VIASTRADA

TRANSPORT PLANNING AND DESIGN

Scheme Assessment Report
SH1 & SH62 Spring Creek Intersection

Report prepared for

NZ TRANSPORT AGENCY
WAKA KOTAHI

ViaStrada Ltd

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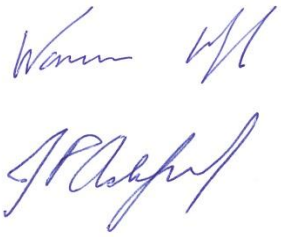
	Prepared by: Warren Lloyd & Jon Ashford	
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Executive Summary

This report examines options for the SH1 / SH62 / Ferry Road intersection in Spring Creek north of Blenheim that will address an existing high crash rate. The project objective is to "determine the best option to progress to the design and construction phase that will reduce the potential of fatal and serious injuries at the intersection while maintaining a suitable level of service for traffic on the National Strategic SH1S".

The intersection features in the Transport Agency's list of the top high risk intersections. It is ranked 17th in the Top 100 intersections in New Zealand and is by far the worst in the top of the South Island. The vast majority of crashes (88%) involve vehicles undertaking a turning manoeuvre, and the alignment of the intersecting roads and intervisibility issues mean that, without change to the intersection, these crashes are likely to continue. Outside of Spring Creek, the State Highways are subject to an open road speed limit. Early indications are that a recent reduction in the speed limit in Spring Creek from 80 to 70 km/h may help reduce crash numbers and severity; however, the low number of crashes since the change and the short observation period mean the change is not statistically relevant yet. There is still a high risk of severe accidents occurring, even at slower speed as the turning and manoeuvring crashes will still occur. Other concerns are severance for pedestrians and cyclists, and high proportions of heavy vehicles and tourists using the intersection. A mix of give way and stop control adds to the complexity.

The site is located approximately 5 km north of Blenheim, is a strategic inter-regional route, and is designated as an over dimension and overweight route in the Transport Agency's network. SH1 is a two lane highway north and south of the intersection, with an AADT of just under 10,000. State Highway 1 and the railway line have created significant severance issues for the residents and businesses at Spring Creek. A dairy and takeaway store, service station, supermarket and hotel are located on the west side of the state highway, whilst the residential area of the township of Spring Creek is located on the east side of the State Highway and rail line. A Kiwirail depot just north of the intersection generates some of the heavy traffic here, but the intersection is also on the heavy vehicle route to and from the ferry at Picton.

The problems have been under investigation for several years, with prior work documented in reports written in 2009 and 2011. The issue that makes the problems difficult to solve is a railway line parallel to SH1 with insufficient offset to the state highway, and expert traffic engineering input was required to develop an option that can meet the project objective without introducing new problems related to the rail operation.

Intersection improvement options that were considered during the scoping study were Do Nothing, to square up the intersection, a four leg roundabout, a Gane Street extension, a SH62 Rapaura Road extension, a three leg roundabout, and traffic signals. Only the roundabout option has been progressed to the scheme assessment report, and this is compared against the Do Nothing option. When a train is using the rail crossing, access to Ferry Road is not possible and lay-bys are provided on all State Highway approaches to prevent vehicles waiting to turn into Ferry Road from obstructing other movements, particularly the through movement on SH1. A variety of lay-by options were considered for this, and the option with the best balance between pros and cons was chosen for implementation.

The preferred option is an Austroads-compliant roundabout with a 16 m diameter central island with an 8.4 m wide circulating lane that includes a 1 m wide mountable apron. Various *Austroads Guide to Road Design* and *Austroads Guide to Traffic Management* documents have been used for the option development. Other guidelines include the *NZ Supplement to Austroads Part 14: Bicycles*, the *Manual of Traffic Signs and Markings*, and certain design components have been checked against the *Traffic Control Devices Rule*. The design optimises the size of the central island within the site constraints and provides sufficient deflection to slow all vehicles approaching and travelling through the

roundabout. The median islands on the State Highway slow through traffic and reduce random property access. This option addresses most crashes and removes the need for the auxiliary acceleration and deceleration lanes, as drivers are accustomed to being held up by HCVs as they enter and exit roundabouts. The option also minimises land purchase requirements. Pedestrians will find it much easier to access the land use on the west side of the state highway, as fewer lanes are to be crossed and crossing provisions are made for them. Likewise, provision has been made for cyclists so that they can bypass the roundabout should that be their preference. The option was tested for fitness for purpose against various strategies and policies, and it complies with them.

The option achieves a BCR of 4. 15 and a FYRR of 31%. This is based on the actual 0.13% traffic growth and includes SIDRA modelling from weekday and weekend volumes. Benefits (PV) assessed are; travel timesaving $ -63,189, VOC savings $ -11,411 and crash cost savings $7,714,896. The most significant external effect of the proposed option is a potential loss of business by the neighbouring shops during the construction period, which will be mitigated by keeping access at all times. The project costs for the detailed design phase, scheduled for the current (2013/14) financial year, are projected to be $113,844 (6% of the base estimate plus contingency) which compares to a budget of $137,000. The project expected estimate for the construction phases, scheduled for the next (2014/15) financial year, is $2,339,744 (base estimate $2,022,395) which is significantly more than the $911,800 budgeted. However, the high BCR demonstrates that the project still provides good value for the investment.

The funding profile of the preferred roundabout has been assessed against the NZ Transport Agency Planning & Investment knowledge base, funding assessment framework. The funding assessment indicates that the project has a High strategic fit rating, a Medium effectiveness rating and a High efficiency rating.

KiwiRail has been consulted with since the scoping study phase. At the Scheme Assessment stage, consultation on the preferred option has been undertaken with the key stakeholders, who include business owners and operators, identified road user groups, and local utility service providers. Significant outcomes from consultation were the agreement on a preferred lay-by option, a by-pass lane to clear the rail line, indented parking bays for state highway users wishing to shop here, agreement on property access locations, agreements on access to the service station, the provision of a u-turn facility, and specific needs that Kiwirail had to be met. The Spring Creek, or Awarua as it is known to local iwi, is a significant local water course, and contact has been established and will be maintained with tangata whenua.

Property purchase is required from the adjacent supermarket, and it is proposed that resulting parking loss be compensated through adjacent land belonging to Marlborough District Council. Procurement will be undertaken by the Transport Agency.

There are three key risks identified that are considered to have the potential to prevent the project from proceeding. Two of these key risks have a medium probability and one key risk has a high probability. Failure to acquire the necessary land has a medium risk, and this will be mitigated by the use of appropriate processes. KiwiRail clearance requirements have a medium risk of not being achievable, and this will be mitigated by modifying the option to ensure that their requirements are met.

A change in crash patterns has a high risk. The project may be delayed, which would allow the collection of more crash data, and the project may not proceed if a significant reduction in crashes becomes evident. If this were to happen, the situation would have to be assessed against the potential further reduction in the frequency and severity of crashes through the roundabout option.

This project offers the Transport Agency the opportunity to trial an innovation. The lay-bys enable the roundabout to continue operating when a train is crossing. There will be safety and operational concerns over the possibility that some drivers won't use the lay-bys,

which might result in the roundabout blocking. However, this event is shown to be of low frequency and it would have fairly minor crash consequences. The consultant, ViaStrada, has also provided a series of subsequent actions the Transport Agency can take to assist road users in using the lay-bys, with the roundabout reverting to a standard layout that blocks during train events as per the three other Blenheim State Highway roundabouts.

This roundabout is a long term solution for this location and it provides the Transport Agency with an opportunity to trial this new layout. If successful, the layout may be applied to other roundabouts, so that the road parallel to the railway can remain operating during train crossing events.

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1 Project Objective

The NZ Transport Agency objective for this intersection is “To determine the best option to progress to the design and construction phase that will reduce the potential of fatal and serious injuries at the intersection while maintaining a suitable level of service for traffic on the National Strategic SH1S”

2 Project Brief

The NZ Transport Agency has engaged ViaStrada to prepare a scheme assessment report that endorses the best intersection design option to progress to the design and construction phase. The objective for the preferred scheme option is to reduce the potential of fatal and serious injuries at the intersection while maintaining a suitable level of service for traffic on the national strategic SH1S. Following the scheme assessment report and subject to NZ Transport Agency funding approval, the project will progress to the design and construction phases.

There have been several previous reports undertaken for this intersection including:

- TPC Road Safety Review January 2011,
- OPUS Project Feasibility Report September 2010,
- MDC statement of proposal report Marlborough Growth & Development report pages 69 to 75.
- ViaStrada scoping study report for Spring Creek June 2013

These reports have been referenced to give historical information and previous options development context to the project.

3 Site Description

The site is located approximately 5 km north of Blenheim at the intersection of State Highway 1S (RP 18/4.57) with Rapaura Road (SH62) and Ferry Road. SH1 runs almost directly north-south at this location. SH1 is a two lane highway with 3.5 m traffic lanes north and south of the intersection.

Figure 3-1: Existing site

This state highway intersection at Spring Creek (State Highway SH 1s and SH 62 Rapaura Road and Ferry Road; refer Figure 3-1) is a strategic inter regional route and is designated as an over dimension and overweight route in the NZ Transport Agency network.

3.1 AADTs & HCV %

State Highway 1

The NZ Transport Agency traffic count site SH1 at the Opawa River Bridge (Site 18 RP 8.871 Site Reference 01S00026) recorded a 2012 AADT of 9,602 with 9.6% of heavy vehicles.

State Highway 62 - Rapaura Road

A count on SH62 between Jefferies to Jackson Road (December 2012) recorded an ADT of 2,439 with 15% heavy vehicles.

Ferry Road

A count on Ferry Road between March Street and the bridge abutment (May 2012) recorded an ADT of 1,144 with 6% heavy vehicles. As most heavy vehicle turn from Ferry Road into Gouland Road prior to the count site, the heavy vehicle percentage is not realistic. The average percentage of heavy vehicles recorded exiting Ferry Road during the intersection counts was 15%.

3.2 Rail Crossing

The South Island Main Trunk Line [SIMTL] runs on the eastern side of the SH1 and crosses Ferry Road just 11 metres from the state highway limit line. The SIMTL has a parallel loading loop line 40 m north of Ferry Road that services the Blenheim Freight Centre and is used for loading and unloading road/rail goods with destinations to the west coast via SH 62 and to the south via SH 1s.Vehicle movements in and out of Ferry Road are not permitted when trains use the crossing. The rail crossing has warning lights and bells that operate when trains are approaching.

4 Problem Description

The state highway intersection at Spring Creek (State Highway SH 1s and SH 62 Rapaura Road and Ferry Road; refer Figure 3-1) features in the NZ Transport Agency's list of the top high risk intersections. It is ranked 17th in the Top 100 high risk intersections in NZ and is by far the worst intersection in the top of the South Island, well ahead of the Waimea / Motueka St intersection in Nelson, ranked 120th.

The vast majority of crashes (88%) involve vehicles undertaking a turning manoeuvre and the alignment of the intersecting roads and inter visibility issues mean these are likely to continue occurring. Early indications are a recent reduction in the speed limit from 80 to 70 km/h may help reduce crash numbers and severity; however the low number of crashes since the change and the short observation period mean the change is not expected to be statistically relevant yet.

4.1 Road Users

This state highway intersection is a strategic inter regional route and is designated as an over dimension and overweight route in the NZ Transport Agency network. It has a complex mix of different road users with a high percentage of heavy commercial vehicles (HCVs) associated with the KiwiRail operation at the Blenheim freight centre, day visitors and tourists driving large camper vehicles use this intersection to access the coast roads of Port Underwood, Rarangi and Whites Bay and there is seasonal use associated with local forestry and vineyards, which involves slower moving agricultural vehicles. Combined with these users are the commuters that routinely use the intersection during the AM, noon and PM peak hours. There is also some commercial activity at the intersection, which creates a pedestrian crossing desire, but there are no crossing facilities provided. Added to this complex mix of road users is the train that crosses Ferry Road up to thirteen times a day.

4.2 Pedestrians and Cyclists

State Highway 1 and the railway line have created a significant severance issues for the residents and businesses at Spring Creek.

The dairy and takeaway store, service station, supermarket and hotel are located on the west side of the state highway whilst the residential area of the township of Spring Creek is located on the east side of the state highway and rail line. The provision of slip lanes and turn bays at the intersection means pedestrians and cyclists must cross five [relatively high speed] traffic lanes to get across the state highway. There are no pedestrian crossing facilities at the intersection and young children have been observed standing on the double yellow lines between the opposing state highway traffic flows trying to cross the road.

It is understood that the police regularly enforce the stop sign on Rapaura Road based on their observation that pedestrians crossing the north approach are vulnerable to left turn drivers looking to their right while making this turn, without stopping.

4.3 Spring Creek Presence on the Network

The Spring Creek intersection has a low presence on the state highway network as it is not a small rural town and drivers may not expect pedestrians or significant crossing traffic at this location.

4.4 Crash History

There have been 17 crashes recorded in the Crash Analysis System (CAS) within 50 m of the intersection in the 5 year period between September 2008 and August 2013. 88% of these crashes have involved vehicles undertaking a turning manoeuvre at the intersection.

There have been 32 crashes recorded in the Crash Analysis System (CAS) within 50 m of the intersection in the 10 year period between September 2003 and August 2013. Of these crashes, 24 (75%) have involved vehicles making a turning manoeuvre.

In March 2011, the speed limit at Spring Creek was lowered from 80 to 70 km/h. Early indications show fewer crashes, however the low number of crashes since the change and the short observation period mean the change is not expected to be statistically relevant yet.

It is standard practice to report crash records for complete calendar years, however, two crashes were known to have occurred at the intersection during 2013, one in May and one in August. As these have occurred in the short observation period since the speed limit change, the crash reporting date range was adjusted to include these crashes.

For detailed crash data refer to Section 5.4 and Appendix G .

4.5 Rail Crossing

The South Island Main Trunk Line [SIMTL] crosses Ferry Road just 11 metres from the state highway limit line. The SIMTL has a parallel loading loop line immediately [40 m] north of Ferry Road that services the Blenheim Freight Centre. This is a train sidling for loading and unloading road/rail goods with destinations to the west coast via SH 62 and to the south via SH 1s. The trains [freight and passenger] cross Ferry Road up to thirteen times a day, resulting in limited access at Ferry Road and occasionally causing traffic queues on the road approaches. Trains on the loop track can cause the rail alarms to function which can see road vehicles queuing unnecessarily. Trains on the loop track can also restrict visibility for drivers exiting Ferry Road.

4.6 Road Alignment

Rapaura Road and Ferry Road intersect with SH1 at angles of 60 degrees and 54 degrees respectively, which restricts the visibility to approaching drivers. Austroads Guide to Road Design Part 4A recommends the minimum entry angle is 70 degrees. Visibility issues are compounded for vehicles exiting Ferry Road by the proximity of the rail line to the State Highway and the limited stacking space between the rail line and the limit line. Several drivers of large trucks were observed making their decision to enter the intersection from the eastern side of the rail line, some 20 m back from the limit line.

To the south of the intersection, SH1 makes a 7 degree deviation towards the east; this can be seen in Figure 3-1. As a result of this deviation, vehicles waiting in the northbound right turn bay obscure the inter-visibility between northbound through vehicles and

vehicles in the southbound right turn bay waiting to turn into Rapaura Road (SH62). As a result of the angled approaches of Rapaura Road and Ferry Road, the right turn bay limit lines on both SH approaches are some distance from the exit lane. This results in turning vehicles, particularly larger trucks, having to travel for a considerable distance and time to clear the intersection. In the event of vehicles turning from the northbound and southbound right turn bays at the same time, then one or both vehicles are required to travel in a contra-flow direction in the traffic lane to complete the manoeuvre. This is exacerbated if one of the turning vehicles is a large truck such as a semi-trailer.

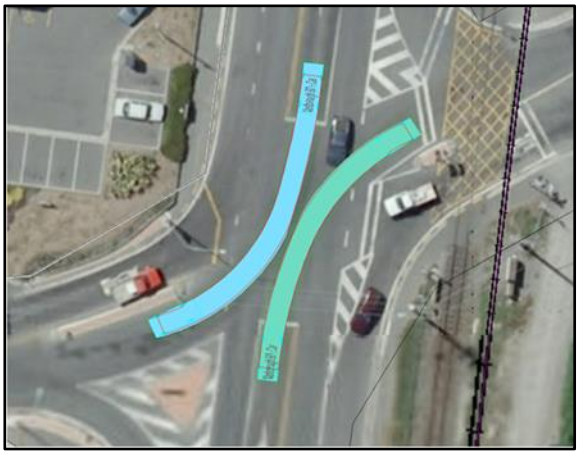


Figure 4-1: Right turning car swept paths

Figure 4-2: Right turning HCV & car swept paths

4.7 Corridor Consistency

Spring Creek is located on the National Strategic SH1 between Picton and Blenheim.

The NZ Transport Agency has undertaken the following safety improvements between Picton and Blenheim in the last few years to improve the KiwiRAP star rating of this corridor:

- Elevation Overbridge realignment (completed June 2005)
- Koromiko South Bound passing lane (Feb 2006)
- Para north bound passing land completed (May 2007)
- North Bound passing lane north of Spring Creek completed (April 2009)
- Blenheim to Picton hazard protection (underway due to be completed by June 2014)
- Vickerman St drainage and intersection improvements
- Tuamarina, Spring Creek and Grovetown speed limit review.

There are already three roundabouts in Blenheim within 6 kilometres of Spring Creek that have varying degrees of rail interaction as seen in Figure 4-3.

Figure 4-3: Existing Blenheim roundabouts

Queuing for trains at roundabouts is not a new scenario for locals, see Figure 4-4, however the high visitor and tourist population, particularly during the summer months must be considered in the design.

Figure 4-4: A train blocking Blenheim roundabout

The proposed roundabout at Spring Creek has been considered alongside the current and proposed corridor/route treatments and is considered a compatible solution.

4.8 Priority Controls

The existing layout has Ferry Road with a Give Way control and Rapaura Road is with a Stop control. This can lead to crashes with some drivers being aware that Ferry Road traffic has priority over Rapaura Road, as visitors and infrequent users of the intersection are unlikely to be aware the signs are different and they have a different sign priority.

4.9 Previous Reports

The following reports on Spring Creek have been referenced in this report

- SH1S, SH62 Spring Creek intersection: 2009 Opus Blenheim
  (to consider previous options)
- SH1/SH62 Intersection Spring Creek, Blenheim Road Safety Review: 2011 Traffic Planning Consultants
  (to consider previous options)
- 5D Spring Creek – Southern Marlborough Report Spring Creek
  (to consider future development and issues)
- The Ecology of Spring Creek – Awarua: 2000 Cawthron Institute
  (to consider ecological implications of the intersection project)
- Chapter 19 Spring Creek Ecology from the MDC Groundwater Report
  (to consider ecological implications of the intersection project)

4.10 Clifford Bay

It is possible that at some stage in the future, a new inter-island ferry terminal will be built at Clifford Bay, south of Blenheim. This would result in a reduction in SH1 traffic through Spring Creek, particularly HCVs, and is likely to see a lot of SH62 traffic re-route to SH6 via Renwick. However, it is noted that only two of the crashes in the last 10 years have involved HCVs, and without safety improvements at this intersection, it is likely that crashes will continue to occur.

A new Clifford Bay terminal would also lead to a significant reduction in rail movements and hence the frequency of Ferry Road rail crossings.

The proposed roundabout will still be an appropriate intersection control at Spring Creek should Clifford Bay proceed at some time in the future. This is because the roundabout will continue for function safety and efficiently with lower volumes whereas, if traffic signals were installed, the likely impacts of Clifford Bay may result in the removal of the traffic signals.

Clifford Bay press releases

The following two press releases have been downloaded from stuff.co.nz[1]

Inter-island ferries stay in Picton, by Vernon Small, Last updated 12:22 14/11/2013

"The axe is no longer hanging over the heads of Picton's businesses, the town's mayor says after the Government decided against moving the Cook Strait ferry terminal to Clifford Bay. The Government had been looking at moving the ferries to the bay, south of Seddon in Marlborough, since May 2011. The move would have cut about half an hour off the sea journey and about an hour off the road journey to Christchurch, saving fuel and making the moving of freight from Auckland to Christchurch more efficient. However Transport Minister Gerry Brownlee this morning rejected the idea, saying after more analysis it was found that initial estimates of moving the port were off the mark."

Port boost for Picton, by Cathie Bell, Last updated 07:11 15/11/2013

"Picton's the place: Port Marlborough chief executive Ian McNabb celebrates the Government's decision to keep the ferries in Picton. The Government's decision to keep the interisland ferry terminal in Picton means tens of millions of dollars of investment will go ahead in the town. Transport Minister Gerry Brownlee announced yesterday morning that a new ferry terminal at Clifford Bay, south of Seddon, was not commercially viable as a fully funded project."

4.11 Horizontal Alignment

Approaching the intersection from the south, SH1 has a 150 m long left turn lane leading into an uncontrolled left turn slip lane, a through lane, and a right turn bay with a 40 m storage length. North of Rapaura Road, there is a wide shoulder lane marked with chevrons, this lane is used as acceleration and merge lane for slower vehicles.

Approaching the intersection from the north, SH1 has a 70 m long left turn bay leading to a give way controlled left turn slip lane, a through lane and a right turn bay with a 55 m storage length. South of Ferry Road, a 130 m acceleration and merge lane is provided for vehicles turning left from Ferry Road.

Rapaura Road (SH62) is a two lane rural road that intersects SH1s from the west at an angle of 60 degrees and has a narrow median island at the intersection. A stop control is placed against Rapaura Road.

Ferry Road is a long straight two lane residential road and intersects SH1s from the east at an angle of 54 degrees. There is a continuous exit slip lane provided for left turning vehicles out of Ferry Road with a give way control is placed through and right turning traffic. The main south rail line crosses Ferry Road 10.5 m from its intersection with SH1s and the level crossing features bells and lights but not barrier arms.

[1] http://www.stuff.co.nz/the-press/news/9399001/Inter-island-ferries-stay-in-Picton
http://www.stuff.co.nz/marlborough-express/news/9403405/Port-boost-for-Picton

4.12 Speed Limit

SH1 has a 70 km/h speed limit through the intersection, which was reduced from 80 km/h in March 2011. The speed limit of 70 km/h is physically identified with standard rural to residential speed thresholds located approximately 300 m prior to the intersection on the north and south approaches to Spring Creek.

The speed limit on (SH62) Rapaura Road is generally 100 km/h with a 250 m section of 80 km/h on the approach to the Spring Creek intersection. Ferry Road has a 50km/h speed limit.

4.13 Surrounding Land Use

The surrounding land use is a mix of residential, agricultural and commercial. North east of the intersection is an area of light industrial businesses including the KiwiRail Blenheim Freight Centre. Freight is transported to and from the west coast via SH62.

A dairy and takeaway store, service station and a two storey hotel are located in the south west corner of the intersection with some parking available in a service lane beside SH1s. A Four Square supermarket and associated car parking is located on the northwest corner of the intersection. The north east and south east corners comprise the rail corridor and as such are free of buildings, however, there is a backpackers hostel located on the south east side of Ferry Road next to the rail corridor.

4.14 Freight Value

Spring Creek is located at the state highway [1S & 62] intersection between Picton, Nelson and Christchurch. The heavy vehicle annual average daily traffic, port tonnage and value can be seen diagrammatically in Figure 4-5.

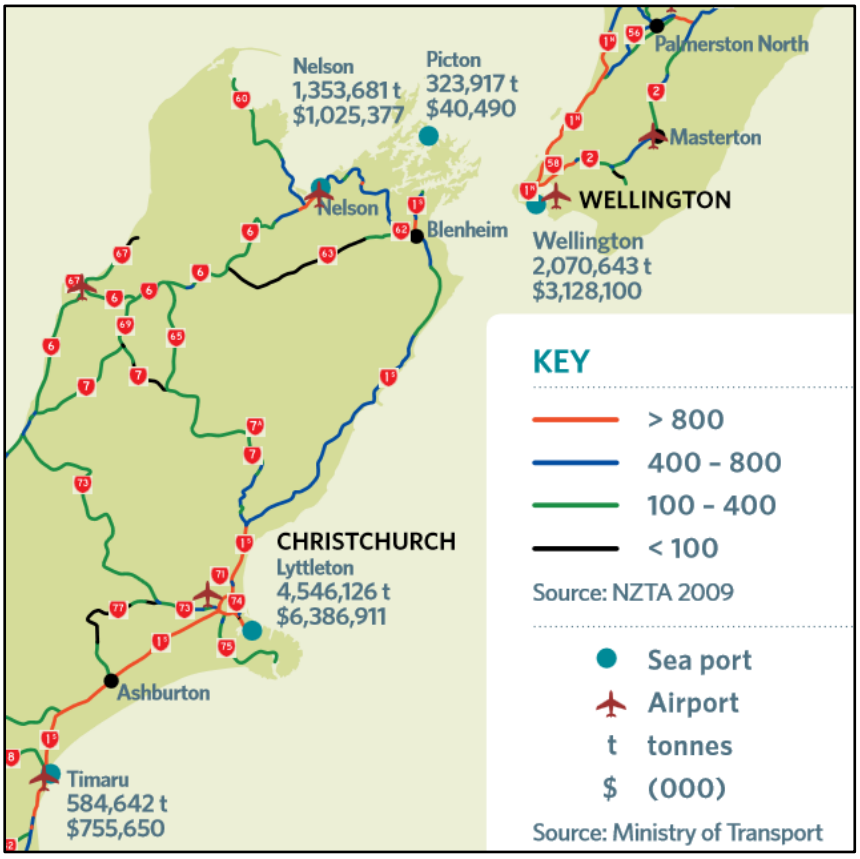


Figure 4-5: HCV AADT, Port tonnage and value

The following Table 4-1 shows the freight tonnages and values for each of the three locations that connect through Spring Creek.

Table 4-1: Freight Value & Tonnage[2]

Location	HCV AADT	Tonnes	Value
Christchurch	400 - 800	4,546,126	$6,386,911
Picton	>800	323,917	$40,490
Nelson	400 - 800	1,353,681	$1,025,377

The Spring Creek intersection in this strategic location of on the network will mean that a safe and efficient intersection design will add value to the state highway network.

4.15 Spring Creek Waterway

The Spring Creek waterway that gives the intersection its name is located in the north west quadrant and features a stop bank on the eastern bank of Spring Creek which provides protection to Rapaura Road, the all-day car park and the 4 Square supermarket.

5 Collected Data

5.1 Topographical Survey

The topographical survey was undertaken by Gilbert Haymes & Associates Ltd in August 2013 in accordance with the requirements of the NZ Transport Agency's Minimum Standard Z/16 - Survey Specification. Survey techniques used ensured that temporary traffic management and disruption to the traffic flow were minimised.

Datum

The datum is the LINZ Nelson Vertical datum.

Bench Mark

The surveyor advises that the nearest LINZ benchmarks have been destroyed. The origin is from the Marlborough District Council river cross section benchmarks which are in terms of the LINZ datum. The origin mark is an iron pin in the southern bridge abutment of the Ferry Road Bridge over the Wairau River. The reduced level of this mark is 7.59 m.

Coordinates

The topographical survey and the scheme design plans are provided in Marlborough 2000 coordinates.

5.2 Road Traffic Data

Collected road traffic data is summarised here, for detailed road traffic data refer to Appendix 0

5.2.1 Daily Volumes

The SH1 traffic volumes have been analysed from the NZ Transport Agency traffic count Site [01S00026 Opawa] for March 2013. This is a 24 hour, seven day a week count site

[2] NZTA 2009 volumes from http://www.nzta.govt.nz/consultation/classification-system/docs/appendix5.pdf

which provides the mid-week and weekend traffic flow profiles plus any seasonal variation.

SH62 Rapaura Road and Ferry Road ADT's are taken from the RAMM data provided by the NZ Transport Agency.

Table 5-1: Traffic volumes

Road	Traffic count	Count date
State Highway 1	9,602 AADT	2012
Rapaura Road SH62	2,439 ADT	Dec 2012
Ferry Road	1,144 ADT	May 2012

5.2.2 Growth

The traffic growth on SH1 at the Opawa River Bridge (Site 18 RP 8.871) shows a fairly flat ten year period of traffic growth between 1992 and 2001. There is a sharp rise between 2001 and 2003 followed by slow increase up to 2007 followed by a general decline in volumes to 2012.

5.2.3 Turning Counts

The LowDown traffic data collection undertook traffic counts at Spring Creek on Saturday 13th April, Sunday 14th April and Wednesday 17th April 2013, which provided AM, mid-day and PM peak hour traffic counts to inform geometric and lane decisions. Because this is a recognised tourist node and there is also a significant amount of commercial traffic operating 24/7, a turning count during the weekend mid-day peak hours has also been included in the analysis.

5.2.4 Peak Hour

The survey period and peak hour traffic flow times identified are shown in Table 5-2. The two hour survey period was used to allow the actual peak hour to be identified.

Table 5-2: Survey periods

Survey	Survey period	Peak hour
Mid-week AM	07:30 to 09:30	7:45 to 8:45
Mid-week noon	11:30 to 13:30	11:30 to 12:30
Mid-week PM	16:00 to 18:00	16:30 to 17:30
Saturday	11:15 to 13:15	11:45 to 12:45
Sunday	11:15 to 13:15	11:30 to 12:30

5.2.5 Summary of Turning Counts

It is noted that Spring Creek has weekend volumes that are higher than mid-week volumes as shown in
Table 5-3. The higher weekend traffic flow is reflective of a tourist location. There is also very high commercial activity associated with the rail freight centre, combined with the seasonal agricultural and horticultural activity at this location.

Table 5-3: Summary of peak hour totals

Day	Peak	Light vehicles	HCVs	HCV Percent	Peak hour totals
Mid-week	AM	667	119	18%	786
	Noon	648	140	22%	788
	PM	834	69	8%	903
Saturday	Noon	854	93	11%	947
Sunday	Noon	907	101	11%	1,008

5.3 Rail Traffic Data

The Blenheim Freight Centre at Spring Creek is a transport interchange between road and rail. The rail operations include a 900 m loop track or double rail line that allows trains to shunt off the main line. This operation introduces periods when trains are slowing and shunting across the Ferry Road rail crossing.

Collected rail traffic data is summarised here, for detailed rail traffic data refer to Appendix F

5.3.1 Weekly Rail Schedules

KiwiRail has provided a weekly rail schedules for the rail link between Wellington and Christchurch. The schedule shows the freight and passenger trains, their direction, and times they are scheduled to pass through Spring Creek.

In Appendix F the mid-week peak hour road traffic flows have been overlaid with the times that trains are expected to slow down or stop at Spring Creek. This allows the identification of conflict times where peak road traffic volumes coincide with rail delays, causing additional stress at this intersection.

5.3.2 Rail Conflicts with Peak Hour Traffic

By marking the peak hour traffic periods on the KiwiRail schedules, it is possible to identify when a train crossings occur during peak periods. Table 5-4 indicates when trains are expected during peak hours. KiwiRail advise that actual times may vary by approximately 15 minutes from scheduled times and Table 5-4 notes “Possible” if a scheduled arrival is within 15 minutes of a peak period.

Table 5-4: Rail & peak traffic conflicts

Day	AM Peak	Noon Peak	PM Peak
Monday	No	Yes	Possible
Tuesday	No	Yes	Possible
Wednesday	No	Yes	Possible
Thursday	No	Yes	Possible
Friday	No	Yes	Possible
Saturday	No	Yes	Possible
Sunday	No	Yes	Possible

5.4 Crash Data

It is standard practice to report crash records for complete calendar years, however, two crashes were known to have occurred at the intersection during 2013, one in May and one in August. As these have occurred in the short observation period since the speed limit change, the crash reporting date range was adjusted to include these crashes.

Collected crash data is summarised here, for detailed crash data refer to Appendix G

5.4.1 Five Year Crash History

There have been 19 crashes recorded in the Crash Analysis System (CAS) within 50 m of the intersection in the 5 year period between September 2008 and August 2013. Of these crashes, 17 are considered to be associated with the intersection and of those, 15 (88%) have involved vehicles making a turning manoeuvre.

Of the remaining two crashes, one was a rear end collision and one was a loss of control crash involving a single vehicle.

During the 5 year review period, there has been 1 fatal crash, 2 serious crashes, 8 minor injury crashes and 6 non-injury crashes at the intersection. Some of these crashes have resulted in multiple injuries and the total casualty numbers are 1 fatal, 3 serious and 16 minor injuries.

Table 5-5 lists the CAS crash reference number and the crash severity. The right hand column is the total number of crashes in each year. A single crash may be noted in more than one column if injuries of different severity were recorded, but is still only counted as one crash.

Table 5-5: Summary of crashes by year & severity

Year	Fatal	Serious	Minor	Non-injury	Total crashes
2008		2813786 x 2	2813786	2856659	2
2009			2911241 x 2 2912906 x 2		2
2010	201010058	201012915	201010058 201012915 201011037 201011125 201012209 x 2	201050714 201053750	7
2011			201111225	201150938 201152563	3
2012			201211912 x 2		1
2013			201312293 x 2	201351793	2
				Total	**17**

5.4.2 Ten Year Crash History

There have been 32 crashes recorded in the Crash Analysis System (CAS) within 50 m of the intersection in the 10 year period between September 2003 and August 2013. Of these 32 crashes, 24 (75%) have involved vehicles making a turning manoeuvre. This suggests that the intersection has had the turning manoeuvre crash problems for some time.

The ten year crash history shows 1 fatal crash, 2 serious crashes, 11 minor injury and 18 non-injury crashes.

5.4.3 Crash Changes since Speed Limit Change

The NZ Transport Agency have advised that the 70 km/h (rural to urban) speed threshold located approximately 300 m south and 300 m north of the Spring Creek intersection was installed in March 2011. The crash occurrences have been plotted for the five year period with the installation of the speed threshold overlaid, see Figure 5-1. The threshold is considered relatively recent for crash analysis, but early indications show fewer crashes as a consequence of the lower speeds through the Spring Creek. Prior to the change, a crash was reported every 2.4 months; since the change, there have been four crashes reported, which equals one crash every 7.3 months. Due to the low number of crashes since the change and the short observation period, the change cannot be considered statistically relevant yet.

