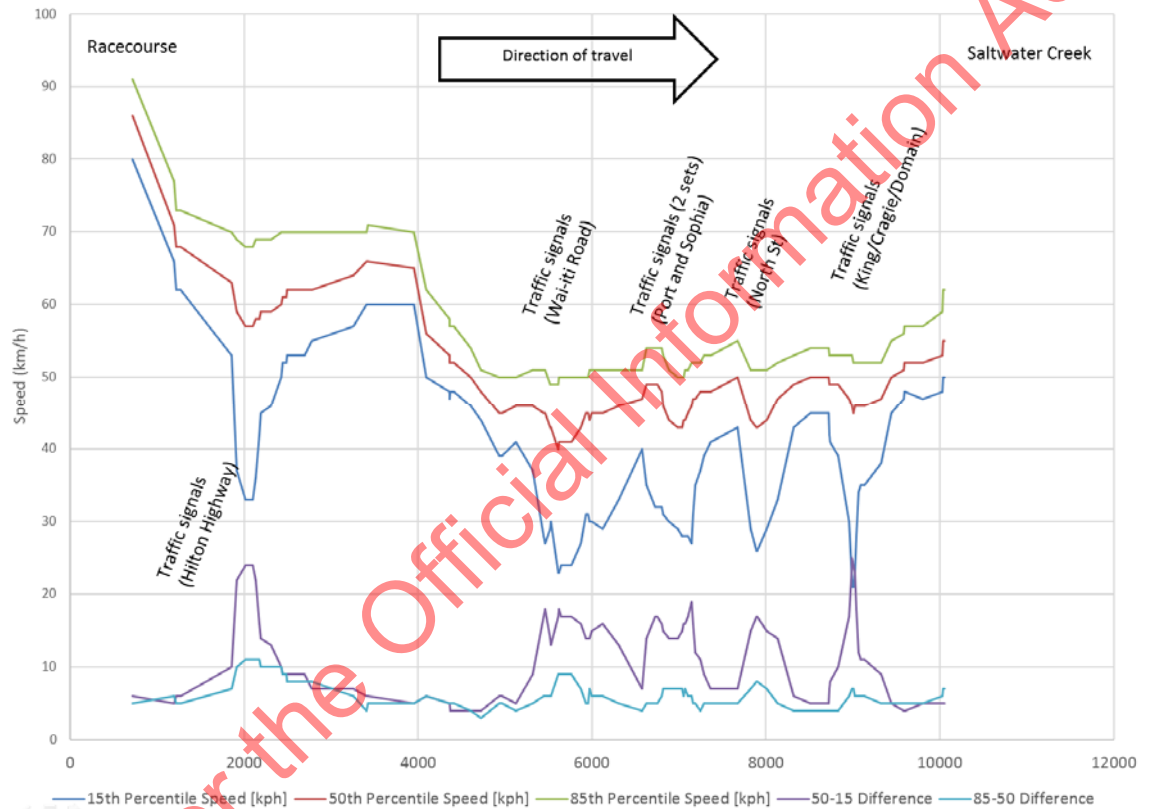


Figure 28 Speed profile in urban Timaru southbound

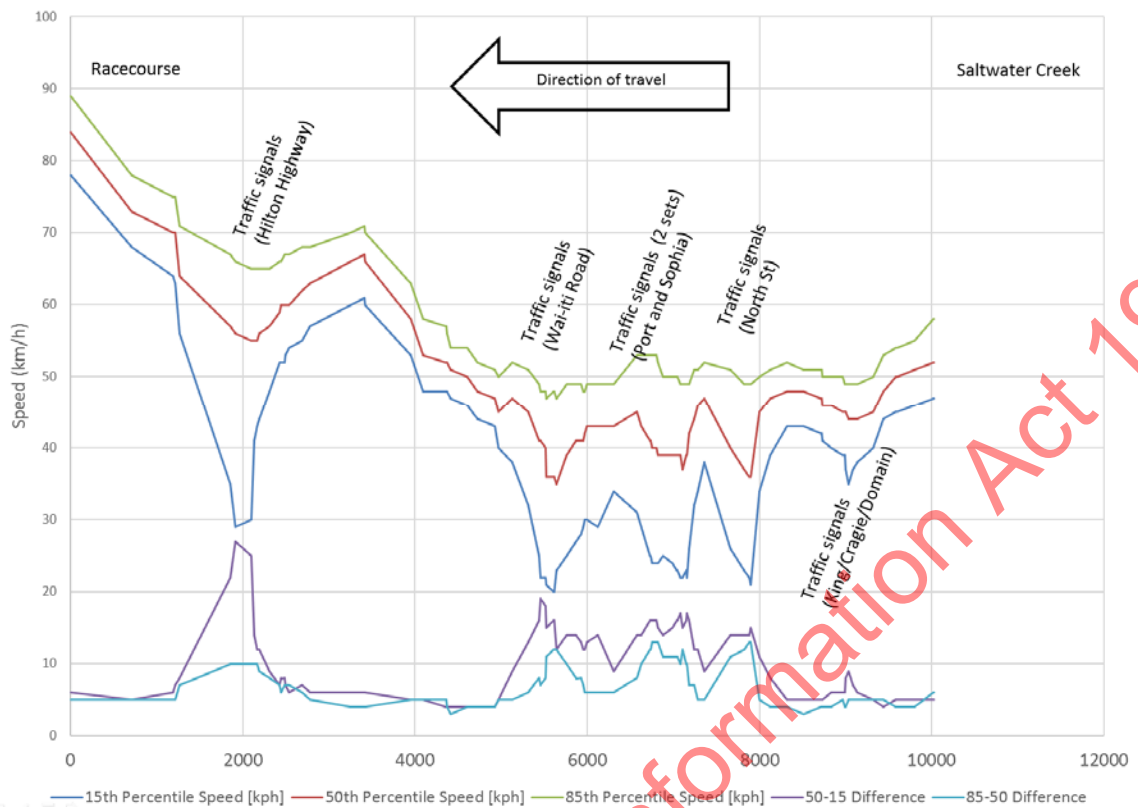


Figure 29 Speed profile in Timaru urban northbound

The median (50th percentile) travel speeds through Timaru is around 60 to 80 km/h on the Washdyke / Hilton Highway sections of the state highway corridor, and 40 to 50 km/h through the Evans Street/Theodosia Street/Craigie Avenue sections of the state highway in the town centre. The 15th and 85th percentile speeds show greater variability compared to the rural sections, particularly at the signalised intersections in Timaru. This evidence confirms the stakeholder group's view that the increasing number of trucks on State Highway 1 and the existing geometric design and layout of the corridor (e.g. merge points a short distance beyond some of the intersections) contributes to traffic reliability issues.

Traffic volumes

In urban Timaru, the growth in traffic volumes (Annual Average Daily Traffic (AADT)) from 2011 to 2015 has been fairly static at one percent per annum as shown in Figure 30. However, during the same period there has been an approximate five percent annual growth in Heavy Commercial Vehicles (HCV's) due to significant growth in freight volumes through PrimePort Timaru

There has been a significant increase in TEU's (20 foot equivalent units) going through PrimePort since the second half of 2014 a following investment by the Port of Tauranga.

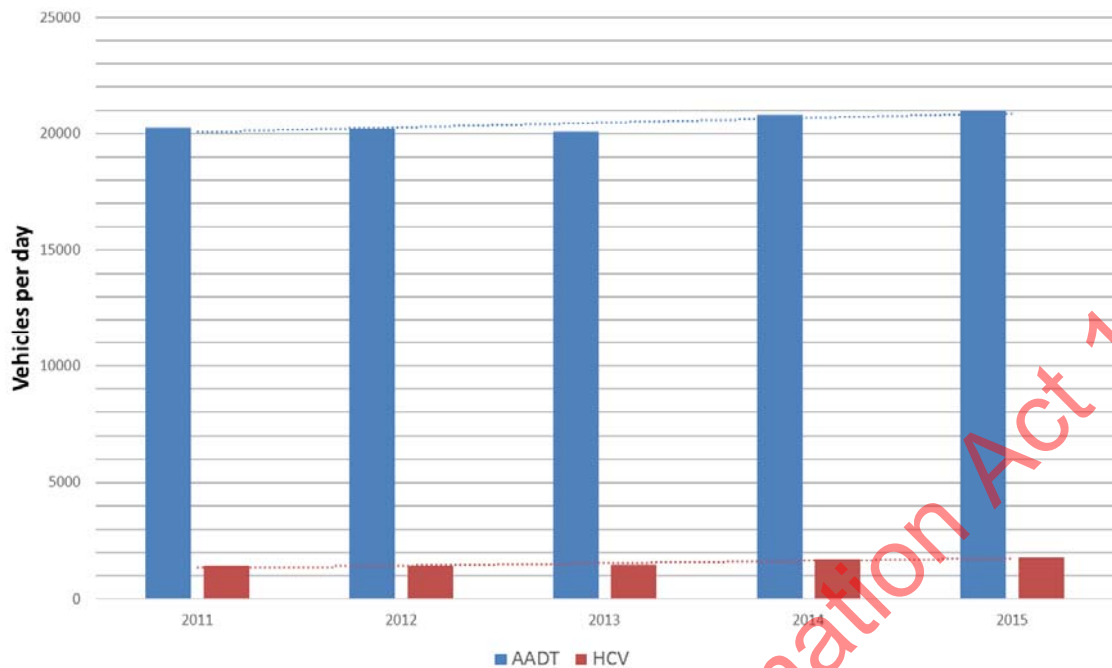


Figure 30 Traffic volumes on state highway 1 (Evans Street) compared to truck volumes from 2011 to 2015

3.2.3 Problem Three: State highway access

Problem statement (Rural and Urban)

Corridor layout and existing land use, combined with increasing traffic volumes constrains access on to, across and off the state highway for all modes of travel.

The evidence

The following are the locations of pedestrian crossing facilities in Timaru as shown in Figure 31 below:

- Frequent signalised traffic crossings around Ashbury Park area;
- Two pedestrian crossings along Anzac Square.

There are no crossing facilities south of the SH1/Domain intersection or north of Newmans Road.

Based on the traffic volume and the crossing distance, the average crossing delay time is 42 seconds, which equates to a LOS F₄ during the peak hour. This is based on the assumption that the peak hour traffic volume is 10% of the AADT and there is no midpoint for pedestrians to wait.

There is anecdotal evidence from the stakeholders that for sections of the highway through Timaru the access is limited. This includes streets such as Waimataitai Street and Bridge Street.

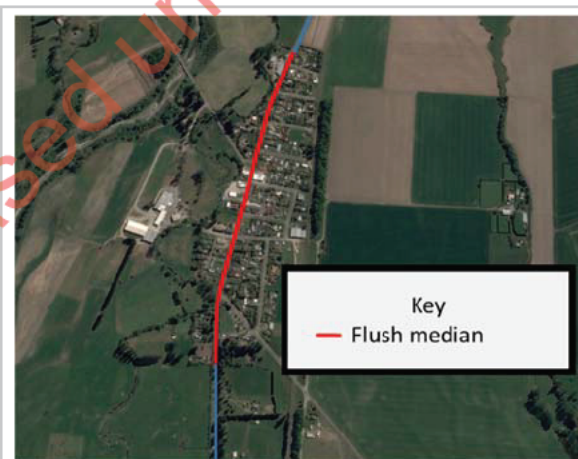
4 Guidelines for the selection of pedestrian facilities – Abley Transportation Consultants 2002



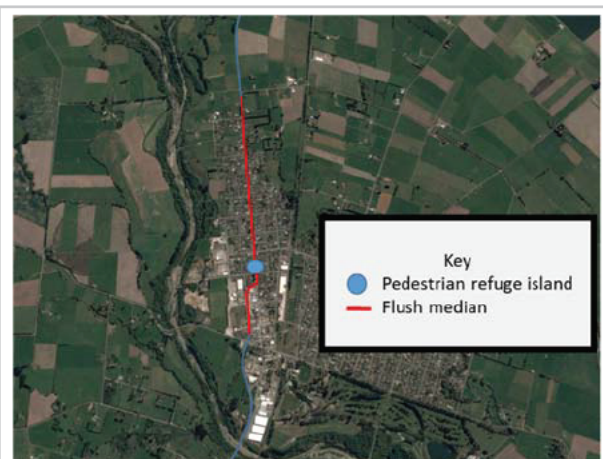
Figure 31: Timaru pedestrian crossing facilities

Figure 32 below shows the pedestrian crossing facilities in the small towns of South Canterbury. The facilities are:

- Flush median through Winchester;
- Flush median and one pedestrian refuge island in Temuka;
- No pedestrian crossing facilities in Orari, St Andrews or Glenavy.



Winchester



Temuka



Figure 32: Existing township pedestrian crossing facilities

Released under the Official Information Act 1982

3.3 North Otago

North Otago is the only segment which includes a resilience problem area. The traffic volume is comparatively low; travel time reliability is not identified as a key issue.

3.3.1 North Otago




Themes	The Problems	Benefit Statement
 Safety	Problem 1: State Highway 1 has a diverse terrain and some unforgiving sections, combined with driver mistakes contributes to fatal and serious injury crashes.	Improved road user safety
 Resilience	Problem 2: Sections of State Highway 1 have resilience issues which results in road closures.	A resilient corridor allowing the movement of people and goods
 State Highway Access	Problem 3: Corridor layout and existing land use, combined with increasing traffic volumes constrains access on to, across and off the state highway for all modes of travel.	Improved access on to, across and off the State Highway

Figure 33 North Otago problem and benefit statements

3.3.2 Problem One (Safety)

Problem statement

State Highway 1 has a diverse terrain and some unforgiving sections, which combined with driver mistakes, contribute to fatal and serious injury crashes. (Safety)

The evidence

In order to determine the actual crash risk for State Highway 1 for the North Otago segment from Waitaki River to Dunedin, data from the NZ Transport Agency's Crash Analysis System (CAS) has been analysed.

Figure 34 and Figure 35 shows they type, severity and location of crashes that occurred in the North Otago segment from 2011 to 2015. There have been 57 fatal and serious injury crashes in rural areas of State Highway 1 between the Waitaki River and Dunedin. It shows that the highest number of fatal and serious injury crashes in North Otago is a of result run-off road type crashes. Fatal injury crashes are occurring at a higher rate between Hampden to Palmerston and Waitati to Dunedin sections.

The North Otago section has an average crash rate of 0.087 fatal and serious injury crashes per kilometre each year. This compares to an average crash rate of 0.049 on the state highways in the Otago region, and a rate of 0.065 on state highways nationally.



Figure 34: North Otago crash type and severity

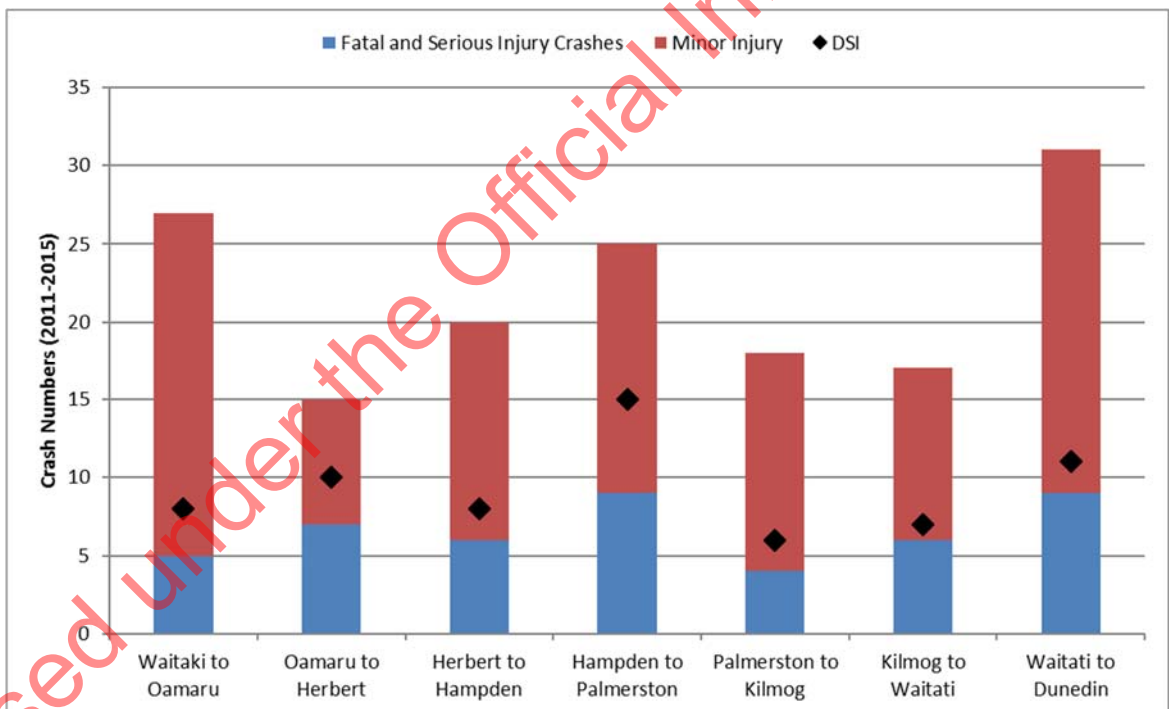


Figure 35: North Otago crash location and severity

The collective and personal risk ratings have been classified using the NZ Transport Agency High Risk Rural Roads Guide for various locations along the North Otago segment.

Table 6 Collective and personal risk for North Otago shows that the sections between Oamaru to Palmerston and Kilmog to Dunedin have a medium-high collective risk. The personal risk for the Herbert to Hampden section is also classified with a medium-high personal risk.

Table 6 Collective and personal risk for North Otago

Location	F+S/km/year	Collective risk	F+S/100Mvkt	Personal risk
Waitaki to Oamaru	0.062	Medium	3.5	Low-Medium
Oamaru to Herbert	0.078	Medium-High	4.3	Low-Medium
Herbert to Hampden	0.120	Medium-High	8.0	Medium-High
Hampden to Palmerston	0.077	Medium-High	5.2	Low-Medium
Palmerston to Kilmog	0.040	Medium	2.3	Low
Kilmog to Waitati	0.089	Medium-High	4.7	Medium
Waitati to Dunedin	0.118	Medium-High	5.2	Medium

3.3.1 Problem Two: Resilience

Problem statement

Sections of State Highway 1 has resilience issues which results in road closures.

The evidence

Network resilience relates to the ability of 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 (such as snow ice, high winds and flooding);
- Geology (events such as land slip, rock falls and coastal erosion);
- Roadworks;
- Obstructions; and
- Crashes.

The main causes of delays, detours, and warnings differ along the route.

The location and cause of road closures have been analysed using NZ Transport Agency's Traffic Road Event Information System (TREIS) data. For the five year period from December 2010 to November 2015 between Waitaki and Dunedin, there were 12 snow and ice closures which resulted in 105 hours of road closure; and eight flooding events resulting in 88 hours of closure. The locations of these road closures are shown in Figure 36.

Crash closures have been included in Figure 36 as there are sections of the corridor without a detour route. The stakeholders at the first and second workshops identified the need for the alternative routes to also be suitable for HPMVs, this includes the bridges which have load restrictions.

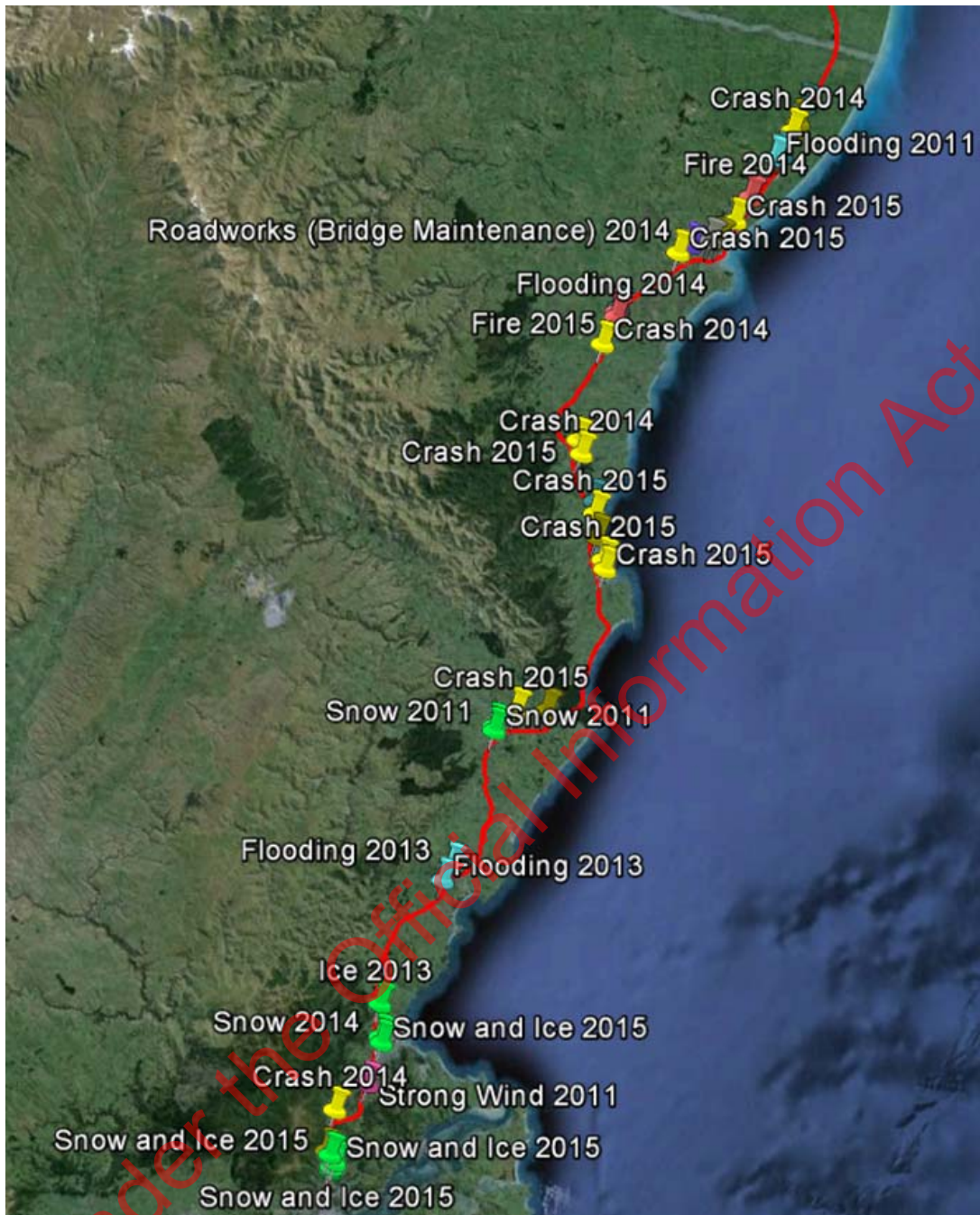


Figure 36 Road closure locations in North Otago

National resilience – High Impact Low Probability events

The NZ Transport Agency has recently assessed the resilience of the state highway network at a broad national level, and developed a methodology for implementation at regional level for low frequency, high impact natural hazards. Maps from the National State Highway Resilience report (June 2016) shows the resilience states for the state highways and highlights key areas of vulnerability of the state highways.

The National Resilience report assessed that the State Highway 1 network between Moeraki to Waitati (the Katiki Straight) along the coastal margin is susceptible to liquefaction, lateral spreading, scour from storm surge and tsunami, and increased exposure to coastal hazards from sea level rise. The likely duration of a loss of service of this section of the road network is considered to be greater than three months. A mapped disruption state of all hazards (e.g. earthquake, tsunami, storms) for the North Otago segment is shown in Figure 37.

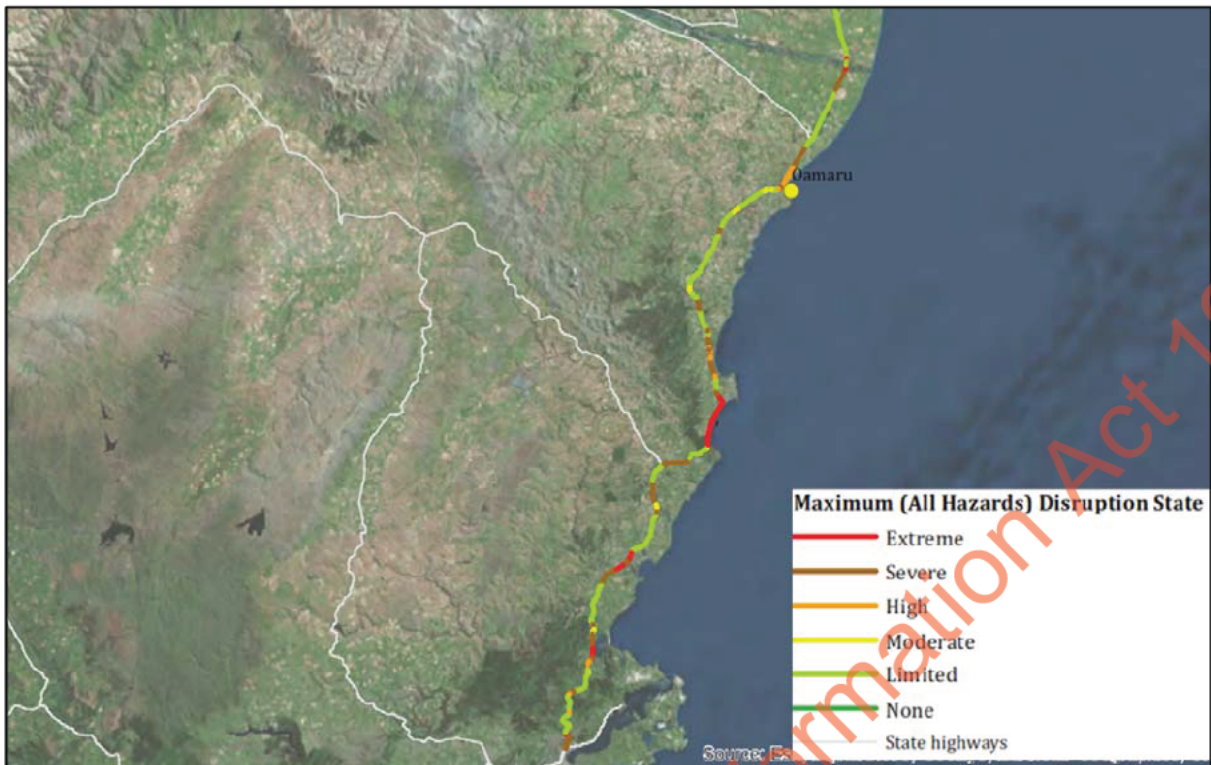


Figure 37 Maximum (all hazards) disruption state levels North Otago

The ability of the corridor to withstand weather, geological and crash events, and to recover as quickly as practical from events is necessary when considering improvements to resilience.

3.3.2 Problem Three: State highway access

Problem statement

Corridor layout and existing land use, combined with increasing traffic volumes constrains access on to, across and off the state highway for all modes of travel.

The evidence

Average pedestrian delay is 28 seconds when crossing SH1 in Oamaru during the peak period, which equates to LOS E. The peak hour flow is based on the assumption of 10 percent of AADT. There is anecdotal evidence from the stakeholders that many pedestrians have difficulty crossing SH1 in the northern sections of Oamaru.

The stakeholders also considered that the pedestrian access in Waitati was insufficient, especially with the shop on the opposite side of the road from the rest of the township. It was also noted that the desire line was in a 100 km/h speed zone and on an out-of-context corner with limited sight lines.

The following is the list of crossing facilities in Oamaru as shown in Figure 38 below:

- Signalised crossings at traffic lights at regular intervals in central Oamaru along SH1
- Four pedestrian crossing in northern Oamaru (Redcastle St, Regina Lane, Farmham St and Caledonian Road) and two pedestrian refuge islands
- One pedestrian crossing in southern Oamaru (Holmes St)



Figure 38: Oamaru pedestrian crossing points

Released under the Official Information Act 1982

Figure 39 below shows the existing pedestrian crossing facilities in the small towns of North Otago. The facilities include:

- A flush median and two pedestrian refuge islands in Herbert;
- A flush median and a pedestrian crossing in Palmerston;
- A flush median and a pedestrian refuge island in Waikouaiti;
- Maheno, Hampden and Waitati have no pedestrian crossing facilities.

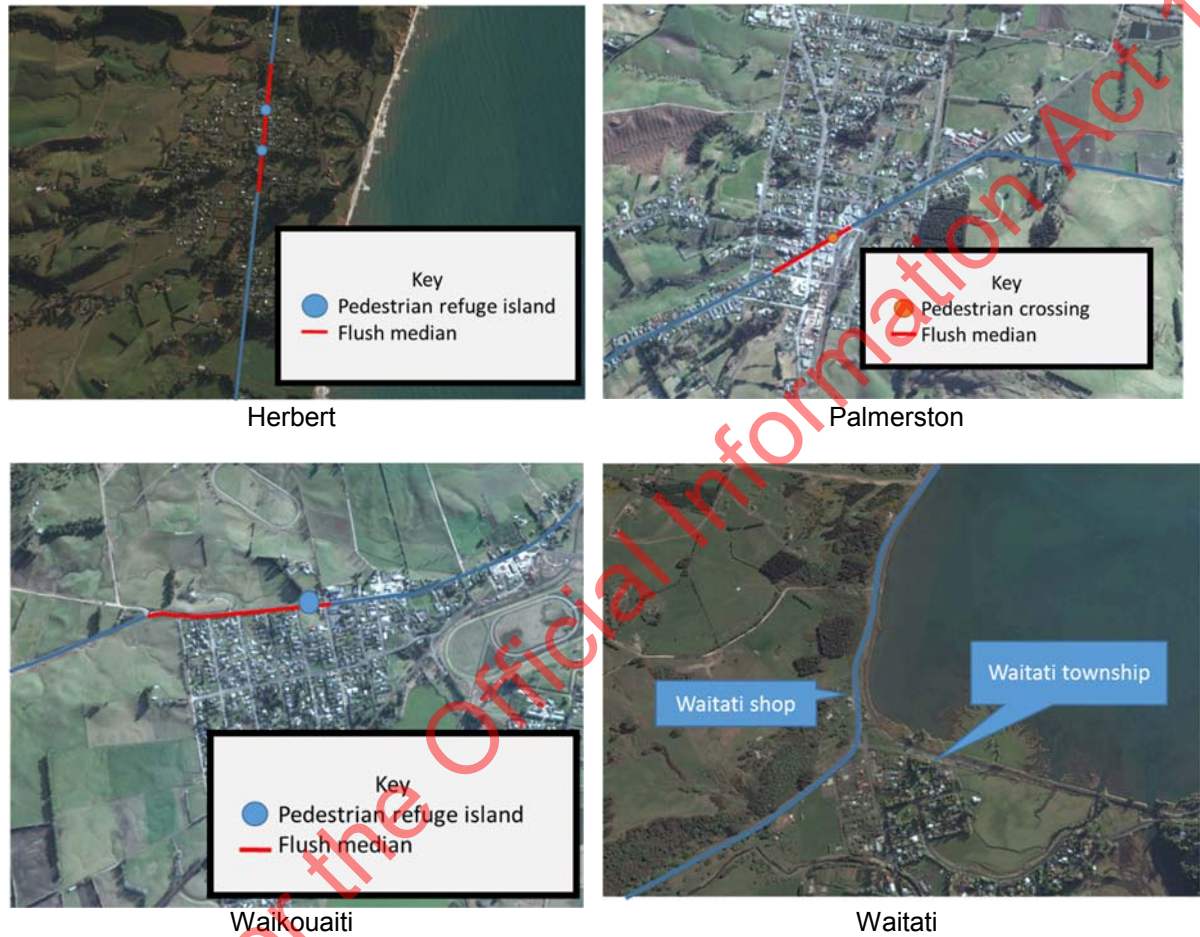


Figure 39: North Otago pedestrian crossing facilities

4. Investment Objectives

The Investment Objectives for this project relate specific to the problems and benefit areas identified developed with stakeholders and key NZ Transport Agency technical officers.