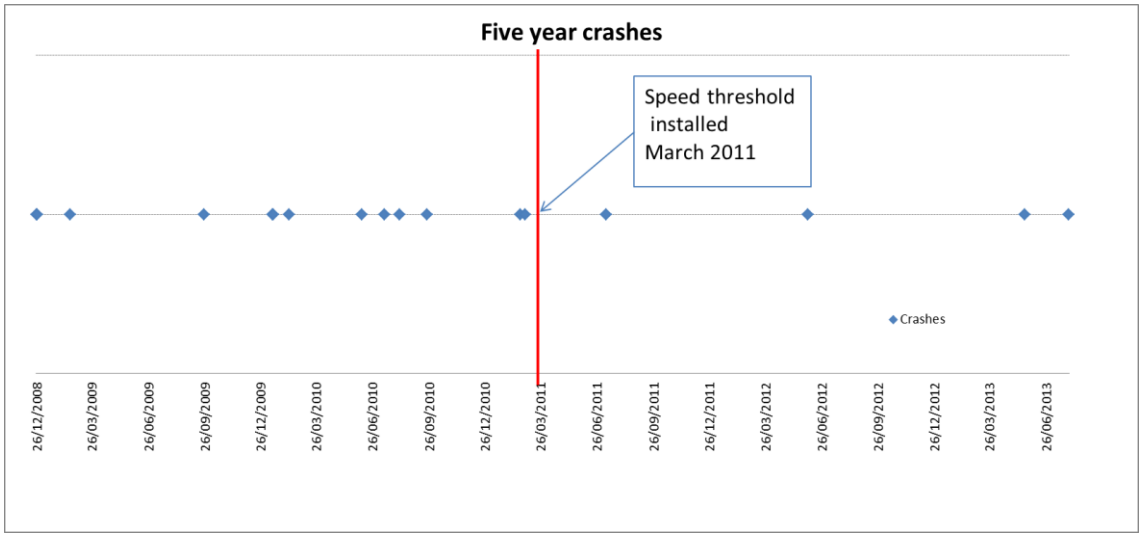


Figure 5-1: Crashes before & after speed limit change

5.5 Geotechnical Testing

Davidson Group, a local Blenheim engineering consultancy has provided provisional advice on the geotechnical requirements for this project. The geotechnical advice is based on the concept alignment shown on ViaStrada plan 1012 /C1 Stakeholder Engagement Plan in Appendix J

5.5.1 Geotechnical Risks

The geotechnical risks are considered to be limited to the bearing capacity within Part Lot 1 DP 568 and the lateral spread towards Spring Creek due to liquefaction in a severe earthquake. This risk is considered to be low and can be readily quantified by standard testing.

5.5.2 Testing Required

The concept roundabout alignment is located wholly within the existing carriageways except for the northwest corner on Part Lot 1 DP 568 which is based on virgin ground.

Davidson Group advise that testing for subgrade strength will essentially be limited to the virgin area with a test pit or machine auger plus some associated Scala Penetrometer measurements required. Where there are signs of pavement stress or where current surface levels are to be lowered, Benkelman beam testing could be carried out.

Geotechnical sub base investigation of the Rapaura Road adjacent to the Spring Creek stop bank may be required to determine if consent for land disturbance within 8m of a stop bank. This will also depend on the need to relocate the two poles and transformer located on the top of the stop bank. The requirement for testing can be confirmed at detail design stage in liaison with Marlborough lines and the Marlborough District Council.

No testing has been carried out to date.

5.5.3 Indicative Costs

Davidson Groups' indicative cost estimate to undertake the suggested geotechnical testing and provide the results would be in the order of $11,000 + GST.

6 Stakeholder Relationship Management & Consultation

With the exception of KiwiRail, no consultation was undertaken during the scoping study. This was to avoid unnecessary concern to local stakeholders regarding options that were unlikely to be progressed due to safety or physical constraints. At the Scheme Assessment stage and with NZ Transport Agency approval, consultation on the preferred option has been undertaken with the key stakeholders, who include business owners and operators. Consultation has also included identified road user groups and local utility service providers.

The need for the Investment Logic Mapping (ILM) stage was not considered appropriate by the NZ Transport Agency as this is a relatively minor roading project. The scheme assessment relationship management & engagement process will provide the opportunity for the stakeholder issues to be heard and addressed.

Stakeholder consultation is summarised here, for full details refer to Appendix J

6.1 Key Stakeholders

The following key stakeholders have been contacted and consulted during this stage. Where applicable, the business owner and business operator have been engaged. The stake holders and their interest are summarised in Table 6-1.

Table 6-1: Key Stakeholders

Stakeholder	Stakeholder interest
KiwiRail	Rail operator
Midland Distributors	Local light industrial business
Junction Hotel	Local public house and accommodation
Spring Creek Motel	Local motel
4 Square supermarket	Local supermarket
The Spring Creek Service Station	Local service station
The Spring Creek Dairy and Takeaways	Local dairy and takeaway store
Swampys Backpackers	Local backpacker accommodation

Consultation with KiwiRail and the 4 Square supermarket was undertaken by the NZ Transport Agency.

ViaStrada contacted the other stakeholders by phone to set up face to face meetings in Spring Creek. One-on-one meetings with stakeholders were held on 12 September where the letter of introduction with project description and concept plan was tabled to seek their initial feedback.

The details of key stakeholder consultation can be found in Appendix J

6.2 Road User Groups

Feedback was also sought from representative road user groups. The consultation varied to address the different road user group needs and requirements at this location.

The following road user groups have been contacted and consulted during this stage.

Table 6-2: Road users

Road user group	Road user interest
Road Transport Association	Heavy commercial vehicle use
NZ Motor caravan Association	Tourist and visitor use
The Blenheim Police	Driver use and behaviour
Tourism Holdings Limited	Tourist and visitor use
The Automobile Association	Driver use and behaviour

ViaStrada contacted the road user groups by phone to establish the correct contact people and their contact details. A letter of introduction was sent out with a description of the revised concept design, reflecting some of the feedback already received. This document also included a description of the issue we perceived road users may have issues with, listed possible options to address the issue and provided commentary on possible information signs that could be implemented.

The details of road user consultation can be found in Appendix K

6.3 Utility Service Providers

Feedback was also sought from the local utility service providers listed in Table 6-3.

Table 6-3: Utility service providers

Utility provider	Interest
Marlborough Roads	Road controlling authority
KiwiRail	Railway operator
Marlborough Lines	Overhead power
Marlborough District Council	Water, sewer, storm water, road
Transpower NZ	Underground power
LINZ	Survey marks
Chorus	Communications

KiwiRail were identified as a key stakeholder in Section 6.1 as a landowner, they have also been included in this section as they have service infrastructure at the intersection.

The details of utility service provider consultation and feedback are in Appendix L

6.4 Stakeholder Consultation Outcomes

Key stakeholders

The following feedback has been received and changes have been agreed or made to our initial consultation plan [see Appendix B] as a consequence of key stakeholder input.

- Inclusion of indented parking bays for state highway vehicles wishing to stop for shopping at Spring Creek.

- Consideration was given to changing priority at the Ferry Road and Gouland Road intersection but this was not actioned due to other safety and access considerations.
- The inclusion of an additional right turn lane on the SH62 approach for use as a lay-by for this right turn movement as this movement experiences a lot of delay just from the state highway traffic.
- Agreement to liaise with owners and occupiers to determine access locations.
- The inclusion of lay-bys for vehicles wanting to turn into Ferry Road when a train is crossing Ferry Road.
- Agreement to liaise with the Spring Creek Service Station regarding access and informing them that any access provided will be subject to a safety audit.
- Include a U-Turn bay at the south end on the SH 1s south approach median island for access.
- Include an emergency lay-by on SH1 to the left of the Ferry Road approach to allow a truck to clear the rail crossing should its entry to the roundabout be blocked for any reason when a train is approaching.
- KiwiRail specifically stated that the Ferry Road Limit lines must be retained at least in their same location as existing and can't be moved closer to the railway line.

Road users groups

The following feedback has been received and changes have been agreed or made to our initial consultation plan [subject to NZ Transport Agency and safety audit approval] as a consequence of road user input. The plan [see Appendix B] that the road user group viewed included several changes from the stakeholder feedback.

- The road user group confirmed the need to include provision for queuing vehicles on the SH 1s approach right turn into Ferry Road and on the SH 62 approach for all vehicles wanting to turn into Ferry Road when a train is crossing Ferry Road.
- The road user group confirmed that the use of international signs to warn drivers of the approaching train and the advisory information on what movements are permitted, i.e. No Right Turn and No Through into Ferry Road.
- Include an emergency lay-by on SH1 to the left of the Ferry Road approach to allow a truck to clear the rail crossing should its entry to the roundabout be blocked for any reason when a train is approaching.
- The road user group confirmed that the SH 1S north approach can remain as it currently is because it works well when a train crossing Ferry Road.

6.5 Tangata Whenua

Spring Creek, or Awarua as it is known to local iwi, is a significant local water course with a considerable catchment area. The MDC recognises the Tangata Whenua status of Ngati Kuia and have provided the name of the Standing Committee iwi representative for Te Runaunga O Ngati Kuia.

[redacted] the iwi representative has provided the following iwi contact details for liaison during the development of the Spring Creek intersection improvement project.

[redacted]

[redacted] commented that the three local representatives would be interested in any proposed intersection changes at Spring Creek and he expressed his concerns of the road and traffic dangers at the Spring Creek intersection.

No formal consultation has been undertaken to date.

7 Options

The following intersection improvement options were considered during the scoping study:

- Square up the intersection
- Four leg Roundabout
- Gane Street Extension
- SH62 Rapaura Road Extension
- Three leg roundabout
- Traffic signals

Only the roundabout option has been progressed to the scheme assessment report. Refer to ViaStrada NZ Transport Agency Scoping Study SH1 SH62 Spring Creek Intersection Report for a full assessment of options considered and discounted.

7.1 Constraints & Assumptions

7.1.1 Constraints

The scope for improvements at the Spring Creek intersection is limited by the proximity of the rail line on the eastern side and existing property developments on the western side plus the close proximity to SH 62 of the Spring Creek stop bank.

7.1.2 Assumptions

The following assumptions have been made:

- There should be minimal delay to the north / south traffic movement
- That funding will remain available
- The roundabout design can accommodate the design requirements of KiwiRail
- That the Four Square and MDC agree to the relocation of the existing access on Rapaura Road
- That the acquisition of the required Four Square land is achievable within a reasonable time frame and cost
- That the NZ Transport Agency and MDC can reach agreement on using the land area south west of the Four Square for access and provide increased parking
- Any consents required will be obtainable within a reasonable time frame and cost
- Future traffic growth will be 2% per annum or lower
- That the development of Clifford Bay is not a consideration, see 4.10.

7.2 Do Nothing

The do nothing option is to leave the intersection exactly as it is, and this will be used for comparison with the proposed roundabout/s in the economic evaluation.

The change in crashes as a consequence of the speed limit change [lowered from 80km/h to 70 km/h] will be monitored, however, given the stochastic nature of crash occurrence, a minimum time frame of five years of crash data would be necessary to have confidence that the reduction in speed limit has led to a reduction in the crash rate. It is expected that there will be continuance of turning and manoeuvring crashes if this intersection is left as it is.

7.3 Roundabout Option

The roundabout is Austroads compliant with a 16 m diameter central island with an 8.4 m wide circulating lane that includes a 1 m wide mountable apron. A plan of this option is included in Appendix B The design optimises the size of the central island within the site constraints and provides sufficient deflection to slow all vehicles approaching and travelling through the roundabout. The median islands on the state highway slow through traffic and reduce random property access. The roundabout removes the need for the auxiliary acceleration and deceleration lanes as drivers are accustomed to being held up by HCVs as they enter and exit roundabouts. The deceleration left turn lane for southbound drivers turning into Ferry Road is retained to provide adequate swing in and queuing storage if a train is on the crossing. All HCV turning movements have been checked with AutoTrack swept path software. This option requires property purchase in the north west quadrant (the 4 Square supermarket).

The vast majority of crashes occurring at the intersection involve vehicles making turning manoeuvres. Crash reduction information from Austroads Part 4 table 9.5 and the Transit accident countermeasure literature review research report No 10 (1992) along with engineering judgement the author has gained from previous crash reduction studies suggests that the roundabout would result in a 70% reduction in all crash types occurring at the intersection. The NZ Transport Agency draft 29 Nov 2013 – Programme Business Case – Safer Journeys 181113: Section 9.3.5 Crash reduction factors for installing a roundabout indicate that a 70% crash reduction can be achieved for serious and fatal crashes with a 50% crash reduction for all injury crashes. The 70% and 50% reductions have been applied in the EEM.

With a single entry lane to the roundabout, any vehicle waiting to turn into Ferry Road while a train is crossing will hold up all other traffic in that lane. This is of particular concern on the southern approach, with the high volume of through traffic heading toward Picton will be delayed. Section 7.4 discusses the options considered to prevent this.

7.4 Parking Lay-by's and Warning Message Signs

When a train is using the rail crossing, access to Ferry Road is not possible and lay-bys are provided on both state highway approaches and Rapaura Road to prevent vehicles waiting to turn into Ferry Road from obstructing other movements, particularly the through movement on SH1. Signage will be used to inform motorists that a train is approaching the crossing and where they can queue while the train is crossing.

7.4.1 Lay-by Options Considered

ViaStrada explored three options to address the blocking concern with their relative merits and problems.

7.4.1.1 Do Nothing

Let drivers stop at the limit lines and block cars behind them or enter the roundabout and block the intersection when a train is crossing Ferry Road.

Pros:

- Low cost
- Blockage would occur relatively infrequently.
- Delays are of relatively short duration.

Cons:

- Frustration for blocked vehicles, particularly those heading to the Picton Ferry
- Drivers may cut through the commercial areas to bypass the roundabout
- Drivers may enter the roundabout and then have to stop, blocking the roundabout for all other road users
- This option may see two state highways blocked for a short period of time on most days.

7.4.1.2 Queue on LHS of Both Approaches

Drivers queue on left hand side (LHS) of road on both approaches. This will have to occur 50 m to 100 m prior to the intersection due to retail activity.

Pros:

- The LHS is a more intuitive place to park and queue.
- There is space available on the LHS of both approaches.
- Drivers likely check their right side rear view mirrors before exiting into the traffic lane.

Cons:

- This is not an intuitive location to queue if you wish to travel through or turn right at the intersection.
- The LHS lay-by is some distance from the limit lines and will require advance signage of how to use the LHS parking space.
- Drivers exit back into the traffic lane in a higher speed location, with increased risk of damage or injury from a crash.
- Drivers may not be able to see the train or warning signals or hear the bells being further away from the intersection.
- Unfamiliar drivers may drive past lay-by without realising its purpose.

7.4.1.3 Queue on RHS on Both Approaches

This can occur within the raised median island at the intersection.

Pros:

- Drivers are making the decision to queue at the intersection where they should be able to see the train and the warning signals.
- The signs can be located on the median island where drivers are making their decision and need to queue.
- Advance caution signs could be added later if drivers are not getting sufficient warning of the train approaching.

Cons:

- Drivers do not intuitively check their left side rear view mirrors before exiting into a traffic lane. However, this may make drivers more cautious?
- A convex mirror can be installed to assist visibility.

- Driver may pull out when drivers are entering the roundabout or exiting the commercial areas, but in a lower speed environment.

7.4.1.4 Selected Lay-by Option

The preferred lay-by option has the lay-bys on the RHS of the approach roads.

7.4.2 Warning Message Signs Considered

For this location, the preference is to use international symbolic signs due to the high number of visitors and Tourists using this intersection.

The signs proposed will be a mixture of advisory [for information] and mandatory [must be obeyed] using LED technology.

The signs will need to be coordinated with the railway warning system. The sign displays will start to flash before the railway bells/lights start ringing / flashing. It is considered important to use the same sign layouts on both approaches for road user consistency.

Text is not considered appropriate to inform drivers what to do. Text takes time to read, comprehend and then take the correct action, therefore international symbolic signs are recommended for this location.

Table 7-1: Warning message signs information

	**SH1** These signs are for the SH1 south approach. The No Right Turn sign would be a LED sign on a black background which would only be 'on' and visible to motorists when a train is approaching the level crossing. The train approaching sign would be black with the roundels on the top corners, which flash when a train is approaching the level crossing.
	**SH62 Rapaura Road** These signs are for the SH62 approach. The No Straight Ahead is not an existing MOTSAM sign and would need to be approved. The sign would be a LED sign on a black background which would only be 'on' and visible to motorists when a train is approaching the level crossing. The train approaching sign would be black with the roundels on the top corners, which flash when a train is approaching the level crossing.

7.4.3 Proposed Solution

Consideration has been given to the provision of lay-bys on the SH1 (northbound) and SH62 approaches to the intersection as shown on the attached plan. The central median islands will have a physical indented lay-by with a painted flush median for queuing over. There will be a requirement for signs to inform drivers of this facility. The signs plan as seen in Table 7-1 show options for electronic signs that come on during the time the rail crossing is operational. Vehicles wishing to enter Ferry Road will be able to queue in the lay-bys until such time as the rail crossing has finished operating, thereby keeping the roundabout open for other traffic movements.

8 Options Evaluation

The following evaluation is based on the preferred roundabout plan 1012-2 / TS01 as shown in Appendix C

8.1 Assessment

The preferred option is an Austroads compliant roundabout is to be progressed for this site. This option addresses most crashes and removes the need for the auxiliary acceleration and deceleration lanes as drivers are more accustomed to being held up by HCVs as they enter and exit roundabouts.

8.1.1 Land Transport Management Act 2003 (LTMA) Compliance

Policy / Strategy	Roundabout option compliance
LTMA Section 3: The purpose of this Act is to contribute to an effective, efficient, and safe land transport system in the public interest	This option will improve safety by reducing crashes whilst maintaining an effective and efficient intersection and improving pedestrian access.
LTMA Section 19: In essence these new government documents place road safety as a key component to be addressed in any investment decisions.	This option will improve safety by reducing crashes whilst maintaining an effective and efficient intersection and improving pedestrian access.
Connecting New Zealand: *Connecting New Zealand draws together the policy direction set out in a number of other guidance documents, including the National Infrastructure Plan and the Government Policy Statement on Land Transport Funding 2012/13–2021/22 (GPS 2012).* The government is seeking an effective, efficient, safe, secure, accessible and resilient transport system that supports the growth of our country's economy, in order to deliver greater prosperity, security and opportunities for all New Zealanders	This option will improve safety by reducing crashes whilst maintaining an effective and efficient intersection and improving pedestrian access.
NZTA's National State Highway Strategy: One of the goals of the strategy is to provide safe state highway corridors for all users and affected communities.	This option will improve safety by reducing crashes whilst maintaining an effective and efficient intersection and improving pedestrian access.
NZTA Urban Design Policy: • ensure state highways contribute to vibrant, attractive and safe urban and rural areas; and • achieve integration between state highways, local roads, public transport, cycling and walking networks and the land uses they serve.	There is limited opportunity at Spring Creek to fulfil the objectives of the NZ Urban Design Protocol. However, the provision of pedestrian and cycle facilities meets NZ Transport Agency's aims.
Marlborough Regional Land Transport Strategy: The Marlborough Regional Land Transport Strategy MRLTS (November 2012) lists this intersection as a priority for improvements. Appendix 7 (page 110) lists SH1 as having a National Strategic SH classification and SH62 as having a Regional Strategic SH classification.	This option will improve safety by reducing crashes whilst maintaining an effective and efficient intersection and improving pedestrian access. This option maintains the strategic significance of SH1 & SH62

Policy / Strategy	Roundabout option compliance
Marlborough District Council – Growing Marlborough[3] This planning and consultation exercise looked at the opportunities and restraints for growth in the Spring Creek area (pages 69 - 75). In summary there is no opportunity for growth to the east of SH1 due to flooding risk, but there may be some opportunity for growth to the west of SH1.	This option will enhance future growth.

8.2 Cost Estimates

A cost estimate for the preferred option has been prepared based on a full pavement reconstruction. The estimate includes costs associated with land purchase of a part of the 4 Square property in the north west quadrant to accommodate the proposed roundabout and part of the MDC land to the west of the 4 Square property.

A detailed cost estimate is provided in Appendix O

Option	Base Estimate	Contingency	Project Expected Estimate
Roundabout	$2,022,395	$317,349	$2,339,744

8.3 Economic Evaluation

An economic evaluation using the NZ Transport Agency EEM SP5 Isolated intersection improvements worksheets is provided for the full pavement reconstruction of the Spring Creek intersection roundabout and the do minimum option.

The following PV benefits have been assessed for the preferred option:

- Travel time cost savings $ - 63,189
- Vehicle operating cost savings $ - 11,411
- Crash cost savings $ 7,714,896

The preferred option achieves a Benefit Cost Ratio of 4.15 and a First Year Rate of Return of 0.31 or (31%).

Refer to Appendix P for details of the economic evaluations and resultant Benefit Cost Ratio (BCR).

8.3.1 External Effects

The most significant external effect of the proposed option is a potential loss of business by the neighbouring shops during the construction period. To mitigate this, all steps should be taken during construction to maintain access at all times to local businesses.

[3] www.marlborough.govt.nz/Your-Council/Growing-Marlborough.aspx

This may be compensated by the expected increase in business activity as a result of improved safety and access to the shops and businesses.

The outputs of the transport modelling undertaken indicate that there are likely to be negligible benefits or dis-benefits for the proposed scheme from changes in travel time or CO2 emissions.

Other external effects which could be considered (in line with EEM guidance) include, road traffic noise, vibration, water quality, special areas, ecological impact , visual impacts, community severance, overshadowing and isolation. However, it is considered that the proposed option is not different enough from the existing road layout to impact significantly on any of these external factors.

9 Property Requirements

Property purchase is required in the north west quadrant, which currently operates as a 4 Square supermarket, and it is proposed that resulting parking loss be compensated through adjacent land belonging to Marlborough District Council.

It is also suggested that consideration is given to the purchase of a small area of land from the hotel at the south west quadrant of the intersection to ensure appropriate intervisibility between pedestrians and turning drivers (refer 9.2).

The NZ Transport Agency are providing most of the property and land acquisition requirements in house, including initial meeting, developing the property evaluation strategy, the property acquisition strategy and requirements.

9.1 Preliminary Land Requirement Plan

Two property acquisition plans have been provided by ViaStrada. Plan number C1 was provided to the NZ Transport Agency for the initial engagement meeting with the 4 Square business regarding the proposed roundabout and associated land requirements. This has now been replaced by plan number TS01-P1. A copy of plan C1 is attached in Appendix B , a copy of plan TS01-P1 is attached in Appendix M

9.2 Preservation of Crossing Intervisibility Sight Line

The intervisibility between pedestrians and drivers has been checked on all crossings and there is acceptable intervisibility. However, if the Hotel site gets fully developed at some point in the future, building a high fence on the boundary line would compromise intervisibility from the crossing point on the south west corner.

Consideration should be given to securing a section of property on the south west [Hotel] corner to protect the sight line intervisibility.

10 Summary of Environmental and Social Effects

It is considered that the roundabout option, when considered in terms of environmental and social effects, can provide solutions that avoid, remedy or mitigate these effects and the estimated costs are economically viable.

Refer to the environmental and social screen in Appendix H

11 Risk

There are two key risks identified as having a medium probability and one key risk with a high probability which are considered to have the potential to prevent the project from proceeding:

- Failure to acquire necessary land (medium);
- KiwiRail clearance requirements may not be achievable (medium);
- Change in crash patterns (high).

Table 11-1 is a matrix of risks identified for the project.

Table 11-1: Risk matrix

Risk	Probability	Basis of assessment	Consequence	Mitigation or avoidance
Funding: Project may not receive funding approval	Low	Both of the roundabout options (full reconstruction and overlay) show good BCRs at 6.4 and 7.6, respectively.	Roundabout option unlikely to proceed	Confirm funding available
Legal & Compliance: Project may be delayed due to consent processes	Low	No apparent consenting or compliance issues	Project delayed	Ensure all necessary consents & compliance issues are dealt with in a thorough and timely manner
Culture and heritage: Discovery of artefacts	Low	There are no heritage buildings, sites, places or trees were shown at Spring Creek in the Marlborough District Council's Appendix A Register of Significant Heritage Resources dated 28 October 2010.	Project delayed	Liaise with Tangata Whenua & historic places trust
Strategic: Changes to strategic planning & decision making	Low	Option is currently a strategic fit. Changes unlikely	Roundabout option unlikely to proceed	Monitor any changes in strategic policy direction.
Stakeholder consultation: Option unacceptable to	Medium	Stakeholder feedback generally positive	Projects delayed by design	Ensure robust option put

Risk	Probability	Basis of assessment	Consequence	Mitigation or avoidance
some / all stakeholders			modifications & re-consultation	forward for consultation.
Road User consultation: Option unacceptable to some / all road users	Medium	Road users may be resistant to changed layout	Projects delayed by design modifications & re-consultation	Ensure robust option put forward for consultation.
Proximity of rail line: KiwiRail clearance requirements may not be achievable	Medium / Low	The site is very constrained between the rail line and existing property	Roundabout option unlikely to proceed if workable solution not achievable	Modify option to ensure KiwiRail requirements are met
Land acquisition: Required land acquisition not achieved	Medium	Small area of land required from one property	Roundabout option unlikely to proceed	Use appropriate process to secure required land
Project site contaminated: The 4 Square site has operated as a service station and is identified as a HAIL site and possibly contaminated	Medium	The 4 Square site has operated as a service station. If contaminated, treatment will be required.	Possible project delay	Site investigation required to check for contamination
Safety Audit: The concept design safety audit may identify serious safety concerns.	Medium	The roundabout option is an innovative & complex design that accommodates queuing vehicle when the rail crossing is active. The audit may identify serious safety concerns that are difficult to address.	Projects delayed by design modifications or unlikely to proceed if workable solution not achievable	Address any significant concerns
Change in crash patterns: The number & severity of crashes will reduce with the reduction in speed limit from 80 to 70 km/h	High	Crash frequency has reduced since the limit was lowered in March 2011. Time frame too short for statistical significance.	Project may be delayed while more crash data is collected. Project may not proceed if a significant reduction in crash frequency & severity is evident.	This should be assessed against the potential further reductions in frequency & severity of crashes through the roundabout option

12 Safety Audit

The NZ Transport Agency provided an independent Road Safety Audit in accordance with the Land Transport New Zealand publication "*Road Safety Audit Procedures for Projects – Guideline*" TFM9.

The concept plans provided [20/09/2013] [Spring Creek Roundabout plan for concept safety audit.pdf] titled Spring Creek intersection: Scheme Assessment – Option for Safety Audit; Drawing No's 1012-2 / SA1, 1012-2 / SA2 and 1012-2 / SA3.

The results of the concept stage safety audit can be found in Appendix N .

12.1 Alternate Roundabout Option Considered

Concerns raised in the safety audit regarding vehicles queuing in the lay-bys merging to their left were discussed at the NZ Transport Agency Spring Creek intersection meeting held in Blenheim on Nov 11 2013 attended by [redacted], [redacted] [from NZ Transport Agency / Marlborough Roads] and [redacted] [ViaStrada Ltd]

An alternative roundabout concept was developed with two lanes on the SH1 south and SH62 approaches with direct access onto the roundabout. This design removed the potential conflict between through traffic and vehicles merging back into the traffic lane from the lay-by.

The concept looked to work well but the additional space required to accommodate two circulating lanes meant that this design encroached a significant distance into the 4 Square site and would require relocation of the existing supermarket building. It would also remove the existing vehicle access around the front of the Hotel. It was considered that delays associated with land acquisition and the property related costs would prevent this option from proceeding and it was discarded. A plan of this option 1012-2 / C5 is in Appendix B .

13 Value Assurance Decision Making Approvals

13.1 Problem Definition and Primary Objective

The SH1/SH62/Ferry Road intersection at Spring Creek has a significant crash history and the three investigations carried out to date point to similar reasons for this. There have been 32 crashes recorded for this site in the past 10 years, most of which involve vehicles undertaking a turning manoeuvre.

The layout of the intersection with side roads joining SH1on oblique angles resulting in long exposures of right turning traffic to the through SH1 lanes. These long exposures give rise to variable assessments of gaps by drivers and the time it takes to clear the SH1 lanes. This is compounded by higher than typical numbers of heavy vehicles making these turns.

The prime objective of this project is to reduce the number and severity of crashes at the intersection.

13.2 Options Considered

A range of options was initially explored, then narrowed down to six for further investigation at the scoping study stage.

The options explored were:

- Square up the intersection
- Four leg Roundabout
- Gane Street Extension
- SH62 Rapaura Road Extension
- Three leg roundabout
- Traffic signals

Reference is made to Section 7: Options considered and Appendix A: Option plans of the ViaStrada scoping study report. A further (modified three leg roundabout) option was added to the scoping study report in Appendix H.

13.3 Basis for Option Selected

The Austroads compliant roundabout was progressed for this site as the preferred option that addressed most crashes, provides good non-motorised user access, slows through vehicles and removes the need for the auxiliary acceleration and deceleration lanes, as drivers are more accustomed to being held up by HCVs as they exit roundabouts.

13.4 Roundabout Option: Funding Profile

The likely funding profile of the preferred roundabout option is assessed against the NZ Transport Agency Planning & Investment Knowledge Base Assessment Famework for;

- Strategic fit
- Effectiveness
- Efficiency

13.4.1 Strategic Fit

The strategic fit assessment considers how an identified problem, issue or opportunity aligns with the NZTA's strategic investment direction, which derives from the GPS. New and improved infrastructure projects for state highways are rated for strategic fit as either low, medium or high. By default, the strategic fit rating is low.

The roundabout option qualifies as a high rating as it meets the following requirement:

- potential to provide a significant reduction in the *actual crash risk* involving deaths and serious injuries in accordance with the Safer Journeys strategy:
    - at a high risk urban intersection.
    - this intersection is identified at No 17 in the draft top 100 high risk intersections.

Spring Creek intersection can be considered as an urban intersection as the dairy and takeaway store, service station, supermarket and hotel are located on the west side of the intersection whilst the residential township of Spring Creek is located on the east side of the state highway and rail line.

The roundabout option meets the necessary criteria to qualify as a high strategic fit rating.

13.4.2 Effectiveness

The effectiveness assessment factor considers the contribution that the proposed solution makes to achieve the potential identified in the strategic fit assessment, and to the purpose and objectives of the Land Transport Management Act 2003.

A project may be given a Medium rating for effectiveness if it meets each of the following:

1. All the low effectiveness criteria are met.
2. Is part of or will contribute to an NZTA supported strategy, endorsed package, programme or plan (for inclusion to the *NLTP* a completed strategy that will be presented to the NZTA for support in the near future may be considered sufficient).
3. Is significantly effective (will deliver a measurable impact or outcome) in achieving the potential impact or outcome identified in the 'strategic fit' assessment.
4. Provides a long term solution with enduring benefits appropriate to the scale of the solution.
5. Provides a solution that responds to land use strategies and implementation plans, where appropriate to the activity.
6. Provides a solution that makes a contribution to multiple GPS impacts, where appropriate to the activity.

The preferred roundabout meets all of the efficiency criteria for the medium rating as follows

- The Scoping Study and Scheme Assessment reports demonstrate evidence that the roundabout option meets all the low effectiveness criteria
- The preferred roundabout is part of an NZTA supported strategy for the top of the South Island road network.
- The preferred roundabout will be significantly effective in achieving the potential to provide a significant reduction in the actual crash risk involving deaths and serious

injuries in accordance with the Safer Journeys strategy at this high risk urban intersection as identified in the 'strategic fit' assessment.

- This preferred roundabout will provide a long term solution with enduring safety benefits to all road users and the Spring Creek community that are considered appropriate for the site and the scale of the project.
- The preferred roundabout provides a solution that will accommodate the current and foreseeable future land use strategies and implementation plans, including the Marlborough District Council: Growing Marlborough District Wide Strategy.
- The preferred roundabout is considered to make a contribution to several GPS impacts including reductions in deaths and serious injuries as a result of road crashes, more transport choices, a secure and resilient transport network and contributions to positive health outcomes.

The preferred roundabout option meets all necessary criteria required to qualify as a medium efficiency rating.

13.4.3 Efficiency

The economic efficiency assessment considers how well the proposed solution maximises the value of what is produced from the resources used. The Benefit Cost Ratio (BCR) is the primary measure of economic efficiency of any road project.

A BCR greater than or equal to 4. 0 and receives a high efficiency rating

The preferred roundabout has a BCR of 4.15 and receives a high efficiency rating.

13.4.4 Funding Assessment Profile

Based on the above assessment, the preferred roundabout option has the following funding profile:

Strategic fit rating: High

Effectiveness: Medium

Efficiency: High

13.4.5 Funding Status

The NZ Transport Agency has funding approved under New & improved infrastructure for State highways for Marlborough District Council for the investigation stage of the SH1 SH62 Spring Creek Intersection Roundabout project. Funding is probable for the Design and Construction stages. The current funding status for the proposed Spring Creek roundabout can be seen in Table 13-1.

Table 13-1: NZ Transport Agency funding sources[4]

	Phase type	RP*	Profile	WC*	FAR*	Total phase Cost ($000)	2012/13 NZTA ($000)	2013/14 NZTA ($000)	2014/15 NZTA ($000)	Funding Priority	Funding Source
Marlborough											
Marlborough District Council											
New & improved infrastructure for State highways											
SH1 SH62 Spring Creek Intersection RAB	Investigation		MMH	324	100	150	39.4	115.2	0	Approved	N
SH1 SH62 Spring Creek Intersection RAB	Design		MMH	324	100	133	0	137	0	Probable	N
SH1 SH62 Spring Creek Intersection RAB	Construction		MMH	324	100	885	0	0	911.8	Probable	N

RP* - Regional priority
WC* - Work category
FAR* - Average Financial Assistance Rate

13.5 Roundabout Option: Design Profile

13.5.1 Key Relevant Standards

The roundabout has been designed to concept stage in general accordance with the design guidance of the following standards:

Austroads Guide to Road Design:

- Part 3- Geometric Design;
- Part 4 Intersections general;
- Part 4B- Roundabouts;
- Part 6A- Pedestrian and Cyclist Paths.

Austroads Guide to Traffic Management:

- Part 6- Intersections, Interchanges and Crossings;

NZ Supplement to Austroads Part 14 Bicycles.

NZ Manual of Traffic Signs and Markings / Traffic Control Devices Rule.

CPTED (Crime Prevention through Environmental Design) principles have been considered in the development of the roundabout option.

13.5.2 Pedestrian and Cyclist Requirements

The requirements for pedestrians and cyclists have been considered and allowed for in the development of this concept plan. Records do not show a pedestrian or cycle crash history and their counts are relatively low.