Key Performance Areas (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 Mid Canterbury

Investment Objective 1: Improve safety outcomes

Baseline	42 deaths and serious injuries for the five years 2010 to 2015 (annual average DSI of 8.4)
KPI 1.1	Reduction in deaths and serious injuries
Baseline	92% of SH1 between Selwyn and Rangitata Rivers has a Star Rating of 3 or higher (100 m sections)
KPI 1.2	Improved road safety risk assessment rating (KiwiRAP)

Investment objective 2: Maintain reliability outcomes

Baseline	60 minute median travel time between Selwyn and Rangitata Rivers
KPI 2.1	Maintain travel times
Baseline	6 min difference between 15 th and 50 th percentile speeds
KPI 2.2	Maintain travel time variability

Investment objective 3: Improve state highway access outcomes

Baseline	(this baseline needs to be measured)
KPI 3.1	Improve vehicle access in Ashburton
Baseline	Average pedestrian crossing delay of 24 seconds
KPI 3.2	Maintain crossing delay

4.2 South Canterbury

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	86% of SH1 between Rangitata and Waitaki Rivers has a Star Rating of 3 or higher (100 m sections)
KPI 1.2	Improved road safety risk assessment rating (KiwiRAP)

Investment objective 2: Maintain reliability outcomes

Baseline	83 minute median travel time between Rangitata and Waitaki Rivers
KPI 2.1	Maintain travel times
Baseline	8 min difference between 15 th and 50 th percentile speeds
KPI 2.2	Maintain travel time variability

Investment objective 3: Improve state highway access outcomes

Baseline	(this baseline needs to be measured)
KPI 3.1	Improve vehicle access between Temuka and Timaru, and Timaru urban area
Baseline	Average pedestrian crossing delay of 42 seconds
KPI 3.2	Maintain crossing delay

4.3 North Otago

Investment Objective 1: Improve safety outcomes

Baseline	76 deaths and serious injuries for the five years 2011 to 2015 (annual average DSI of 15.2)
KPI 1.1	Reduction in deaths and serious injuries
Baseline	80% of SH1 between Waitaki River and Dunedin has a Star Rating of 3 or higher (100 m sections)
KPI 1.2	Improved road safety risk assessment rating (KiwiRAP)

Investment objective 2: Improved resilience outcomes

Baseline	35 road closures between Waitaki River and Dunedin (per 5-year period)
KPI 2.1	Reduction in the number of closures
Baseline	6.2 hours of average closure time
KPI 2.2	Reduction in average duration of closure

Investment objective 3: Improve state highway access outcomes

Baseline	(this baseline needs to be measured)
KPI 3.1	Improve vehicle access in Oamaru urban
Baseline	Average pedestrian crossing delay of 28 seconds
KPI 3.2	Maintain crossing delay

Released under the Official Information Act 1982

Part B – Developing the Programme

5. Alternatives and Options

The following alternatives were prepared by the project team, with specific options identified, developed and assessed with the stakeholders and using previous studies. The potential alternative areas identified were consistent for each segment (i.e. Mid Canterbury, South Canterbury and North Otago) across the corridor.

Road corridor improvements – Minor works (online)

Improvements to the existing SH1 road corridor for specific areas along the corridor would achieve moderate to minor benefits overall. Improvement works are an important element in maintaining the safe and efficient operation of the existing transport corridor. However, these improvement options are unlikely to provide significant contributions to the investment objectives of safety, reliability, and state highway access for Mid and South Canterbury, and safety, resilience, and state highway access for North Otago.

Minor improvements are defined as short term interventions within a programme to address high-need safety areas.

Road corridor improvements – Major works (online)

Construction of new road corridor sections along the route would generally achieve moderate to median. Other benefits likely to be achieved are improved access and safety for local road users, visitors and the community. Risk could include their affordability, environmental impact and land ownership considerations.

Major corridor improvements are dependent on provisions around minor corridor improvements.

Road corridor improvements – Major works (offline)

Construction of new road corridor along the route would generally achieve moderate to major benefits or positive impacts. Other benefits likely to be achieved include improved travel time reliability if bypassing an urban area, and resilience to the network. There are some risks around the high cost of the alternatives, and the need to revoke the remaining sections of the corridor to local authorities.

Rail improvements

Major rail infrastructure improvements such as new rail lines, rail line realignment or improvements to rail operations would largely achieve minor to moderate benefits. The exception could be a new rail corridor along sections of the route prone to coastal erosion, which could greatly contribute to the resilience investment objective.

Freight movement by rail could significantly contribute to the objectives for this corridor and enable the movement of goods between Christchurch and Ashburton. Integrating nodes at transport hubs to enable greater use of rail for freight is considered to have minor benefits in terms of travel time reliability due to the reduction in trucks on the roads.

The cost of such options is relatively high compared to other options.

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 services, and workplace travel plan initiatives. Such ideas have

particular merit when considering management of peaks and journey time reliability on event days.

The proposed option provides moderate accessibility improvements, as well as minor reliability improvements. However, there are risks associated with insufficient uptake and elasticity of demand. Options relating to this alternative area were not voiced strongly by stakeholders during the workshops.

Freight management

Freight management options include management of over-dimensional vehicles, as well as the improvement of existing operations and policies of freight management. The measures are expected to realise minor safety benefits and minor to moderate travel time reliability benefits to the corridor.

Implementation of measures to manage freight movements on road 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 ITS, enforcement and rail improvement options.

Intelligent Transport Systems (ITS)

Three broad types of Intelligent Transport Systems (ITS) have been proposed; those that give general messages about conditions on the corridor (e.g. via Variable Messaging Signs (VMS)) and those that are location specific, e.g. at high risk sites and triggered when certain conditions are met such as Rural Intersection Advanced Warning Signs (RIAWS). Traffic signal optimisation in urban areas is also an important consideration.

It is considered that ITS can provide some minor benefits for the corridor particularly of weather events, crashes and at high risk locations.

Education

Education is a crucial element to support many of the other alternatives in the corridor. Relative to other built infrastructure options, it does not cost much and it can achieve major safety and reliability gains as people are able to make more informed choices about their journeys. This is a particular issue on the section north of Dunedin which experiences seasonal resilience issues due to adverse weather.

Options within the education alternative are predominantly focused on programmes targeting specific groups and behaviours of customers, including driving in rural areas, use of the state highway by agricultural and over-dimension vehicles, and education for visitor drivers.

Enforcement

Enforcement is crucial element of the safe and efficient operation of any transport corridor, especially this corridor due to the high number of death and serious injuries that occur.

Enforcement is best used within a coordinated approach to safer road use as is currently occurring across the region and for this corridor. Increased police enforcement/presence is dependent on increased police funding at a national level.

The enforcement options were all assessed as having minor to moderate safety benefits, with negligible benefits in terms of travel time, reliability, and state highway access.

Policy

The options identified in the policy alternative area are wide ranging and include interventions such as land use planning changes, review and/or confirm the road hierarchy to identify key intersections and corridors to be improved, as well as urban engineering to reinforce the speed limit in urban areas.

The land use planning and urban engineering options are both considered to have benefits across all investment objectives.

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 travel time reliability of the corridor. Travel planning and behaviour change programmes will be part of programme options that seek to significantly alter travel behaviours. They are particularly compatible with public transport, walking, cycling and education options.

A workplace travel plan initiative was announced by Synlait during the development of this programme business cases.

Operations and maintenance

The NZ Transport Agency and stakeholders currently work collaboratively to operate the network effectively. The options identified, and to be developed, as part of the programme are divided into two areas:

- Daily operation of the network, and
- Operation of the network and response during an event, i.e. crash, weather events.

Operations will be a key component of the programme options developed. There are a range of minor and moderate benefits that can be realised through improvements to operations and response planning for the corridor.

Walking improvements

Walking is an important element to support active travel in townships along the corridor (as is cycling), and to address safety issues for vulnerable road users. Infrastructure improvements for walking such as improved footpaths, pedestrian crossings or addressing potential community severance issues (i.e. Rakaia River bridge). 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.

Cycling improvements

Cycling is an important element to support active travel in townships along the corridor (as is walking). Cycling improvements are best used within a coordinated approach including walking improvements and behaviour change alternatives. The assessment has revealed benefits in all three investment objective areas, particularly safety benefits.

It should be noted that the South Canterbury and North Otago segments have been identified as part of the New Zealand Cycle Trail (Heartland Ride – potential routes).

Non-Transport

There were some non-transport options raised under this alternative area. Examples include the provision of toilet facilities to encourage motorists to stop and have a rest, technology changes (i.e. mobility as a service, autonomous vehicles, improvements in the safety performance of vehicles), investigating future of rural traffic and road incident group planning.

The range of non-transport options proposed have potential to complement a larger programme by addressing specific issues and making minor contributions to the investment objectives.

⁵ Introduced on 1 August 2016, Synlait provides employees with a free daily commuter coach service (50 seater) from Rolleston to their Dunsandel site. It is expected on average that 72 cars are removed from Main South Road during the morning and evening peak periods.

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/Do minimum' through to targeted safety and corridor safety focused, mixed level of investments (safety, reliability or resilience, and state highway access) through to do maximum (major capital investment) focus. These programme options were then presented and refined during a workshop.

6.2 Long list to draft short list

Stakeholders reviewed the long list of programme options and identified those that that were to be short listed. For the purposes of this assessment, the timeframes⁶ are:

- Short term 1 to 3 years;
- Medium term 3 to 10 years; and,
- Long term 11 to 30 years.

Table 7 details why the programmes options for Mid Canterbury were or were not carried forward to the short list.

Table 7 Assessment of the long list (Mid Canterbury)

Long List			Draft Short List
No #	Description		Reason for Rejection or Refinement
1	Business as Usual (Do Minimum) <i>Existing strategies and current funding of ongoing activities in current 3 year programme</i>	▶ Carried forward with no change	Business as Usual (Do Minimum) <i>Note: The business as usual programme option is carried forward as a 'comparator' for the assessment.</i>
2	Target Safety and some Access Improvements <i>This option targets improving the safety outcomes along high risk corridors without improving the capacity along the corridor.</i>	✖ Not carried forward	Target Safety and some Access Improvements <i>This programme was not carried forward as travel time reliability will be impacted over time as volumes increase over time. The stakeholders also considered that the programme did not have a significant level of investment in safety outcomes that are attained by creating a higher quality and consistent road environment expected for SH1.</i>
3	Corridor Safety (3½ - 4 Star) <i>This corridor solely targets safety to a high star rating. The safety options negatively impact reliability outcomes</i>	✖ Not carried forward	Corridor Safety (3½ - 4 Star) <i>This programme was not carried forward due to the impacts on travel times and travel time reliability that will occur with major safety improvements such as median dividers where additional capacity is not provided and passing opportunities are decreased. Stakeholders were also concerned with the inability of vehicles to access cross and leave the state highway.</i>
4	Balanced Mid-Level Investment (Safety, Travel Time, Access) <i>This option delivers good safety outcomes across the corridor. The programme adds capacity in the</i>	▶ Carried forward for further	Balanced Mid-Level Investment (Safety, Travel Time, Access) <i>Stakeholders considered that this programme achieved the safety, travel time reliability and access outcomes to a level that was deemed to be appropriate.</i>

⁶ Note: the timeframes were revised for the programme assessments when developing the preferred programme (short term 1-10 years, medium term 11-20 years and long term 21-30 years).

	<i>highest volume area between Selwyn River and Ashburton.</i>	refinement	
5a	Balanced High Level Investment (Safety, Travel Time, Access) <i>This option delivers good safety outcomes across the corridor. The programme adds capacity along the corridor with a 2+1 configuration throughout rural sections of the segment.</i>	▶ Carried forward for further refinement	Balanced High Level Investment (Safety, Travel Time, Access) <i>Stakeholders deemed that this programme delivered sufficient outcomes for safety, travel time reliability and access. The stakeholders considered that this programme needed some further refinement.</i>
5b	Balanced High Level Investment with Second Ashburton River Bridge <i>This programme is the same as programme 5a, with the addition of the Ashburton Second River Bridge.</i>	▶ Carried forward for further refinement	Balanced High Level Investment with Second Ashburton River Bridge <i>The stakeholders considered that the programme did meet the objectives, but did come with a high cost for the scale of the problems.</i>
6	Maximum Travel Time Reliability and 4 Star Safety (Do Max) <i>This programme is a high level investment to improve both safety and reliability, as well as provide suitable access for all modes of travel.</i>	× Not carried forward	Maximum Travel Time Reliability and 4 Star Safety (Do Max) <i>The stakeholders considered that the programme achieved high levels of safety and reliability, however they deemed the investment would not provide value for money given the traffic volumes predicted.</i>

Table 8 details why the programmes options for South Canterbury were or were not carried forward to the short list.

Table 8: Assessment of the long list (South Canterbury)

Long List- First Draft			Draft Short List
No#	Description		Reason for Rejection or Refinement
1	Business as Usual (Do Minimum) <i>Existing strategies and current funding of ongoing activities in current 3 year programme</i>	▶ Carried forward with no change	Business as Usual (Do Minimum) <i>Note: The business as usual programme option is always carried forward as a 'comparator' for the assessment.</i>
2	Target Safety and Minor Access Improvements <i>This option targets improving the safety outcomes along high risk corridors without improving the capacity along the corridor.</i>	× Not carried forward	Target Safety and Minor Access Improvements <i>This programme was not carried forward as the stakeholders deemed that the reliability outcomes delivered were insufficient.</i>
3	Corridor Safety (3½ - 4 Star) <i>This corridor solely targets safety to a high star rating. The safety options negatively impact reliability outcomes</i>	× Not carried forward	Corridor Safety (3½ - 4 Star) <i>This programme was not carried forward as the stakeholders deemed that the reliability outcomes delivered were not suitable.</i>
4a	Balanced Programme (Safety, Travel Time Reliability, Access, and Timaru Urban Road Optimisation) <i>This option delivers good safety outcomes across the corridor. The programme adds capacity in the highest traffic volume area between Timaru and Temuka.</i>	▶ Carried forward for further refinement	Mixed Programme (Safety, Travel Time Reliability, Access, and Urban Road Optimisation Timaru) <i>Stakeholders consider that this programme delivered sufficient safety, travel time reliability and access outcomes. Further refinement is required to achieve better outcomes in each of the problem areas.</i>
4b	Balanced Programme (Safety, Travel Time Reliability, Access) with extra Timaru Capacity <i>This option delivers good safety outcomes across the corridor. The programme adds capacity in the highest traffic volume area between Timaru and Temuka.</i> <i>This programme also has four lanes between Washdyke and the Port.</i>	▶ Carried forward for further refinement	Mixed Programme (Safety, Travel Time Reliability, Access) with extra Timaru Capacity <i>Stakeholders agreed that this programme delivered suitable outcomes for safety and travel time reliability. Stakeholders considered that the negative access outcomes was an acceptable trade-off for improved travel time reliability through Timaru.</i>
5	Consistent and Higher Standard (ONRC) State Highway Corridor (Safety, Travel Time Reliability, and Access)	▶ Carried forward for	Consistent and Higher Standard (ONRC) State Highway Corridor (Safety, Travel Time Reliability, and Access) <i>The stakeholders considered that the programme would ensure that the corridor have a sufficient</i>

	<i>This programme is a higher level of investment than programme 4a, it includes capacity improvements throughout the corridor when traffic volume thresholds are met.</i>	further refinement	<i>reduction in deaths and serious injuries as well as deliver suitable travel time reliability and access outcomes. The stakeholders considered that this programme may not deliver the value for money, especially where the 2046 predicted traffic volumes were high.</i>
6	4 Star Safety and Increased Capacity Corridor <i>This programme is a significant investment across the entire corridor to improve all problem areas.</i>	* Not carried forward	4 Star Safety and Increased Capacity Corridor <i>The stakeholders considered that the programme achieved high levels of safety and reliability, however they deemed the investment would not provide value for money, given the traffic volumes predicted.</i>

Table 9 details why the programmes options for South Canterbury were or were not carried forward to the short list.