The dairy and takeaway store, service station, supermarket and hotel are located on the west side of the state highway whilst the residential area of the township of Spring Creek is located on the east side of the state highway and rail line. The provision of slip lanes and turn bays at the intersection means pedestrians and cyclists must cross five [relatively

[4] NZTA funding for the Marlborough Region from http://www.nzta.govt.nz/planning/nltp-2012-2015/report-table.html?Region=Marlborough&RegionID=37&UDT=1384945200

high speed] traffic lanes to get across the state highway. There are no pedestrian crossing facilities at the intersection and young children have been observed standing on the double yellow lines between the opposing state highway traffic flows trying to cross the road.

The roundabout option will improve the opportunity for pedestrians to cross the state highways and local road at the intersection. This offers considerable safety and access improvement in terms of 'connecting' the Spring Creek township that exists on both sides of SH1.

Roundabouts generally are not considered desirable for cyclists. However, sufficient on road width is provided for confident cyclists. The roundabout design provides shared path facilities with median island refuges to enable cyclists and pedestrians to cross the all legs of the roundabout. This path provides an alternate option for cyclists that are not comfortable riding on the road at the proposed roundabout. .Dropped crossings are provided at all kerbs.

13.5.3 Integrated Planning / Travel Demand Management

Integrated planning and travel demand management are difficult to bring to an existing rural project in New Zealand. Typically small towns develop at transport junctions and often reflect little consideration of these values.

Encouraging multi-modal travel in this location is unlikely with conventional public transport and/or park & ride provision due to the low population. However, carpooling is already happening on the MDC land adjacent to the 4 Square site, being used for all day parking throughout the horticultural season for staff.

Typically locals would use a car to make short local trips to the Spring Creek shops and sports club rooms and fields as crossing the State Highways on foot has considerable safety concerns. The proposed roundabout option provides locals and visitors with increased opportunities to walk or cycle safely between the residential area to the commercial and sports activities of Spring Creek. This should see a reduction in locally generated motorised traffic, as walking and or cycling may now be considered an acceptable and realistic mode choice for local transport.

13.5.4 Outline of Procurement Strategy, Project Timeline Contingencies

13.5.5 Risk

13.5.5.1 Risks to the Project

Refer to Section 11.

13.5.5.2 Risks Following Construction

The safety audit identified concerns regarding the operation of the lay-bys and the potential for crashes between vehicles exiting the lay-by areas and through traffic. Measures to address this risk are discussed in Section 13.5.6.3.

13.5.6 Mitigation Measures

13.5.6.1 Environmental and Social Issues

Refer to Appendix H

13.5.6.2 Risks to the Project

Refer to Section 11.

13.5.6.3 Risks Following Construction

Indented Parking Lay-bys

A project risk is that infrequent drivers entering the roundabout may not realise a lay-by facility is provided for Ferry Road bound vehicles. In this case drivers may just wait at the limit lines while a train is crossing Ferry Road or they may enter the roundabout and wait in the circulating lane.

There are two roundabouts in Blenheim where the rail line crosses one of the approach legs close to the intersection and an third roundabout at the intersection of SH1s and Main Street where the rail line actually passes through the roundabout. There are generally between 10 and 13 trains per day passing through Spring Creek and Blenheim and it is expected that many local drivers will be familiar with rail crossings in close proximity to roundabouts. There are several other mitigation measures that can be bought to the Spring Creek roundabout project to help drivers use the roundabout as intended. These can be added after the roundabout has been in operation for some time, if it is found that some drivers are having difficulty reading and interpreting the layout.

Kerb side convex mirrors

The RTA suggested that convex mirrors could be located on the left hand side of the road near the lay-by exits. These mirrors could be used by drivers exiting the lay-by to check if there are cars approaching and/or in their blind spot.

Additional signs

A text sign could be included on the median island advising ‘Ferry Road Traffic Wait Here’, with an arrow indicating the parking indent. However, this has not included this in the proposal as it uses a lot of text, not all drivers will know which is Ferry Road it may not be understood by international visitors.

	This sign would be located well in advance to the intersection to alert drivers that a train is approaching the intersection. The sign would have flashing roundels on the top corners and the train and text could also flash when a train approaches.
	There is insufficient space available for KiwiRail to install railway barriers on the Ferry Road approach from the state highway. However, two pairs of Dual LED No Entry signs could be added to the Ferry Road entry on the north and west approaches. These signs can flash when a train is approaching and crossing Ferry Road. The sign location will form a gate to Ferry Road

Cross Hatching

To prevent drivers from blocking the state highway, cross hatching could be marked in locations around the circulating lane. To address concerns of differential skid resistance, all paint markings should have skid resistance levels of 45BPN.

Island infill

If a high proportion of drivers still do not use the indented lay-by as intended the lay-by could be physically filled in. This would mean that the splitter islands would revert to a normal island shape and the roundabout would function as per the other Blenheim roundabouts.

13.5.7 Opportunities for Innovation

When a train is using the rail crossing, access to Ferry Road is not possible and lay-bys are provided on both state highway approaches and Rapaura Road to prevent vehicles waiting to turn into Ferry Road from obstructing other movements, particularly the through movement on SH1. VMS signage will be used to inform motorists that a train is approaching the crossing and that vehicle wishing to enter Ferry Road should queue in the lay-bys provided.

This project offers the Transport Agency the opportunity to trial an innovation. The lay-bys enable the roundabout to continue operating when a train is crossing. There will be safety and operational concerns over the possibility that some drivers won't use the lay-bys, which might result in the roundabout blocking. However, this event is shown to be of low frequency and it would have fairly minor crash consequences. Section 13.5.6.3 provides a series of subsequent actions the Transport Agency can take to assist road users in using the lay-bys, with the roundabout reverting to a standard layout that blocks during train events as per the three other Blenheim State Highway roundabouts.

14 Statutory Approvals

The statutory approvals, requirements and project stages can be seen in Table 14-1.

Table 14-1: Statutory approvals

Approval	Required	Project stage
Entry Agreements(s)	Designer to check	Design
Building Consent(s)	NA	
Resource Consent(s)	Yes	Design
Designation(s)	Yes	Design
Historic Places Trust	Designer to check	Design (if required)
Department of Conversation	NA	
Notice of Requirement	Yes (for purchased land)	Design
Outline Plan	Yes	Design
Other(s)… Kiwirail	Design approval	Design

14.1 Consenting Requirements

If all of the affected parties are in agreement then consent can be processed with minimal fees and without a hearing.

If the NZ Transport Agency can reach agreement with 4 Square on the land required and designate the land as road then MDC can discount any district land use consent requirements. Storm water discharge is a permitted activity from the road network under 27.1.14.

14.1.1 Storm Water Discharge to Land from Road and Rail Network [27.1.14]

Discharge of storm water from the Council and New Zealand Transport Agency's road network and from the New Zealand Railways Corporation network to land, is a Permitted Activity subject to the following standards:

a) The discharge shall not worsen or cause any significant erosion or inundation of land;

b) The discharge shall not have any significant adverse effect on soil or vegetation;

c) The discharge shall not have any adverse effect on wildlife habitats or recreational values of any land;

d) No discharge shall alter natural drainage patterns;

e) Any discharge point and its associated structure shall be maintained in a condition such that it is clear of debris and structurally sound;

f) The storm water discharge system does not drain:
- A total area greater than 500 m^2 undergoing earthworks;
- An uncovered area greater than 0.2 ha where an activity is undertaken associated with industrial or trade premises (excluding any area used solely for car parking);
- An area of land greater than 4 hectares;
- Hazardous substances storage facilities;
- Service stations;
- Petroleum or soil storage facilities;
- Sale yards or any other animal holding area greater than 100 m^2.

g) That the discharge does not cause flooding on private land;

h) Except for existing storm water discharges from road and rail infrastructure at the time those plans become operational, the storm water being discharged shall originate from the same catchment as the natural storm water flow pattern.

MDC will have to consider regional resource consent requirements.

14.1.2 Disturbance within 8m of a Stop Bank

There is a stop bank structure located on the true right bank of Spring Creek[5]. The stop bank provides protection to Rapaura Road, the all-day car park and the 4 Square site see Figure 14-1. Disturbance to this stop bank will require resource consent.

[5] The true right bank is the right bank when looking downstream.

Figure 14-1: Spring Creek Stop Bank

14.1.2.1 Land Disturbance within 8m of a Stop Bank

MDC advise that the NZ Transport Agency will require resource consent for land disturbance within 8m of a stop bank. There is a stop bank on the west boundary of the 4 Square car park between Spring Creek and the car park. The proposed option will require modification to the stop bank.

14.1.3 Land Disturbance on a Contaminated Site

The 4 square site was a former Service Station and is identified as a HAIL site so it is potentially a contaminated site. This will need to be confirmed during design stage. This may also apply to the land held by MDC that is currently used for Car parking off Rapaura Road, adjoining the 4 Square site.

14.2 Consenting Strategy

The NZ Transport Agency to determine if the MDC land and 4 Square land required for road is a HAIL contaminated site.

The NZ Transport Agency to reach agreement with MDC and 4 Square on the land required for road.

The NZ Transport Agency designate the required land as Road.

The NZ Transport Agency apply for consent for land disturbance within 8m of a stop bank at detail design stage.

15 Appendices

Appendix A Locality Plan, Overweight & Over Dimension Routes

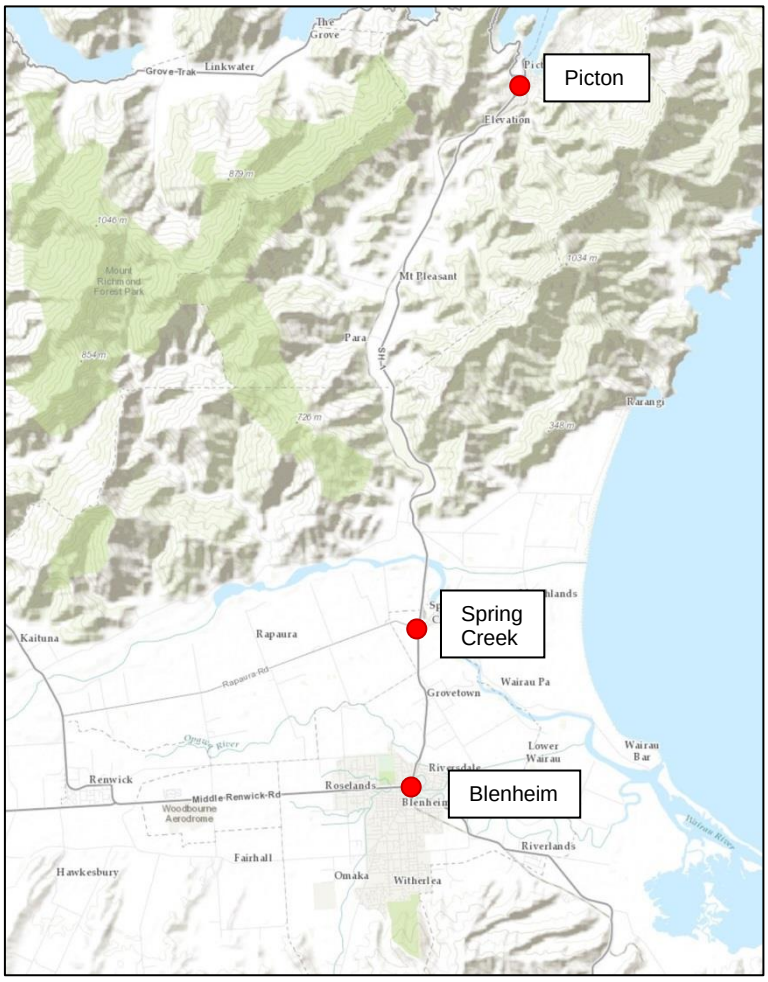


Figure 15-1: Locality Plan

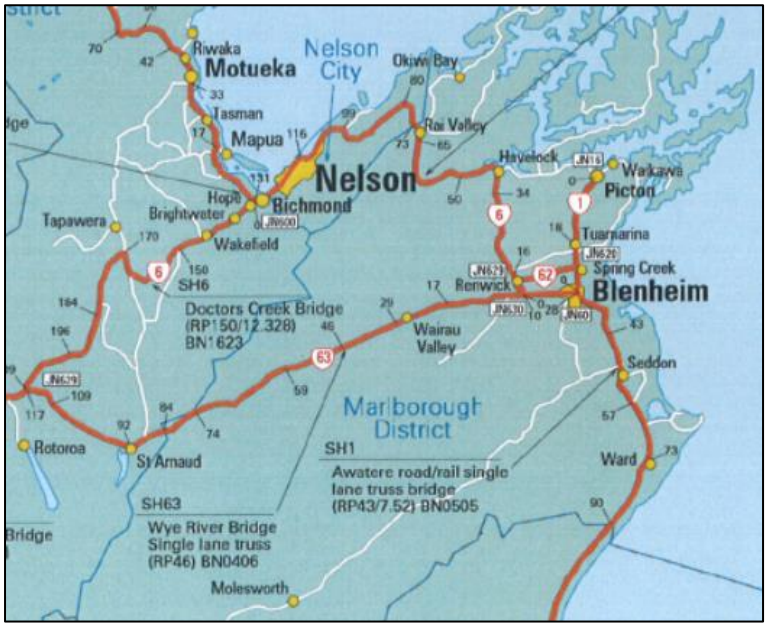


Figure 15-2: NZ Transport Agency over dimension routes

Appendix B Scheme Outline Plans

The following plans show the preferred option developed from the Scoping Study.

Figure 15-3 shows the plan presented to the key stakeholders: **1012-2 / C1**

Figure 15-4 shows the plan presented to the road user stakeholders: **1012-2 / RU1.**

This roundabout option was developed from the Scoping Study with key stakeholder feedback included.

Figure 15-5 shows a 2 & 1 lane roundabout option: **1012-2 / C5.**

This roundabout option was developed after the NZ Transport Agency Spring Creek intersection meeting held in Blenheim on Nov 11 2013 attended by [redacted] [from NZ Transport Agency] and [redacted] [ViaStrada Ltd]

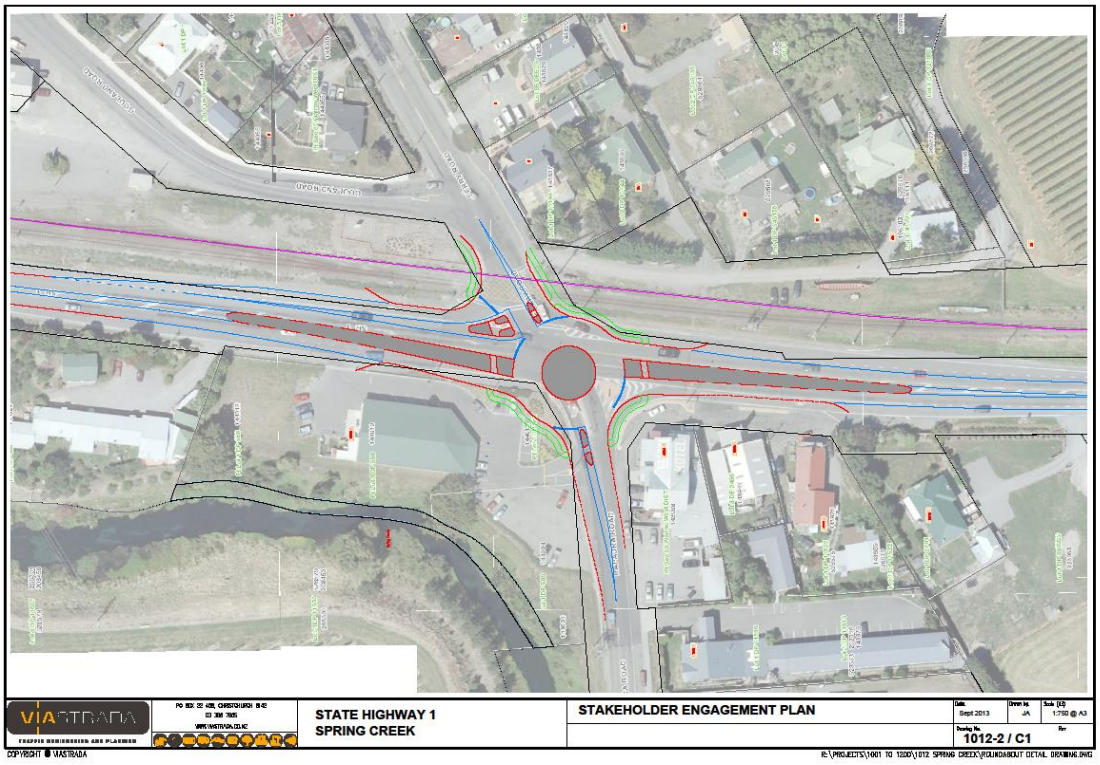


Figure 15-3: Stakeholder engagement plan C1

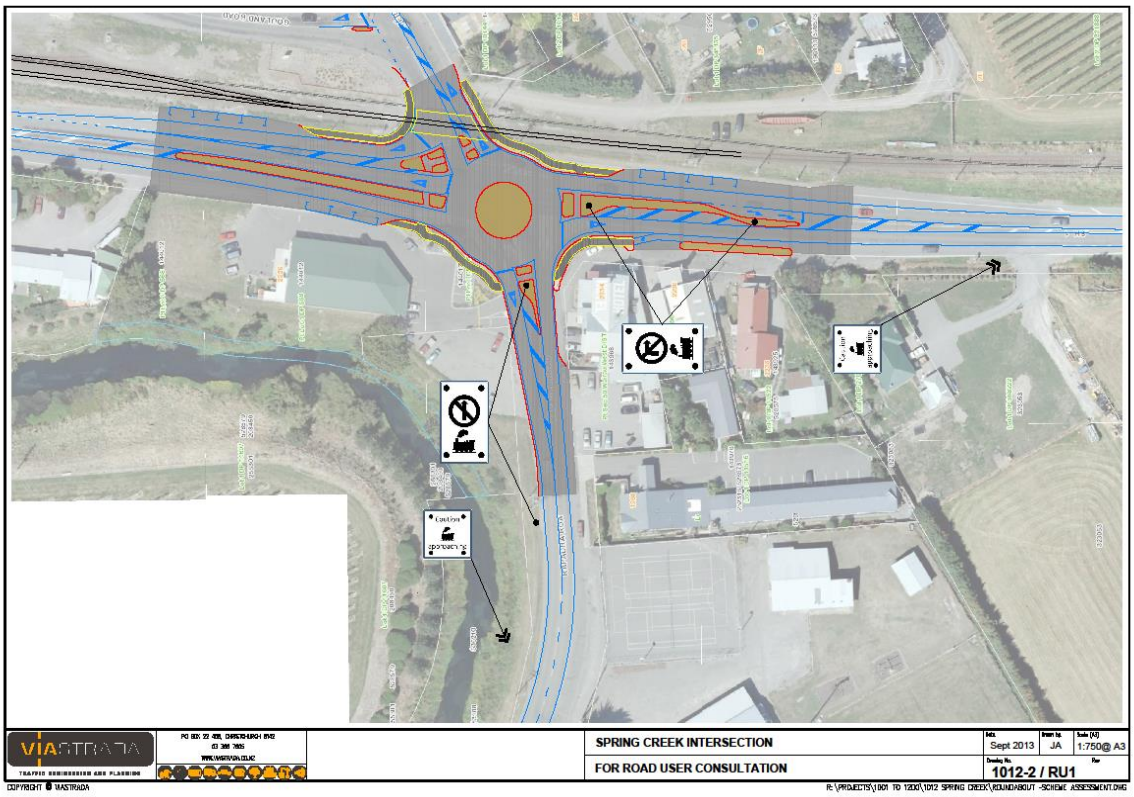


Figure 15-4: Road user plan RU1

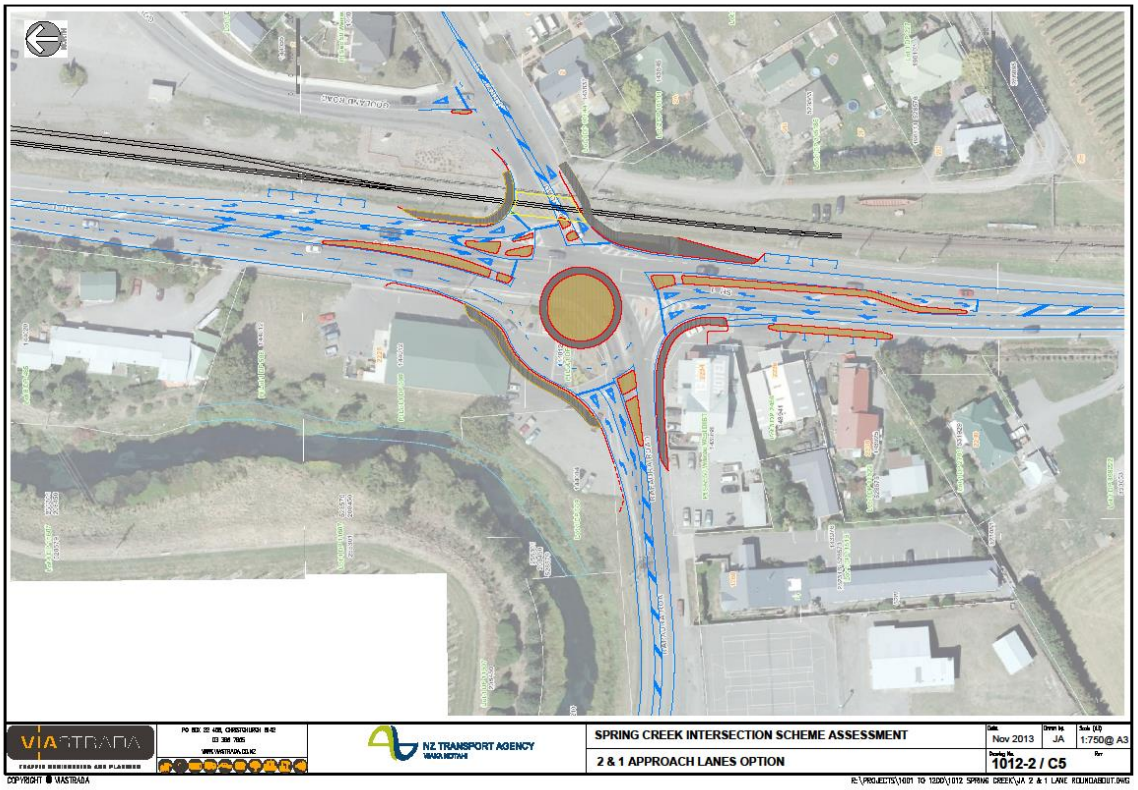


Figure 15-5: 2 & 1 lane roundabout Plan C5

Appendix C Scheme Drawing – Preferred Option

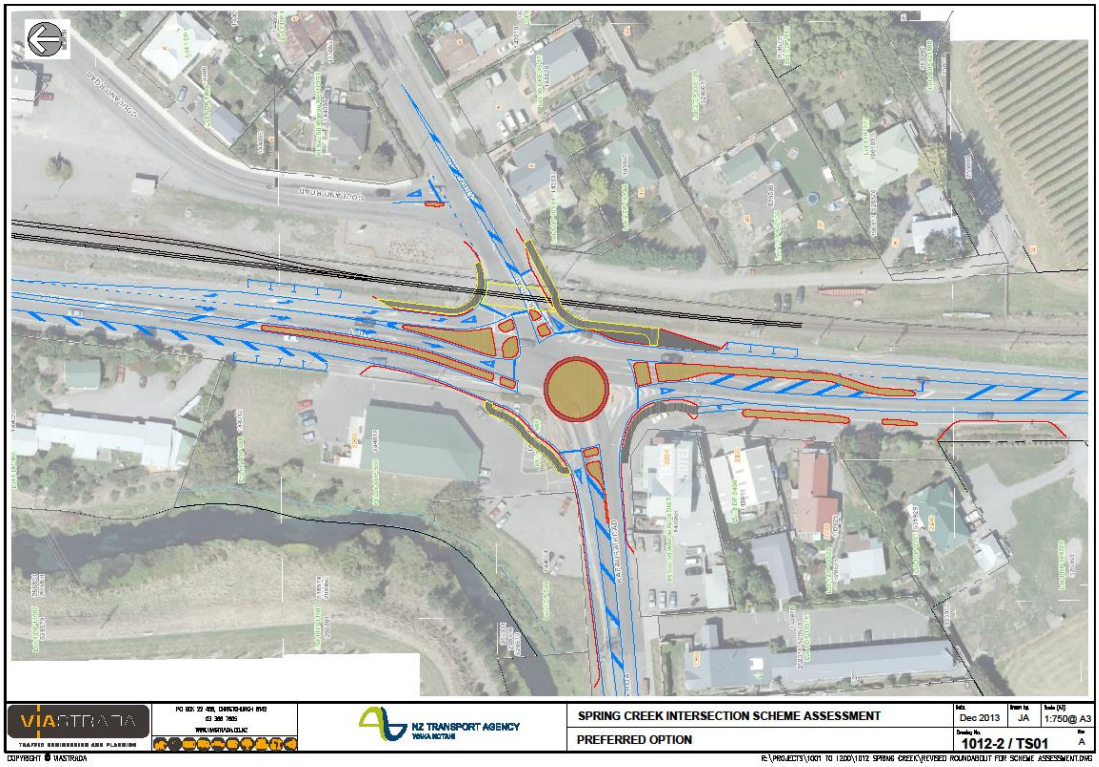


Figure 15-6: Preferred option roundabout TS01 rev A

Appendix D Preliminary Design Philosophy Statement

Key Relevant Standards:

The roundabout has been designed to concept stage in general accordance with the design guidance of the guidelines and standards listed in Section 13.5.

CPTED (Crime Prevention through Environmental Design) principles have been considered in the development of the roundabout option.

The roundabout option will improve the opportunity for pedestrians to cross the state highways and local road at the intersection. This offers considerable safety and access improvement in terms of 'connecting' the Spring Creek residents on the east side of the highway to the commercial businesses, shops and sports facilities that exist on the west side of the state highway.

Roundabouts generally are not considered desirable for cyclists. However, sufficient on road width is provided for confident cyclists. Further, it is proposed to accommodate less confident cyclists wishing to bypass the roundabout, using the footpath areas around the intersection as an option to them using the traffic lanes.

Geometry

The geometry for the Roundabout is based on the Austroads Guide to Road Design: Part 4B- Roundabouts; with the following dimensions

Central Island

The central island has an 8 m radius which is the [Absolute] minimum central island radius of a single lane roundabout based on an approach speed of 50 km/h. The Austroads guidance says no speed reduction treatments are required prior to the entry curve for this radius6. There is also a low mountable apron proposed on the outside of the central island resulting in a 9 m radius [18 m Diameter] for general traffic.

Circulating lane

The circulating carriageway width shown is 8.4 m to accommodate a 19 m semi-trailer[7]. The circulating width has been checked using Civil CAD AutoTrack software to ensure the semi-trailers can make all turns with the 500 mm buffer [except on the mountable apron] to ensure the high number of HCVs using this intersection can do so. Refer Figure 15-7, Figure 15-8 & Figure 15-9.

[6] Austroads Guide to Road Design: Part 4B- Roundabouts Table: 4.1.
[7] Austroads Guide to Road Design: Part 4B- Roundabouts Table: 4.3.

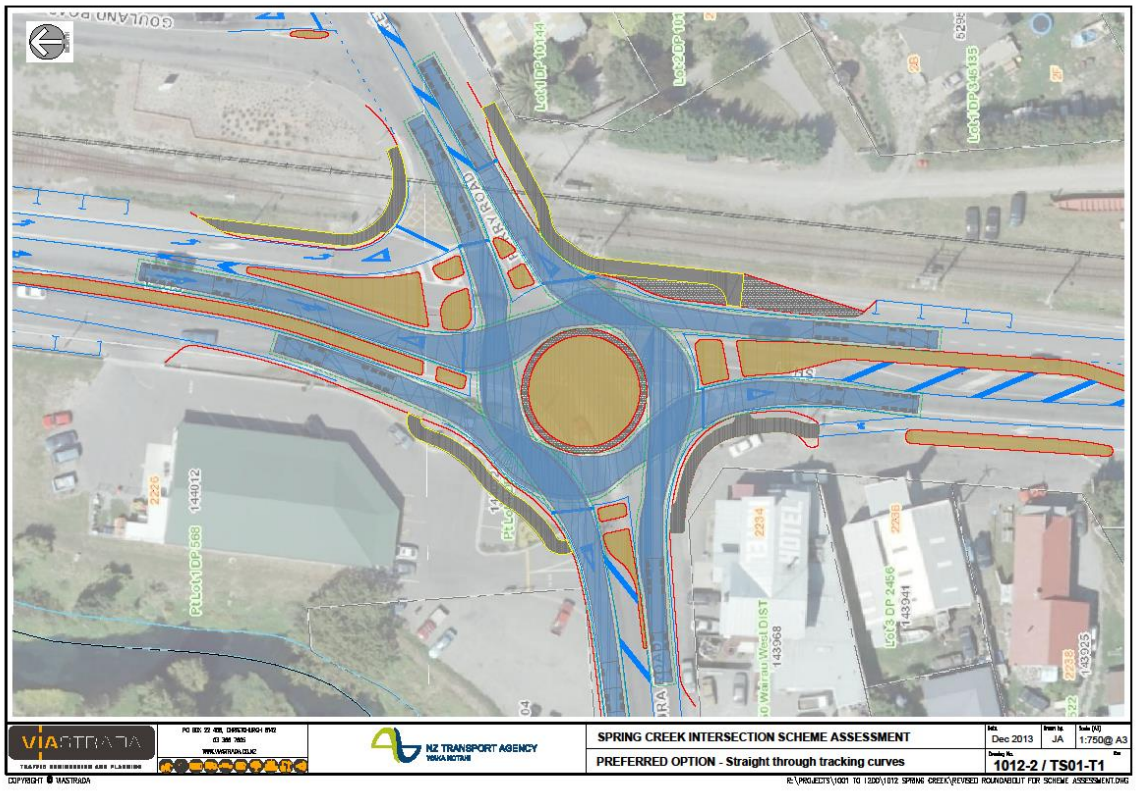


Figure 15-7: 19m semi-trailer straight through tracking plan TS01-T1

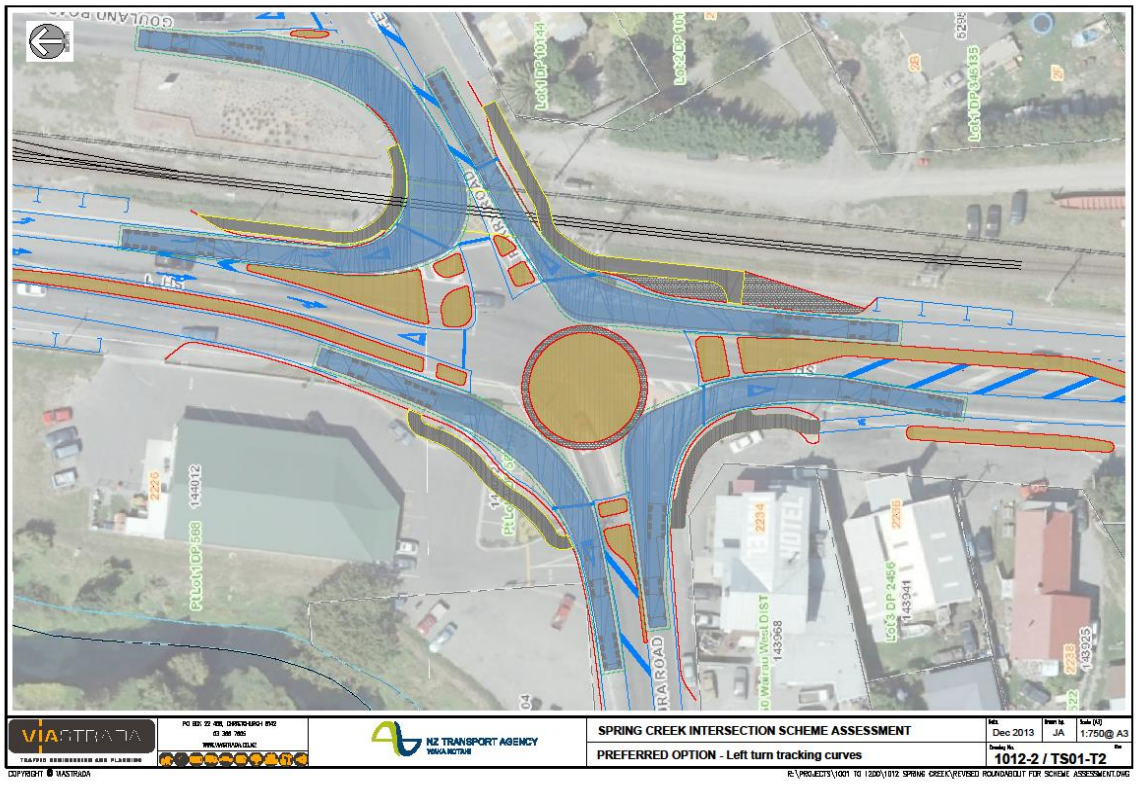


Figure 15-8: 19m semi-trailer left turn tracking plan TS01-T2

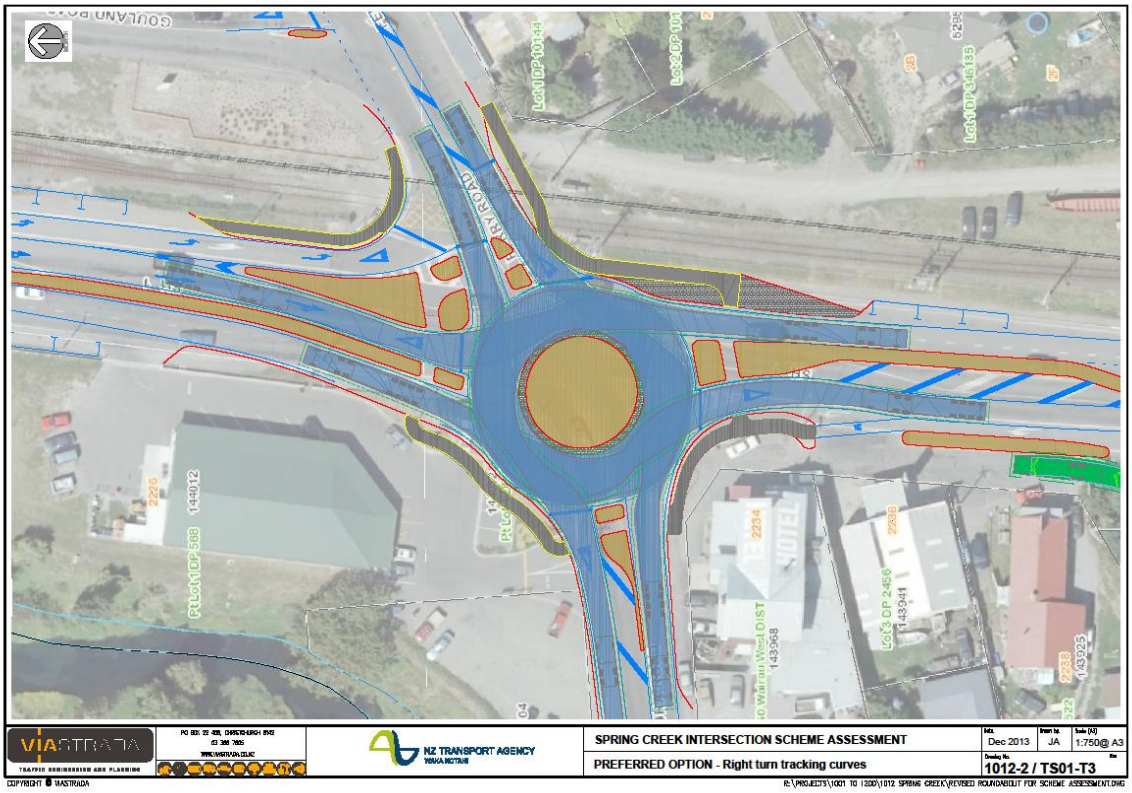


Figure 15-9: 19m semi-trailer right turn tracking plan TS01-T3

Pedestrian Intervisibility

As noted in Section 9.2, the intervisibility between pedestrians and drivers has been checked on all crossings and there is acceptable intervisibility. If the Hotel site gets fully developed at some point in the future, a high fence built on the boundary line would reduce intervisibility on the south west corner to the minimum acceptable distance.