Table 9 Assessment of the long list (North Otago)

Long List			Draft Short List
No#	Description		Reason for Rejection or Refinement
1	Business as Usual (Do Minimum) <i>Existing strategies and current funding of ongoing activities in current 3 year programme</i>	► Carried forward with no change	Business as Usual (Do Minimum) <i>Note: The business as usual programme option is always carried forward as a 'comparator' for the assessment.</i>
2	Target Safety and Minor Access Improvements <i>This option targets improving the safety outcomes along high risk corridors without improving the capacity along the corridor.</i>	* Not carried forward	Target Safety and Minor Access Improvements <i>The stakeholders considered that the reduction in deaths and serious injuries was not significant enough for this segment of the corridor, given the significant number in the 2011-2015 period. With the expected closure times expected to increase significantly, the stakeholders deemed the resilience outcomes of this project to be unacceptable.</i>
3	Targeted Safety with Resilience for Low Impact Probability events <i>This programme targets safety investment into sections of the corridor which are considered high risk. This programme has some resilience to address flooding as well as addressing erosion sites along Katiki Straight.</i>	* Not carried forward	Targeted Safety with Resilience for Low Impact Probability events <i>This programme was not carried forward for further refinement. The stakeholders want a programme which aligns with the ONRC, so has safety improvements along the entire corridor. The programme also did not address Deborah Underpass. The stakeholders also were concerned that the resilience investment was not significant enough and the expected closures were not deemed to be acceptable.</i>
4	Corridor Safety with Resilience for Low Impact High Probability events <i>This programme has significant safety improvements across the corridor to bring up above minimum ONRC levels. Additional safety improvements are also included for the sections which have a safe systems transformation treatment philosophy as per the High Risk Rural Roads Guide. This programme provides a permanent coastal sea wall which would be a long term solution to coastal erosion.</i>	► Carried forward for further refinement	Corridor Safety with Resilience for Low Impact High Probability events <i>This programme is being carried forward to the short list to be refined. The stakeholders agreed that the reduction in DSIs were acceptable given the geographical constraints. The stakeholders agreed with the permanent solution the length of Katiki Straight, but had reservations as to the value for money of a sea wall, when rock armouring was an option.</i>

5	<p>Corridor Safety, Resilience, Access and Active Mode Connectivity</p> <p><i>This programme has significant safety improvements across the corridor to bring up above minimum ONRC levels. Additional safety improvements are also included for the sections which have a safe systems transformation treatment philosophy as per the High Risk Rural Roads Guide. This programme provides improvements for cyclists. This programme provides a permanent coastal sea wall which would be a long term solution to coastal erosion. This option has a wider seal along Katiki Straight to allow adequately for cyclists.</i></p>	<p>► Carried forward for further refinement</p>	<p>Corridor Safety, Resilience, Access and Active Mode Connectivity</p> <p><i>This programme is being carried forward to the short list to be refined. The stakeholders agreed that the expected reduction in DSIs were acceptable, as well as a corridor with the improved star rating. The stakeholders considered the reduction in the number of closure hours and the treatment at Katiki Straight to be acceptable, however considered widening the road to have a 12 m seal would not be value for money.</i></p>
6	<p>Highly Safe, Accessible, Connected and Resilient Coastal Corridor at Katiki Straight</p> <p><i>This programme has significant safety investment above previous options including earthworks to achieve curve smoothing. More cycling facilities are included in this programme to keep cyclists off the state highway where possible. Significant resilience work, including preventative maintenance at high risk locations. The sea wall at Katiki Straight has a separated cycleway.</i></p>	<p>► Carried forward for further refinement</p>	<p>Highly Safe, Accessible, Connected and Resilient Coastal Corridor at Katiki Straight</p> <p><i>The stakeholders deemed that the reduction in DSIs was acceptable, as well as the improvements to the KiwiRAP star ratings. The reduction in number of closure hours was also deemed to be acceptable to the stakeholders. The stakeholders had reservations over the significant cost of this programme and the value for money that would be achieved, given the traffic volumes in this segment of the highway. There were doubts as to whether or not a separated cycle facility would be worthwhile, unless there was a national budget for cycle facilities which could be used to cover costs. More detailed investigations regarding the protection of SH1 along Katiki Straight was required.</i></p>
7	<p>Highly Safe, Accessible, Connected and Resilient Inland Realignment at Katiki Straight</p> <p><i>This programme has significant safety investment above previous options including earthworks to achieve curve smoothing. A new inland alignment is proposed for Katiki Straight</i></p>	<p>× Not carried forward</p>	<p>Highly Safe, Accessible, Connected and Resilient Inland Realignment at Katiki Straight</p> <p><i>This programme has not been carried forward into the short list. The stakeholders were uncomfortable with the option to retreat and let the coast erode away, which would in time remove the rail connection between Christchurch/Timaru and Dunedin. The stakeholders considered that rail was still significant and did not want additional freight on the road network.</i></p>

6.3 Short list refinement

The stakeholders made refinements to the draft short list to form the short list that will be carried forward to detailed assessment. As part of the refinement process, the stakeholders were asked to challenge and revise the implementation process. The tables below detail the refinements to each of the programmes.

Table 10: Short list refinements (Mid Canterbury)

Draft Short List		Short List
#	Description	Programme Refinements
1	Business as Usual (Do Minimum)	<p>► Short Listed</p> <p>No refinements to the Business as Usual programme. Note: The business as usual programme option is always carried forward as a 'comparator' for the assessment.</p>
4	Balanced Mid-Level Investment (Safety, Travel Time, Access) This option delivers good safety outcomes across the corridor. The programme adds capacity in the highest volume area between Selwyn River and Ashburton.	<p>► Short Listed</p> <p>The stakeholders considered that this programme required a second bridge across the Ashburton River and was agreed to be included in the short listed programme. The stakeholders believe that the programme needs a minimum KiwiRAP star rating of 3.5 stars, especially for the higher volume sections of the highway. Walking and cycling measures need to be included in other rural towns in the area, (especially Rakaia and Dunsandel). The stakeholders consider that more feasibility work needs to be done with regards to freight on rail as well as a passenger rail service and is limited due to this section being single track. Behaviour change needs to consider signage around merging 'like a zip'. The other key behaviour change element that needs to be considered in this segment of the corridor is agricultural vehicles and the time of day which they are on the road, and avoiding the state highway where possible. Oversize vehicles operators needed to be educated on use of pilot vehicles and the time of day which they travel.</p>
5a	Balanced High Level Investment (Safety, Travel Time, Access) This option delivers good safety outcomes across the corridor. The programme adds capacity along the corridor with a 2+1 configuration throughout rural sections of the segment	<p>* Not Short Listed</p> <p>This programme has not been short-listed as the need for a second river bridge has been identified. The refinements will be added to the 5b programme where appropriate. The stakeholders consider that the rural intersections need to be prioritised to target the highest risk locations first. This needs to also consider the short stacking distance between the railway line and SH1 on local roads. Intersection rationalisation and movement restrictions, with local road connectivity improvements. The stakeholders considered that this programme should ensure a 3.5-4-star safety rating across the corridor. Walking and Cycling improvements to remove pinch points. Education around the use of 2+1 configuration to ensure that slower vehicles allow faster moving vehicles to easily get past as well as merging behaviours. Overtaking lanes (crawler lanes) at the speed limit change at town exits to allow vehicles to pass slower vehicles when accelerating out of townships and reduce riskier overtaking at high speeds along the corridor. Pull off areas for trucks at approximate 20 km intervals for truck drivers.</p>
5b	Balanced High Level Investment with Second Ashburton River Bridge This programme is the same as programme 5a, with the addition of the Ashburton Second River Bridge.	<p>► Short listed with refinements</p> <p>The programme includes the refinements from programme 5a above. Four lanes at the existing Ashburton River Bridge location is not preferred. The stakeholders consider that there must be a second bridge across the river at another location to disperse traffic movements away from the SH1 alignment and intersections close to the existing bridge. Other improvements in Ashburton which need to be done include:</p> <ul style="list-style-type: none"> • Signals at Walnut Ave (2 sets) • Signals at Grahams Rd • Four lanes between Havelock and Moore St (take out existing car parking and intersections) • Better walking and cycling access <p>Other safety measures to be included in the programme are:</p> <ul style="list-style-type: none"> • Traffic calming on 100 km/h approaches to towns • Rural intersections to be converted to a staggered-T intersections <p>Stakeholders consider that the corridor must have 2.5 m shoulder to ensure safety, as well as allow vehicles to safely pass the agricultural vehicles/provide for cyclists.</p>

Table 11: Short list refinement (South Canterbury)

Draft Short List			Short List
No #	Description		Programme refinements
1	Business as Usual (Do Minimum)	▶ Short Listed	<i>No refinements to the Business as Usual programme. Note: The business as usual programme option is always carried forward as a 'comparator' for the assessment.</i>
4a	Mixed Programme (Safety, Travel Time Reliability, Access, and Urban Road Optimisation Timaru) <i>This option delivers good safety outcomes across the corridor. The programme adds capacity in the highest volume area between Timaru and Temuka.</i>	▶ Short Listed	<i>The stakeholders considered that the measures targeting safety needed to be brought forward into the short and medium term. The 2+1 configuration between Timaru and Temuka also needed to be moved forward to realise the safety and travel time reliability benefits sooner. Stakeholders considered that there needed to be slow vehicle bays/acceleration lanes at the exits of towns and speed limit change to allow cars/light vehicles to pass slower HCVs which take considerable time to accelerate. Associated "let them pass" signage included to improve effectiveness. The stakeholders considered that the intersection improvements needed to include intersections with a large number of HCVs accessing the state highway. The urban Timaru road optimisation needed to have improved merge distances at the following locations:</i> <ul style="list-style-type: none"> • North of Newman St, northbound • South of Grasmere St, southbound • North of Wai-iti Rd, northbound • South of Sophia St, southbound <i>The stakeholders considered that the road optimisation needed to include intersection rationalisation and/or turning movement restrictions. There is also a road optimisation opportunity to 'connect' the mid-block lane configurations between some intersections which are located in close proximity e.g. Grasmere and Te Weka. The stakeholders identified a need to connect Waimataitai Street with Bridge Road. Some short term improvements were identified which could be done (i.e. line marking), i.e. removal of a short section of on-street parking. The group of stakeholders refining programme 4 considered four lanes between Washdyke and the Port to have a large impact with minimal benefit.</i>
4b	Mixed Programme (Safety, Travel Time Reliability, Access) with extra Timaru Capacity <i>This option delivers good safety outcomes across the corridor. The programme adds capacity in the highest volume area between Timaru and Temuka and also has four lanes between Washdyke and the Port.</i>	▶ Short Listed	<i>The refinements in the rural sections were similar to programme 4a, with the addition of improved local road connectivity between Timaru and Temuka with the implementation of 2+1 configuration. A bridge improvement was identified at the Waituna Stream. This was based on the out-of-context curve and narrow lane width over the bridge. The stakeholders who were refining the programme considered the cross section of 4 lane road through Timaru should include a flush median and each lane should be wide enough to allow for a truck. The stakeholders considered a dedicated cycle facility in the corridor, but instead include a major cycleway route near the corridor (which requires investigation), with education to encourage cyclists to not use the highway. This was primarily due to reducing the required amount of property purchase required. If this solution is unachievable cycle facilities will need to be provided within the SH corridor. The stakeholders considered a need to improve the access to and from Waimataitai.</i>
5	Consistent and Higher Standard		<i>The stakeholders considered that the 2+1 between Timaru and Temuka was justified due to the traffic volumes being</i>

<p>State Highway Corridor (Safety, Travel Time Reliability, and Access)</p> <p><i>This programme is a higher level of investment than programme 4a, it includes capacity improvements throughout the corridor when traffic volume thresholds are met.</i></p>	<p>× Not short listed</p>	<p><i>significantly higher in this section than the rest of the rural South Canterbury segment. There was a consensus amongst the stakeholders that this needed to occur in the medium term. The upgrade from 2+1 to four lanes between Timaru and Temuka was considered unlikely by the stakeholders in the long term in 2046.</i></p> <p><i>It was considered that the 2+1 configuration between the Rangitata River and Temuka would only be justified if there was 2+1 south of Ashburton and there was a traffic volume growth higher than what has been estimated in 2046.</i></p> <p><i>The stakeholders considered that the 2+1 configuration south of Timaru would not be justified in the 30-year programme due to the low traffic volumes now, as well as predicted for 2046. The stakeholders considered that more passing lanes and extensions of the existing passing lanes would be sufficient travel time reliability improvements.</i></p> <p><i>The stakeholders considered that the rural intersection improvements need to be in the programme for both short term and medium term, as well as the long term and to be included in the shortlisted options</i></p> <p><i>The stakeholders considered there needed to be encouragement to ensure of freight was going on rail. It was noted that the Oceania Dairy were constructing a rail siding. The stakeholders considered that sponsoring a rail siding at the Studholme Fonterra Factory may be a worthwhile investment to reduce the number of trucks carrying freight on the state highway.</i></p>
--	-------------------------------	---

Table 12: Short list refinement (North Otago)

Draft Short List			Short List
No #	Description		Programme Refinements
1	<p>Business as Usual (Do Minimum)</p> <p><i>Note: The business as usual programme option is always carried forward as a 'comparator' for the assessment.</i></p>	<p>▶ Short Listed</p>	<p><i>No refinements to the Business as Usual programme.</i></p>
4	<p>Corridor Safety with Resilience for Low Impact High Probability events</p> <p><i>This programme has significant safety improvements across the corridor to bring up above minimum ONRC levels. Additional safety improvements are also included for the sections which have a safe systems transformation treatment philosophy as per the High Risk Rural Roads Guide.</i></p> <p><i>This programme provides a permanent coastal sea wall which would be a long term solution to coastal erosion.</i></p>	<p>▶ Short Listed with refinements</p>	<p><i>The stakeholders considered that the safety investment in this programme was sufficient, however the safety works needed to be brought forward in the programme timeline to be short and medium term projects.</i></p> <p><i>The stakeholders considered that the programme did need to include safety improvements to the corridor in the northern section of Oamaru.</i></p> <p><i>Following the reduction of the speed limit at the Deborah Underpass the stakeholders noted that the safety outcomes had improved and thus recommended that this element be pushed out to be done in the long term.</i></p> <p><i>The stakeholders considered that the Kakanui Point bridge improvements were not required, given the closure of the state highway would likely also result in the closure of the associated detour route.</i></p> <p><i>The flooding measures were not deemed critical and should be pushed out into the long term. The stakeholders also noted that the snow and ice measures should have a short term returns due to the reduction in the snow and ice closures with climate change.</i></p>
5	<p>Corridor Safety, Resilience, Access and Active Mode Connectivity</p>	<p>× Not Short Listed</p>	<p><i>The stakeholders consider that the safety measures needed to be brought forward to get the benefits as soon as practical.</i></p>

	<p>This programme has significant safety improvements across the corridor to bring up above minimum ONRC levels. Additional safety improvements are also included for the sections which have a safe systems transformation treatment philosophy as per the High Risk Rural Roads Guide. This programme provides improvements for cyclists.</p> <p>This programme provides a permanent coastal sea wall which would be a long term solution to coastal erosion. This option has a wider seal along Katiki Straight to allow adequately for cyclists.</p>		<p>The stakeholders agreed that a permanent solution at Katiki Straight was the best way to proceed, however they noted that a short term solution needed to exist until the permanent solution can be implemented.</p> <p>The stakeholders noted that the width of the road (referring to Katiki Straight) would be a national directive.</p> <p>Access improvements to be implemented in the northern section of Oamaru.</p> <p>The stakeholders considered that there needs to be improvements to incident management and response plans.</p>
6	<p>Highly Safe, Accessible, Connected and Resilient Coastal Corridor at Katiki Straight</p> <p>This programme has significant safety investment above previous options including earthworks to achieve curve smoothing. More cycling facilities are included in this programme to keep cyclists off the state highway where possible. Significant resilience work, including preventative maintenance at high risk locations.</p> <p>The sea wall at Katiki Straight has a separated cycleway.</p>	<p>► Short listed with refinements</p>	<p>The stakeholders consider that the programme builds on programme 4 and 5, but is a step up. The stakeholders considered that the programme should include intersection improvements north of Oamaru. This section also needed to include flooding resilience improvements, which could come under maintenance and operations i.e. building up the pavement.</p> <p>The intersections around Moeraki were deemed to be dangerous and required some improvements.</p> <p>The stakeholders considered that the Waitati Shop required some form pedestrian crossing opportunity.</p> <p>The Kilmog should be an operational response and come under the maintenance and operations spending.</p>

6.4 Short list programme options summary

The 'Business as Usual/Do minimum' is included in the short list assessments as the comparator (including baselines for KPIs). It was agreed by stakeholders that the current operation, form and function of SH1 between Christchurch to Dunedin is unacceptable as a strategic road corridor within the South Island. The evidence also confirms that this corridor to be safer, more reliable in some sections and resilient for the movement of people and goods.

The short listed programme options are summarised below with indicative implementation timeframes.