Rapaura Road Speed Limit

The speed limit on (SH62) Rapaura Road is generally 100 km/h with a 250 m section of 80 km/h on the approach to the Spring Creek intersection. The 80 km/h speed limit is considered too high for the geometric alignment of the approach and it does not match the SH 1s speed limit of 70 km/h.

The Rapaura Road approach has two curves with a 200 m radius and a 90 m radius heading east towards the intersection. There is a distance of 80 m between these two curves. There is then a short straight of 50 m leading into another slight curve over a distance of 40 m to the limit lines at SH 1s.

The design speed for the two curves on the approach would be [220R] 76 km/h and the [90R] 51 km/h suggesting a lower speed limit on this approach would be more appropriate. The speed limit along the full length of Rapaura Road could be assessed as an independent project.

For Further Discussion

The Rapaura Road approach speed limit could be posted to 70 km/h to be consistent with the SH 1s speed limit. This would mean the Ferry Road speed signs would be correct and not require changing. The consistent speed limits would also help balance the approach speeds to the roundabout thus making the roundabout safer.

Austroads Clear Zone Compliance

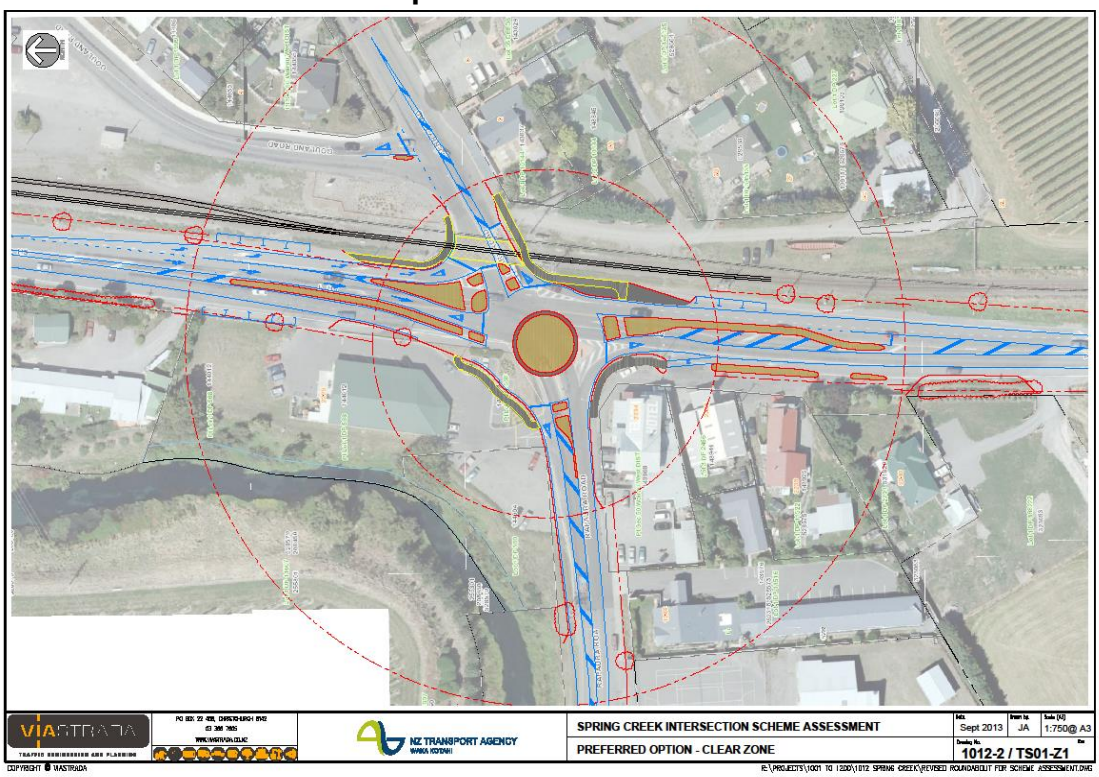


Figure 15-10: Clear zone plan TS01-Z1

Austroads Deflection Compliance

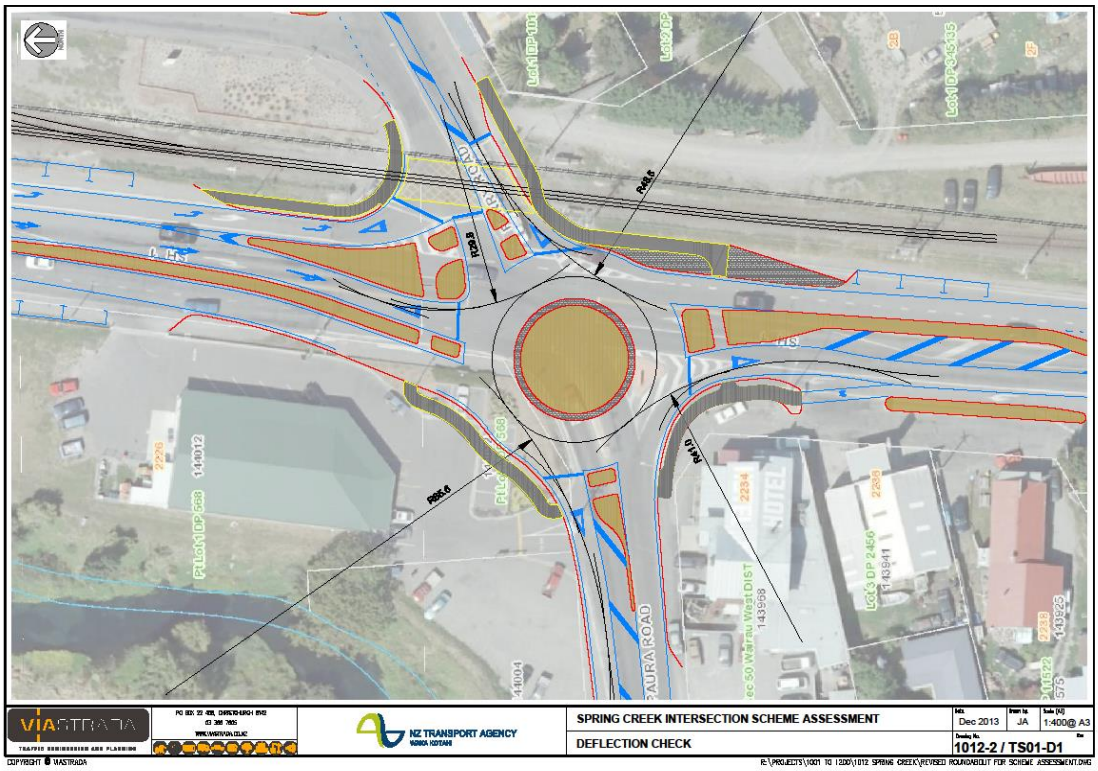


Figure 15-11: Deflection check plan TS01-D1

Shared Path Provision

The proposed roundabout has a shared path that circumnavigates the central island providing a facility for pedestrians and cyclists to cross the various toad approaches a single traffic lane at a time. This considerably safer than crossing the wide multiple high speed traffic lanes that pedestrians and cyclists currently have to do. This path provides an alternate option for cyclists that are not comfortable riding on the road at the proposed roundabout, as this can be risky for cyclists.

However, for cyclists to be permitted to legally ride on a footpath in New Zealand, the local road controlling must publicly resolve sections of footpath to be facility that can be shared by pedestrians and cyclists.

Intersection Signs

If the roundabout option proceeds, all existing intersection signage will need to be reviewed and amended or replaced as required to suit the new layout. This should be undertaken at the detail design stage.

ADS Signs

There are three existing 'advance direction signs' stack signs on the state highway approaches to the intersection that will require to be upgraded to AD5 Map signs on the state highway approaches to the Spring Creek intersection. There are no advance directional signs on the Ferry Road approach. Allowance is made for new AD5 Map signs in the Scheme Assessment estimate.

Figure 15-12 Rapaura Road west approach

Figure 15-13: SH1s north approach

Figure 15-14: SH1s south approach

Intersection Directional Signs

The existing IDS are based on a cross road configuration and will require updating to fit the new roundabout. There are two Rapaura Road IDS that could be reused, but they should have the SH62 shield included therefore all new IDS should be allowed for in the project. It appears that the SH62 shield was retro fitted to the IDS blade (left most photo) for Rapaura Road and it does not fit as per the MOTSAM Part 1 section 7 Guide signs. Allowance is made for new IDS in the Scheme Assessment estimate.

Figure 15-15: Intersection direction signs

Other Signs

There is a solar powered, electronic speed sign on the SH 1s north approach to the Spring Creek intersection. This sign reflects the speed that drivers are approaching the Spring Creek intersection from the north. This sign is not considered appropriate in this location as the design speed through the new roundabout is 50 km/h and 80 km/h will be too fast.

Consideration could be given to relocating this electronic speed advisory sign closer to the roundabout with a 50 km/h advisory speed or relocating the sign closer to the speed threshold to give more emphasis to the speed reduction expectation.

Consideration could be given to relocating this electronic speed advisory sign to another site.

Figure 15-16: Solar speed sign

There is a Motorist Service (MS) sign indicating a camper van waste site and wineries on the SH 1s north approach (note that there is no corresponding sign on the south approach).

Consideration could be given to rationalising the need for this sign, having a corresponding MS sign on the south approach, including it on the AD5 sign or removing it from this location.

Figure 15-17: MS sign

There is a 'PASSING LANE 300 m AHEAD'; sign located on the SH 1s north departure from Spring Creek. This sign is partially obscured by the speed threshold signs on the north approach the Spring Creek.

Consideration could be given to the location of this sign with respect to its location behind the speed threshold signs

Figure 15-18: Passing lane sign

There is a pair of permanent warning signs for railway across Ferry Road on the SH 1s south approach.

These signs can be removed as part of the roundabout construction works as they will effectively be replaced by the AD5 Map signs

Figure 15-19: PW signs south approach

There is a pair of permanent warning signs for railway on SH 1s north approach.

These signs can be removed as part of the roundabout construction works as they will effectively be replaced by the AD5 Map signs

Figure 15-20: PW signs north approach

There is a pair of 70 km/h signs prior to the railway crossing on the Ferry Road approach to SH 1s. These signs could mislead a driver into thinking they can increase their speed as they travel along Ferry Road, without realising they are entering the proposed roundabout. They are incorrect for Rapaura Road speed limit but correct for the SH 1s speed limit.

Consideration could be given to removing these signs or reducing the speed on Rapaura Road.

Figure 15-21: 70 km/h signs on Ferry Road

Appendix E Road Traffic Data

Traffic Growth

The traffic growth on SH1 at the Opawa River Bridge (Site 18 RP 8.871) shows a fairly flat ten year period of traffic growth between 1992 and 2001. There Figure 15-22 is a sharp rise between 2001 and 2003 followed by slow increase up to 2007 with a general decline in volumes to 2012.

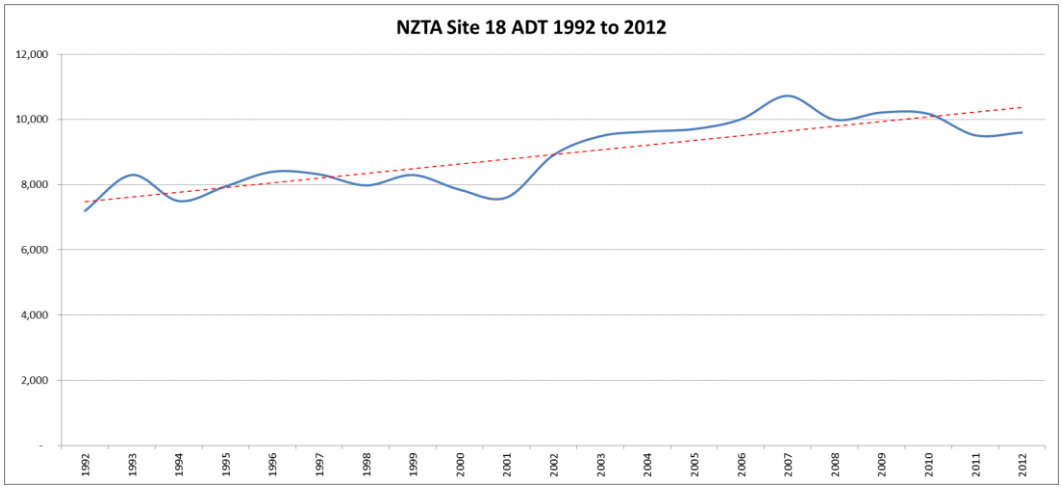


Figure 15-22: Traffic growth on SH1 Blenheim

The red dotted trend line in Figure 15-22 indicates an annual average linear growth rate of 1.93% over the twenty year period. It is noted that the traffic volumes since 2006 have been more or less static.

Daily Volumes

The traffic volumes have been analysed from the NZ Transport Agency traffic count Site [01S00026 Opawa] for March 2013. This is a 24 hour, seven day a week count site and volumes have been averaged over the month to give mid-week and weekend traffic flow profiles. The traffic flow profile in Figure 15-23 provides information to identify the mid-week peak hours and the weekend peak hour.

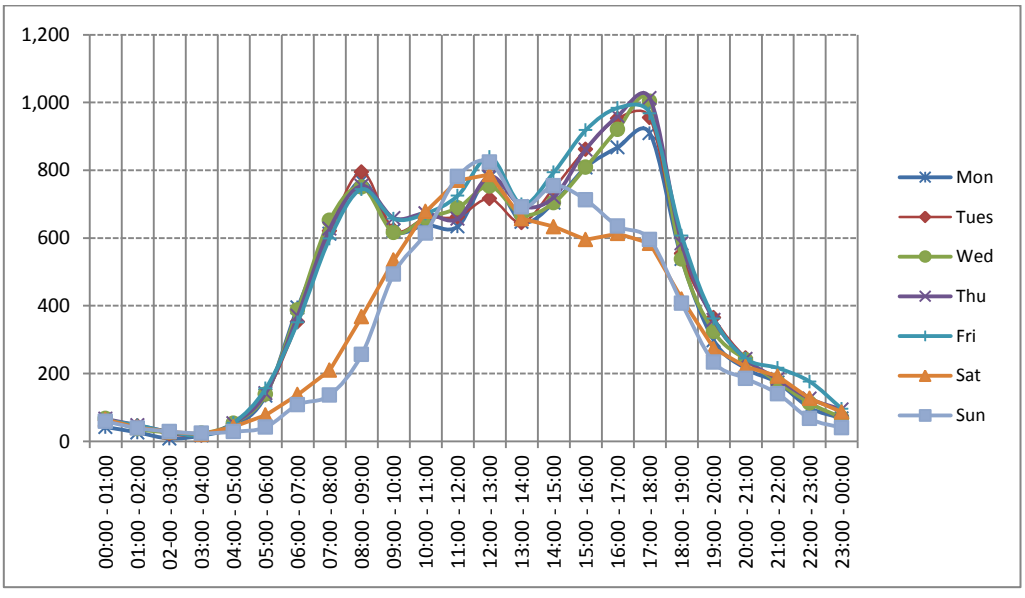


Figure 15-23: Daily traffic flow profile March 2013

Peak Hours

The survey period and peak hour traffic flow times identified are shown in Table 15-1. The two hour survey period was used to allow the actual peak hour to be identified.

Table 15-1: Survey times

Survey	Survey period	Peak hour
Mid-week AM	07:30 to 09:30	7:45 to 8:45
Mid-week noon	11:30 to 13:30	11:30 to 12:30
Mid-week PM	16:00 to 18:00	16:30 to 17:30
Saturday	11:15 to 13:15	11:45 to 12:45
Sunday	11:15 to 13:15	11:30 to 12:30

Turning Counts

To allow an effective design analysis for this intersection, detailed turning and classification counts are required. The LowDown traffic counting company has provided AM, noon and PM peak hour traffic counts to inform geometric and lane decisions. Spring Creek is on a recognised tourist route and there is a significant amount of commercial traffic operating 24/7. A turning count during the weekend (Saturday and Sunday) mid-day peak hours has also been undertaken and included in the analysis.

The location of the camera and orientation of the road labels used in the turning count surveys are shown in Figure 15-24.

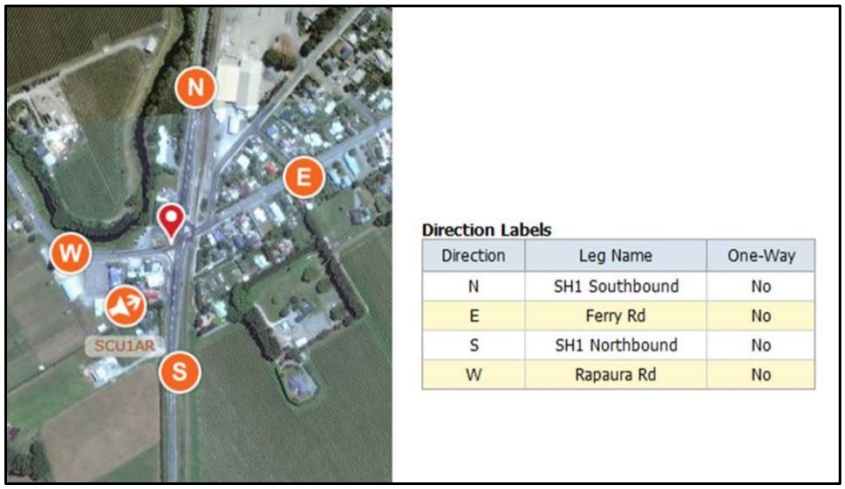


Figure 15-24: Traffic survey camera setup

AM Peak Hour

The mid-week 7:45 to 8:45 AM peak hour traffic survey volumes are shown in Figure 15-25. There is an exceptionally high percentage of HCVs recorded on Rapaura Road and northbound on the state highway heading towards Picton. The mid-week AM two hour traffic survey recorded 13 pedestrians and 3 cyclists outside of the peak hour.

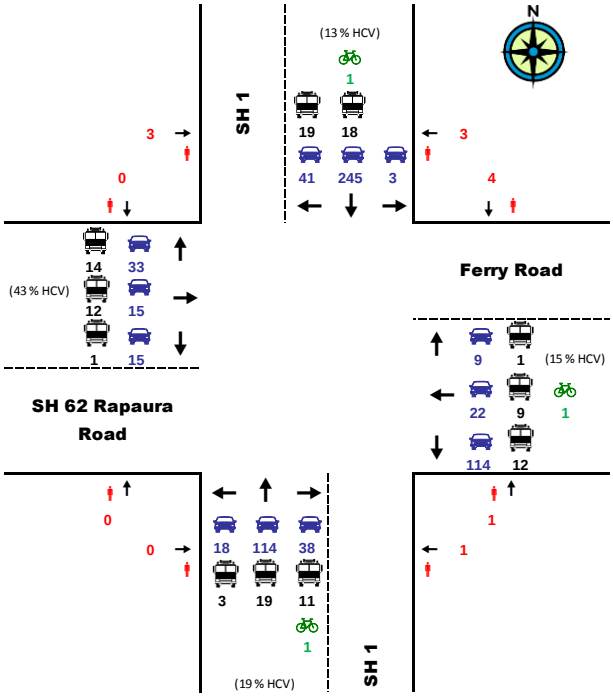


Figure 15-25: AM peak hour turning count

Noon Peak Hour

The mid-week 11:30 to 12:30 noon peak hour traffic survey volumes are shown in Figure 15-26. Again, there is an exceptionally high percentage of HCVs recorded on Rapaura Road, Ferry Road and southbound on the state highway. No cyclists were recorded during the full two hour survey and no pedestrians were recorded outside of the peak hour.

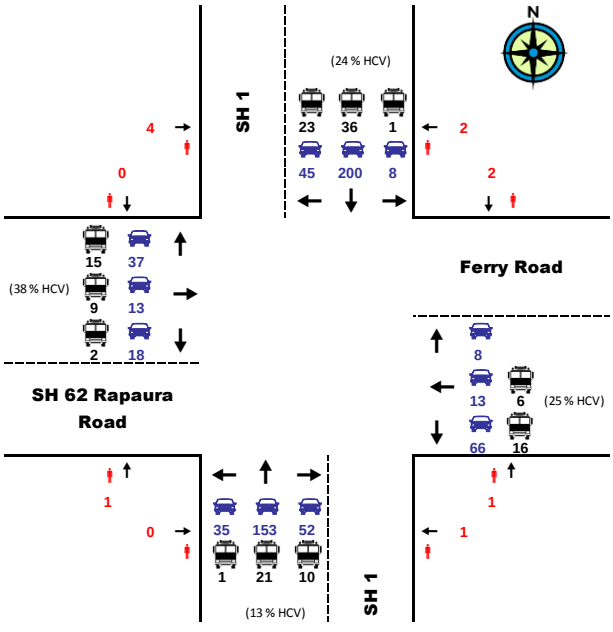


Figure 15-26: Noon turning count

PM Peak Hour

The mid-week 16:30 to 17:30 PM peak hour traffic survey volumes are shown in Figure 15-27. There is a high percentage of HCVs recorded on Ferry Road. Only one cyclist and no pedestrians were recorded during the full two hour survey.

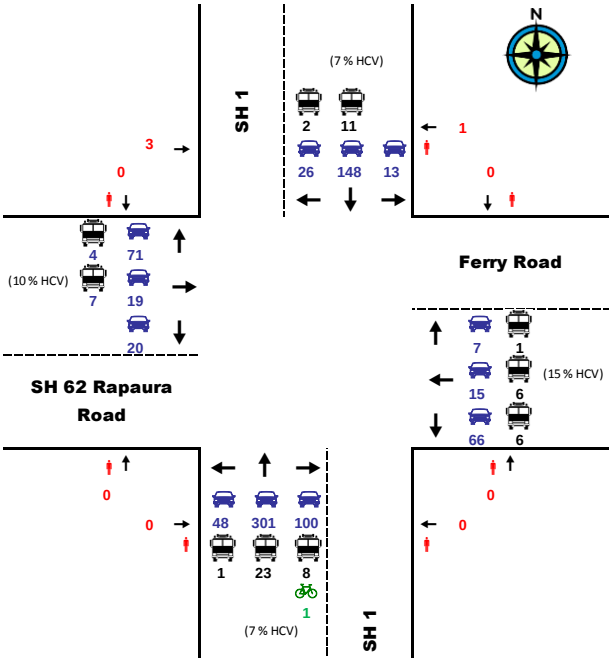


Figure 15-27: PM peak hour turning count

Saturday Peak Hour

The Saturday 11:45 to 12:45 peak hour traffic survey volumes are shown in Figure 15-28. The percent of HCVs on Saturday remains high particularly on Rapaura Road and southbound on the state highway. Three pedestrians and two cyclists were recorded outside of the peak hour. The percentage of HCVs remains high on Rapaura Road and southbound on the state highway.

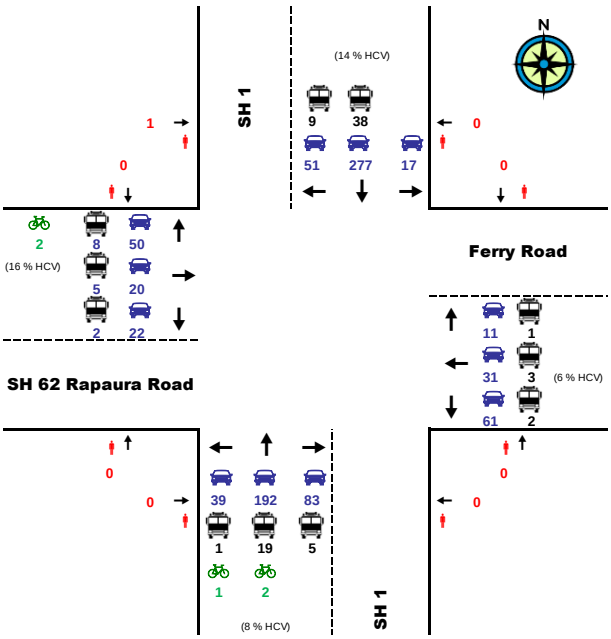


Figure 15-28: Saturday peak hour turning count

Sunday Peak Hour

The Sunday peak 11:30 to 12:30 hour volumes are shown in Figure 15-29. The southbound percent of HCVs remains high.

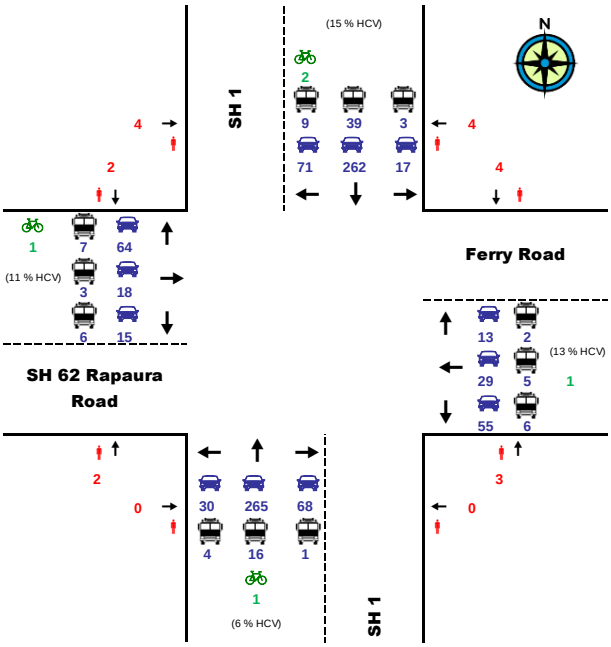


Figure 15-29: Sunday peak hour turning count

There are cyclists recorded on all approaches but there are low pedestrian volumes during the peak hour. There were fifteen pedestrians and three cyclists recorded outside of the peak hour survey.

Summary of Turning Counts

It is noted that Spring Creek has weekend volumes that are slightly higher than mid-week volumes as shown in Table 15-2.

The higher weekend traffic flow is reflective of a tourist location. There is also very high commercial activity associated with the rail freight centre, the seasonal agricultural and horticultural activity at this intersection.

Table 15-2: Summary of peak hour totals

Day	Peak	Light Vehicles	HCVs	Percent	Peak hour totals
Mid-week	**AM**	667	119	18%	786
	Noon	648	140	22%	788
	PM	834	69	8%	903
Saturday		854	93	11%	947
Sunday		907	101	11%	1,008

Appendix F Rail Traffic Data

The Blenheim Freight Centre at Spring Creek is a transport interchange between road and rail. The rail operations include a 900 m loop track or double rail line that allow trains to shunt off the main line and be loaded or unloaded or access the various sidings. This operation introduces periods of trains slowing and shunting across the Ferry Road intersection.

Weekly Rail Schedules

KiwiRail has provided its rail schedules for a week for the rail link between Wellington and Christchurch. The schedule shows the freight and passenger trains, their direction, and times they are scheduled to pass through Spring Creek. The schedules do not show 'specials' which are non-routine maintenance and / or inspection rail vehicles and like all things are subject to change over time.

Tuesday Rail Schedule

The rail schedule for Tuesday is shown in Figure 15-30. Time is shown on the horizontal axis, and distance is shown on the vertical axis, respectively. The location of Spring Creek is shown as a green horizontal dashed line. The train schedules are shown as angled lines with the dark blue lines being passenger trains and the light blue lines representing freight trains. The lines indicate direction of travel and route times along the horizontal time axis. A short horizontal line indicates the train is stopped at Spring Creek. It is only the freight trains that stop and this is for loading, unloading etc. at the Blenheim freight centre at Spring Creek. The periods of trains stopping at Spring Creek on Tuesday are identified with a red ellipse.

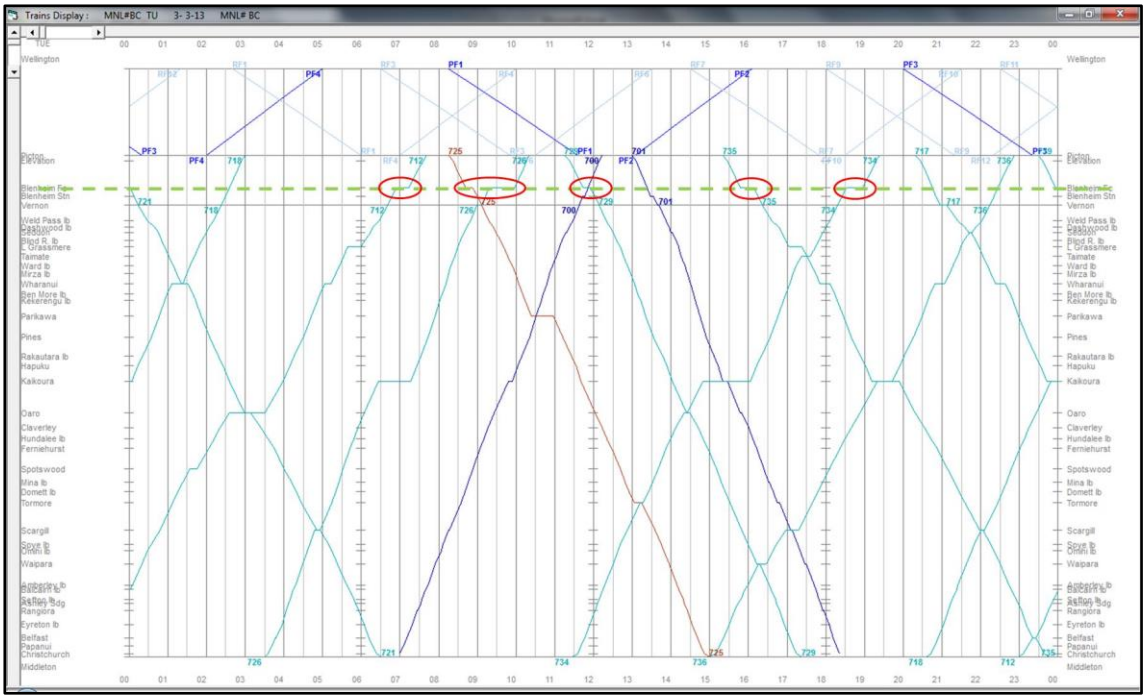


Figure 15-30: Tuesday rail schedule

The rail schedule graph for Tuesday (Figure 15-30) has been enlarged in Figure 15-31 to show the time period 5:30AM to 8:00PM. The mid-week peak hour road traffic flows are shown as red rectangles and these are overlaid with the times that trains are expected to slow down or stop (shown as red ellipses) at Spring Creek from the train schedules. This allows the identification of conflict times where peak road traffic volumes coincide with rail delays, causing additional stress at this intersection.

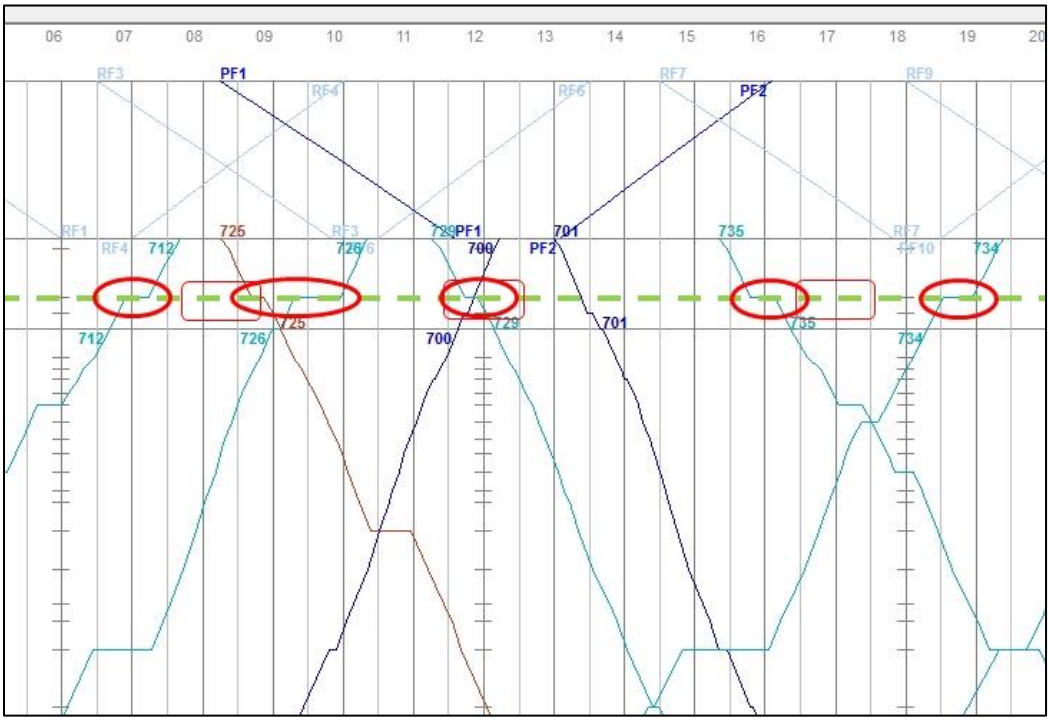


Figure 15-31: Tuesday rail & traffic conflict times

The 700 series numbers are train identification numbers. On Tuesday there is overlap in the morning peak hour for road traffic and train 725. The horizontal line on train 726 schedule between 9:15AM and 10:00AM at Spring Creek indicates a 45 minute period of train parking or shunting associated with the Blenheim freight Centre at Spring Creek (location shown as green dashed line on graph).

The following Table 5-4 was provided by KiwiRail to show the actual train schedules for our corresponding traffic survey dates. From this data we can identify the peak road traffic times and assess the conflict exposure with respect to the railway lights and bells operating and thus closing access to Ferry Road.
KiwiRail advised that on Saturday 20 April a train crossing occurred between an Up passenger train and a Down freight train already waiting in the yard. This would give the minimum 35 seconds time between alarm operations for successive trains. KiwiRail noted that in April there were a total of 10 such close train crossings with all except one involving an Up passenger train followed by a Down freight train. On 19 April an Up freight was involved which would have given about 46 second alarm operation followed by 35 second gap then 90 second alarm operation.

This indicates that the longest close delay between an Up passenger train (46 seconds) followed by a Down freight train (90 seconds) is a total of 136 seconds or two minutes and sixteen seconds, however, there would be a 35 s gap between the two close train movements that would allow some queued vehicles to clear.

Table 15-3: Rail crossing operation times

KiwiRail

Ferry Road 324.80 km Spring Creek Calculated Alarm Operation Times

Wednesday, 17 April 2013

Train					Alarm Time		
No.	Type	Time	length	km/h	Start	Cancel	Diff.
719	Down through freight	0:15:00	335	80	0:14:37	0:15:22	00:45
718	Up through freight	2:45:00	388	80	2:44:24	2:45:12	00:48
723	Down freight from yard	4:50:00	336	25	4:49:50	4:51:11	01:21
712	Up freight to yard	6:05:00	477	25	6:04:12	6:05:51	01:39
726	Up freight to yard	9:45:00	199	25	9:44:12	9:45:11	00:59
700	Up passenger	12:00:00	140	90	11:59:28	12:00:01	00:32
729	Down freight from yard	12:30:00	318	25	12:29:50	12:31:09	01:19
701	Down Passenger	13:35:00	140	90	13:34:40	13:35:12	00:32
735	Down freight from yard	16:05:00	481	25	16:04:50	16:06:32	01:42
734	Up freight to yard	18:25:00	339	25	18:24:12	18:25:32	01:19
717	Down through freight	20:35:00	448	80	20:34:37	20:35:27	00:50
736	Up through freight	21:15:00	426	80	21:14:24	21:15:14	00:49
719	Down through freight	23:45:00	372	80	23:44:37	23:45:24	00:47

Saturday, 20 April 2013

Train					Alarm Time		
No.	Type	Time	length	km/h	Start	Cancel	Diff.
718	Up through freight	3:10:00	541	80	3:09:24	3:10:19	00:54
723	Down freight from yard	5:30:00	429	25	5:29:50	5:31:25	01:35
712	Up freight to yard	6:00:00	522	25	5:59:12	6:00:58	01:45
726	Up through freight	11:00:00	473	80	10:59:24	11:00:16	00:51
700	Up passenger	12:10:00	120	90	12:09:28	12:10:00	00:32
729	Down freight from yard (X)	12:10:57	324	25	12:10:35	12:12:06	01:31
701	Down passenger	13:25:00	120	90	13:24:40	13:25:11	00:32
735	Down freight from yard	14:50:00	481	25	14:49:50	14:51:32	01:42
734	Up freight to yard	18:20:00	566	25	18:19:12	18:21:04	01:52
717	Down through freight	20:30:00	482	80	20:29:37	20:30:29	00:52

Sunday, 21 April 2013

Train					Alarm Time		
No.	Type	Time	length	km/h	Start	Cancel	Diff.
719	Down through freight	0:00:23	479	80	0:00:00	0:00:52	00:52
720	Up through freight	2:40:00	217	80	2:39:24	2:40:04	00:40
722	Up through freight	5:45:00	361	80	5:44:24	5:45:11	00:46
739	Down through freight	7:00:00	480	80	6:59:37	7:00:29	00:52
700	Up passenger	12:00:00	120	90	11:59:28	12:00:00	00:32
710	Down passenger	13:20:00	120	90	13:19:40	13:20:11	00:32
735	Down through freight	15:20:00	332	80	15:19:37	15:20:22	00:45
730	Up through freight	16:35:00	275	80	16:34:24	16:35:07	00:43

Analysis date: 12/09/2013

Ferry Road train crossing events

Figure 15-32 shows the train crossing times, that close Ferry Road compiled from Spring Creek calculated alarm times, (Table 15-3) in order of length. These times relate specifically to Wednesday 17th, Saturday the 20th and Sunday the 21st of April 2013 from this table.

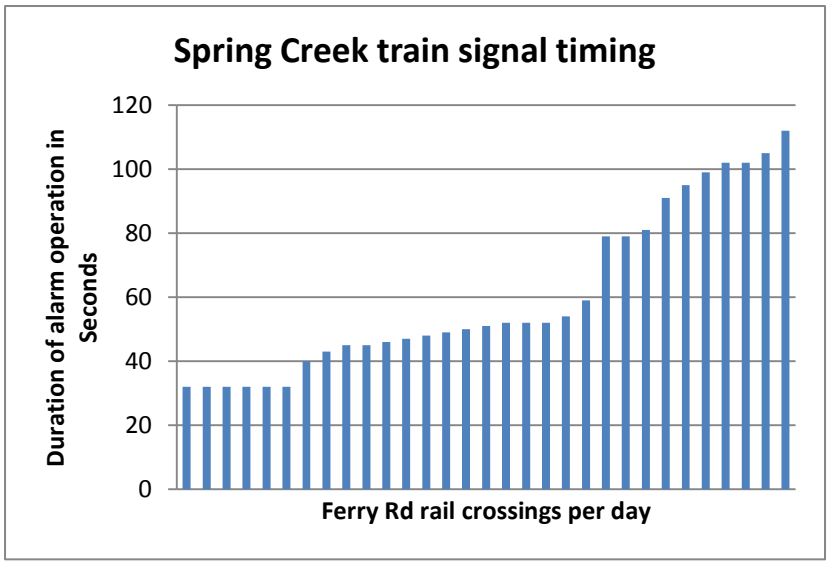


Figure 15-32: Ferry Road closure duration

Two thirds of the Ferry Road closure times are less than 60 seconds with only ten above a minute and the maximum length of closure recorded was one minute and 52 seconds, occurring at 6:20 PM on the Saturday night.

It is evident that the rail crossing is typically closed for short periods of time ranging from 32 seconds to 112 seconds with an average crossing time of 60 seconds. Sunday lunchtime has the busiest hour for traffic volumes over a whole week and also includes a northbound passenger train closing Ferry Road for 32 seconds.

Appendix G Crash data

Five year crash history

For crash analysis, the NZ Transport Agency requires an assessment of crashes over the last five years to identify trends, patterns, commonality and changes over this period. This timeframe also eliminates 'one off' events that can skew data over a shorter time period. The crashes over a longer 'ten year' period are investigated in section 5.4.2 to look at longer term trends, costs and consequences from changes to the built environment.

It is standard practice to report crash records for complete calendar years, however, two crashes were known to have occurred at the intersection during 2013, one in May and one in August. As these have occurred in the short observation period since the speed limit change, the crash reporting date range was adjusted to include these crashes.

There have been 19 crashes (see Figure 15-33) recorded in the Crash Analysis System (CAS) within 50 m of the intersection in the 5 year period between September 2008 and August 2013. Of these crashes, 17 are considered to be associated with the intersection and of those, 15 (88%) have involved vehicles making a turning manoeuvre. Of the remaining two crashes, one was a rear end collision and one was a loss of control crash involving a single vehicle.

There was a total of 1 fatal crash, 2 serious crashes, 8 minor injury crashes and 6 non-injury crashes at the intersection. Some of these crashes have resulted in multiple injuries and the total casualty numbers are 1 fatal, 3 serious and 16 minor injuries.

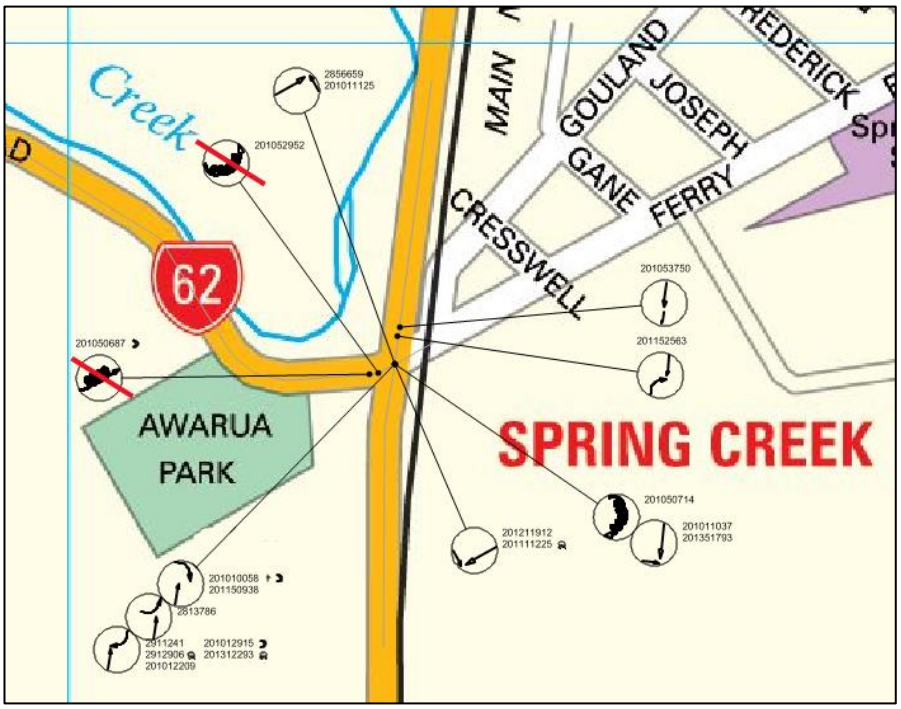


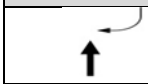
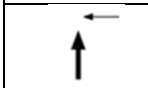
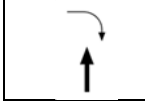
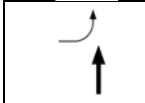
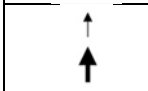
Figure 15-33: Spring Creek crash diagram

As can be seen in Figure 15-33 the south approach to the intersection has the highest number of crashes and this approach also has the most severe crashes. The two crashes with red lines through the icon are not associated to the intersection.

Five year crash summary

The 17 crashes have been grouped into their crash types and their numbers against crash severity. This identifies crash commonality which isolates problems at the intersection and informs mitigation measures.

Table 15-4: Crash summary

Symbol	Crash Type	Description	No.	Crash severity			
				Fatal	Serious	Minor	Non injury
	LB	Crossing / Turning making turn	6		1	4	1
	HA	Crossing / Turning right angle	6			4	2
	JA	Crossing / Turning right turn right side	2	1			1
	KA	Crossing / Turning left turn in	1		1		
	FA	Rear end obstruction slow vehicle	1				1
	DA	Loss of control various	1				1
Crash totals by severity			**17**	**1**	**2**	**8**	**6**

The six LB crashes (1 serious, 4 minor and 1 non-injury) are failure to give way that can be a consequence of right turning drivers who are unable to see approaching through traffic due to opposed queued vehicles and the curved SH alignment. Drivers making this turn are exposed for a long period of time to cover the right turn distance.

The six HA crashes (4 minor and 2 non-injury) are failure to give way that can be a consequence of poor approach angle, poor intervisibility plus being exposed for a long period of time to cover the crossing distance.

Five year crash information

The following Table 15-5 shows the 17 crash types and descriptions from the CAS database for the five year period September 2008 to August 2013 used in this analysis.

Table 15-5: CAS data

Crash ID	Description	Causes
201012209 Minor LB	CAR2 turning right hit by oncoming CAR1 NBD on SH 1S	CAR1 failed to give way when turning to non-turning traffic, attention diverted by scenery or persons outside vehicle CAR2 failed to give way when turning to non-turning traffic, attention diverted by scenery or persons outside vehicle
201152563 Non-injury LB	CAR2 turning right hit by oncoming VAN1 SBD on SH 1S	CAR2 failed to give way when turning to non-turning traffic, inattentive, didn't see/look when required to give way to traffic from another direction ENV: entering or leaving other commercial
2911241 Minor LB	BUS2 turning right hit by oncoming CAR1 NBD on SH 1S	BUS2 failed to give way when turning to non-turning traffic, attention diverted by scenery or persons outside vehicle, didn't see/look when required to give way to traffic from another direction
2912906 Minor LB	CAR2 turning right hit by oncoming CAR1 NBD on SH 1S	CAR2 failed to give way when turning to non-turning traffic
201012915 Serious LB	SUV2 turning right hit by oncoming CAR1 NBD on SH 1S	SUV2 failed to give way when turning to non-turning traffic, misjudged speed etc… of vehicle coming from another direction with right of way
201312293 Minor LB	VAN2 turning right hit by oncoming CAR1 NBD on SH 1S	VAN2 failed to give way when turning to non-turning traffic, didn't see/look when required to give way to traffic from another direction
2856659 Non-injury HA	CAR1 EBD on SH 62 hit CAR2 crossing at right angle from right	CAR1 failed to give way at stop sign, didn't see/look when required to give way to traffic from another direction
201211912 Minor HA	CAR1 SBD on FERRY ROAD hit CAR2 crossing at right angle from right	CAR1 failed to give way at give way sign, attention diverted by other traffic
201111225 Minor HA	CAR1 WBD on FERRY ROAD hit SUV2 crossing at right angle from right, CAR1 hit House Or Bldg	CAR1 failed to give way to traffic approaching/crossing from the right, overseas/migrant driver failed to adjust to NZ road rules and road conditions
201011125 Minor HA	CAR1 EBD on SH 62 RAPAURA ROAD hit SUV2 crossing at right angle from right	CAR1 alcohol test above limit or test refused, failed to give way at stop sign SUV2 alcohol test above limit or test refused
201011037 Minor HA	CAR1 SBD on SH 1S hit VAN2 crossing at right angle from right	VAN2 did not stop at stop sign, misjudged speed etc… of vehicle coming from another direction with right of way, new driver showed inexperience
201351793 Non-injury HA	CAR1 SBD on SH 1S hit CAR2 crossing at right angle from right, CAR2 hit Guard Rail	CAR2 failed to give way at stop sign, inattentive: failed to notice intersection or its stop/give way control
201010058 Fatal JA	TRUCK1 NBD on SH 1S hit TRUCK2 turning right onto SH 1S from the left, TRUCK1 hit Guard Rail, TRUCK2 hit Post or Pole	TRUCK2 alcohol test above limit or test refused, did not stop at stop sign, attention diverted by cell phone, fatigue (drowsy, tired, fell asleep), casualty thrown from vehicle
201150938 Non-injury JA	SUV1 NBD on SH 1S hit VAN2 turning right onto SH 1S from the left	VAN2 failed to give way at stop sign, didn't see/look when required to give way to traffic from another direction, overseas/migrant driver failed to adjust to NZ road rules and road conditions

Crash ID	Description	Causes
2813786 Serious KA	SUV1 NBD on SH 1S hit CAR2 merging from the left	CAR2 failed to give way at stop sign, overseas/migrant driver failed to adjust to NZ road rules and road conditions
201053750 Non-injury FA	CAR1 SBD on SH 1S hit rear end of SUV2 stopped/moving slowly	CAR1 failed to notice car slowing, attention diverted by other traffic
201050714 Non-injury DA	VAN1 SBD on SH 1S lost control turning right, VAN1 hit Fence, Post Or Pole on right hand bend	VAN1 load not well secured or moved

Ten year crash history

There have been 32 crashes recorded in the Crash Analysis System (CAS) that are considered to be associated with the intersection in the 10 year period between September 2003 and August 2013. Of these crashes, 24 (75%) have involved vehicles making a turning manoeuvre. This suggests that the intersection has had the turning manoeuvre crash problems for some time.

The ten year crash history shows 1 fatal crash, 2 serious crashes, 11 minor injury and 18 non-injury crashes.

Appendix H DSI conversion (10 years)

Reported collective risk (5 year – 50m radius)

Table 15-6: Reported collective risk

		Crash severity					
Crash Type	No	Fatal	Serious	Minor	Non-injury	Adjusted DSI's (HRIG Table A3.8)	DSI Equivalents
LB	6		1	4	1	0.35	1.75
HA	6			4	2	0.5	2
JA	2	1			1	0.36	0.36
KA	1		1			0.25	0.25
FA	1				1	0.1	0
DA	1				1	0.3	0
						Total	**4.36**

Reported collective risk = 4.36 DSI **High** (HRIG Table 4-1)[8]

Personal risk

Product of flow measure = $(9602/2 \times 3000/2)^{0.4}$ = 553

Personal risk = (4.36 x 100,000,000) / (553 x 5 365 x 1.7)

= 254 DSI equivalents per 100M VKT **High** (HRIG Table 4-2)

Transformation potential

5 year DSI at existing priority crossroads = 0.8 (HRIG Fig 6.3)

5 year DSI at a roundabout = 0.25 (HRIG Fig 6.3)

Potential 5 year DSI reduction = (4.36 - 0.25) / 4.01 = 94%

Potential 5 year DSI saved by change to roundabout = 4.01 – 0.25 = 3.76

DSI saved per $100m

(4.01 – 0.25) x $100m / Project cost

Table 15-7: DSI saved

Project cost	DSI saved per $100m	Project cost	DSI saved per $100m
$1.6M	256.9	$2.4M	171.3
$1.8M	228.3	$2.6M	158.1
$2.0M	205.5	$2.8M	146.8
$2.2M	186.8	$3.0M	137.0

[8] NZTA High Risk Intersection Guide

Appendix I Social and environmental screen

Table 15-8: Social & environmental management form

Social and environmental screen			Social and environmental assessment		
Issue	**Effects**	**Effect H / M / L / NA**	**Requirements**	**Specific actions**	**Estimated cost ($)**
Noise	The roundabout option will require SH1 traffic to give way. There will be more noise associated with traffic slowing and accelerating at the intersection, however, this may be offset by a lower overall noise associated with the lower speed environment.	L	A noise assessment will be required for this site.	Arrange for noise assessment to be undertaken	$1,500
Air Quality	The main issue for air quality is increased dust nuisance and air pollution associated with the construction of the roundabout. There is not expected to be and significant changes to motorised vehicle pollutants as a result of the roundabout.	L	Mitigate the effects of dust during construction	Contractor to take appropriate actions such as water spraying to minimise dust during construction.	Included in construction cost
Water resources	A key consideration is the potential impact on Spring Creek which that runs parallel to and on the north side of SH62 Rapaura Road and then parallel along the west side of SH1S. The watercourse is protected by a stop bank and is located some 30 m from the expected construction extents. The main issue is water pollution associated with the construction of the roundabout finding its way into this watercourse. Any earthworks within 8 m of the stop bank will require consent.	L	Consent to build within 8m of stop bank will be required subject to final design layout.	Consent requirements will need to be explored with the Marlborough District Council.	$NA
Erosion and sediment control	Sediment control will be required during construction to prevent sediment entering Spring Creek.	NA	A site specific erosion & sediment management plan will be required during construction.	Manage erosion & sediment in accordance with the treatment plan.	Included in construction cost

Issue	Effects	Effect H / M / L / NA	Requirements	Specific actions	Estimated cost ($)
Social responsibility	No negative effects identified resulting from the proposed option. New pedestrian footpaths and crossing points will improve connectivity.	NA	NA	NA	
Culture and heritage	The three local iwi representatives are expected be interested in any proposed intersection changes at Spring Creek. No formal consultation has been undertaken with local iwi to date. No heritage buildings, sites, places or trees were shown at Spring Creek in the Marlborough District Council's Appendix A Register of Significant Heritage Resources dated 28 October 2010. The Historic Places Trust Register [No 1495] St Luke's Church (Anglican) 20-22 Ferry Road Spring Creek as category 2. The church is located some 200 m from the intersection. A waka is located to the southeast of the intersection, however, stakeholder engagement indicated no cultural or heritage association with the Waka at this site and it is a commercial activity.	L	Consult with local iwi in accordance with NZ Transport Agency consultation guidelines.	Consult with local iwi in accordance with NZ Transport Agency consultation guidelines.	$NA
Ecological resources	The proposed roundabout is located at the site of the existing intersection. No vegetation or fauna will be effected by the construction.	L	NA	NA	$NA
Spill response and contamination	The effects of spills from vehicle accidents or on-site fuel storage during construction can be addressed by the building contractor during construction. The 4 Square site was previously a service station and as such is a HAIL site. If contamination is identified then treatment will be required in accordance with Ministry for the Environment guidelines.		A site specific spill containment plan will be required. Test 4 Square site for contamination in accordance with Ministry for the Environment HAIL requirements.	Treat any spills in accordance with the spill containment plan. If HAIL contamination is identified then remediate the contaminated land in accordance with Ministry for the Environment requirements.	Included in construction cost

Issue	Effects	Effect H / M / L / NA	Requirements	Specific actions	Estimated cost ($)
Resource efficiency	To be considered at detail design stage.	NA	NA	NA	Included in construction cost
Climate change: adaptation & mitigation	No considered an issue at this site.	NA	NA	NA	NA
Visual quality	The intersection currently provides minimal visual quality for locals or through traffic. There will be an opportunity to enhance the visual amenity of this site with the establishment of landscaping.	L	To enhance the visual amenity of this site with the establishment of landscaping	Maximise landscaping opportunities	Included in construction cost
Vibration	There may be some vibration associated with compaction of the pavement layers during construction. This is not expected to be significantly different to the current movement of large trucks and train movements for the few properties close to the intersection.	L	Minimise the effects of vibration during construction.	Use best practice construction techniques to minimise the effects of vibration.	Included in construction cost
Land use and transport integration	The Spring Creek township is located to the east of SH1 (and the rail line). The dairy and takeaway store, service station, supermarket, sports facilities and hotel are located on the west side which creates a pedestrian crossing desire, but there are no crossing facilities provided. The roundabout option will provide locals and visitors with increased opportunities to walk or cycle safely across all legs of the intersection. This should see a reduction in locally generated traffic, as walking and or cycling may now be considered a realistic mode choice for transport.	NA	NA	NA	$NA
Urban design	This option will enhance opportunities for future growth in the area and provide crossing facilities for pedestrians and cyclists across SH1 where none currently exist.	NA	NA	NA	NA

Issue	Effects	Effect H / M / L / NA	Requirements	Specific actions	Estimated cost ($)
Public health	The main public health benefit from this proposal is addressing the major crash types that have resulted in fatal, serious and minor injury crashes.	NA	NA	NA	NA
Cycling infrastructure & Cycle crossing facilities	As roundabouts generally are not considered desirable for cyclists, the roundabout design provides shared path facilities with median island refuges to enable cyclists and pedestrians to cross the all legs of the roundabout. This path provides an alternate option for cyclists that are not comfortable riding on the road at the proposed roundabout. .Dropped crossings are provided at all kerbs.	NA	NA	NA	NA
Walking infrastructure & crossing facilities	The roundabout design provides footpaths on all legs of the intersection and provides shared facilities with median islands to enable pedestrians to cross the all legs of the roundabout. Dropped crossings are provided at all kerbs.	NA	NA	NA	NA
Bus related infrastructure	Not applicable at this site.	NA	NA	NA	NA
Priority lanes	Not applicable at this site.	NA	NA	NA	NA
Traffic management	An NZ Transport Agency approved Traffic Management Plan will be required for the construction stage.	L	The movement of traffic through the site will need to be managed during construction to maintain safety and minimise delays.	An NZ Transport Agency approved Traffic Management Plan will be required for the construction stage	Included in construction cost

Appendix J Key stakeholder relationship management

Scoping Study stage

During the scoping study stage, the local stakeholders were to be contacted directly by the NZ Transport Agency or their representative to discuss the options developed by ViaStrada to get their feedback. However, other than KiwiRail, no other stakeholder engagement was undertaken during the scoping study stage. This gave the NZ Transport Agency a greater understanding of the options and their appropriateness to the location. This meant options that were never going to be built due to safety or physical constraints reasons did not have to be canvassed unnecessarily with local stakeholders.

Table 15-9: Key stakeholder engagement plan

Key stakeholder engagement plan	
Project or work programme	**SPRING CREEK INTERSECTION Scheme Assessment Report**
Project or work programme owner	NZ Transport Agency
Unit	<Unit name>
Business group	<Business group name>
Date	September 2013

There are two groups identified for engagement, the first being ‘local’ stakeholders including business owners and operators at Spring Creek and the secondly being specific road users of this intersection, including ‘national’ representatives from heavy transport, tourist and motor caravan interests.

From the scoping study the following stakeholders were identified for consultation

Table 15-10: Summary of key stakeholder contact details

KiwiRail	[redacted]
Midland Distributors	[redacted]
Junction Hotel	[redacted]
Motels	[redacted]
4 Square	[redacted]
Service Station	[redacted]
Dairy	[redacted]
Swampys Backpackers	[redacted]
Other	[redacted]

Table 15-11: Project programme stakeholders

Stakeholder	Level of interest	Ability to impact	What we want from stakeholder	What stakeholder wants from us	Partnering continuum status *Current & desired*	NZTA roles and responsibilities	Relationship owner(s)	NZTA internal cross-over with stakeholder
KiwiRail	High interest and same outcomes desired as per NZTA with interest in safety.	KiwiRail may require time and funds to coordinate advance VMS signs with their warning systems.	Coordinate advance VMS signs with rail warning systems. This will depend on if VMS signs are part of the project.	A final design plan from NZTA so KiwiRail can design the appropriate coordination.	Partnership for minor approach changes to the Ferry Road and VMS coordination if required.	No conflict role or responsibility.	[redacted] NZTA	Possible cross over with respect to cost share.
Midland Distributors	Lower interest than NZTA but interested in efficiency.	Low impact	Verbal or written support of SA concept plan	Information that shows we have listened and considered their feedback.	Networking with respect to large trucks using the SA roundabout and lay-bys.	No conflict role or responsibility.	[redacted] NZTA	NA
Junction Hotel	Lower interest than NZTA with interest in safety	Low impact	Verbal or written support of SA concept plan	Information that shows we have listened and considered their feedback.	Networking with respect to feedback on engagement.	Minor conflict on safety versus access.	[redacted] NZTA	NA
Spring Creek Motels	Lower interest than NZTA with interest in safety	Low impact	Verbal or written support of SA concept plan	Information that shows we have listened and considered their feedback.	Networking with respect to feedback on engagement.	No conflict role or responsibility.	[redacted] NZTA	NA
4 Square	High interest and may conflict with NZTA with respect to land	High impact	Land and agreement to proceed	Agreement on new road boundary location and car	Collaboration required with respect to land and resource	Possible conflict with respect to MDC consent and safety	[redacted] NZTA	Possible cross over with respect to MDC consent

Stakeholder	Level of interest	Ability to impact	What we want from stakeholder	What stakeholder wants from us	Partnering continuum status *Current & desired*	NZTA roles and responsibilities	Relationship owner(s)	NZTA internal cross-over with stakeholder
	required and compliance with their consent for parking.			park operation with the SA concept plan.	consent requirements.	versus access.		
Service Station	High level of interest with respect to business access and may conflict with NZTA.	Low impact	Verbal or written support of SA concept plan	Information that shows we have listened and considered their feedback.	Cooperation with respect to access as per their feedback on engagement.	Minor conflict on safety versus access.	[redacted] NZTA	NA
Spring Creek Dairy	High level of interest with respect to business access and may conflict with NZTA	Low impact	Verbal or written support of SA concept plan	Information that shows we have listened and considered their feedback.	Cooperation with respect to access as per their feedback on engagement.	Minor conflict on safety versus access.	[redacted] NZTA	NA
Swampys Backpackers	Low interest	Low impact	NA	Info showing we listened and considered their feedback.	Coexistence only required.	No conflict role or responsibility.	[redacted] NZTA	NA

Note: if you identified Māori as a key stakeholder through the stakeholder mapping process, advice on defining relationship owners and planning engagements should be sought from the Māori Perspectives section (Strategic Engagement & Communications unit, Strategy & Performance group).

Table 15-12: Key Stakeholder activity timetable

Stakeholder	Engagement purpose	Engagement technique	Engagement frequency	Date(s) and location	Activity owner	Activity progress
KiwiRail	Collaborate	One-to-one meeting	As required	On going	NZTA	On going
Midland Distributors	Explore	One-to-one meeting	One during SA stage	12/9/2013 Spring Creek	ViaStrada	Feedback to Stakeholder/complete
Junction Hotel	Listen	One-to-one meeting	One during SA stage	12/9/2013 Spring Creek	ViaStrada	Feedback to Stakeholder/complete
Spring Creek Motels	Listen	One-to-one meeting	One during SA stage	12/9/2013 Spring Creek	ViaStrada	Feedback to Stakeholder/complete
4 Square	Explore	One-to-one meeting	As required	9/9/2013 Spring Creek	NZTA	On going
Service Station	Listen	One-to-one meeting	One during SA stage	12/9/2013 Spring Creek	ViaStrada	Feedback to Stakeholder/complete
Spring Creek Dairy	Listen	One-to-one meeting	One during SA stage	12/9/2013 Spring Creek	ViaStrada	Feedback to Stakeholder/complete
Swampys Backpackers	Listen	One-to-one meeting	One during SA stage	12/9/2013 Spring Creek	ViaStrada	Feedback to Stakeholder/complete

SA = scheme assessment

Table 15-13:Key stakeholder monitoring and reporting

Date	NZTA staff or representative	Stakeholder name	Organisation	Engagement activity summary and issues raised	Follow-up actions	Action status
On going	NZTA	[redacted]	KiwiRail	1. KiwiRail would have no objection to the installation of a roundabout on the SH 1 / Ferry Road Rapaura Road intersection providing that existing clearances to the railway and the existing left turn acceleration lane are retained, footpaths are safely positioned and all costs are met by parties outside KiwiRail.	1. The existing clearance to the railway and the existing left turn acceleration lane can be retained, and the footpaths are safely positioned. 2. The indented parking bays and signs have been modified to improve driver use	The NZ Transport Agency to consider KiwiRail costs

Date	NZTA staff or representative	Stakeholder name	Organisation	Engagement activity summary and issues raised	Follow-up actions	Action status
				2. KiwiRail could provide an interface to operate special signs while the level crossing alarms are operating. (Up to 15 s advance warning of the alarm operation could be provided at significant additional cost.) However it is my opinion that the proposed lay-bys and special warning signs are unlikely to sufficiently modify driver behaviour to eliminate or significantly reduce the number of times that blockage of the roundabout would occur. 3. Ferry Road is one of only 17 public road crossings in the country that have had more than one collision in the last 10 years. The crossing does not carry sufficient traffic to justify the addition of half-arm barriers and the close proximity of the SH 1 intersection (whether as exists or future roundabout) would not present a safe layout for half-arm barriers even if these were justified by future traffic levels. This means that the only appropriate intersection improvement from a railway safety point of view, would be to install road traffic signals interfaced with the level crossing alarms. 4. There is probably a partly double lane roundabout design out there except that there would appear to be insufficient space. If there were two lanes entering the roundabout from the south, the right-hand lane could be labelled “Ferry Road Only” and traffic could queue in this lane (perhaps assisted by a special flashing sign such as you have proposed) without losing priority. This lane would operate in a similar manner to the existing left turn lane over the crossing for traffic from the north. The approach from Rapaura Road is more complex but clearly two lanes would at least allow left turn traffic to proceed when the railway crossing is closed.	during train events. 3. Traffic signals are not considered a suitable option in this location. 4. This option has been fully explored and the additional time delay and costs associated with the two lane approaches prohibit this from proceeding.	
12/9/2013	ViaStrada Ltd	[redacted]	Midland	1. Thinks this is the ultimate solution to the issues at the	1. No action required	ViaStrada to

Date	NZTA staff or representative	Stakeholder name	Organisation	Engagement activity summary and issues raised	Follow-up actions	Action status
		[redacted]	Distributors	intersection and feels that a lot of the present issues that have arisen are due to people not knowing the road rules. This proposal will eliminate many of the present issues. 2. Trucks travelling south park on the BYLs on the approach to the left turn lane and access the 4 Square Supermarket. This could prove a problem even with this new layout unless the kerb is lengthened and BYL's enforced. 3. Turning into Ferry Road / Gouland Road from SH1 (from the north) is really tight so would like it designed to allow the turn and this may result in a reduction to the splitter island on that approach. When the ferries are being serviced there is an increase in trucks into Midland Distributors and some of these are oversized vehicles. 4. Eastbound traffic – when train shunting is occurring (generally between 4-5pm) trucks wait on SH 62 and this can result in 2 -3 trucks in a line, blocking the passage of other traffic. Some of this traffic that is turning left on to SH 1 use the 4 Square car park as access to the north. 5. Traffic turning right into the 4 Square from Rapaura Road blocks westbound traffic. 6. The MDC land to the west of the access to the 4 Square is used as all - day parking. These workers access their vehicles by using the 4 Square car park entrances to the north of the intersection. 7. Pedestrian facilities a good addition as they have been stuck on the median waiting to continue across the road.	2. Consider Parking Bay For Southbound Vehicles 3. Consideration Given To Changing Priority At The Ferry Road And Gouland Road Intersection. 4. This Is Being Addressed In The Concept Design, But The Scheme Will Be Subject To Consultation Feedback And Safety Audit. 5. There Is Limited Room On Rapaura Road For An Additional Lane But We Will Explore The Use Of The Lay-by For This Right Turn Movement. 6. This will need to be part of the discussions between the 4 Square and the NZ Transport Agency. 7. No action required	include 2. 4. 5.in concept plan. The NZ Transport Agency to consider 3. and 6.
12/9/2013	ViaStrada Ltd	The business owners are	Junction Hotel	Property Owner a) Great concept b) Concerned about the length of the kerb line along the	Property Owner a) No action required. b) Need to liaise with owner to	ViaStrada to include b. 3. 5. 6. and 7. in concept

Date	NZTA staff or representative	Stakeholder name	Organisation	Engagement activity summary and issues raised	Follow-up actions	Action status
		[redacted]		front of the hotel, west along Rapaura Road as this could limit access to the hotel car park. Should not extend beyond the entrance to the hotel car park. Business Owner 1. Crashes are caused by driver error 2. The lowering of the speed limit and the remarking of the road has shown improvements in behaviour and felt that this should be monitored for longer before any new proposal occurs. 3. Reducing southbound from three lanes (acceleration, straight through and right turning) to one is not seen as good as trucks exiting Ferry Road will hold up traffic coming from Picton and trucks no longer able to merge. 4. Intersection needs policing – motorists do not obey intersection controls. 5.Access to hotel car park essential and retention of park at the door (backing out onto Rapaura Road) 6. Uncomfortable with loss of business that could occur if people have to queue to go round roundabout to access the bottle store. They will not stop to buy and business will reduce. 7. The loading dock for the hotel is next door to the Service Station (south side of building) and therefore access to that area is essential as it is very awkward to load from elsewhere on site. 8. 90% of people (mainly local) do not stop at the Stop sign. 9. There is a lot of foot traffic. This is from the sports fields. There are no footpaths and felt that the proposed footpaths were a good idea but need to extend to sports fields. (During site visit observed) that most patrons of the hotel parked to the west of the building in the car park. The hotel vehicle was parked facing in to the building	determine access locations. Business Owner 1. No action required. 2. No action required. 3. Needs further explanation of the safety benefits. 4. No action required. 5. This may need further discussion with respect to safety and access. 6. This may need further discussion with respect to how much better access with be to the Hotel. 7. This may need further discussion with respect to safety and access. 8. No action required. 9. The concept plan will improve pedestrian access, no action required.	plan. The NZ Transport Agency to consider 5. 6. and 7.