Table 13 Mid Canterbury short list and indicative timeframes

Programme	Short Term	Medium Term	Long Term
1. Business as Usual (Do Minimum)	-South Street signals -Signal Optimisation	-Rakaia to Ashburton Safety improvements -Chertsey level crossing improvements	
4. Balanced Mid-Level Investment (Safety, Travel Time, Access)	-Speed activated warning signs and thresholds. -South Street signals -Signal Optimisation	-Second Ashburton River bridge - 2+1 north of Rakaia -Passing lane extensions -Walnut intersection improvements -Tinwald corridor improvements	- 2+1 between Rakaia and Ashburton -Rural intersection improvements

		-Safer corridors treatments -Walking and cycling improvements in Rakaia and Dunsandel	
5. Balanced High Level Investment (Safety, Travel Time, Access)	-Speed activated warning signs and thresholds. -South Street signals -Signal Optimisation	-Second Ashburton River bridge - 2+1 north of Ashburton -Passing lane extensions -Walnut intersection improvements -Ashburton intersection improvements -Tinwald corridor improvements -Safer corridors treatments -Removal of walking and cycling pinch points -Truck pull over areas	- 2+1 between Ashburton and the Rangitata River -Rural intersection improvements

Table 14 South Canterbury short list and indicative timeframes

Programme	Short Term	Medium Term	Long Term
1. Business as Usual (Do Minimum)	-Rangitata to Timaru Safety Improvements -Winchester Level Rail Crossing Improvements -Merge Improvements (Timaru)		
4a Mixed Programme (Safety, Travel Time Reliability, Access, and Urban Road Optimisation Timaru)	-Rangitata to Timaru Safety Improvements -Winchester Level Rail Crossing Improvements -Merge Improvements (Timaru) -Timaru signal and road optimisation	-2+1 Configuration Temuka to Timaru -Rural intersection improvements -Grants Street Signals -Timaru Cycleway Strategy implementation. -Safer corridor treatments	-Waituna Stream bridge improvements and associated curve improvements -Waimataitai St connection to Bridge Road
4b. Mixed Programme (Safety, Travel Time Reliability, Access) with extra Timaru Capacity	-Rangitata to Timaru Safety Improvements -Winchester Level Rail Crossing Improvements -Merge Improvements (Timaru) -Timaru signal and road optimisation	-2+1 Configuration Temuka to Timaru -Rural intersection improvements -Grants Street Signals -Timaru Cycleway Strategy implementation. -Safer corridor treatments More passing opportunities south of Timaru	-Four Lanes between Washdyke and the Port -Waimataitai St connection to Bridge Road

Table 15 North Otago short list and indicative timeframes

Programme	Short Term	Medium Term	Long Term
1. Business as Usual (Do Minimum)	-North Oamaru corridor improvements -Oamaru to Dunedin Safety Improvements -Kat ki Straight rock armouring (high risk sites only)		
4 Corridor Safety with Resilience for Low Impact High Probability events	-Oamaru to Dunedin Safety Improvements	-Corridor safety improvements -Safe System treatments (high risk sites) -Oamaru access and safety improvements -Permanent solution along length of Kat ki Straight.	-Deborah Underpass improvements -Flooding resilience works (Hilderthorpe, Maheno, Big Kuri Creek, Waikouaiti)
6. Highly Safe, Accessible, Connected and Resilient Coastal Corridor at Katiki Straight	-Oamaru to Dunedin Safety Improvements -Kat ki Straight rock armouring (high risk sites only)	-Corridor safety improvements -Safe System treatments (high risk sites) -Oamaru access and safety improvements -Permanent solution along length of Kat ki Straight. -Deborah Underpass improvements -Relocation of the Waitati Shop	- -Flooding resilience works (Hilderthorpe, Maheno, Big Kuri Creek, Waikouaiti) -Rural intersection improvements -Curve smoothing

6.5 Short list programme option assessment

This section outlines the process utilised to assess programme short list and provides an assessment against of how each of the 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; and
- **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 40.

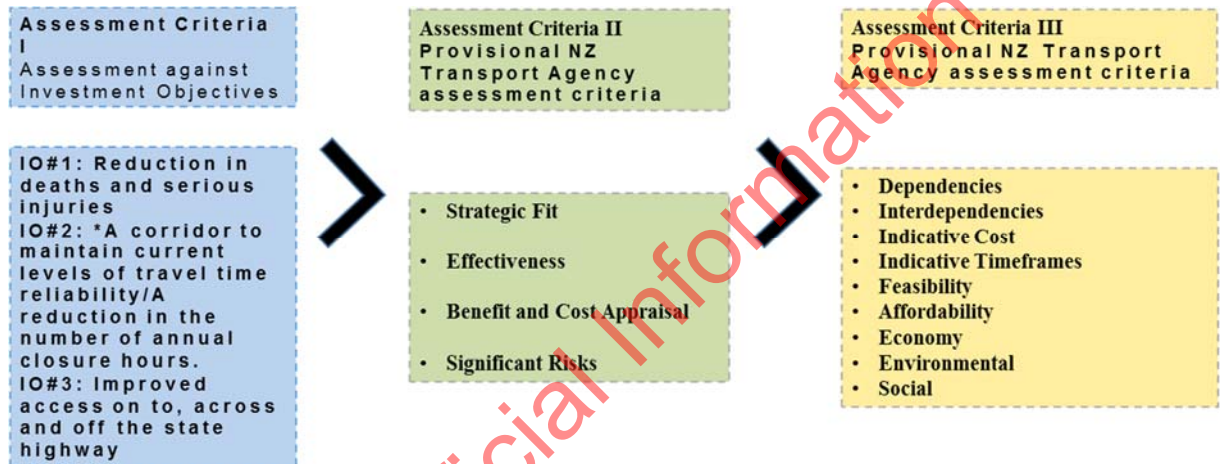


Figure 40 Tiered assessment criteria

The assessment against the assessment criteria including the investment objectives is summarised in Table 16.

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

Table 16 Short list programme options assessment summary

Mid Canterbury

Programme Multi - Criteria Assessment at 2046		Programme 1 Business as Usual	Programme 4 Balanced Mid-Level Investment (Safety, Travel Time Reliability, Access)	Programme 5b Balanced High Level Investment with Second Ashburton River Bridge
Investment Objectives KPI Outcomes	Reduction in deaths and serious injuries	20% increase on 2011-2015	45%-55% decrease on BAU	55%-65% decrease on BAU
	Expected deaths and serious injuries in 2042-2046	45-55 DSI --	20-25 DSI ++	15-20 DSI ++
	Improved road safety risk assessment rating (KiwIRAP) (Proportion of length 3 star or better)	86% - 89%	95% - 98% ++	97+% ++
	Median travel time	60-63 mins --	55-58 mins ++	55-57 mins +
	Open road median speed North of Ashburton South of Ashburton	80 90 -	93 92 ++	93 95 +++
	Maintain travel time reliability (Difference between programme 85th percentile and 2015 median travel times)	7 min --	4½ min +	4 min ++
	Intersection level of service	--	0	++
	Pedestrian and cyclist access	--	+	+++
	Other factors	Effectiveness	--	++
Risk		-	0	0
Public & Stakeholders		-	0	-
Inter/dependencies		++	-	--
Feasibility		+++	-	--
Affordability		+++	-	-
Costs		\$5 - \$15 M	\$200 - \$350 M	\$350 - \$550 M
Benefit Cost Ratio		High	Medium	Low / Medium
Programme Consideration		Short Listed	Recommended Programme	Short Listed

South Canterbury

Programme Multi - Criteria Assessment in 2046		Programme 1 Business as Usual / Do Minimum	Programme 4a Mixed Programme (Safety, Travel Time Reliability, Access and Timaru Road Optimisation)	Programme 4b Mixed Programme (Safety, Travel Time Reliability and Access) with extra Timaru Capacity (4 lane)
Investment Objectives KPI Outcomes	Reduction in deaths and serious injuries	20% reduction on 2011-2015	40% reduction on BAU	40% reduction on BAU
	Expected deaths and serious injuries in 2042-2046	35-40 DSI +	20-25 DSI ++	20-25 DSI ++
	Road safety risk assessment rating (KiwiRAP) (Proportion of length 3 star or better)	82% -	93% ++	93% ++
	Median travel time	82 min -	78 min +	75-77 min ++
	Open road median speed	88 km/h -	92-94 km/h +	92-94 km/h ++
	Improve travel time reliability (Difference between programme 85th percentile and 2015 median travel times)	7¼ min -	6½ min +	6 min ++
	Intersections level of service	--	-	--
	Pedestrian and cyclist access	--	+	0
Other factors	Effectiveness	--	+	-
	Risk	++	0	-
	Public & Stakeholders	+	++	-
	Inter/ dependencies	+	0	-
	Feasibility	+++	0	-
	Affordability	+++	+	--
	Costs - including operations and maintenance	\$5 - \$15 M	\$150- \$190 M	\$260 - \$320 M
	Benefit Cost Ratio	High	Medium	Low
Programme Consideration	Short Listed	Recommended Programme	Short Listed	

Programme Multi - Criteria Assessment in 2046		Programme 1 Business as Usual	Programme 5 Corridor Safety, Resilience, Access and Active Mode Connectivity	Programme 6 Highly Safe, Accessible, Connected and Resilient Coastal Corridor at Katiki Straight
Investment Objectives KPI Outcomes	Reduction in deaths and serious injuries	20% reduction on 2011-2015	15-25% reduction on BAU	25-35% reduction on BAU
	Expected deaths and serious injuries in 2042-2046	55-60 DSI 0	45-50 DSI ++	40-45 DSI ++
	Road safety risk assessment rating (KiwiRAP) (Proportion of length 3 star or better)	73% -	87%-90% ++	91% ++
	Average closure duration	11 hrs -	6 - 7 hours ++	6 - 7 hours ++
	Number of road closures (per 5 year period)	29 events -	17 events ++	17 events ++
	Intersection level of service	-	++	++
	Pedestrian and cyclist access	0	++	+++
Other factors	Effectiveness	--	++	++
	Risk	--	-	--
	Public & Stakeholders	-	-	--
	Inter/dependencies	++	+	0
	Feasibility	++	-	--
	Affordability	+++	++	--
	Costs - including operations and maintenance	\$10 - \$25 M	\$80 - \$170 M	\$140 - \$190 M
	Benefit Cost Ratio	Low / Medium	Low	Low
	Programme Consideration	Short Listed	Short Listed	Recommended Programme

7. Recommended Programme – Description and Assessment

7.1 The Recommended Programme

7.1.1 Mid Canterbury

The recommended programme option 4 – Balanced Mid-Level Investment (Safety, Travel Time Reliability and Access) with the addition of the Ashburton Second River Bridge as shown in Figure 41.



Figure 41 Mid Canterbury recommended programme

The main safety components of the recommended programme are:

- Safe Road Alliance work between Selwyn River and Ashburton prior to 2+1 implementation
- Implementation of the safer corridors treatment philosophy south of Ashburton to include shoulder widening, wide centreline, ATP and roadside hazard removal
- Intersection improvements south of Ashburton

The reliability components of the recommended programme are:

- 2+1 between Selwyn River and Ashburton to be delivered in two stages (north of Rakaia initially followed by south Rakaia to Ashburton)
- Passing lane improvements south of Ashburton

The access improvements of the recommended programme are:

- Ashburton Second River Bridge;

- Ashburton and Tinwald intersection improvements as shown in Figure 42 and Figure 43 respectively.

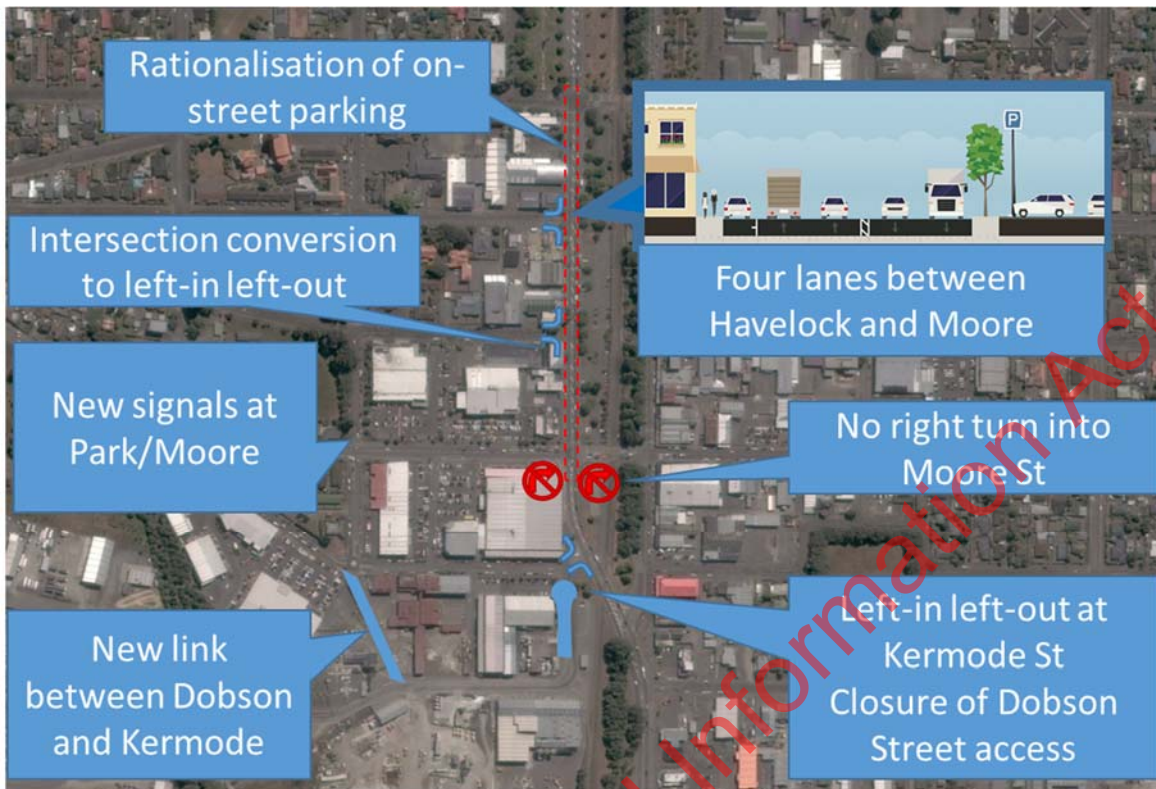


Figure 42: Ashburton intersection improvements



Figure 43: Tinwald corridor improvements

7.1.2 South Canterbury

The recommended programme is Programme Option 4a - Mixed Programme (Safety, Travel Time Reliability, Access, and Urban Road Optimisation Timaru) as shown in Figure 44 below. The programme includes short term isolated safety treatments with corridor wide safety treatments in the medium to long term. An alternating 2+1 configuration is proposed between Temuka and Timaru for safety and reliability benefits. It is noted that heavy vehicle numbers through Timaru must be monitored regarding their effect on travel time. 4 laning has been suggested but will be very expensive with environmental impacts.

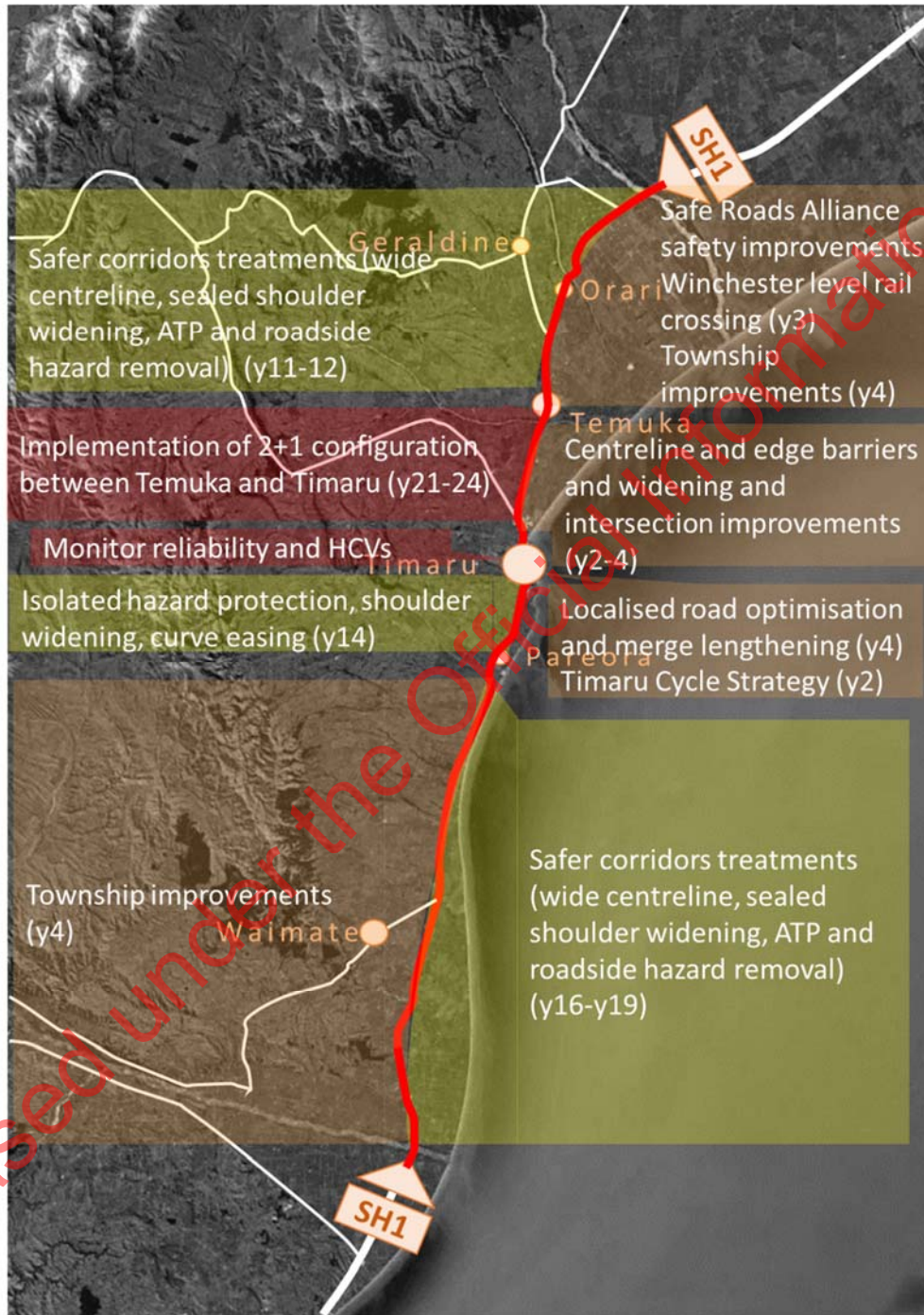


Figure 44: South Canterbury recommended programme

The safety components of the recommended programme are:

- Winchester level rail crossing improvements

- Initial Safe Roads Alliance safety work between Rangitata River and Temuka
- Safer corridor treatments corridor wide
- Centreline and edge wire rope barriers, shoulder widening and intersection improvements between Temuka and Timaru

The travel time reliability components of the recommended programme are:

- 2+1 configuration between Temuka and Timaru
- Localised Timaru road optimisation and merge lengthening
- Monitoring of travel time reliability and HCV travel times in Timaru
- Four lanes between Washdyke and the Port determined by travel time reliability monitoring and effectiveness of the optimisation interventions; based on current volumes and projections, and the assessment of the effectiveness of optimisation works it is not expected that this will be required within the programme time period (30yrs)

The access components of the recommended programme are:

- Corridor wide township improvements
- Implementation of the Timaru cycle strategy

Released under the Official Information Act 1982

7.1.3 North Otago

The recommended programme is programme option 6 – Highly Safe, Accessible, Connected and Resilient Coastal Corridor at Katiki Straight. The programme has a significant safety investment in the short to medium term and resilience works throughout the programme as shown in Figure 45 below.