Date	NZTA staff or representative	Stakeholder name	Organisation	Engagement activity summary and issues raised	Follow-up actions	Action status
				which required backing out into the SH to exit.		
12/9/2013	ViaStrada Ltd	[redacted]	Spring Creek Motels	Discussion with Manager 1. Does agree with a roundabout because of the speed of the highway traffic. Felt it would result in more accidents. 2. Need to slow traffic, reduce the speed limit to 50Km/hr. 3. Traffic banks up when there is a train 4. Present signs do not slow traffic along SH 1. 5. Need good footpaths but would not let my children cross SH 1. Information left with manager for property owner but no response to date.	1. Information on how much safer roundabouts are was explained during interview. 2. Explained that roundabout will achieve this speed reduction. 3. Lay-bys may solve this. 4. See 2. 5. No action required	Email sent but still no response from property owners. ViaStrada to include 3. in concept plan.
On going	NZTA		4 Square			NZTA to complete
12/9/2013	ViaStrada Ltd	[redacted]	Service Station	1. The length of the island and access is crucial to his business surviving. He would like to see the island terminated at the end of the solid lines as shown on the plan and not extended south. 2. If island is the total length it would kill his business. 3. Signs have slowed traffic, especially the flashing sign 4. Narrowing effects the speed and though the small islands outside his business did effect his turnover they slowed speed. 5. Improvements would be a free left turn out of Rapaura Road towards Picton. 6. Two lanes out of Ferry Road, as the traffic banks up here. 7. Traffic flow fluctuates – downturn in numbers between May and August	1. The access will need to be designed in liaison with [redacted] and will be subject to a safety audit. 2. See 1. 3. No action required 4. No action required 5. Yes this would result in an efficiency improvement but would require substantially more land. Not applicable to a single lane roundabout. 6. see 5. 7. This is one of the reasons a roundabout is the most appropriate from of control.	The NZ Transport Agency to consider 1. and 2.
12/9/2013	ViaStrada Ltd	[redacted]	Spring Creek Dairy	1. The majority of Spring Creek residents live to the east of this intersection and the businesses are to the west of the intersection. Their customers come from	1. This should be addressed with the u turn bay provided at the south end on the SH 1s	The NZ Transport Agency to consider 1. and 2.

Date	NZTA staff or representative	Stakeholder name	Organisation	Engagement activity summary and issues raised	Follow-up actions	Action status
				across the road, turn left (south) travel a short distance and then turn right into the parks outside the shop. If there is a full island across this area then there will not be access to their business (they are the local fish and chip shop). 2. Must have access for the business. Not a lot of trade at present and cutting access will reduce this further. 3. Feels that the speed reduction to 70 km/h has worked but would like to see it reduced further (explained that single lanes and roundabout signage and the narrowing down with kerbs will reduce speed.)	south approach median island. 2. The access will need to be designed in liaison with [redacted] and will be subject to a safety audit. 3. The roundabout will achieve this speed reduction.	
12/9/2013	ViaStrada Ltd	[redacted]	Swampys Backpackers	1. Is opposed to a roundabout. 2. it's a main highway so a roundabout is not good. 3. Flashing sign seems good but should be one on north side as well. 4. Pedestrian access not seen as important as she did not perceive any issues with crossing the road. 5. There is a lot of frustration for motorists using roundabouts.	1. Information on how much safer roundabouts are was given at interview. 2. No action required. 3. There is a flashing sign on north approach but interviewee was unaware of this. The roundabout will achieve this speed reduction. 4. Needs to watch pedestrians crossing the SH and hear how much safer this roundabout will be for pedestrians. 5. See 1, 3 and 4.	No further action required except to send out final scheme assessment plan when available.

Appendix K Road user stakeholder engagement

There has also been road user engagement for assessment of the indented queuing lay-bys on the SH1 (south approach) and SH62 (west approach) to the proposed roundabout. This has been done to assess how specific road user groups will react to our proposed layout.

A copy of the letter sent to the road user stakeholders for their feedback can be found at the end of this section.

Table 15-14:Road user engagement activity timetable

Stakeholder	Engagement purpose	Engagement technique	Engagement frequency	Date(s) and location	Activity owner	Activity progress
Road Transport Association	Explore	Phone call and follow up letter - email	One during SA stage	25/9/2013	ViaStrada	On going
Motor Caravan Association	Explore	Phone call and follow up letter - email	One during SA stage	25/9/2013	ViaStrada	Complete
NZ Police	Explore	Phone call and follow up letter - email	One during SA stage	02/10/2013 15/10/2013	ViaStrada	On going
Automobile Association	Explore	Phone call and follow up letter - email	One during SA stage	25/9/2013	ViaStrada	Complete
Tourism Holdings limited	Explore	Phone call and follow up letter - email	One during SA stage	25/9/2013	ViaStrada	Complete

Table 15-15:Road user monitoring and reporting

Date	NZTA staff or representative	Stakeholder name	Organisation	Engagement activity summary and issues raised	Follow-up actions	Action status
7/10/2013	ViaStrada	[redacted]	Road Transport Association	1. Most, but not all, truck drivers have a good idea of when the trains operate. 2. A driver waiting to turn right when a train approaches can turn left along the SH and do a loop at Annie's retail store (approx. 1 km south of Spring Creek). 3. Would prefer a mountable apron on the central island but without a kerb – needs to ramped edge.	Provide revised plan [redacted]	

Date	NZTA staff or representative	Stakeholder name	Organisation	Engagement activity summary and issues raised	Follow-up actions	Action status
				Apron to suit 99%ile cars. 4. Crossing bells can ring when train is parking in shunting loop (1st week in Oct). Drivers uncertain if they are safe to go. Local truck drivers can differentiate between trains loading on the loop and train moving along the track. 5. Largest NZ truck is 22m long with 50t capacity & Toll, Big Chill & Hilton Haulage operate them at Spring Creek. (Note: NZ is only country that allows them on all roads). 6. Gouland Rd will become a heavy (over weight) route. 7. Current opposing Stop (Rapaura) & Give Way (Ferry) controls create problems for drivers. 8. Convex mirror on LHS would be a good idea for both approaches. 9. The RT bay on SH1 south approach should be lengthened. 10. Could make 4 Square one way, in from SH out to Rapaura. 11. Could provide signals on SH1 north approach if a truck is queued on Ferry Rd as train approaches. 12. Consider moving 70km/h signs further back from intersection. <u>Signs</u> 13. Some drivers on Rapaura Rd may not turn if sign is on. 14. Happy with 'Train approaching' sign.		
25/9/2013	ViaStrada	[redacted]	Motor Caravan Association	[26/09/2013] In response to your request for feedback on the proposed roundabout at the Junction of SH 1 and SH 62 at Spring Creek I have given careful consideration to each of the three lay-by options presented. I suggest that option 3, to have drivers queue on the right hand side (RHS) of the traffic lane	[26/09/2013] Email sent to MCA thanking them for their response and no further action required	Complete

Date	NZTA staff or representative	Stakeholder name	Organisation	Engagement activity summary and issues raised	Follow-up actions	Action status
				on both approaches and within the raised median island at the intersection, would have to be the preferred and safest option. Motorists in this lane would not be in any different situation to that many of them would find themselves at other roundabouts when their intended exit is blocked. Although the Land Transport (Road User) Rule requires motorists not to enter an intersection if their intended exit is blocked this requirement is very often not complied with. [26/09/2013] The proposed electronic warning signs should overcome this problem and with a good public education programme there should not be any problems. This would enable traffic, other than those entering or exiting Ferry Road, to continue to flow smoothly while trains are crossing Ferry Road. Although these signs are not currently in use in New Zealand they are international symbolic signs which are more easily understood by international visitors than would be the case if we were to develop signage that is unique to New Zealand.		
25/9/2013	ViaStrada	[redacted]	Automobile Association	The Automobile Association does not provide this type of advice but they could initiate a member survey in Blenheim to get feedback from locals. They suggested that we could develop a video showing a generic mock as a good way to provide the information and get feedback, without reference to Spring Creek! The AA could provide the questionnaire and feedback from their Blenheim members for a relatively low cost	The NZ Transport Agency don't want to explore the membership survey offer from AA	Complete
02/10/2103	ViaStrada	[redacted]	THL	No feedback has been received from THL	No further action required	Complete
02/10/2013	ViaStrada	[redacted]	NZ Police	Email response to road users letter received 2/11/2013 7:19PM. By way of a (short) reply I would have concerns with the use of lay-bys of any type due for the concerns you mentioned with vehicles passing on the nearside to those waiting whilst at speed.	[redacted] ViaStrada met with [redacted] NZ Police on site on 11 November [immediately after the NZ Transport Agency meeting in Blenheim] to discuss and	Keep [redacted] informed of project development

Date	NZTA staff or representative	Stakeholder name	Organisation	Engagement activity summary and issues raised	Follow-up actions	Action status
				Would it be possible for the lay-bys to be full running lanes controlled by lights? That way all traffic moving north and wanting to turn right into Spring Creek could be held at the lights which could be phased to suit whatever need. The traffic going straight over from Rapaura Road could be controlled the same. This waiting traffic would also contain the vehicles turning right from Rapaura Road to go south on SH1, but from my casual observations the number of vehicles doing this is very minimal (most locals that need to travel south from the Spring Creek area use Murrays Road). We would delay some (for a short time) by this plan but it would maximise safety. With sufficient early warning for drivers to 'get in lane' and then these lanes light controlled by lights the through traffic could proceed as normal as could the vast majority of vehicles that emerge from Rapaura Road as they head north towards Picton. The suggest as is would lead to issues as you foresaw in you submission and due to these I would not be happy for this solution.	address concerns raised in the email. Keep [redacted] informed of project direction.	
25/9/2013	ViaStrada	[redacted]	Tourism Holdings limited	Tourism Holdings limited did not respond with any advice on the layout, but did offer to allow us to canvas there Christchurch branch office to interview tourists to see how they perceive the proposed layout	No further action required	Complete

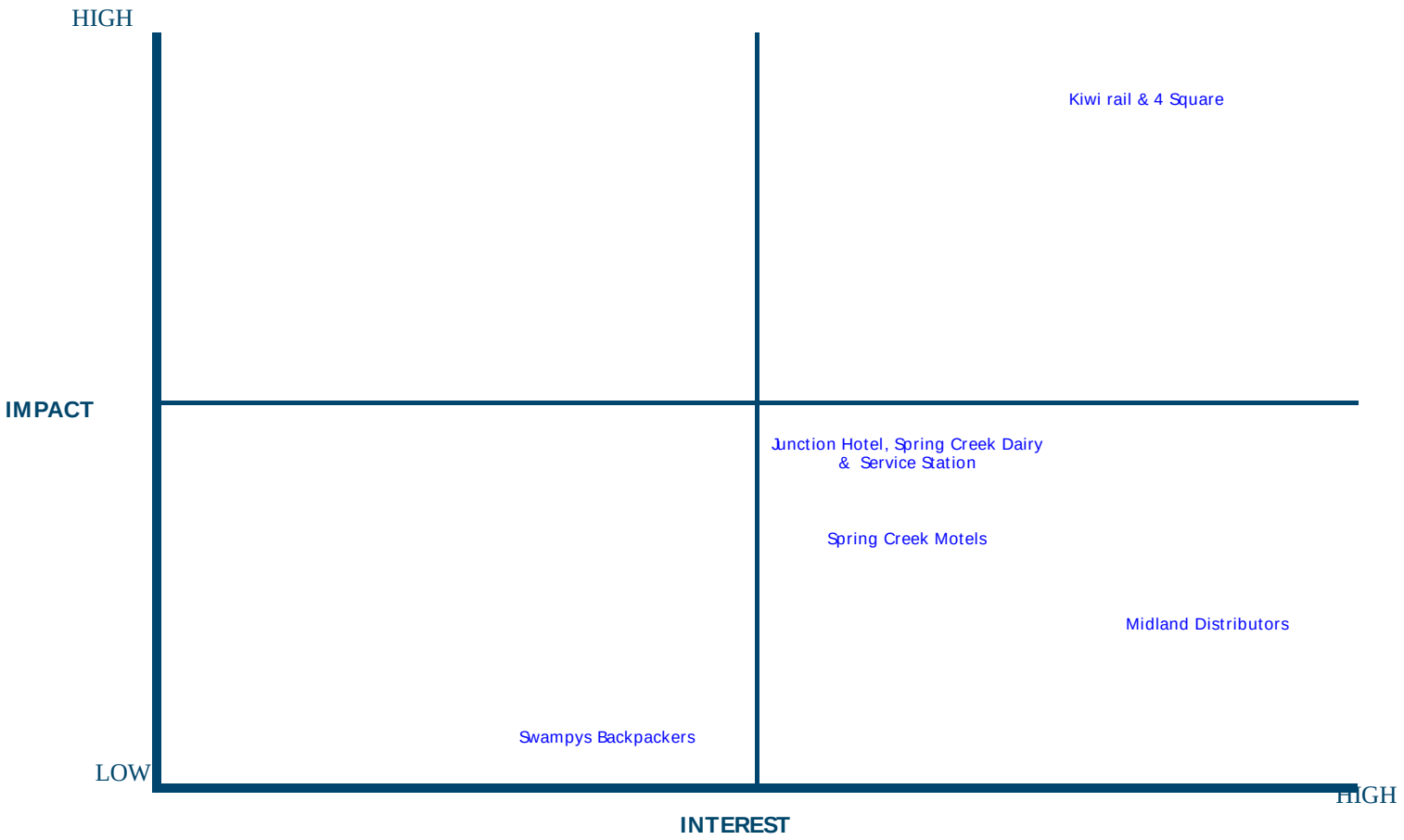


Figure 15-34: Stakeholder mapping chart

Reference source: The NZTA's *Effective engagement toolkit* has used the Ministry for the Environment's *Stakeholder engagement toolkit*, published in August 2009, as a reference source.

Letter with attachment sent to road user stakeholders

Date September 2013

Name
Address
TRANSMITTAL VIA EMAIL

Attention *Name*

RE: Proposed Roundabout: SH 1 and SH 62 Spring Creek Intersection

The New Zealand Transport Agency (NZTA) has engaged ViaStrada Ltd to examine options for improvements to the SH1/ SH62 intersection at Spring Creek Marlborough, to address an existing high crash rate. This is a complex intersection with a very high percentage of heavy commercial vehicles associated with the KiwiRail operation at the Blenheim freight centre, there are many visitors and tourists in larger camper vehicles accessing the coast roads and there is seasonal use associated with forestry and the vineyards, which involve slow moving agricultural vehicles.

A concern we have for this intersection is cars queuing while a train is crossing Ferry Road blocking the whole intersection unless we provide an intuitive and safe facility where drivers can queue out of the traffic lanes while a train crosses.

The reason for this early consultation with you is to invite you to examine the queuing lay-by and sign options we have developed and get back to us with your feedback. We are keen to hear how you perceive your road user group will 1. Interpret the signs and 2. Use the indented lay-bys during train crossings? The concept is currently being safety audited and we will include this and your feedback before we develop the scheme for public release. Please note that the project is at an early stage and will be subject to many more deign details as it progresses. Your prompt response will be appreciated.

Please use the attached information and plans to consider our design and develop your feedback from your road user perspective. If you would like to discuss the matter directly please feel free to use my contact details below.

Kind Regards

Director
ViaStrada Ltd
[redacted]
warren@viastrada.co.nz
www.viastrada.co.nz

LETTER ATTACHEMENT

Current Crossing Operation

Data for the rail operation show that there are typically seven times that the rail crossing is operational each day from 6am to 6pm and approximately another five times outside of these hours. Sunday lunchtime has the busiest hour for traffic volumes over a whole week and includes a northbound passenger train closing Ferry Road for 32 seconds. The bells and lights are on for varying periods depending on the train purpose, with a maximum of 2 minutes during freight shunting operations. From traffic counts taken it is estimated that during the longest 2 minute period, vehicles wishing to enter Ferry Road will be held up within the roundabout during that period unless alternative provision is made. Currently the right turn drivers on the SH1 south approach wait within the right turn bay and the through vehicles from SH62 just block the Rapaura Road and left turn drivers cut through the 4 Square car park.

Lay-by Options considered

We have explored three options to address the blocking concern as seen in Table 1 with their relative merits and problems.

Table1: Pros & Cons of lay-by options

Lay-by Option	Pros	Cons
Do nothing i.e. expect drivers to stop at the limit lines and block cars behind them or enter the roundabout and block the intersection when a train is crossing Ferry Road.	This would be relatively low cost. Blockage would occur relatively infrequently. Delays are of relatively short duration.	Blocked drivers in a hurry to meet the Picton Ferry won't appreciate any delay. Drivers may cut through the commercial areas to bypass the roundabout. Drivers may enter the roundabout and then have to stop as they enter Ferry Road, blocking the roundabout for all other road users. This option may see two state highways blocked at the new intersection for a short period of time on most days.
Drivers queue on left hand side (LHS) of the traffic lane on both approaches. This will have to occur 50 m to 100 m prior to the intersection due to retail activity.	The LHS is a more natural place to park. There is space available on the LHS of both approaches. Drivers intuitively check their right side rear view mirrors before exiting into the traffic lane.	This is not a natural place to park queue if you wish to travel through or turn right at the intersection ahead. The LHS lay-by is some distance from the limit lines and will require advance signage of how to use the LHS parking space. Drivers may not be able to see the train or warning signals or hear the bells being further away from the intersection.

Lay-by Option	Pros	Cons
		Drivers exit into the traffic lane in a slightly higher speed location, with increased risk of damage or injury from a crash.
Drivers queue on right hand side (RHS) of the traffic lane on both approaches. This can occur within the raised median island at the intersection.	Drivers are making the decision to queue at the intersection where they will probably be able to see the train and possibly the warning signals. The signs can be located on the median island where drivers are making their decision to queue. Advance caution signs could be added later if drivers are not getting sufficient warning of the train approaching. Drivers exit into the traffic lane are doing so in a lower speed location, resulting in less severe crashes.	Drivers do not intuitively check their left side rear view mirrors before exiting into a traffic lane. However, this may make drivers more cautious? A queued driver may pull out when drivers are entering the roundabout or exiting the commercial areas, however, this occurs in a lower speed environment with less crash severity.
Road User lay-by feedback		

Sign options considered

Our preference is to use international symbolic signs due to the high number of visitors and Tourists using this intersection. The signs will be advisory [for information] and not mandatory [must be obeyed] using LED technology. The signs will be coordinated with the railway warning system. The sign displays will start to flash before the railway bells / lights start ringing / flashing. We intend to use the same sign layouts on both approaches for road user consistency.

We do not want to use text on the signs to inform drivers what to do. Text takes time to read, comprehend and then take the correct action, therefore international symbolic signs are recommended for this location.

Proposed Solution

Drivers queue on right hand side of the traffic lane on both approaches. The provision of indented queuing lay-bys on the SH1 (south approach) and SH62 (west approach) to the intersection is shown in Figure 1. The central median islands will have a physical indented lay-by with a painted flush median for queuing over. There will be a requirement for signs to inform drivers of this facility. The signs in Table 2 show the electronic signs that come on prior and during the time the rail crossing is operational. Vehicles wishing to enter Ferry Road will be able to queue in the lay-bys until such time as the rail crossing has finished operating, thereby keeping the roundabout open for other traffic movements. The warning signs will then switch off when the rail signs and bells terminate and queued drivers can re-enter the traffic stream. The proposed 'Caution TRAIN approaching' warning sign is currently considered optional and its exact location in advance of the intersection is yet to be determined.

Table 2: Warning signs and feedback

Signs	ViaStrada comment
 	These signs are for the SH1 south approach and the SH62 approach. A misinterpretation could be that drivers interpret this as trains are not allowed to turn right! The whole sign would be black with the roundels on the corners, the train and no Through/Right arrow flashing white or yellow LEDs.
	This sign could be added later and located well in advance to the intersection to alert approaching drivers about a train approaching. The whole sign would be black with the roundels on the corners, the train flashing white or yellow LEDs
Road User sign feedback	

The road user stakeholder plan delivered with this letter can be seen in Figure 15-4.

The following letter was received from Federated farmers.

FEDERATED FARMERS OF NEW ZEALAND

11 November 2013

NZ Transport Agency
National Office
Private Bag 6995
WELLINGTON 6141

cc Marlborough Roads
P O Box 1031
BLENHEIM 7240

cc The Manager
Marlborough District Council
15 Seymour Street
BLENHEIM 7201

Dear Sir

Re: Spring Creek Roundabout

At a meeting of the Marlborough Federated Farmers on 7th November the proposed roundabout at Spring Creek in Marlborough was discussed.

Members are all totally opposed to the idea of a roundabout in that particular area as it is the main road from Picton to Blenheim and carries all of the ferry traffic. They feel that a roundabout would cause needless delays and would not be as suitable as other options.

A few alternatives were offered as below:

- East West Pedestrian and Cyclist underpasses
- Slip lanes to merge traffic off Rapaura Road and Ferry Road
- Remove stop signs
- Drop traffic to 50km
- Much better overhead signage required
- Rumble lines

Members also felt strongly that residents in the area would appreciate being consulted as to decisions made on the Spring Creek intersection.

Yours faithfully
Federated Farmers Marlborough

Glenda Robb
Secretary

Appendix L Utility Service provider feedback

Figure 15-35 shows the plan of the proposed roundabout option with existing services information recorded by the topography survey as issued to the utility service providers.

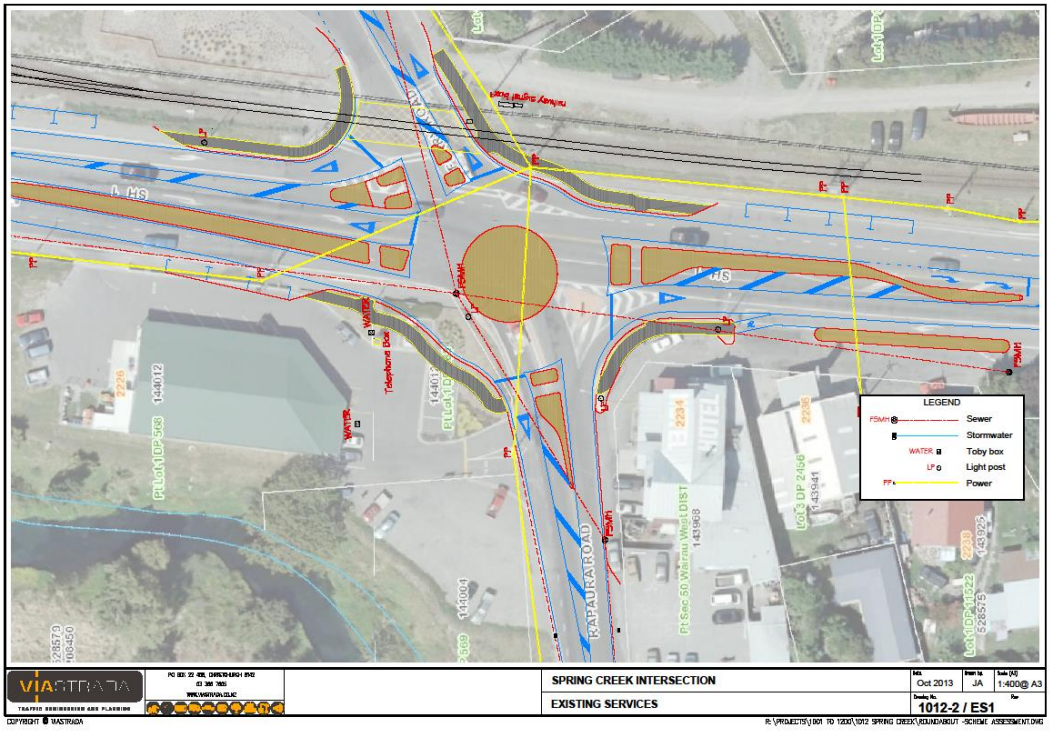


Figure 15-35: Plan issued to utility service providers

The feedback from the utility service providers can be found in the supplementary document entitled Spring Creek Utility Services requirements dated 04 December 2013, see Figure 15-36. This document was provided to the NZ Transport Agency Blenheim on 04 November 2013.

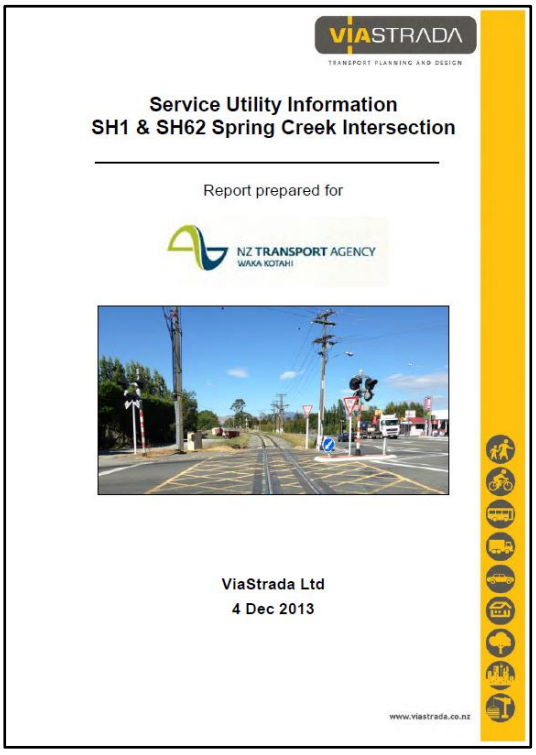


Figure 15-36: Utility services information document

Appendix M Land requirement plan

The ViaStrada Plan 1012-2 / TS01 – P1 was provided to show the areas required for road with the preferred roundabout. See Figure 15-37.

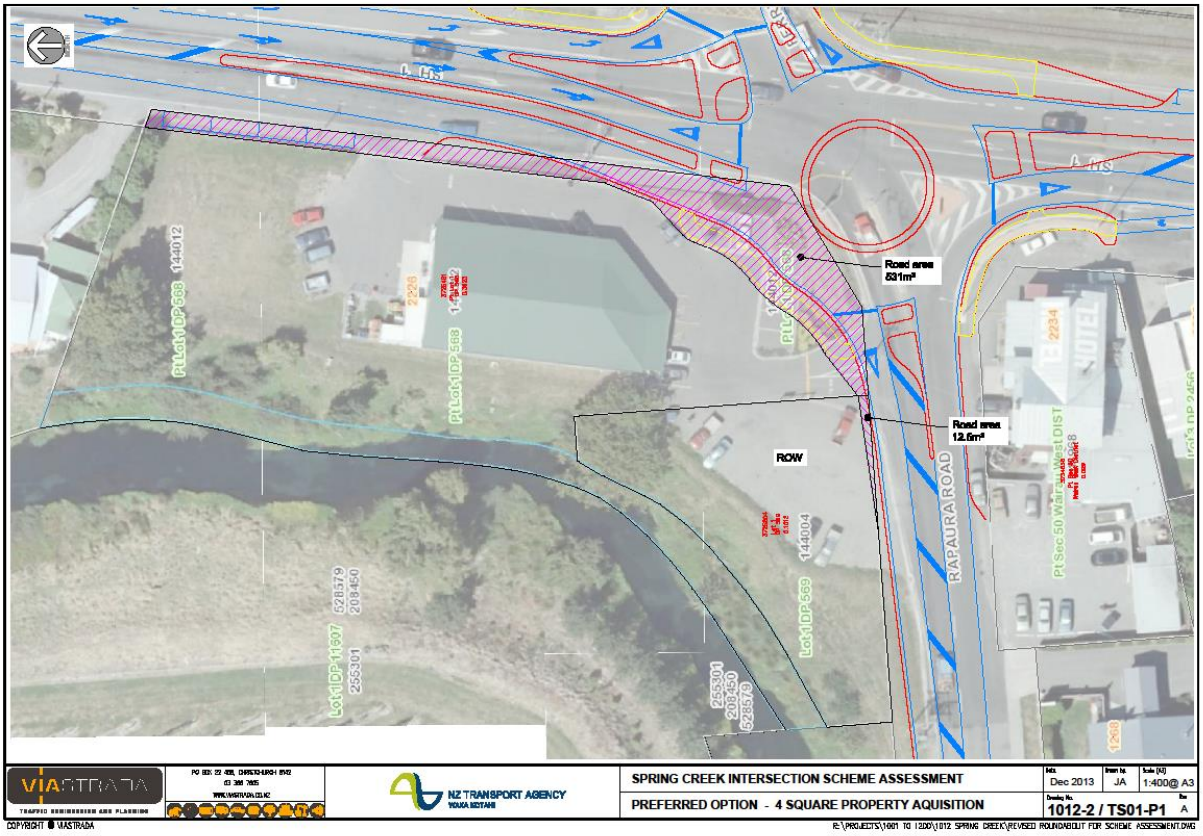


Figure 15-37: Land acquisition plan TS01-P1

This plan shows potential boundary locations and that the existing MDC land that is currently used for car parking could be reconfigured to provide access and more car parking.

Appendix N Concept roundabout safety audit

A Concept Stage road safety audit was undertaken by Opus International Consultants Ltd in October 2013. The safety audit team was [redacted] Transportation Safety Manger, Opus International Consultants, Nelson and [redacted] Wellington Region Safety Engineer, NZ Transport Agency, Wellington. The following ViaStrada concept design drawings provided for the safety audit:

- 1012-2/SA1
- 1012-2/SA2
- 1012-2/RU1 without warning signs
- 1012-2/RU1 with warning signs added

SH1 Spring Creek Intersection

Stage 1 - Concept Stage Road Safety Audit – October 2013

Opus International Consultants Ltd, Nelson

This report has been prepared for the benefit of NZTA. No liability is accepted by this company or any employee or sub-consultant of this company with respect to its use by any other person or company.

This disclaimer shall apply notwithstanding that the report may be made available to other persons for an application for permission or approval or to fulfil a legal requirement.

Quality Assurance Statement

Project Manager:	[redacted]
Prepared by:	[redacted]
Reviewed by:	[redacted]
Approved for issue by:	[redacted]

Revision Schedule

Rev. No	Date	Description	Prepared by	Reviewed by	Approved by
V1	14/10/13	Draft for Review	[redacted]	[redacted]	
V2	16/10/13	Final Submission	[redacted]	[redacted]	

Table of Contents

1 Background

1.1 Safety Audit Procedure

A road safety audit is a term used internationally to describe an independent review of a future road project to identify any safety concerns that may affect the safety performance. The audit team considers the safety of all road users and qualitatively reports on road safety issues or opportunities for safety improvement.

A road safety audit is therefore a formal examination of a road project, or any type of project which affects road users (including cyclists, pedestrians, mobility impaired etc.), carried out by an independent competent team who identify and document road safety concerns.

A road safety audit is intended to help deliver a safe road system and is not a review of compliance with standards.

The primary objective of a road safety audit is to deliver a project that achieves an outcome consistent with Safer Journeys and the Safe System approach, that is, minimisation of death and serious injury. The road safety audit is a safety review used to identify all areas of a project that are inconsistent with a safe system and bring those concerns to the attention of the client in order that the client can make a value judgement as to appropriate action(s) based on the risk guidance provided by the safety audit team.

The key objective of a road safety audit is summarised as:

> *To deliver completed projects that contribute towards a safe road system that is increasingly free of death and serious injury by identifying and ranking potential safety concerns for all road users and others affected by a road project*.

A road safety audit should desirably be undertaken at project milestones such as:

- Concept Stage (part of Business Case);
- Scheme or Preliminary Design Stage (part of Pre-Implementation);
- Detailed Design Stage (Pre-implementation / Implementation); and
- Pre-Opening / Post-Construction Stage (Implementation / Post-Implementation).

A road safety audit is not intended as a technical or financial audit and does not substitute for a design check on standards or guidelines. Any recommended treatment of an identified safety concern is intended to be indicative only, and to focus the designer on the type of improvements that might be appropriate. It is not intended to be prescriptive and other ways of improving the road safety or operational problems identified should also be considered.

In accordance with the procedures set down in the *"NZTA Road Safety Audit Procedures for Projects Guidelines - Interim release May 2013"* the audit report should be submitted to the client who will instruct the designer to respond. The designer should consider the report and comment to the client on each of any concerns identified, including their cost implications where appropriate, and make a recommendation to either accept or reject the audit report recommendation.

For each audit team recommendation that is accepted, the client shall make the final decision and brief the designer to make the necessary changes and/or additions. As a result of this

instruction the designer shall action the approved amendments. The client may involve a safety engineer to provide commentary to aid with the decision.

Decision tracking is an important part of the road safety audit process. A decision tracking table is embedded into the report format at the end of each set of recommendations to be completed by the designer, safety engineer and client for each issue documenting the designer response, client decision (and asset manager's comments in the case where the client and asset manager are not one and the same) and action taken.

A copy of the report including the designer's response to the client and the client's decision on each recommendation shall be given to the road safety audit team leader as part of the important feedback loop. The road safety audit team leader will disseminate this to team members.

1.2 The Safety Audit Team

The road safety audit was carried out in accordance with the "*NZTA Road Safety Audit Procedure for Projects Guidelines - Interim release May 2013"*, by:

- [redacted] Transportation Safety Manger, Opus International Consultants, Nelson
- [redacted] Wellington Region Safety Engineer, NZTA, Wellington

The Safety Audit Team (SAT) met at Opus Consultants' Nelson office to review the drawings on 2 October 2013. The clients' representative, [redacted] briefed the safety audit team on the project and clarified the scope of the audit. A site inspection was subsequently undertaken on 3 October 2013.