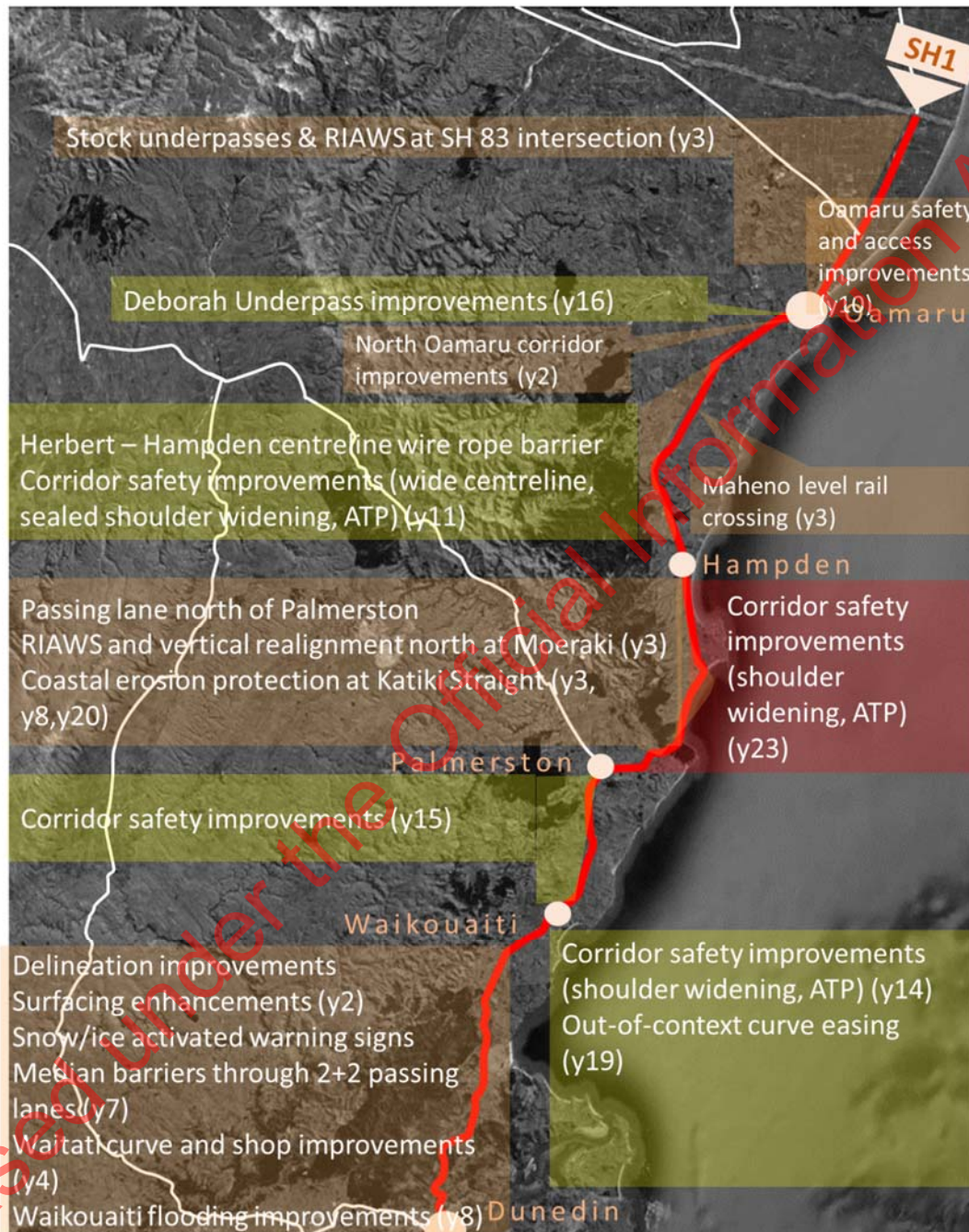


Figure 45: North Otago recommended programme

The main safety components of the recommended programme are:

- Oamaru safety improvements;
- Oamaru to Dunedin safety improvements;
- Implementation of the safer corridors treatment philosophy to include shoulder widening, ATP and roadside hazard removal;

- Deborah Underpass improvements;
- Maheno level rail crossing improvements;
- Installation of RIAWS at highest risk intersections;
- Herbert to Hampden centreline barrier;
- Vertical realignment at Moeraki;
- Out-of-context curve easing;
- Passing lane safety improvements (Leith Saddle).

The main resilience components of the programme are:

- Hilderthorpe Straight Flood Improvements;
- Coastal erosion protection at Katiki Straight;
- Flooding improvements at Waikouaiti;
- Flooding improvements at Waitati;
- New snow clearing equipment;
- Snow/ice activated warning signs;
- Preventative maintenance over the Kilmog.

Access improvements in the programme are:

- North Oamaru corridor improvements;
- Oamaru access improvements;
- Waitati shop relocation and townside improvements.

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; and
- Economic efficiency of the proposed solution.

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

7.2.1 Strategic Fit

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.

7.3 Assessment Profile

Table 12 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:</p> <ul style="list-style-type: none"> • employment • access to economic opportunities, including activities identified in regional economic growth strategies and in support of special housing area orders • tourism • freight 	<p>Overall, addressing the corridors problems and benefits is considered to have a high strategic fit. The section of corridor is considered a national strategic route and is the main route for domestic, tourist and commercial road users between Christchurch and Dunedin, the two main centres in the South Island.</p> <p>The state highway crosses several braided rivers along the corridor, and these bridges are important infrastructure assets due to the limited viable detours available in the event of an outage.</p> <p>The corridor has high volumes of freight traffic and is an important strategic haulage route. From a regional and national resilience perspective the corridor segment south of the Waitaki River is vulnerable to slips, flooding, snow and coastal erosion. Many of the sections where unplanned events are likely to occur do not have a suitable detour route for HCVs</p> <p>Road closures creates a high level of inconvenience, with longer travel times resulting from:</p> <ul style="list-style-type: none"> • Travelers 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 around on some sections of SH1.
<p>There is a significant gap in the customer levels of service for:</p> <ul style="list-style-type: none"> • journey time reliability • resilience (including lifelines) • mismatched capacity and demand that results in capacity constraints 	<p>The northern part of the corridor has a diverse range of vehicles travelling on state highway 1, including agricultural vehicles. These vehicles are speed limited and can be difficult to pass at times, leading to travel time reliability issues.</p> <p>The narrow bridges which cross the braided river can feel narrow to some users resulting in reduced speeds across these bridges. These bridges are required to be closed to allow over dimension road users to cross them, leading to travel time reliability issues.</p> <p>The Katiki Straight coastal erosion issue is a high-impact high probability event which would lead to a long term outage should the coast erode away. Weather and geometry constraints impose frequent 'low impact' events resulting in the closure of the corridor for significantly longer periods per kilometre than most nationally strategic state highways. Local communities are also dependent on SH1 for access to work, education, and critical community amenities.</p> <p>The geography is considered to have the reliability and resilience constraints that would warrant a medium or high strategic fit rating.</p>
<p>OR</p> <ul style="list-style-type: none"> • a high crash risk 	<p>The SH1 corridor has a Medium-High collective risk overall (classifying it as a high risk rural road), with sections having High collective risk. These sections include Dunsandel to Rakaia and Temuka to Timaru. The North Otago segment has a per kilometre deaths and serious injury rate which is significantly higher than the rest of the corridor and the national state highway network.</p>

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

7.3.1 Effectiveness

An indicative 'high' rating for Effectiveness was achieved on the basis that the identified problems and potential investment meets the components of the criteria as follows:

Figure 46 Recommended programme effectiveness assessment

Rating	Assessment
High	<p>Outcomes Focussed:</p> <p>The recommended programme option delivers strong outcomes when considering the investment objectives identified. It is anticipated that the following outcomes would result in the long term if this programme option is adopted</p> <ul style="list-style-type: none"> considerable reductions in deaths and serious injuries and significant improvements in road safety risk assessments maintaining the current levels of travel time reliability reducing the number of annual road closures and average duration of the closures improving pedestrian, bicycle and vehicle access to SH1
High	<p>Integrated:</p> <p>The recommended programme option delivers strong outcomes when considering integration with current network and future transport plans the mixture of medium/high outcomes reflect the corridors role as the main north to south transport connection between Christchurch to Dunedin in the South Island.</p>
High	<p>Correctly scoped</p> <p>The degree of works and outcomes achieved for the recommended programme option suggests a medium/high rating against these criteria. The programme addresses the problem identified for the corridor, however it also provides infrastructure to maintain travel time for this corridor in the face of growth. 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>Affordable</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>It is likely that this programme option would have medium/high affordability as the improvements in the recommended programme option are all online (with exception of minor realignments).</p> <p>The long distance widening and capacity improvements in the northern sections will reduce the affordability of the programme.</p>
High	<p>Timely</p> <p>This programme option delivers outcomes in the short to long term.</p>
High	<p>Confidence</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>Overall</p> <p>Note: Overall, this is based on the lowest rating of all components.</p>

7.3.2 Benefit Cost Appraisal

The preliminary benefit cost ratio is 1.0 – 1.2 (this is being further analysed with additional benefits from the investment yet to be quantified).

This is based on a NPV benefit of \$ 380 M – \$420 M and a NPV cost of \$320 M - \$380 M.

The following assumptions have been made for the BCR calculations:

- 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
- travel time used the 2015 update factor, 1.44;
- Vehicle Operating Costs (VOC) and Safety used the updated 2016 factors;
- 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 LIHP 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;
- traffic growth assumptions rural
 - 2.25% north of Ashburton
 - 1.5% south of Ashburton
- Traffic growth assumptions urban
 - 1.5% Ashburton
 - 0.5% Timaru
 - 0% Oamaru

Sensitivity Analysis

Three sensitivity tests were carried out on the benefit cost ratio. These included the following:

- 4 percent discount rate
- 8 percent discount rate
- without the 30 percent contingency on capital expenditure

Lowering the discount rate increases the BCR to 1.3 and increasing the discount rate reduces the BCR to 0.9.

Without the 30 percent contingency, the BCR increases to 1.4 when calculated with a 6 percent discount rate

7.4 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 12 below.

Table 17 Summary of Identified Key Risks

Risk Area	Description	Treatment Strategy
Land acquisitions	There is an unknown about the infrastructure on the property side of the road corridor boundary (i.e. pivot irrigators)	Early consultation and engagement with potentially affected land owners to reduce likelihood of additional infrastructure that would need to be moved at a later date
Affordability	The risk that Ashburton District Council will be unable to afford their share in the second river bridge	Increase the Funding Assistance Rate for the Ashburton Second River Bridge
Operational	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
Financial	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
Full or partial failure of SH1	<p>There is a low risk that failure of critical assets (i.e. bridges) that sever the link between Christchurch and Dunedin</p> <p>There is a significant risk of coastal erosion at Katiki Straight leading to a long term closure</p>	<p>Ongoing structural observations need to continue. Incident response plans and detour route planning</p> <p>Short term treatment strategy to protect highest risk area, followed by a long term treatment</p>
Population growth	Population growth is faster than predicted, leading to a reduction in travel time reliability	Monitoring of travel times and vehicle numbers

8. Programme Financial Case

8.1 Funding Arrangements

The proposed programme of works and associated costs are significant.

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. The second Ashburton River bridge is a local project but would still likely require a significant funding contribution from the NZ Transport Agency to realise the transport benefits to the state highway network.

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. These opportunities will be explored in more detail following the completion of the programme business case.

8.1 Indicative Cost and Programme Cash Flow

An indicative programme cost has been estimated at approximately \$600 million. The breakdown by intervention type is shown in Table 18.

Table 18 Indicative Programme Cash Flow (un-escalated)

Year Number	Years 1-10	Years 11-20	Years 21-30	Total
Mid Canterbury	Township improvements Corridor safety improvements Ashburton intersection improvement Tinwald corridor improvements Level rail crossing improvements	Mid Canterbury 2+1 implementation Ashburton second river bridge Passing lanes and extensions Intersection improvements		\$297,000,000
South Canterbury	Timaru urban road optimisation Timaru Cycle Strategy Townside improvements Level rail crossing improvements	Safer corridor improvements	Timaru – Temuka 2+1 implementation Four lanes Washdyke to the Port (if required)	\$165,000,000
North Otago	Oamaru Safety and Access improvements Level rail crossing improvements Katiki Straight Townside improvements	Deborah Underpass Flood prevention work Katiki Straight Corridor safety Curve smoothing	Corridor safety	\$139,000,000
Capex	\$156,000,000	\$342,000,000	\$102,000,000	\$600,000,000
Operations and Maintenance	\$18,000,000	\$21,000,000	\$23,000,000	\$62,000,000

Part C – Delivering and Monitoring the Programme

9. Planning and Delivery Overview

The recommended programme adopts a strategic response of operational interventions and improvements to deliver the mix of safety, reliability, resilience and accessibility outcomes. The operational interventions include activities such as:

- Driver behaviour programmes – particularly dealing with safety and being able to influence journey choice
- Incident Response Systems – the corridor is occasionally closed with impacts on freight and community, getting better information out and managing detour routes is a key stream of work
- Optimising existing assets – through signal management, ITS monitoring systems, minor improvements, maintenance and renewals

The above activities will enable the formalisation of a monitoring programme to identify the scale of the problems and identify the appropriate trigger points for when longer-term interventions should be implemented.

The programme is focused on the State Highway and will predominantly be delivered by the Transport Agency. However, there are some activities identified to be delivered by local authorities, which will involve co-funding arrangements.

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

Short-term safety, access and reliability improvements

There are a number of short-term safety improvements that have been identified and those already identified in the NLTP have begun the Detailed Business Case phase through the Safe Roads Alliance. Other activities will be explored for delivery through Network Operating Contracts or minor improvement works. These will need to be assessed on a case by case basis and reflect the evidence provided in the PBC. The Walnut Avenue improvement has already completed the pre-implementation phase and has an opportunity to be delivered early in conjunction with a major sewer upgrade being undertaken by Ashburton District Council. Other candidates for early intervention are the Tinwald Corridor improvements that have already had a specific Programme Business Case previously undertaken.

Short to medium term multi-faceted (safety, reliability, resilience and state highway access) improvements

A large number of improvements have been identified that can have an improvement to the current SH1 corridor and its operation. These improvements are most likely to be effectively through developing 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 should be further developed through an Indicative Business Case. Examples of such projects in each segment include:

- Mid Canterbury - Ashburton traffic signal intersection and mid-block improvements (Walnut, Havelock, Moore/Kermode/Park)

- South Canterbury - north Timaru road optimisation (addressing merge points on intersection departures)
- 2+1 configurations between Selwyn to Ashburton (excluding the bridges)
- Second Ashburton River bridge
- 2+1 configuration between Temuka to Timaru
- Deborah Underpass improvement
- Corridor improvements between Oamaru and Dunedin
- North Otago - Katiki Straight coastal erosion protection.

A number of the improvement activities in the programme are already identified in the current NLTP, either within the first three years, or the subsequent three years. The following activities are recommended for early development through DBCs or progression of the pre implementation and implementation phases. These include:

Table 19 Recommended Activities for Early Development

Activity	Outcome	Status	Next Phase	Expected Implementation
Rakaia to Ashburton safety improvement	Safety, Reliability	In NLTP, expand north to Selwyn River, target highest risk Dunsandel to Rakaia	DBC through Safe Roads Alliance; 2016/17	2017/18
Walnut Ave intersection	Safety, Reliability, Accessibility	In NLTP, Pre implementation complete	Implementation, cost share with ADC	2017/18
Tinwald corridor improvements	Accessibility, Safety	In NLTP	DBC, 2017/18	2018/19
Rangitata to Timaru safety improvement	Safety, Reliability	In NLTP, expand south to Pareora, target highest risk Temuka to Timaru	DBC through Safe Roads Alliance; 2016/17	2017/18
Timaru corridor improvements	Reliability	In NLTP	DBC for corridor optimisation, 2017/18	2018/19
Timaru Cycle Strategy	Accessibility, Reliability	In RLTP (TDC activity)	DBC new activity	2018/19
Oamaru to Dunedin safety improvements	Safety, Accessibility	In NLTP, expand north to Waitaki	DBC through Safe Roads Alliance; 2016/17	2017/18
North Oamaru corridor improvements	Accessibility, Safety	In NLTP	DBC, 2018/19	2020/21
Katiki Coastal Erosion resilience improvement	Resilience	Initial enhanced network resilience work underway, additional activity in NLTP	IBC for full intervention, 2017/18 (note complexity requires IBC first)	2018/19

Long term monitoring

The programme includes the monitoring of certain data to ascertain whether projects are economically viable to proceed with as well as help meet the agreed investment objectives. The programme requires the following additional data to be monitored annually:

- Timaru travel time and travel time reliability, and HCV numbers
- structural loading on the bridges

- coastal erosion at Katiki Straight, to mitigate future risk of closures
- intersection delay at key intersections

Four lanes between Washdyke and the Port has been included in the cost benefit analysis, however it is not anticipated that this project will be constructed within the 30-year programme, due to low estimated traffic growth and effectiveness of optimisation works proposed.

The bridges are monitored (strain gauges) following the introduction of HPMVs. There is no additional maintenance cost allowed for in the bridges above the existing expenditure. The current assessments indicate that the lifetime of the bridges is beyond the 30 year programme. There is no budget for capital expenditure for bridge replacements or improvements in the programme.

Work not included in the programme based on existing funding

The existing bridges along the corridor contain a minimum shoulder that does not allow for a safe provision for cyclists. It is anticipated that the benefits obtained would only be realised by a few cyclists and therefore is not a sound investment. In the event that there is a national policy change regarding cyclists, the bridge improvements for cyclists should be considered.

Released under the Official Information Act 1982

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 Southern region 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 Southern region have ultimate responsibility for the outcomes of the planning, improvements and monitoring for the programme.

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 for SH1 between Christchurch to Dunedin and the transportation needs of the wider Mid- and South Canterbury and North Otago regions.

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 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.

Released under the Official Information Act 1982

Released under the Official Information Act 1982

Appendices

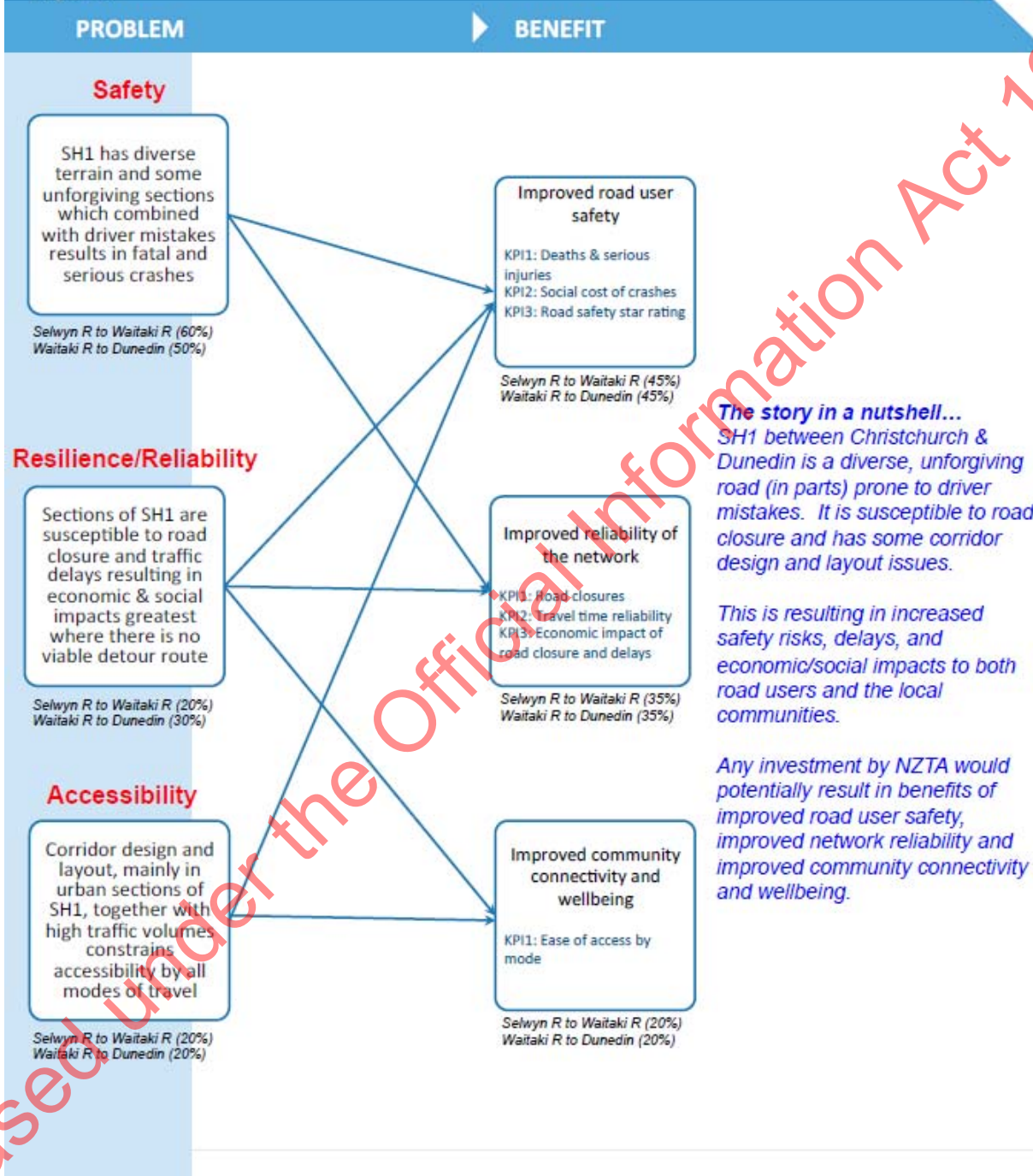
Appendix A – Investment Logic Maps

1. Christchurch to Dunedin
2. Timaru Urban

Released under the Official Information Act 1982

SH1 from Christchurch to Dunedin – Improving the Journey Experience

INVESTMENT LOGIC MAP
Programme



The story in a nutshell...
SH1 between Christchurch & Dunedin is a diverse, unforgiving road (in parts) prone to driver mistakes. It is susceptible to road closure and has some corridor design and layout issues.

This is resulting in increased safety risks, delays, and economic/social impacts to both road users and the local communities.

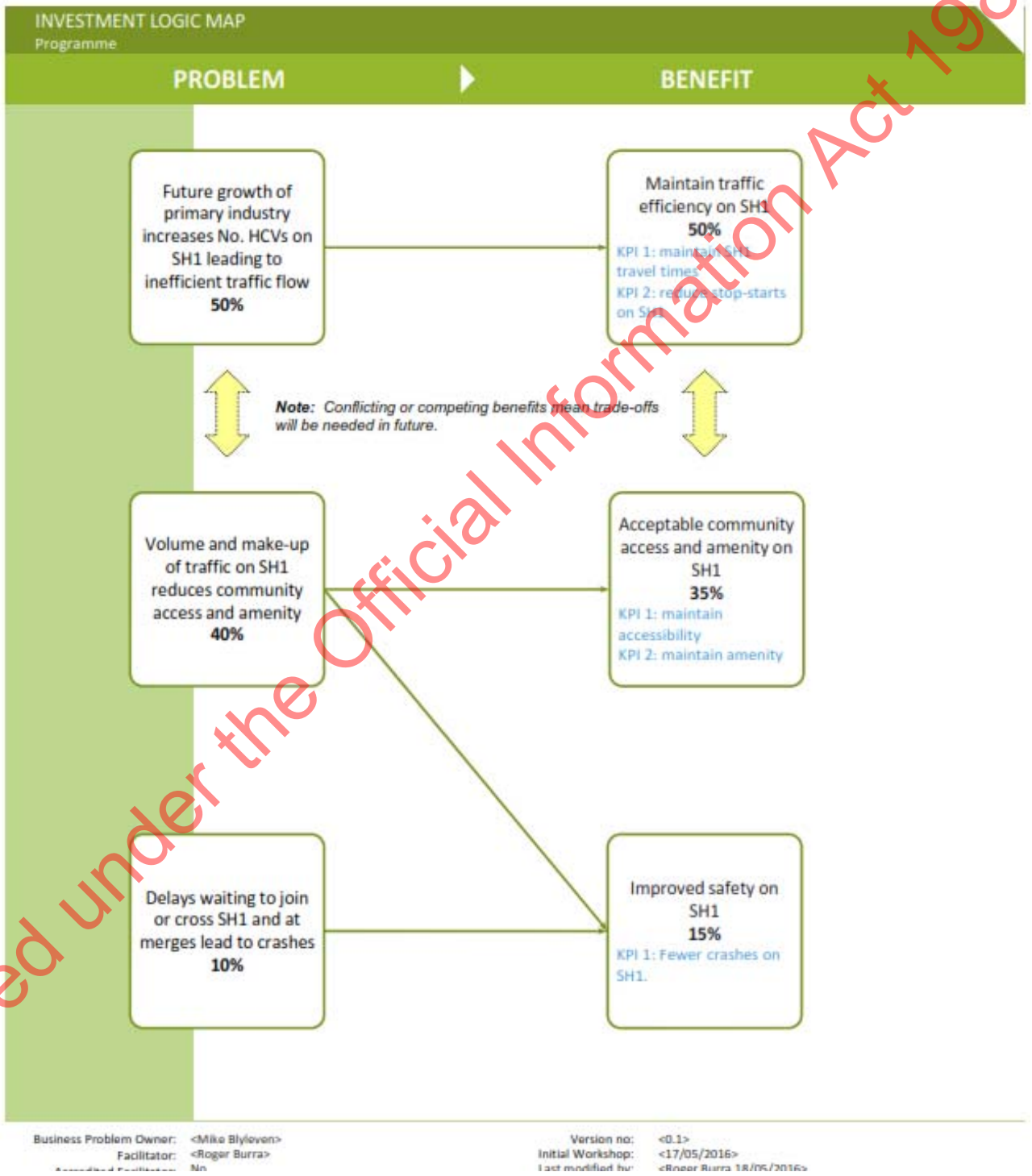
Any investment by NZTA would potentially result in benefits of improved road user safety, improved network reliability and improved community connectivity and wellbeing.

NZTA: Ian McCabe/Chad Barker, Colin Knaggs/Ian Duncan
Facilitator: Mark Young
Accredited Facilitator: Yes

Version no: 4.0 (Final)
Workshop: December 14th 2015
Last modified by: Mark Young
Template version: 5.0