1.3 Report Format

The potential road safety problems identified have been ranked as follows:-

The expected crash frequency is qualitatively assessed on the basis of expected exposure (how many road users will be exposed to a safety issue) and the likelihood of a crash resulting from the presence of the issue. The severity of a crash outcome is qualitatively assessed on the basis of factors such as expected speeds, type of collision, and type of vehicle involved.

Reference to historic crash rates or other research for similar elements of projects, or projects as a whole; have been drawn on where appropriate to assist in understanding the likely crash types, frequency and likely severity that may result from a particular concern.

The frequency and severity ratings are used together to develop a combined qualitative risk ranking for each safety issue using the Concern Assessment Rating Matrix in Table 1 below. The qualitative assessment requires professional judgement and a wide range of experience in projects of all sizes and locations.

Severity (likelihood of death or serious injury)	Frequency (probability of a crash)			
	Frequent	Common	Occasional	Infrequent
Very likely	Serious	Serious	Significant	Moderate
Likely	Serious	Significant	Moderate	Moderate
Unlikely	Significant	Moderate	Minor	Minor
Very unlikely	Moderate	Minor	Minor	Minor

Table 1: Concern Assessment Rating Matrix

While all safety concerns should be considered for action, the client or nominated project manager will make the decision as to what course of action will be adopted based on the guidance given in this ranking process with consideration to factors other than safety alone. As a guide a suggested action for each concern category is given in Table 2 below.

RISK	Suggested Action
Serious	A major safety concern that must be addressed and requires changes to avoid serious safety consequences.
Significant	Significant concern that should be addressed and requires changes to avoid serious safety consequences.
Moderate	Moderate concern that should be addressed to improve safety
Minor	Minor concern that should be addressed where practical to improve safety.

Table 2: Concern Categories

In addition to the ranked safety issues it is appropriate for the safety audit team to provide additional comments with respect to items that may have a safety implication but lie outside the scope of the safety audit. A comment may include items where the safety implications are not yet clear due to insufficient detail for the stage of project, items outside the scope of the audit such as existing issues not impacted by the project or an opportunity for improved safety but not necessarily linked to the project itself. While typically comments do not require a specific recommendation, in some instances suggestions may be given by the auditors.

1.4 Scope of Audit

This audit is a Concept Design Stage Safety Audit of SH1 Spring Creek Intersection. Concept design drawings have been produced by ViaStrada for NZTA. The audit brief is to report on safety concerns with the proposed Concept design and to further comment on suitability of the overall design from a safety perspective.

1.5 Documents Provided

The SAT has been provided with the following documents for this audit:

- ViaStrada Scoping Study – SH1 & SH62 Spring Creek Intersection (Final).

- ViaStrada Plans 1012-2 / SA1, SA2 & SA3 – Scheme Assessment – Option for Safety Audit
- ViaStrada Plans 1012-2 / RU1 – For Consultation
- ViaStrada Note For Safety Auditors

Also provided for background information only:

- Copy of e-mail correspondence dated 2 October 2013: additional information relating to ViaStrada Scoping Report, Section 7.6 - Option Elimination - Discussion regarding a Traffic Lights option for the intersection.

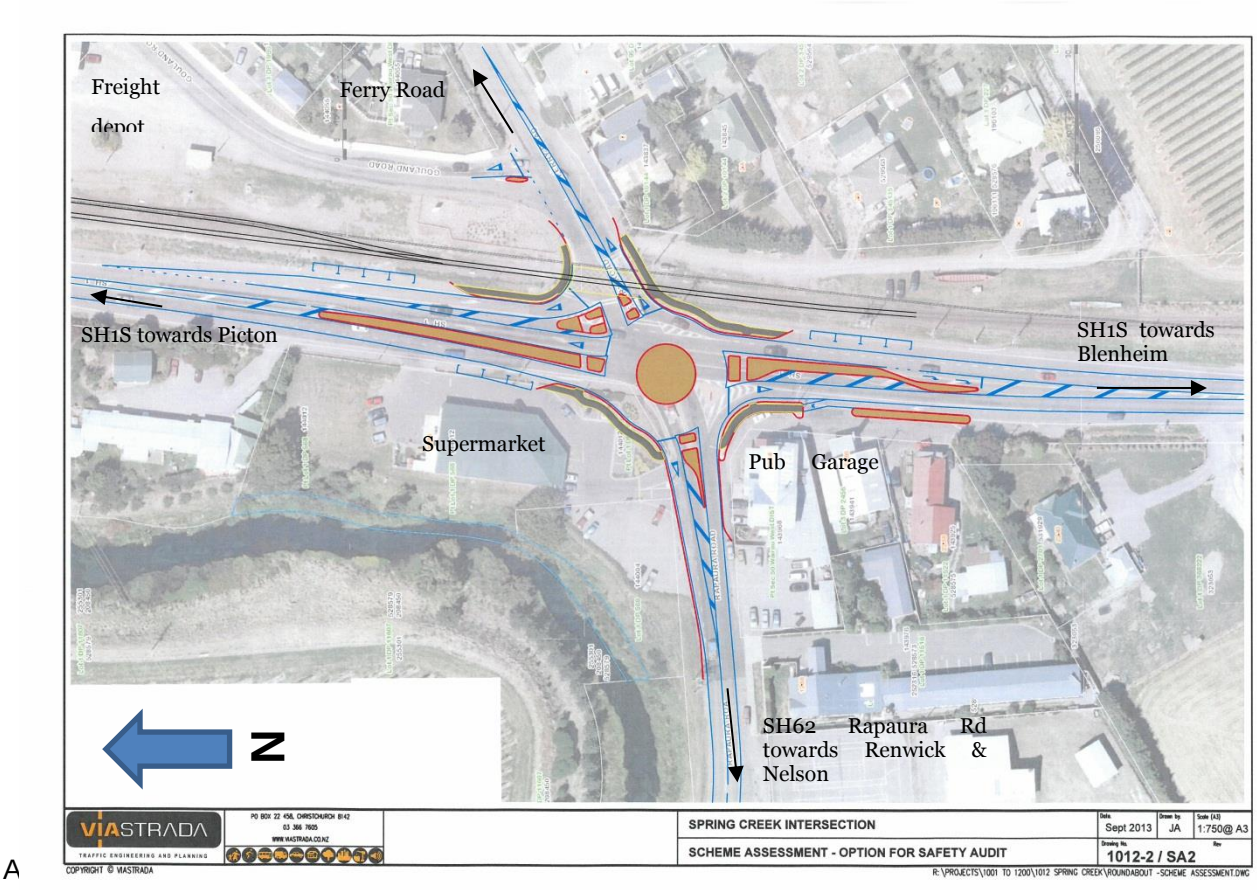
1.6 Disclaimer

The findings and recommendations in this report are based on an examination of available relevant plans, the specified road and its environs, and the opinions of the SAT. However, it must be recognised that eliminating safety concerns cannot be guaranteed since no road can be regarded as absolutely safe and no warranty is implied that all safety issues have been identified in this report. Safety audits do not constitute a design review nor an assessment of standards with respect to engineering or planning documents.

Readers are urged to seek specific technical advice on matters raised and not rely solely on the report.

While every effort has been made to ensure the accuracy of the report, it is made available on the basis that anyone relying on it does so at their own risk without any liability to the safety audit team or their organisations.

1.7 Project Description



A

The subject Concept proposal, and the subject of this audit, is an extensive re-modelling of the SH1/SH62 intersection involving a 4-leg roundabout.

Presently the intersection is an angled cross roads with SH1 being the through priority flow and SH62 Rapaura Rd and Ferry Rd being the side roads. SH1 goes from Picton to Blenheim and SH62 acts as a shortcut to the west to join with SH6 on to Nelson. Ferry Road serves a residential area and a rail freight depot as well as accommodating light tourist traffic to the coastal area.

The intersection has a high percentage of HCVs and a high crash rate. There are a number of commercial operations located to the west of the intersection on either side of SH62 Rapaura Road, which generate local short-trip movements.

The intersection is complicated by a rail level crossing without barrier arms located just 15m or so along Ferry Rd. Train movements include the Coastal passenger service, freight trains to the ferry port in Picton and shunting operations associated with the freight yard.

2.0 Safety Audit Findings

2.1 Rail Crossing **Significant**

The Concept proposal does not adequately address one of the biggest safety shortcomings of the present intersection, i.e. the rail crossing. Historically there have been few actual vehicle vs train incidents resulting in injury, but it is definitely a serious concern for any expensively re-modelled intersection. There have been three recorded minor injury car vs train accidents in the period before ViaStradas' ten year analysis. The crashes occurred in 1981, 1991 and 2002 with cars being caught while waiting on the rail crossing or else not seeing approaching trains. It is the opinion of the auditors that the close proximity of the rail crossing to the intersection will not permit an adequate, or significant reduction in the risk posed by the crossing, simply by changing the intersection to a roundabout layout.

The proposal to introduce holding areas for Ferry Road-bound vehicles produces its own set of safety issues, and still does not alleviate all concerns associated with the railway crossing itself. The following photos show issues with the rail crossing which are not fully addressed with the Concept proposal.
In some respects the Concept proposal actually reduces a driver's ability to clear the rail crossing. Vehicles committing themselves to crossing the rail line do not have any guarantee of being able to complete the manoeuvre.

Some of the specific issues relating to the rail crossing are described in more detail in following sections, and this section 2.1 relates to the general overall proposal to change the intersection to a roundabout design.

Recommendation:

The Concept plan must consider safety issues with the rail crossing as well as safety issues with vehicle movements on the intersection itself. Despite traffic lights being considered and discarded as an option, the audit finds that lights will likely provide the safest way (and possibly the ONLY safe way) to incorporate the rail crossing into a safe upgraded intersection. The auditors do not consider that being 'out-of-context' is a suitable reason for not installing a traffic light controlled intersection. A Safe System approach to improving safety at this intersection should discount the slight delays to traffic which would be a result of traffic lights, and focus instead on providing safe outcomes for all transport users.

The auditors acknowledge that there are constraints imposed on the Concept design due to commercial operations, land boundaries, cross-roads alignments, disparity in approach speeds and volumes etc, but this substandard intersection should not be upgraded at great cost by implementing a Concept which does not address all safety failings.

Frequency Rating:	***Severity Rating:***
Crashes are likely to be **Occassional**	*Death or serious injury is* **Very likely**

Designer Response: *The auditors comment that the "One of the biggest safety shortcomings of the present intersection" is the rail crossing. This statement is qualified by saying there have been three recorded minor injury crashes since 1981. This is over thirty years with no fatal or serious crashes recorded at the rail crossing. To say that one crash every ten years is* ***Occasional*** *is questioned and saying that death or serious injury is* ***Very Likely*** *is not supported by the last thirty years of crash data. The roundabout was proposed as we consider the biggest safety shortcoming at this intersection is the vast majority of crashes that have involved turning vehicles and the roundabout will significantly reduce these crashes.*

The objectives of safer journeys are to see a safe systems approach brought to designs. The two issues that traffic engineers can specifically address are 1. Safe roads / Road sides and 2. Safe speeds. 1. Roundabouts are predictable and forgiving of mistakes, they are self-explaining in that their design encourages appropriate road user behaviour and 2. The approach speed of vehicles will reduce as drivers slow down to negotiate the roundabout.

Traffic signals are considered out of context at Spring Creek with its minor development on the west side only of the state highway as drivers will have travelled for hours and many kilometres as they pass through the intersection. Traffic signals also speed up traffic as drivers anticipate the stale green, they also have what is called the dilemma zone where some drivers may accelerate and other may brake during the orange display. The cross road geometry is also retained with signals so any crashes are at more severe angles. A recent Austroads publication Improving the performance of Safe System Infrastructure: Stage 1 interim report stated that "The literature review revealed that roundabouts are very effective in reducing severe injury crashes (37 - 40%) and, in particular, fatal crashes (60 – 100%). This level of step wise road safety improvement demonstrates good progress towards the Safe System objectives. Roundabouts were shown to be twice as safe as traffic signals".

The statement that 'improving safety at this intersection should discount the slight delays to traffic which would be a result of traffic lights' is incorrect. The only way to achieve slight delays with traffic signals would be to have a simple two phase logic, and allow vehicles to filter. This will see many of the crossing and turning crashes continuing in this location. To increase safety with traffic signals, the intersection could run as a split phase where each approach has its turn to run, while the other three approaches are stopped. This will introduce significant delays and queues, plus cause rat running through the Four Square car park during most phases rather than when a train is crossing Ferry Road once every hour or so. Another consideration is providing for pedestrians crossing state highway 1s, this is a long crossing and will further delay road traffic. The roundabout provides single lane crossing widths and simplified decision making for pedestrians.

Safety Engineer: ***Agree with designers response, I consider the frequency should be "Infrequent", therefore the risk classification becomes "Moderate"***

Client Decision: ***Accept both the designers and safety engineers response***

Action Taken: ***None necessary***

2.2 Speeds **Moderate**

The reduction in posted speed limit through Spring Creek has been discussed in Section 5.3.4 of the Scoping Study. It appears that crash incidence has reduced since the posted speed limit was reduced from 80kph to 70kph. Recent CAS analysis confirms that this improved trend continues. With this in mind, a lot of the crash types and severities may be able to be addressed through further reductions in speed, or improved enforcement of current limits.

Recommendation:

1. *Monitor crash rates and consider the effects on the intersection upgrade proposals as a result. Future crash types may vary from those studied to date, leading to different intersection upgrading proposals. Download data from the existing SID devices to analyse compliance.*
2. *Install fixed speed cameras (with advance warning) to ensure compliance with the 70kph posted speed limit.*
3. *Consider reducing the posted speed limit yet further to continue improvements in crash rates and severities.*

Frequency Rating:	***Severity Rating:***
Crashes are likely to be **Occassional**	*Death or serious injury is* **Likely**

Designer Responses:

1. *Agree that the crashes do appear to be trending down, however the crash types are not likely to change as the geometry is not changing, but the crash severity is expected to reduce. Another reason a roundabout has been selected as the preferred treatment is*

*that the crash angles are reduced, minimising crash severity because our bodies have limited ability to withstand these forces[9]. This would indicate the severity rating is less than **Likely** in the expected 50 km/h environment of the roundabout.*

2. *Agree that it would be useful to confirm compliance with the posted speed limit. This additional enforcement is not considered essential with the roundabout due to their self-explaining nature, but may add value if traffic signals are used.*
3. *Reducing the speed further with the current layout or traffic signals would have to go hand in hand with other interventions to make drivers more aware of the land use and expected lower speed in this open and higher speed environment.*

Safety Engineer: ***Agree with designer's response, although review of crashes should be undertaken at the start and end of the design phase and before construction to reiterate the investment logic explained by the designer. Recommendation 2 only warranted should the RAB not be progressed.***

Client Decision: Agree with the designers comments – until any construction happens as a consequence of this project this site will continue to be the subject of the normal maintenance monitoring regime and if project doesn't progress to construction for whatever reason strategies such as 2 and 3 will need to be considered at that time

Action Taken: Review crash data at end of design phase

2.3 Geometric Standards **Moderate**

Austroads minimum standards have been applied to the roundabout design. With the large numbers of HCVs and the location of the intersection on a road of National Strategic significance, these design standards are deemed to be unsatisfactory.

Recommendation:

Re-design the roundabout with improved geometric standards relating to circulatory radius, approach deflections and sight distances.

Frequency Rating:	***Severity Rating:***
Crashes are likely to be **Occassional**	*Death or serious injury is* **Likely**

Designer Response: *The Austroads minimum standards require the designer to include consideration of the expected road users, particularly HCVs. All turns have been checked using CAD AutoTrack software to ensure all turns can be made using the largest NZ design vehicle. We have received feedback from the RTA[10] suggesting the use of a low mountable apron to allow trailer units to trail overt the central island. We will explore this suggestion as it allows us to increase deflection through the roundabout as discussed in 2.4.*

Item 2.1 acknowledges the constraints of this site. The roundabout design meets the Austroads guidelines and the constraints of the site.

[9] Road safety audit procedures for projects: Guidelines interim release May 2013 section 3 and figure 3.2
[10] NZ Road Transport Association

*The assigned crash severity of **Likely** is questioned because the lower 50 km/h speed environment of the roundabout will result in lower crash severity.*

Safety Engineer: Designer to confirm that the RAB is designed to accommodate an 18m semi using RTS-18, with the required 0.5m clearance

Client Decision:Agree with designer comments

Action Taken: Request designer to confirm that the RAB is designed to accommodate an 18m semi using RTS-18 (Including 0.5m clearance) and t o redesign to provide improved deflections (I note that revised layout drawing 1012-2/TS01 provided in Dec 13 provides enhanced deflections on approaches)

2.4 Approach Deflection **Moderate**

Roundabout approach deflection for the SH1S Southbound approach is minimal which may encourage high speeds for traffic heading straight through the roundabout. This will reduce the ability of HCVs to enter the roundabout from Ferry Road and exacerbate queuing across the rail track. The existing intersection layout has a left turn acceleration lane for the Ferry Road approach which eases the merge for HCVs coming from the freight depot.

Recommendation:

Consider inclusion of a left turn-out merge lane for Ferry Road and/or relocate the centre island to even-up the approach deflections for the SH1S approaches.

Frequency Rating:	***Severity Rating:***
Crashes are likely to be **Occassional**	*Death or serious injury is* **Likely**

Designer Response: *Adjustments to the approach lane will be considered to improve deflection. The auditors comment that the through deflection is minimal and suggest that we introduce another exit lane. This would reduce the ability to improve deflections.*

We have received feedback from the RTA suggesting we retain the use of the left turn out exit lane from Ferry Road. We have given this some consideration and believe the safest way to achieve this would be the use of a raised tactile surface that HCVs can travel over, but the integrity of the roundabout deflections are retained.

Safety Engineer: Agree with designer's response, consideration of raised tactile surface should be included in design phase

Client Decision: *As per note 2. – the* ***revised layout drawing 1012-2/TS01 provided in Dec 13 provides enhanced deflections on approaches – any use of a raised tactile surface would need to be in conformance with NZTA standards – the close vicinity of residential properties may not allow its use***

Action Taken: Designer (in discussion with safety engineer) to confirm if tactile use is possible - if so note in SAR for incorporation into the detailed design

2.5 Occupied Rail Crossing Holding Areas **Minor**

The Concept plans and the associated discussion in the Note for Safety Auditors propose vehicle holding areas in the median area on both SH62 eastbound and SH1 northbound to contain vehicles waiting for the rail crossing to clear. The SH1 area is long enough for only 5-6 cars or only 1 or 2 trucks. The area on SH62 conflicts with vehicles wishing to turn right into the supermarket (see section 2.9). Both these holding areas are very unorthodox in that they require vehicles to wait off to the right of the traffic lane, and then pull back into that traffic lane using only the left hand mirror. This manoeuvre is inherently unsafe, particularly for trucks which will have blind spots in their rear vision. There is some discussion around how this holding area would be communicated to motorists and provision of clear signage may be problematic.

Recommendation:

Although the holding area and its associated signage has been discussed in the Concept proposal, the auditors consider that safe and clear provision of a holding area is paramount when considering whether to pursue the Concept roundabout option. The off-to-the-right holding area has been deemed to be the most appropriate of the available options, and this may well be the case, however it is fundamentally flawed. The auditors have concerns with the workability of this proposal and consider that it is not consistent with a Safe System approach. As per Section 2.1, the question of safely integrating the rail crossing into the intersection re-modelling must be satisfied before progressing this particular design.

Frequency Rating:	***Severity Rating:***
Crashes are likely to be **Infrequent**	*Death or serious injury is* **Unlikely**

Designer Response: *Agree with the auditors concern over the laybys for queuing during train crossing events. We have received feedback from the RTA suggesting we consider using a convex mirror placed slightly ahead of the first queued truck on the left hand side of the road to aid visibility to this blind spot. However, again the merits of the roundabout are shown, as approaching drivers will be slowing down for the roundabout and should any crashes occur, they will be low speed and low angle, and any resulting injuries would be expected to be minor or non-injury.*

Safety Engineer: Agree with auditors concerns, although there is limited opportunity for holding traffic elsewhere and the provision of a two lane roundabout (a more conventional solution which would require the relocation of the 4 square) is not considered a fundable solution to mitigate a "Minor risk" and, with some minor amendments to length and details, the provision of stacking, enabling the roundabout to operate when a train is present is better than without (as occurs at the SH6 RAB in Blenheim).

Client Decision: Agree with Safety Engineers response

Action Taken: Designer to modify stacking lanes to optimise storage and safety for final SAR

2.6 Intersection Sight Distances **Moderate**

Roundabout approach sight distances are very dissimilar when comparing the different legs. The SH62 approach has poor sight distance when looking for traffic approaching on the northbound SH1s approach due to the Junction Hotel on the corner.
The proposed parking area on the north-east side of SH1s will severely limit sight distance for vehicles exiting Ferry Road.

Recommendation:

Check and quantify sight distances for all legs, particularly for the SH62 approach to the roundabout. Investigate the effect that poor sight distance here will have on the ability of vehicles to pull out of SH62 in the path of vehicles heading northbound on SH1.
Remove the parking area on the north-east side of SH1.

Frequency Rating:	***Severity Rating:***
Crashes are likely to be **Occassional**	*Death or serious injury is* **Likely**

Designer Response: *Sight distance criteria in Austroads guidance are based on three different criteria, and the auditors are confusing two of those criteria. Criterion 1, which is equivalent to Approach Sight Distance, is not one of the criteria discussed here. Criterion 2 refers to visibility at the limit line, and when the auditors talk about "the effect that poor sight distance here will have on the ability of vehicles to* ***pull out of SH62 in the path of vehicles heading northbound*** *on SH1" (emphasis added by the designer), they are factually wrong. Criterion 2 must be met, and it is met with the proposed design. We agree with the auditor that sight distances are unbalanced on the approach and this refers to Criterion 3. This criterion is not a requirement and one of the more controversial aspects of Austroads guidance, since there is ample evidence that having reduced sight distance on the approach to a roundabout can improve safety as drivers inherently slow down when their visibility is compromised. This has been written into British roundabout design guidance, which allows for screening fences on roundabout approaches,[11] and is the underlying reason why crash rates reduce when visibility on the approach reduces, as found by Turner when he developed crash prediction models for roundabouts.[12] We thus disagree with the auditors.*

Another reason a roundabout has been selected as the preferred treatment is that the crash angles are reduced minimising crash severity because our bodies have limited ability to withstand these forces[13]. This would indicate the severity rating is less than ***Likely*** *in the expected 50 km/h environment of the roundabout.*

Safety Engineer: ***Agree with designer's response***

Client Decision: Agree with the designer/safety engineers response

[11] DFT 2007. Design Manual for Roads and Bridges Vol. 6 Section 2. Part 3 TD 16/07: Geometric Design of Roundabouts. London: Department for Transport.
[12] TURNER, S., ROOZENBURG, A. & SMITH, A. 2009. Roundabout crash prediction models.
[13] Road safety audit procedures for projects: Guidelines interim release May 2013 section 3 and figure 3.2

2.7 Lane Widths on Roundabout Throats **Minor**

The Concept plan is not dimensioned, but it appears that the exit lanes have only minimal width, particularly the southbound SH1 exit from the roundabout where the lack of deflection may result in higher through speeds. Clipping of the kerb may occur at this point, resulting in close proximity of vehicles to pedestrians waiting on the throat island, and de-stabilising of accelerating vehicles.

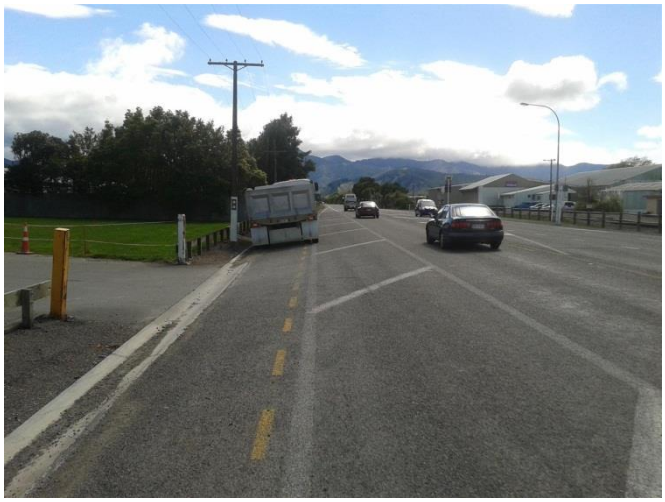
Recommendation:

Ensure exits from the roundabout are of a suitable width and alignment, to permit smooth manoeuvring through the roundabout.

Frequency Rating:	***Severity Rating:***
Crashes are likely to be **Infrequent**	*Death or serious injury is* **Unlikely**
Designer Response: *All entry and exit lanes have been checked using CAD AutoTrack software to ensure all turns can be made using the largest NZ design vehicle.*	
Safety Engineer: ***Agree with designer's response***	
Client Decision: Agree with the designer/safety engineers response	
Action Taken:	

2.8 HCV Parking and Accelerating **Minor**

Presently HCVs regularly park on the SH1 northbound shoulder so that they can shop at the 4-Square supermarket. This parking is not catered for in the Concept design. The location of power poles close to the edge of seal produces a risk of collision with high-sided HCVs (see photos below)
The sealed area presently painted in shoulder bar marking is used for trucks accelerating away from the intersection. This movement is also not catered for in the Concept.



Recommendation:

Provide for HCV parking and accelerating, particularly on the SH1 northbound exit leg

Frequency Rating:	***Severity Rating:***
Crashes are likely to be **Infrequent**	*Death or serious injury is* **Unlikely**
Designer Response: *Parking for three cars is provided on SH 1s outside the Four Square in the concept scheme. There is also space for HCVs to park in the concept scheme as shown in the audit photo above. An auxiliary acceleration lane is not required as part of a roundabout design, and there is a passing lane some 350 m north of the intersection.*	
Safety Engineer: ***Ensure no-stopping lines are removed in final design to permit truck/car parking in the locations shown and provide kerb barrier at pole location (similar to that proposed in Havelock) if unable to relocate pole (to be considered at design stage).*** ***Also provide diagonal shoulder marking between parking area and carriageway edge line to indicate possible slow lane for accelerating trucks.***	
Client Decision:Agree with Safety Engineer	
Action Taken: Modify final SAR design in light of safety engineer's comments.	

2.9 SH62 Access to Supermarket **Minor**

Numerous vehicles access the supermarket car park via the SH62 access shown in the picture below. The right turn-in movement will be blocked when vehicles are using the median area to park while a train is occupying the Ferry Road rail crossing. This access will also be blocked when vehicles are stacked at the SH62 roundabout entry due to the shorter lane length. The Concept plan appears to indicate the throat island extending past the access and also shows a kerb all the way across the supermarket access. If this is the case, then it is implied that all access to the supermarket would be via SH1northbound, which is undesirable.

Recommendation:

Re-consider access off SH62 to the supermarket. Re-configure the access so that it is as far from the roundabout as possible, and so that right-turn-in movements are safeguarded. Ensure that the access does not straddle the power pole as is the case with the existing arrangement.

Frequency Rating:	***Severity Rating:***
Crashes are likely to be **Occassional**	*Death or serious injury is* **Unlikely**
Designer Response: *This entry currently blocks when vehicles queue for trains crossing Ferry Road and access to the Four Square is already restricted. However, our proposal has a flush median that can be used by vehicles right turning into the supermarket, when the lay by isn't being used, which will be most of the time. This will mean the SH 62 west bound lane is open for through movement more often than currently occurs. The NZTA is currently in negotiation with the Four Square and MDC to achieve improved access to these sites. It is our expectation that the new access will be located further from the intersection which would improve the way the access currently operates.*	
Safety Engineer: ***Agree with designer's response***	
Client Decision: *Agree with designer/safety engineers response, land purchase required to enable 4 square access to be relocated*	
Action Taken: ***Client to investigate MDC land purchase adjacent to 4 square to enable access relocation***	

2.10 Pedestrian and Cycling Facilities **Moderate**

The Concept provides reasonably well for pedestrians with numerous pram crossings and island refuges for most pedestrian desire lines. An additional pedestrian refuge may be required some 30m into Ferry Rd to improve safety for people crossing from the freight depot area to the backpackers on Ferry Rd and then across to the pub on the other side of SH1.However, roundabouts do not generally provide for safe, easily negotiated routes for cyclists. In this particular case it is likely that local residents using bicycles would adopt the pedestrian facilities to get from one side of SH1 to the other. There is a cycle path providing for the left turn into SH62 from SH1 northbound, but there is concern that the lane ends abruptly on the roundabout SH62 exit lane, causing accelerating vehicles to merge with cyclists coming off the cycle lane. Cyclists could use the footpaths on the other three corners to carry out left turns at other legs of the roundabout, but the kerb let-downs and merge areas do not cater well for cyclists to re-gain the traffic lane.

Touring and leisure cyclists would likely negotiate the roundabout on the traffic lanes, and incur the usual risks associated with cyclist on roundabouts. It is of note, that with the rail crossing, there is another distraction over and above the norm, to further hinder cyclists' conspicuity in complex intersections.

Recommendation:

Consider an additional pedestrian refuge approx. 30m along Ferry Rd.
Provision for cyclists only extends to the left turn into SH62 Rapaura Rd from SH1. If this Concept is taken further, provision for cyclists should be developed and detailed to enable smooth merge onto shared footpath/cycle lanes around each corner of the roundabout.

Frequency Rating:	***Severity Rating:***
Crashes are likely to be **Infrequent**	*Death or serious injury is* **Likely**

Designer Response: *The additional pedestrian refuge approx. 30m along Ferry Road is not desirable as both the RTA and Phil Taylor, the Director for Midland Distributors have informed us that their large vehicles require more than half of the Ferry Road carriageway to make the turn from SH 1s into Ferry Road and then turn into Gouland Road.*

Provision for cyclists goes beyond the left turn into SH62. Cyclists have the option of riding along the road with slowed traffic, using the proposed shared paths that are located around all four corners of the roundabout or cyclists can use the access lanes that service the Hotel and Four Square supermarket.

Safety Engineer: ***Agree with designer's response***

Client Decision: ***Agree with the designer/safety engineers response***

Action Taken:

2.11 Left Turn-in Movement to Ferry Road **Minor**

When vehicles are giving way at the SH1 left turn-in lane limit line to go into Ferry Rd, they will have very poor visibility of the roundabout circulatory due to vehicles slowing/stopping at the SH1 straight-through lane limit line.

Recommendation:

Re-position the SH1 southbound limit line to ensure visibility of the roundabout for left turners going into Ferry Rd.

Frequency Rating:	***Severity Rating:***
Crashes are likely to be **Infrequent**	*Death or serious injury is* **Unlikely**
Designer Response: *Agree that the southbound limit line on SH 1s can be repositioned to provide better intervisibility.*	
Safety Engineer: ***Agree with designer's response***	
Client Decision: ***Agree with the designer/safety engineers response***	
Action Taken: ***Revise plan for final SAR***	

2.12 Removal of Left Turn Lane from Ferry Road **Moderate**

The present intersection layout has a left turn-out merge lane for vehicles heading south onto SH1 from Ferry Road. This helps prevent stacking of vehicles across the rail crossing and allows any vehicles parked across the train tracks when the bells/lights start going to 'escape' from this conflict area. The Concept proposal does not have this facility and hence may produce a situation where vehicles are across the rail line and then cannot get away due to having to give way to a dominant SH1 southbound flow.

Recommendation:

Consider including a left turn-out lane from Ferry Road as per the present intersection layout. The Concept plan appears to have room for this merge lane within the as-drawn roundabout layout.

Frequency Rating:	***Severity Rating:***
Crashes are likely to be **Occassional**	*Death or serious injury is* **Likely**
Designer Response: *As per 2.4. We have received feedback from the RTA suggesting we retain the use of the left turn out exit lane from Ferry Road. We have given this some consideration and believe the safest way to achieve deflection while still accommodating large vehicles would be the use of a raised tactile surface that HCV trailer units can travel over, but the integrity of the roundabout deflections are retained.*	
Safety Engineer: ***Agree with designer's response***	

Client Decision: *As per 2.4* ***- the revised layout drawing 1012-2/TS01 provided in Dec 13 provides enhanced deflections on approaches – any use of a raised tactile surface would need to be in conformance with NZTA standards – the close vicinity of residential properties may not allow its use***

Action Taken: As per 2.4 - Designer (in discussion with safety engineer) to confirm if tactile use is possible - if so note in SAR for incorporation into the detailed design

2.13 Rail Crossing Barrier Arms **Moderate**

Section 8.2 of the Scoping Report indicates that barrier arms may not be feasible. There would appear to be advantages and disadvantages to the installation of barrier arms (aside from cost).
Vehicles may be queuing across the rail tracks (see section 2.12 above), hear the bells going and then carry out panic manoeuvres into oncoming traffic due to a fear of the barrier arms coming down on their vehicle. However, level crossings are commonly the scene of vehicles attempting to estimate train speed and jumping the gap and this would be prevented by barrier arms.
Clearzone line-marking as is currently in place, will help, but it is common for drivers to mis-read the intentions of the vehicle ahead when it is making the judgement about whether to pull onto a roundabout or not, and this could easily lead to vehicles straddling the tracks.

Recommendation:

Consider fully the implications of barriers arms on the Concept proposal. Ensure that there is adequate stacking space, and some means of escape from the rail crossing area for vehicles stacked on Ferry Road.

Frequency Rating:	***Severity Rating:***
Crashes are likely to be **Infrequent**	*Death or serious injury is* **Very likely**

Designer Response: *Agree with the auditors concerns over barrier arms and these will be included or excluded in collaboration with Kiwirail to ensure current best practise and safety standards are achieved for the rail and road network.*

Safety Engineer:	***Agree with designer's response***
Client Decision:	***Agree with the designer/safety engineers response***
Action Taken:	***Designer should provide "final" scheme plans to KiwiRail for their review and acceptance.***

2.14 Access to Commercial Businesses **Minor**

One of the issues with the present intersection layout is a lack of clarity and formalisation regarding the entry and exit from the various businesses. The Concept plans show kerbing and islands on the two western corners of the roundabout and there is conflict between current desired paths and the locations of these kerbs. Access to the filling station and pub crosses a cycle lane and its prominence should be ensured through green paint etc.

Most of the commercial operations at Spring Creek will have deliveries made by HCV and these movements must be accommodated as well as those of customer light vehicles. The Concept plan provides little indication of how access to these businesses will be safely achieved while ensuring that there is clear direction for safe manoeuvring.

The Concept plan indicates a RTB for vehicles turning into the filling station and pub from SH1 southbound. The line-marking at this point is non-standard as the turning vehicles will have to cross the flush median. There is concern that the amount of angle-bar line-marking through the intersection will lead to confusion.