Timaru Freight Route

Balancing the Link and Place Functions of SH1



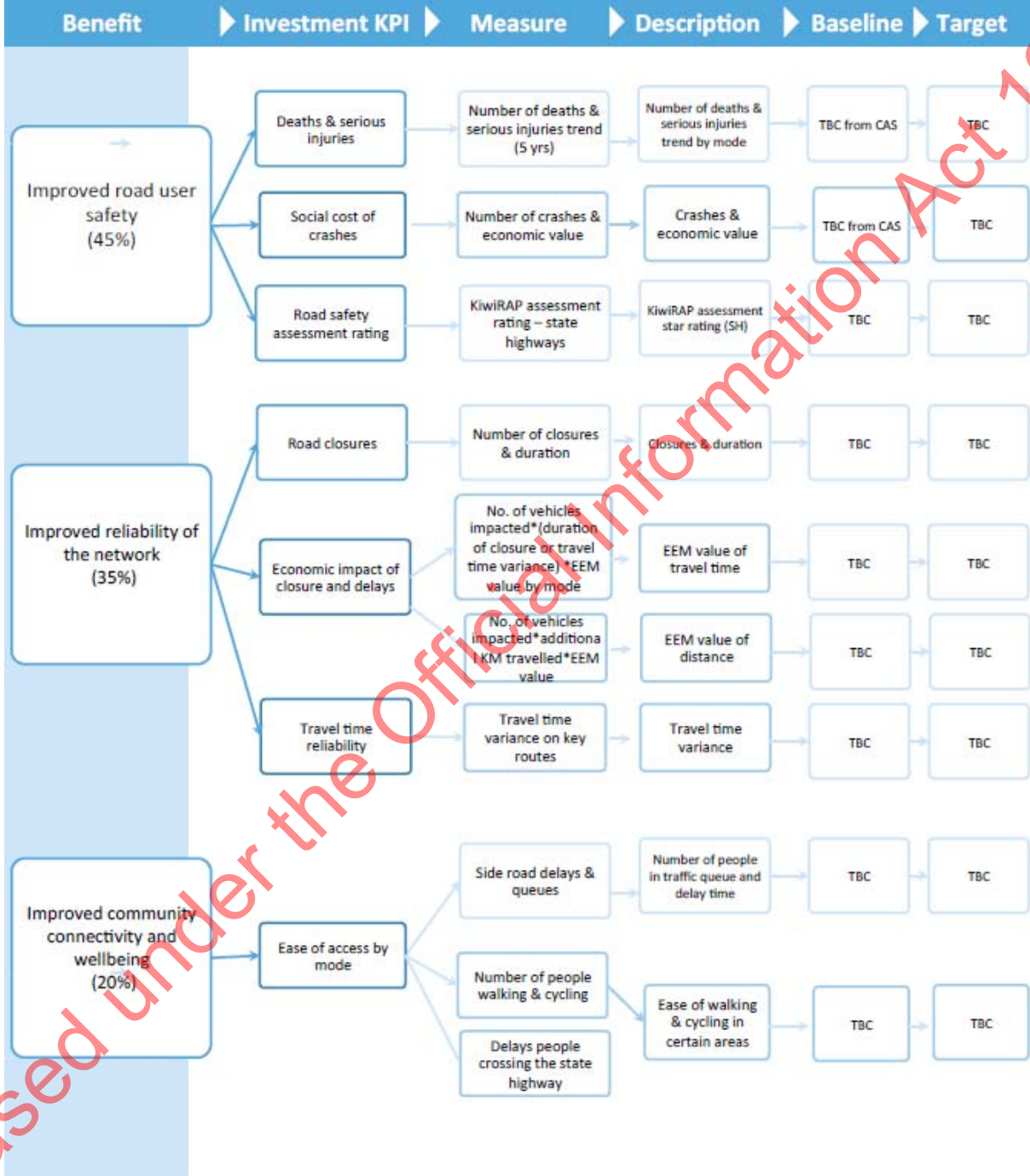
Appendix B – Benefit Maps

1. Christchurch to Dunedin
2. Timaru Urban

Released under the Official Information Act 1982

SH1 from Christchurch to Dunedin – Improving the Journey Experience

Benefits Map Programme

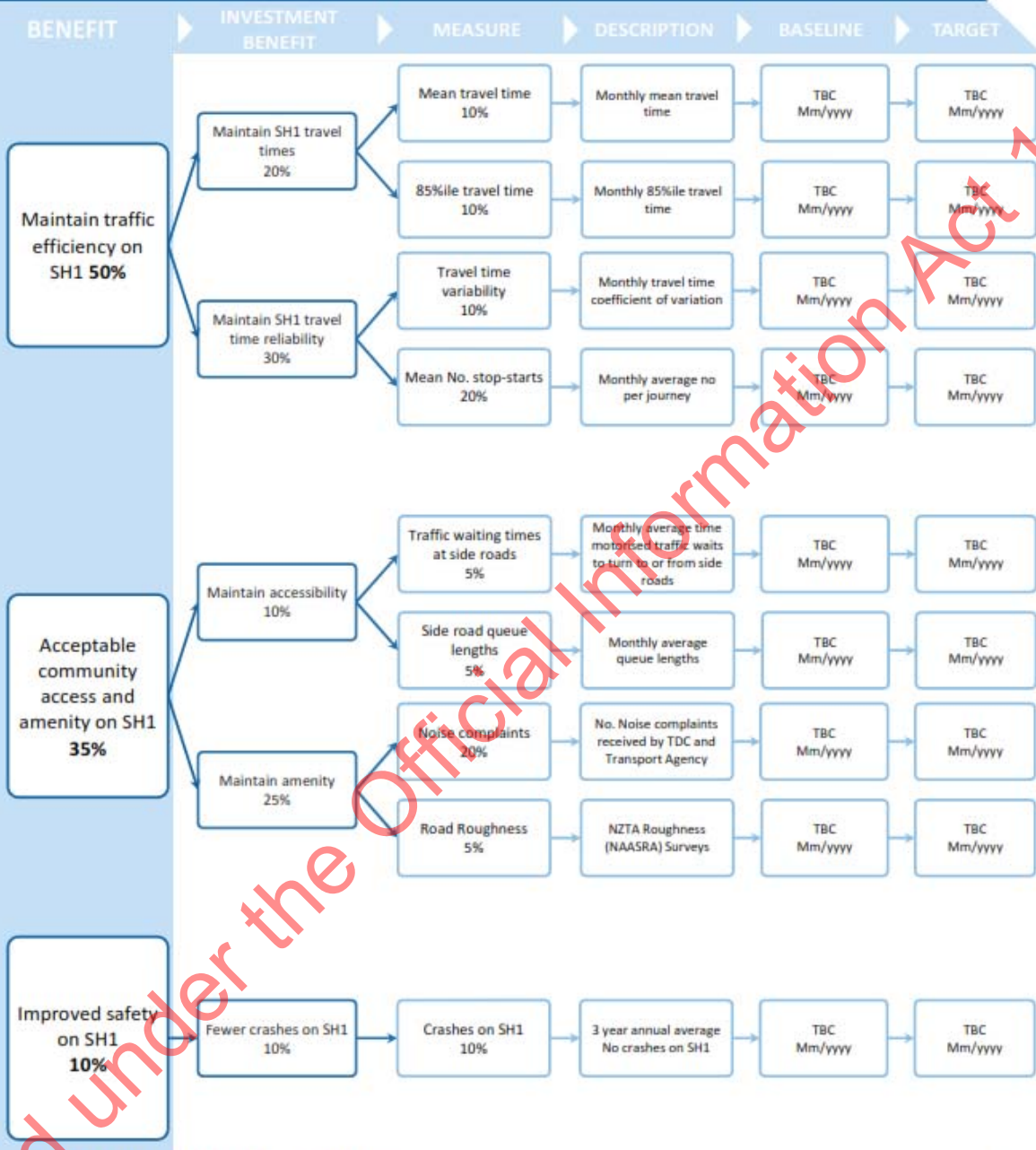


Released under the Official Information Act 1982

Timaru Freight Route

Balancing the Link and Place Functions of SH1

BENEFIT MAP

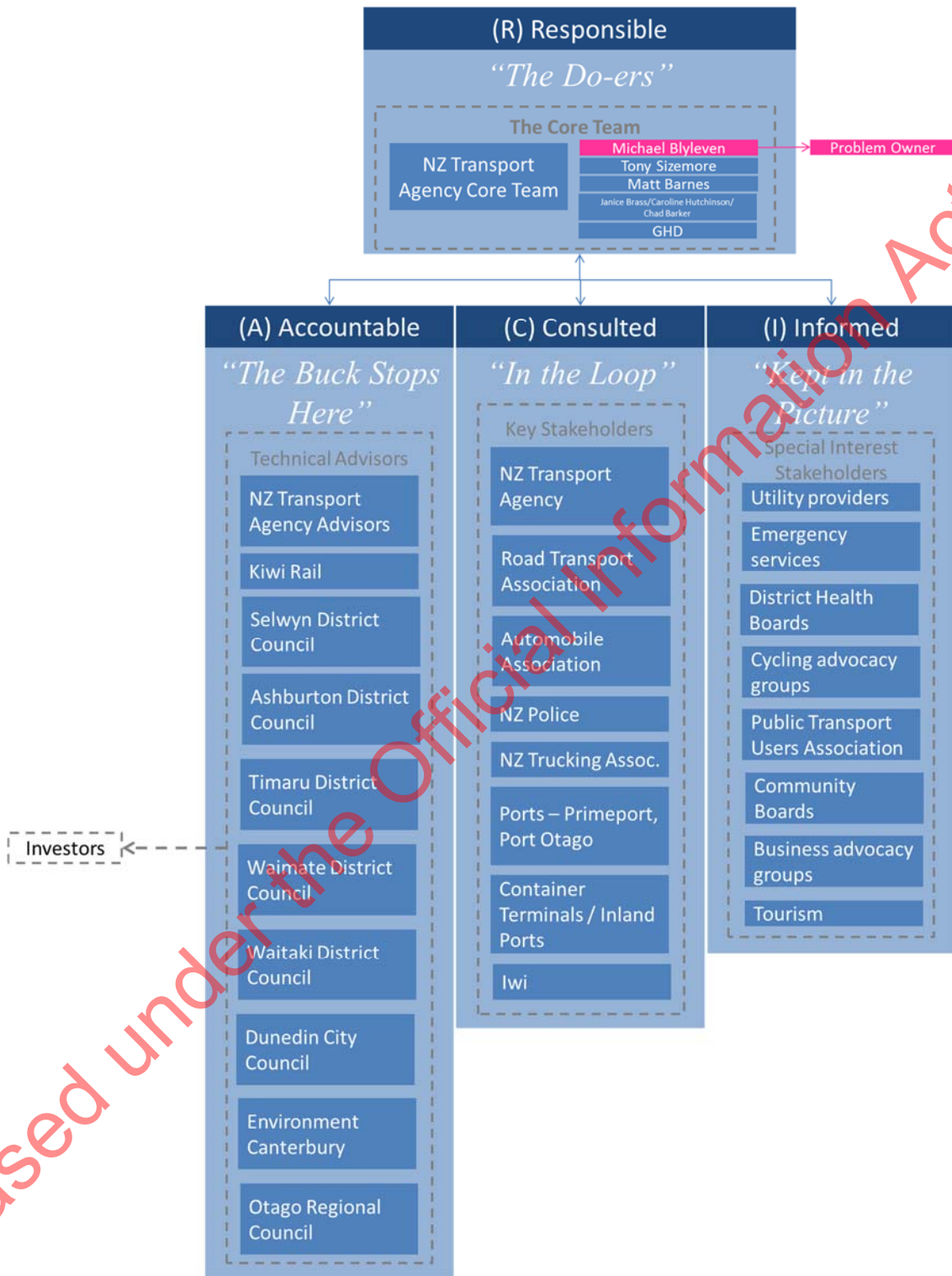


RESPONSIBILITY FOR DELIVERING THE BENEFITS

Name	Position	dd/mm/yyyy
Business Problem Owner: <Mike Blyleven>		
Facilitator: <Roger Burra>		
Accredited Facilitator: No		
Version no: <0.1>		
Initial Workshop: <17/05/2016>		
Last modified by: <Roger Burra>		

Released under the Official Information Act 1982

Appendix C – Christchurch to Dunedin stakeholders



Released under the Official Information Act 1982

Released under the Official Information Act 1982

Appendix D – Uncertainty Log

Released under the Official Information Act 1982

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	Low/Medium	Not considered to be of high impact to operations
	Ability to fund a major infrastructure project	Some uncertainty	Moderate	Moderate likelihood of major infrastructure requirements in the short to medium term
Stakeholder / Public	Stakeholder expectations for programme business case	Low uncertainty	Low	Good understanding of stakeholder expectations
	Stakeholders may not represent full spectrum of stakeholders/community that will be impacted / affected by the programme	Some uncertainty	Low/Medium	Some stakeholders are proxy representatives. Depending on programme development specific engagement may be required with some stakeholders
	Customers level of service expectations	Some uncertainty	High	Increasing expectations of the Levels of Service for this connection
	Impact of perceived problems compared to reality	Near certain	Moderate	Imbalance between actual (as determined by evidence base) and perceived (by stakeholders) issues which need to be continually monitored
	Land ownership (and land use) and consultation around potential future projects	Some uncertainty	Low	Inability to / restriction on the upgrade and improvement of the existing State Highway 1 road corridor
Environmental	Utilising adjacent environmentally sensitive land	Some uncertainty	Low	There may be some areas of environmental and sensitive land, however at this time the likelihood of impacts is deemed to be low.
	Environmental impacts of options and alternatives	Some uncertainty	Medium	Some of the proposed options will have environmental impacts, these can be mitigated, minimised and/ or offset if necessary.
	Global demand for primary industry (agriculture, forestry and others) varies freight volumes on State Highway 1	Some uncertainty	Low	These may be impacted by world demand and commodity prices.

Released under the Official Information Act 1982

	Likelihood of a major event impacting State Highway 1 and/or alternative routes	Near certain	High	The North Otago segment in particular State Highway 1 is impacted by weather and other events resulting in closures, warnings and changing conditions, especially in winter. There are also potential major impacts as a result of an earthquake for this corridor, in particular bridge access across the major rivers.
Economic	Changes to Heavy Vehicle formations (length and height) and HPMVs	Some uncertainty	Medium	Changes to HCV's and HPMVs (regulations, operations, technology and routes)
	Uncertain future growth and development (i.e. apart from Selwyn, the remaining districts have low population growth forecasts, and an aging population)	Some uncertainty	Low	Traffic levels remain constant
	Competitiveness of port and inland port operations	Some uncertainty	Medium	Uncertain outcome of 'Port Wars'
	Impact of route on value of tourism i.e. routes role in tourist decisions	Some uncertainty	Low/ Medium	Potential increases in tourist activity which could impact travel time reliability, safety and general operation of the corridor
	Water management / future irrigation development	Some uncertainty	Medium	Impact of water use project on State Highway 1 travel demands is difficult to predict , especially growth, timeframes and higher trip generation of intensified land use

Area of Issue or Consideration	Issue or Consideration	Comments
Financial	Detailed analysis of impact on economy limited by budget	Levels of investigation and analysis is being communicated with stakeholders throughout the programme business case 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 obtained	Stakeholders are being communicated to throughout the programme business case with continual discussions about what is realistic and a good investment for the NZ Transport Agency
	Ability for KiwiRail to participate as a stakeholder and contribute funding	KiwiRail have been involved in discussions as well as workshops. Continual consultation and communication is required about the Business Case Approach.
	Ashburton, Timaru and Oamaru resident's appetite for 'link' function of the state highway versus 'place' functionality.	Balancing improved travel reliability with accessibility. Most likely to be an issue in north Timaru and north Oamaru
Environmental	Parts of the corridor are prone to flooding	Consideration of 'non transport' solutions
Economic	Capacity of existing rail infrastructure	Limitations in terms of capacity increases with current infrastructure and / or operations
	Capacity of existing road infrastructure	Understand where the lane capacity is insufficient for current and expected future volumes. Assess the geometry and width of the road corridor and how this impacts safety, reliability and accessibility
	No viable alternative transport route for some sections of the corridor OR Some alternative routes but due to unplanned closures (i.e. crashes at certain points of the corridor) but may not viable for all vehicle types	Travel management plans and other response plan to be developed and are implemented
	Tertiary healthcare is based in Christchurch and Dunedin	Accessibility constraint

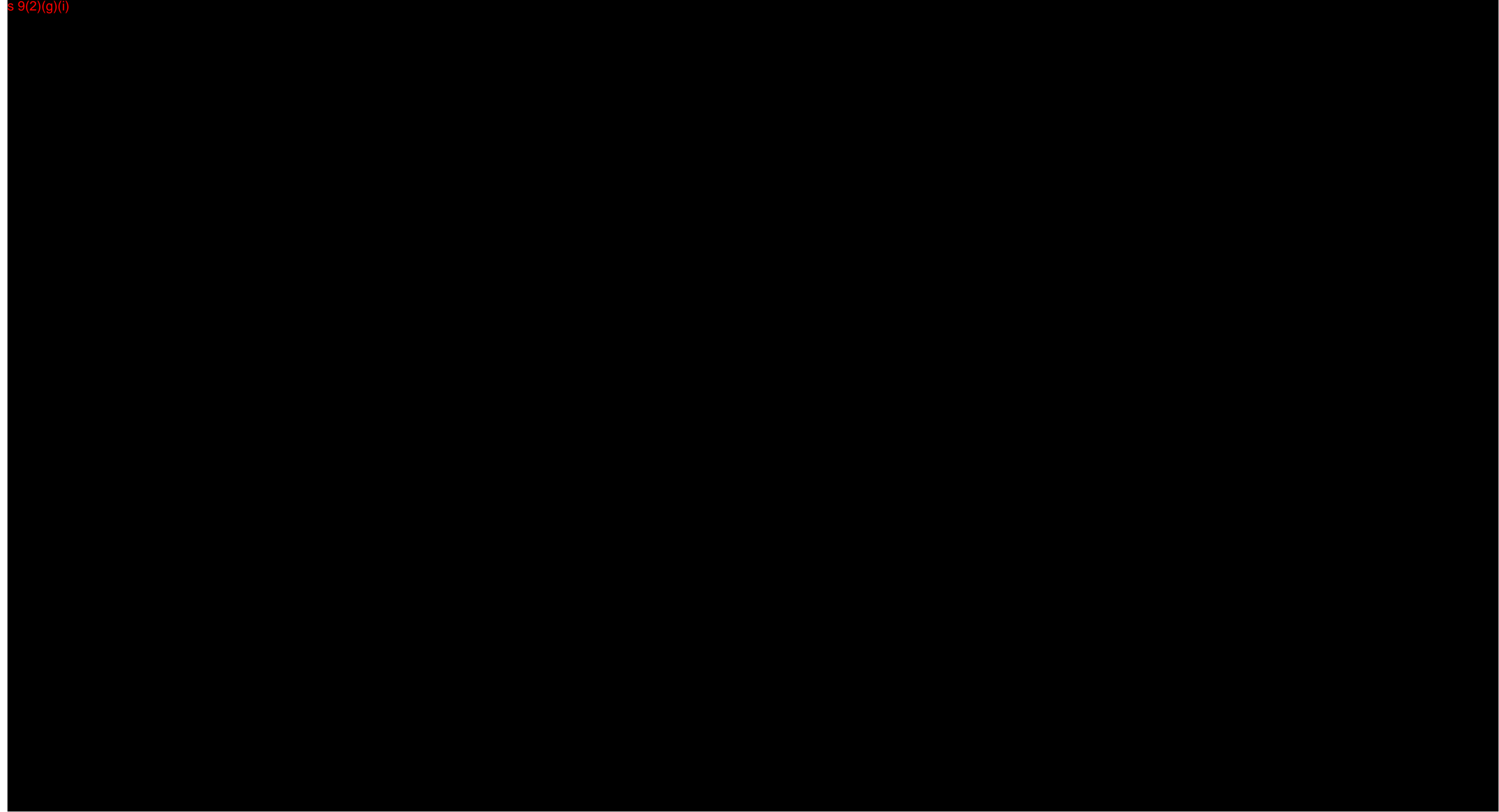
Area of Issue or Consideration	Issue or Consideration	Comments
Social	Tertiary healthcare, education and other services can be cut off during crashes and other events	Appropriateness of arrangements to minimise the impacts of these events
Policy	The statutory powers of local authorities	Potential changes resulting from the Local Government Amendment Bill

Appendix E – Risk Assessment

DRAFT

Released under the Official Information Act 1982

s 9(2)(g)(i)



Relea

s 9(2)(g)(i)

Released

s 9(2)(g)(i)



Released

s 9(2)(g)(i)

Released under th

Released under the Official Information Act 1982