Recommendation:

Consider rationalisation of the accesses serving the supermarket, filling station and pub. In particular question whether the access/egress to the supermarket off SH1 northbound should be closed and instead have all access provided off SH62. Rationalise line-marking at the RTB for the filling station.

Frequency Rating:	***Severity Rating:***
Crashes are likely to be **Infrequent**	*Death or serious injury is* **Very unlikely**

Designer Response: *Agree with the auditor that access definition will be important for safety. The current concept plans have dotted lines across the access locations to indicate*

these are not fixed and will be confirmed during the consultation process between the NZTA and business operators. The proposal is a significant improvement on how the intersection operates with the multiple accesses that currently exist.

The right turn bay markings can be rationalised when the length of the roundabout stacking bay and the shop access location is determined.

Safety Engineer: ***Thus requires further consideration in the design phase***

Client Decision: *Agree with safety engineer*

Action Taken: Review as part of initial design phase consultation with property owners

2.15 Parking on SH1 **Minor**

The Concept indicates that parallel parking spaces are to be provided in three locations on SH1, to the north and to the south of the roundabout. Apart from affecting site distances (Section 2.6) for vehicles exiting Ferry Rd, these parks will encourage unsafe frequent manoeuvring in areas of heavy acceleration and deceleration and will also encourage pedestrians to cross SH1 in areas where there is no provision to do so safely.

Recommendation:

Remove the three parking areas on SH1 and encourage the use of parking on Ferry Road and within the commercial operations' own car parks by rationalising and formalising access arrangements.

Frequency Rating:	***Severity Rating:***
Crashes are likely to be **Infrequent**	*Death or serious injury is* **Very unlikely**

Designer Response: *Agree with the auditor that crossing the state highway is dangerous. However, the roundabout provides improved safety for pedestrians to cross the state highway as they only have to cross one lane at a time. To maximise safety, we could remove all parking from roadsides, but these parking bays [particularly on the west side] are an integral part of the commercial activity at Spring Creek. The retention of parking can be confirmed during the consultation process between the NZTA and business operators.*

Safety Engineer: ***Agree with designer's response***

Client Decision: ***Agree with the designer/safety engineers response***

Action Taken: ***To be considered at design consultation phase***

2.16 Local Traffic Factors **Minor**

While carrying out the site visit at Spring Creek it was apparent that for periods of many minutes there was very little traffic and then for intense periods there was lots of activity. This particular location is very susceptible to platooning of traffic from the Picton ferries and also for HCVs delivering and picking up from the freight depot off Ferry Rd. The Scoping Study report details an hourly traffic volume/turning breakdown but may not give adequate consideration of

the busy- then- lull nature of the local traffic. Effects of this local phenomenon are stacked HCVs on Ferry Rd and also on SH62 Rapaura Rd, as platoons of vehicles head south on SH1 through the intersection as they disembark the ferries.

Recommendation:

Consider if short busy periods of traffic have been adequately considered, particularly in the provision of stacking bay lengths, turning movements, traffic modelling and conflict with train times.

Frequency Rating:	***Severity Rating:***
Crashes are likely to be **Infrequent**	*Death or serious injury is* **Very unlikely**
Designer Response: *Agree with the auditors observations about the variation in traffic flows at this intersection. We have reviewed ten hours of traffic video and have modelled five different time periods in SIDRA. These road traffic volumes have been aligned with the corresponding rail traffic conflict times to ensure we have realistically captured the expected traffic events at Spring Creek. This is again why a roundabout is the preferred option as roundabouts perform well with low to moderate traffic volumes as found at Spring Creek.*	
Safety Engineer: ***Agree with designer's response, see also my comments in 2.5 regarding additional stacking***	
Client Decision: ***Agree with the designer/safety engineers response***	
Action Taken: ***None necessary***	

2.17 Do-Minimum Option **Significant**

Appendix A of the Scoping Study report illustrates 4 other options which were considered and rejected. The first of these is a Do-Minimum option which the auditors consider is actually far in excess of what this type of option should be. With the consideration that the proposed Concept roundabout design still leaves some safety questions unanswered, but also with the acknowledgement that the present intersection layout has immediate serious safety issues, a real Do-Minimum option should be developed and assessed for early implementation.
A Do-Minimum option may involve:

- Speed management and enforcement, eg fixed cameras, Police enforcement etc
- Electronic Warning Signs and/or Active signs
- Speed limit reduction
- Surfacing and line-marking changes
- Access and parking rationalisation
- Pedestrian facility provision

This would permit prompt safety improvements to be carried out, whilst investigations continue into factors which may affect the viability of the proposed Concept:

- Further crash analysis to determine if the reduced crash trend continues following installation of the reduced speed limit
- Decision on moving the Cook Strait ferry service to Clifford Bay (including spin-off effects on the location of the rail freight depot)
- Progression of land purchase negotiations and stakeholder consultation for subsequent construction of a full Concept.

Recommendation:

Develop a true Do-Minimum option for prompt implementation to address serious safety issues with the present intersection layout.
Re-consider the development of a Traffic light-controlled intersection option.
Continue to assess suitability of roundabout Concept option by analysing crash data, whilst progressing land purchase and consultation for a full intersection re-modelling.

Frequency Rating:	***Severity Rating:***
Crashes are likely to be **Common**	*Death or serious injury is* **Likely**

Designer Response: *Developing a 'true' Do-Minimum option for prompt implementation was not requested by the client at the commencement of this project.*

Traffic signals have been assessed and signals will achieve safety or efficiency but they can't deliver safety and efficiency as well as the roundabout will in this location.

It is acknowledged that a speed reduction and the associated enforcements required, making drivers slow down will reduce crash severity but will not address the common turning crash occurrences at this intersection. The intersection approach geometry and different east-west priority controls are main crash factors. I do not support the suggestion that pedestrian provision can be safely achieved across the five traffic lanes on State Highway 1 with the opposed right turn lanes.

This is a difficult recommendation to respond to and the frequency rating and severity rating are questioned.

Safety Engineer: ***Agree with designer's response. Project scope was looking for an enduring solution not a temporary fix. Should the findings of the recommendations in 2.2 regarding crash reviews as the RAB project progresses then the option proposed by the auditors could be re-litigated.***

Client Decision: ***Agree with the designer/safety engineers response- final SAR reprt due soon – this will be internally reviewed by NZTA reviewed early new year when decision making as to how this project continues will be decided.***

Action Taken: As 2.2 - Review crash data at end of design phase

3 Audit Statement

We certify that we have used the available plans, and have examined the specified roads and their environment, to identify features of the project we have been asked to look at that could be changed, removed or modified in order to improve safety. The problems identified have been noted in this report.

Signed: ..... Date:
Andy High, Transportation Safety Manager, Opus International Consultants, Nelson

Signed: ..... Date: 17/10/2013
Steve James, AIPENZ, Wellington Regional Safety Engineer, NZTA

Designer: *Name Warren Lloyd* *Position Director*

Signature WL *Date 11 November 2013*

Safety Engineer: *Name*..... *Position*.....

Signature..... *Date*.....

Project Manager: *Name* Andrew Adams *Position* Senior Project Eng.

Signature ..... *Date* 23/12/13

Action Completed: *Name*..... *Position*.....

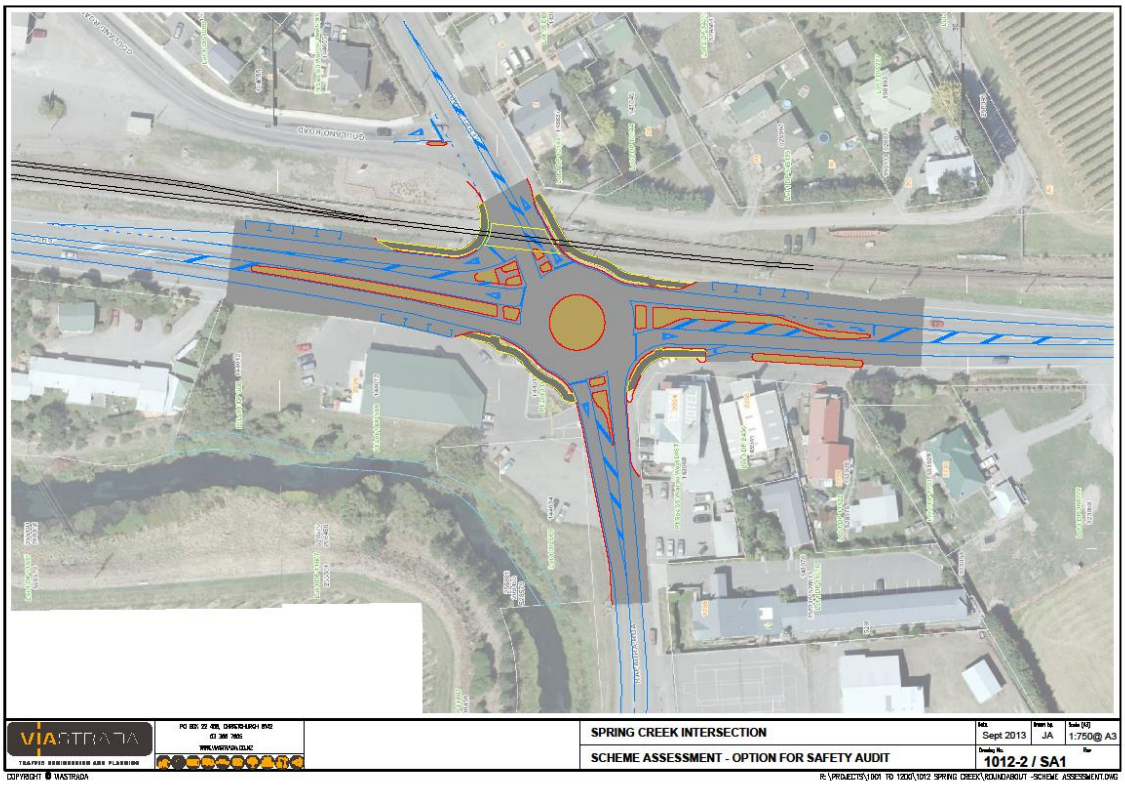
Signature..... *Date*.....

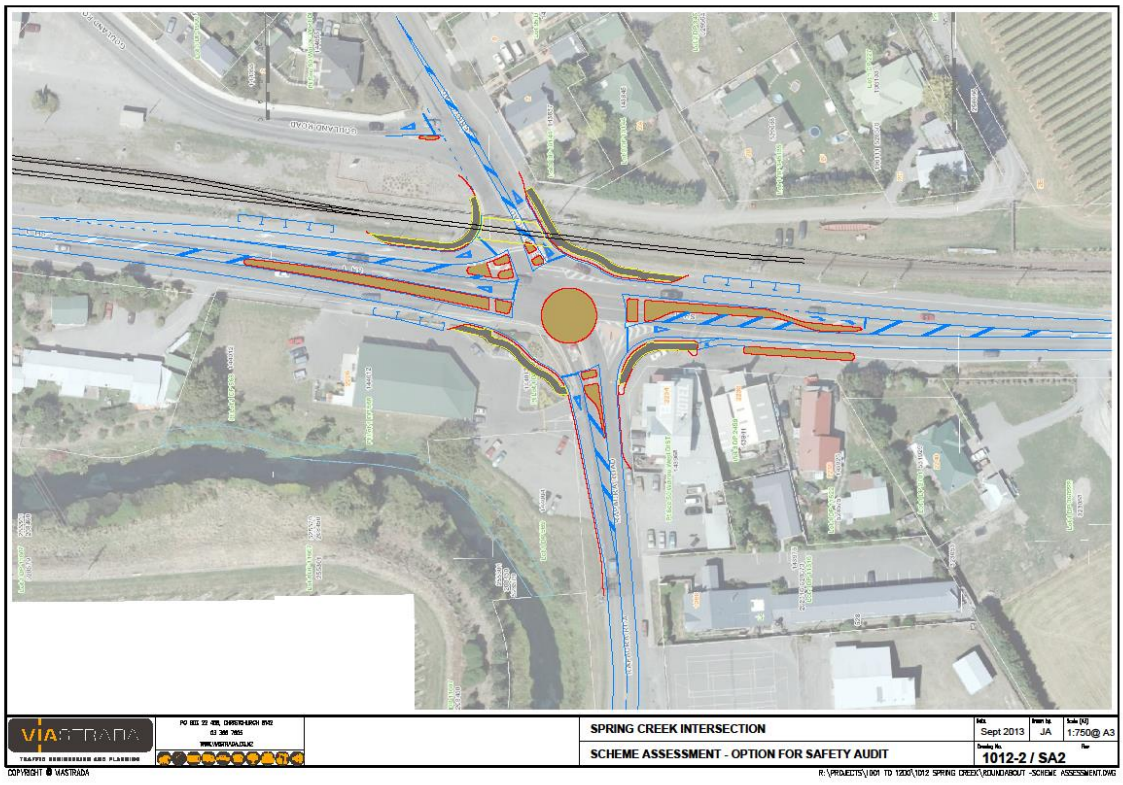
Project Manager to distribute audit report incorporating decision to designer, Safety Audit Team Leader, Safety Engineer and project file.

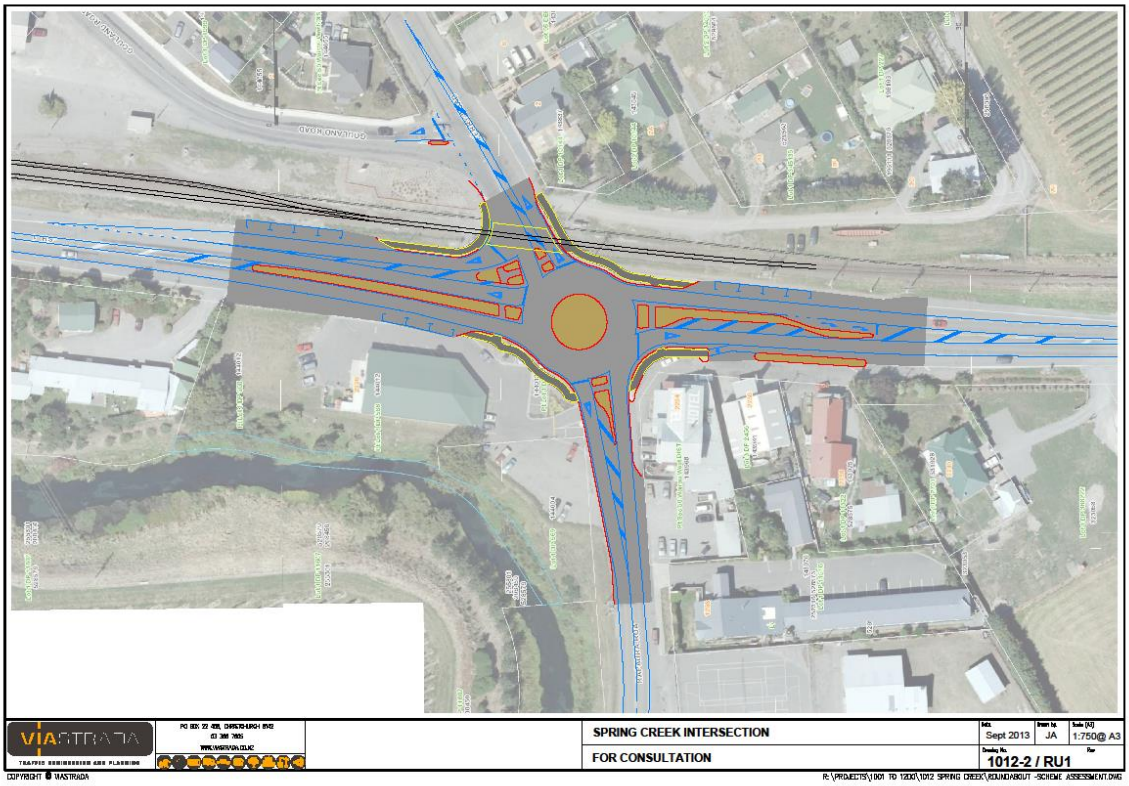
Date: .....

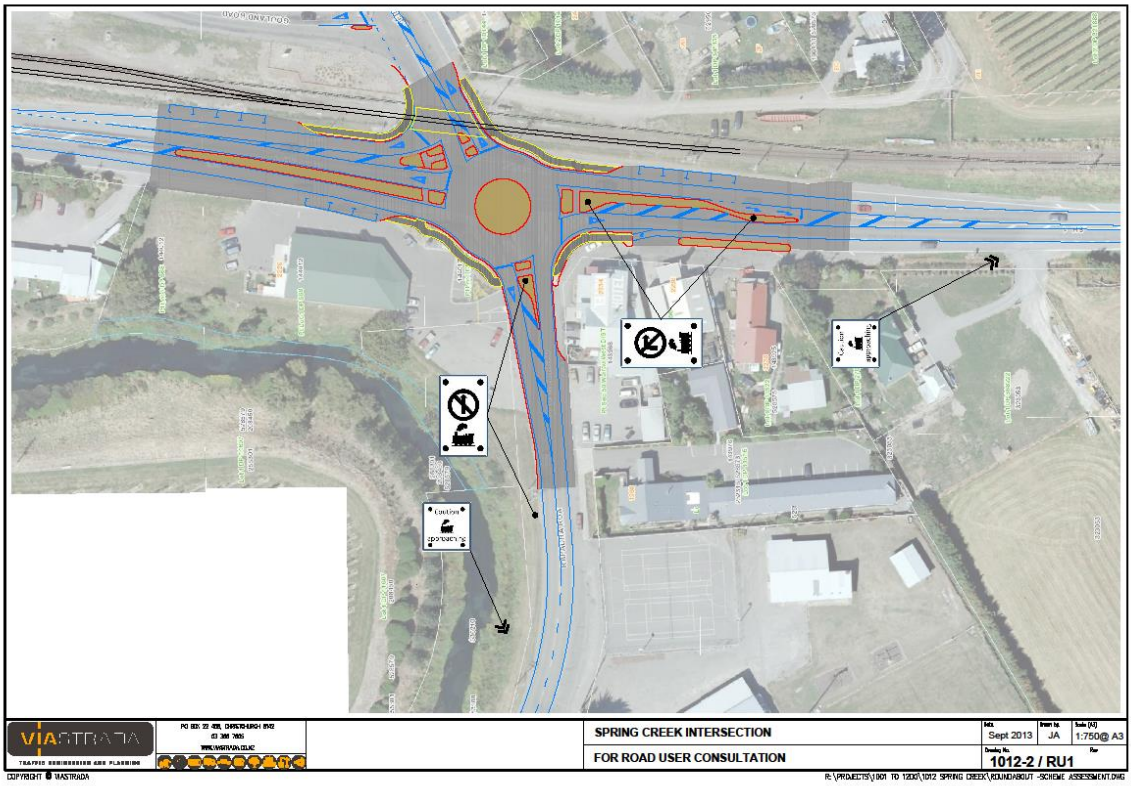
APPENDIX A

Plans examined during the audit.






SPRING CREEK INTERSECTION
FOR CONSULTATION
Sept 2013
JA
1:750@ A3
1012-2 / RU1


SPRING CREEK INTERSECTION
FOR ROAD USER CONSULTATION
Sept 2013
JA
1:750@ A3
1012-2 / RU1

Appendix O Cost Estimate

Spring Creek SH1 / SH6 Intersection
Roundabout
Full Pavement Reconstruction
SE
Scheme Assessment Estimate
Project Estimate

Item	Description	Base estimate	Contingency	Funding risk
A	**Nett project property cost**	174500	26,200	43,600
	Investigation and reporting:			
	– consultancy fees	Nil	Nil	Nil
	– the NZTA–managed costs	Nil	Nil	Nil
B	**Total investigation and reporting**	Nil	Nil	Nil
	Design and project documentation:			
	– consultancy fees			
	– the NZTA–managed costs			
C	**Total design and project documentation**	98,995	14,849	24,749
	Construction			
	MSQA			
	– consultancy fees			
	– the NZTA–managed costs			
	– consent monitoring fees			
	Sub-total base MSQA	98,995		
	Physical works			
1	Environmental compliance	20,000		
2	Earthworks	79,895		
3	Ground improvements	136,270		
4	Drainage	408,375		
5	Pavement and surfacing	405,755		
6	Railway Crossing	50,000		
7	Retaining walls	5,000		
8	Traffic services	180,000		
9	Service relocations	120,000		
10	Landscaping	53,610		
11	Traffic management and temporary works	100,000		
12	Preliminary and general	81,000		
13	Extraordinary construction costs	10,000		
	Sub-total base physical works	1,649,905		
D	Total construction	1,748,900	276,300	552,200
E	Project base estimate (A+C	2,022,395		
F	Contingency (Assessed/Analysed)	(A+C+D)	317,349	
G	Project expected estimate	(E+F)	2,339,744	
	Project property cost expected estimate		200,700	
	Investigation and reporting expected estimate		Nil	
	Design and project documentation expected estimate		113,844	
	Construction expected estimate		2,025,200	
H	Funding risk (Assessed/Analysed)		(A+C+D)	620,549
I	95th percentile Project Estimate		(G+H)	2,960,293
	Project property cost 95th percentile estimate			244,300
	Investigation and reporting 95th percentile estimate			Nil
	Design and project documentation 95th percentile estimate			138,593
	Construction 95th percentile estimate			2,577,400

Date of Estimate: 28/01/2014	Cost index (Qtr/Year)	Dec-13
Estimate prepared by: J Ashford	Signed	
Estimate internal peer review by: W Lloyd	Signed	
Estimate external peer review by	Signed	
Estimate accepted by the NZTA	Signed	

Note: (1) These estimates are exclusive of escalation and GST.
(2) Investigation and reporting project phase estimates are set to nil as these are now sunk costs.

Net Property Costs

Spring Creek SH1 / SH6 Intersection
Roundabout
Full Pavement Reconstruction

Scheme Assessment Estimate
Net property costs

PPC

Property acquisition reference	Property requirements	Purchased	Property purchase cost (A)	(Less) disposal value (B)	Nett property purchase costs (A-B=C)	Property compensation costs (D)	Property owner accom works (E)	Nett project property cost (C+D+E=F)
	Commercial Land Acquisition - FourSquare		40,000	0	40,000	130,000	0	170,000
	MDC land		1,500	0	1,500	3,000	0	4,500
			0	0	0	0	0	0
			0	0	0	0	0	0
			0	0	0	0	0	0
			0	0	0	0	0	0
			0	0	0	0	0	0
			0	0	0	0	0	0
			0	0	0	0	0	0
			0	0	0	0	0	0
			0	0	0	0	0	0
Fees	Property acquisiton agents fees	-	-	-	-	-	-	0
Base Estimate			**41,500**	**0**	**41,500**	**133,000**	**0**	**174,500**
Contingency								26,200
Expected estimate								**200,700**
Funding risk								43,600
95th percentile estimate								**244,300**

Date of Estimate: 28/01/2014	**Cost index**	**Dec-13**
Estimate prepared by: J Ashford	**Signed**	
Estimate internal peer review by: W Lloyd	**Signed**	
Estimate external peer review by	**Signed**	
Estimate accepted by the NZTA project manager	**Signed**	

Note: These estimates are exclusive of escalation and GST.

Elemental Breakdown

Spring Creek SH1 / SH6 Intersection
Roundabout
Full Pavement Reconstruction

Project: 1012-2
Date: 28/01/14
By: JA

Scheme Assessment Estimate

Elemental breakdown for construction costs

Item	Description	Sub-element totals	Element totals
1	**Monitoring MSQA, NZTA-managed costs and consent monitoring fees**		$ 98,995
1.1	MSQA, NZTA-managed costs & consent monitoring fees	$ 98,995	
	Physical works		
2	**Environmental compliance**		$ 20,000
2.1	Management of environmental compliance requirements	$ 10,000	
2.2	Preparation and management of compliance managements plans	$ 10,000	
3	**Earthworks**		$ 79,895
3.1	All clearing, as necessary to carry out the works of all vegetation and other deletrious material and removal off site to an approved dump, unless other scheduled below.	$ 35,000	
3.2	Removal of existing kerbs (Mountable, flat kerb and channel, dish channel)	$ 4,400	
3.3	Remove existing fence to stockpile area	$ 1,125	
3.4	Removal of traffic signs to storage	$ 5,000	
3.5	Removal of existing light poles and foundation	$ 6,000	
3.6	Removal of existing traffic islands(includes Rapaura Road & SH1)	$ 5,500	
3.7	Relocate survey marker (Provisional Item)	$ 3,000	
3.8	Scarify existing bituminous road surface	$ 19,870	
4	**Ground improvements**		$ 136,270
4.1	Strip and stockpile topsoil (100 mm deep)	$ 450	
4.2	Cut to waste (to subgrade level)	$ 86,900	
4.3	Cut to fill (Provisional Quantity)	$ 10,000	
4.4	Formation and shaping of swales	$ 1,120	
4.5	Respread topsoil from stockpile to swale drains, bunds and batters (100mm)	$ 300	
4.6	HAIL site excavate to waste & remediation (Provisional sum)	$ 37,500	
5	**Drainage**		$ 408,375
5.1	Stormwater drainage, temporary stream diversion and culverts and rip-rap	$ 20,000	
5.2	Subsoil and pavement drains	$ 255,400	
5.3	Kerbing/edgestrip	$ 129,975	
5.4	Surface water channel	$ 3,000	
6	**Pavement and surfacing**		$ 405,755
6.1	Sawcut existing pavement (at tie-ins)	$ 300	
6.2	Preparation of subgrade (carrageway only)	$ 17,125	
6.3	Under cut unsuitable foundations (Provisional Quantity) - 200mm deep	$ 3,520	
6.4	Fill to under cut (AP65) (Provisional Quantity) - 200mm deep	$ 8,000	
6.5	Supply and place Filtration Fabric Class C (Provisional Quantity)	$ 12,000	
6.6	Supply and Place AP65 Subbase (350mm)	$ 120,000	
6.7	Supply and Place TNZ M/4 AP40 (150mm)	$ 77,250	
6.8	Membrane seal (Grade 4 chipseal) - RAB and App Rds	$ 14,130	
6.9	Stone Mastic Asphalt (SMA15) 40 mm depth - RAB and App Rds	$ 105,975	
7.0	Two Coat Chipseal (Grade 4/6)	$ 40,455	
7.1	Tie into existing seal on SH1 both ends	$ 4,000	
7.2	Tie into existing seal at Ferry and Rupaura Road	$ 3,000	

7	**Railway Crossing**			**$ 50,000**
7.1	Heavy Duty Train Crossing	$	25,000	
7.2	VMS connections & signals	$	10,000	
7.3	Pedestrian Crossings (incl guard rails)	$	10,000	
7.4	Pavement markings and railway crossing signage	$	5,000	
8	**Retaining walls**			**$ 5,000**
8.1	Timber-piled walling	$	5,000	
9	**Traffic services**			**$ 180,000**
9.1	Pavement markings	$	25,000	
9.2	Install new Signs	$	40,000	
9.3	New VMS signage	$	60,000	
9.4	Re install signs from storage areas	$	5,000	
9.5	Lighting	$	50,000	
10	**Service relocations**			**$ 120,000**
10.1	NZTA cost of all local authority and utility companies (after cost share) and contractors on costs	$	120,000	
11	**Landscaping and urban design**			**$ 53,610**
11.1	Topsoil spreading (100mm) (incl swale)	$	2,050	
11.2	Grassing - sowing (incl swale)	$	2,560	
11.3	Landscape planting	$	20,500	
11.4	Reinstatement of 0.5m high timber fencing (commercial - FourSq perimeter)	$	3,000	
11.5	Footpaths and cycleways	$	25,500	
12	**Traffic management and temporary works**			**$ 100,000**
12.1	Traffic Control/Management By Contractor	$	85,000	
12.2	Traffic management physical works costs	$	15,000	
13	**Preliminary and general**			**$ 81,000**
13.1	Establishment, disestablishment, clean-up, accommodation & other site costs.	$	20,000	
13.2	Contractor Setting Out, Supervision, Location of Exisiting Services	$	20,000	
13.3	Testing by Contractor	$	10,000	
13.4	Testing by Others (Provisional Sum)	$	10,000	
13.5	As Built and RAMM Data Report by Contractor	$	8,000	
13.6	Liaise with Others (including kiwi-rail)	$	5,000	
13.7	Sign Board (Provisional Sum)	$	3,000	
13.8	Contractor Bond and Insurances	$	5,000	
14	**Extraordinary construction costs**			**$ 10,000**
14.1	Abnormal costs: Rail linking to VMS i.e. significant non roading expenses.	$	10,000	

Base estimate			**$ 1,748,900**

Date of Estimate: 28/01/2014	**Cost index**	**Dec-13**	
Estimate prepared by: J Ashford	**Signed**		
Estimate internal peer review by: W Lloyd	**Signed**		
Estimate external peer review by	**Signed**		
Estimate accepted by the NZTA project manager	**Signed**		

Note: These estimates are exclusive of contingency, funding risk, escalation and GST.

Appendix P Project Economic Evaluation

SP5 Isolated intersection improvements

Worksheet 1 – Evaluation Summary

SP5 Isolated intersection improvements

Spreadsheet v 2 (01-July-13)

Worksheet 1 – Evaluation summary

Worksheet 1 provides a summary of the general data used for the evaluation and the analysis results. The information required is a subset of the information entered into Transport Investment Online.

1	Evaluator(s)	Warren Lloyd, Viastrada Christchurch						
	Reviewer(s)							
2	Activity/package details							
	Approved organisation name	The NZ Transport Agency						
	Activity/package name	New & Improved infrastructure for State Highways						
	Your reference	SH1s SH62 Spring Creek Intersection RAB						
	Activity description	Safety improvements						
	Describe the issues to be addressec	High number of serious & fatal crashes and high speeds						
3	Location							
	Brief description of location	Spring Creek is 6 km north of Blenheim on SH1s						
4	Alternatives and options							
	Describe the do-minimum	Leave intersection as it is – do nothing						
	Summarise the options assessed	Roundabout -See Scheme Assessment Report [SAR]						
5	Timing							
	Time zero (assumed construction start date)			1 July	2013			
	Expected duration of construction (months)				6			
6	Economic efficiency							
	Date economic evaluation completed (mm/yyyy)				Dec-13			
	Base date for costs and benefits			1 July	2013			
	AADT at time zero				13,000			
	Traffic growth rate at time zero (%)				0.13%			
	Traffic volume entering the intersection	13,000	in the year	2013/14				
	Posted speed limit	70	km/h					
7	PV cost of do-minimum						$ 1,182,018	A
8	PV cost of the preferred option						$ 3,023,511	B
9	Benefit values from worksheet 4, 5, 6							
	PV travel time cost savings	$ -45,135	C × Update factor ^{TTC}		1.40	= $	-63,189	W
	PV VOC and CO_2 savings	$ -10,765	D × Update factor ^{VOC}		1.06	= $	-11,411	Y
	PV crash cost savings	$ 6,323,685	E × Update factor ^{AC}		1.22	= $	7,714,896	Z
10	BCR_N = PV net benefits / PV net costs	=	W + Y + Z / B – A	=	7,640,296 / 1,841,492	=	4.15	
11	FYRR = PV 1st year benefits / PV net costs	=	[(W + Y) / DF + (Z / DF)] × 0.94 / B – A			=	0.31	%

SP5 Isolated intersection improvements

Spreadsheet v 2 (01-July-13)

Worksheet 2 - Cost of the do-minimum

Worksheet 2 is used to calculate the PV cost of the do minimum. The do minimum is the minimum level of expenditure necessary to keep an intersection open and generally consists of maintenance work.

In a limited number of cases, the do minimum will involve capital expenditure. The cost of any works (including investigation, design and construction) must be included in the evaluation. The costs should be discounted to present value by multiplying by the SPPWF for year 1 (0.94) and reported as one of the periodic maintenance costs.

1 Historic maintenance cost data (indicate whether assessed or actual)

Maintenance costs for the site over last three years	Year 1 $	37,049
	Year 2 $	86,614
	Year 3 $	69,363
Maintenance costs for the site this year	$	80,803
Assessed future maintenance costs	$	68,457

2 PV of annual maintenance costs

Total = $ 68,457 x 15.49 = $ 1,060,405 **(a)**

3 PV of periodic maintenance costs (include any capital works)

Time zero — 1st July in the year: 2013

Periodic maintenance will be required in the following years:

Year	Type of maintenance	Amount $	SPPWF	PV
10	RSB	51,350	0.56	28,674

Sum of PV of periodic maintenance $ 28,674 **(b)**

4 PV or annual operating costs

Total = $ 6,000 x 15.49 = $ 92,940 **(c)**

5 PV cost of the do-minimum

(a) + (b) + (c) = $ 1,182,018 **A**

Transfer the PV cost of do minimum **A**, to **A** on worksheet 1.

SP5 Isolated intersection improvements

Spreadsheet v 2 (01-July-13)

Worksheet 3 - Cost of Option

Worksheet 3 is used for calculating the PV cost of the isolated intersection improvements.

1 PV of estimated cost of proposed work (as per attached estimate sheets)

$ 2,339,744 x 0.94 = $ 2,199,359 **(a)**

2 PV of maintenance cost in year 1

= $ 41,926 **(b)**

3 PV of annual maintenance costs following completion of the work

(years 2 to 40 inclusive) $ 41,926 x 14.52 = $ 608,760 **(c)**

4 PV of periodic maintenance costs

Time zero — 1st July in the year 2013

Year	Type of maintenance	Amount $	SPPWF	PV
15	reseal	123,418	0.42	51,498

Sum of PV of periodic maintenance = $ 51,498 **(d)**

5 PV cost of annual operating costs (separate to maintenance costs)

(years 2 to 40 inclusive) $ 8,400 x 14.52 = $ 121,968 **(e)**

6 PV of total costs of the preferred option

PV total costs **(a)** + **(b)** + **(c)** + **(d)** + **(e)** = $ 3,023,511 **B**

Transfer the PV cost for the preferred option **B**, to **B** on worksheet 1

SP5 Isolated intersection improvements

Spreadsheet v 2 (01-July-13)

Worksheet 4 - Travel time cost savings

This worksheet is used for calculating travel time cost savings from modifying or changing the control of an intersection eg, from priority control to traffic signals. Intersection analysis requires modelling to be used for both the do minimum and project option. It is not allowable to compare calculated delay and measured delay. Instead, the measured delay must be used to calibrate the calculated delay.

The annual travel time costs for the do minimum and the project option are to be calculated either using direct output from a suitable computer programme or by aggregating outputs for representative time periods. Output and notes should be attached. Alternatively, fill in the tables in worksheet 4 as per the instructions below.

The travel time cost (TTC) calculations start at the beginning of year 2 (following completion of construction works in year 1) and finish at the end of year 40.

Annual travel time cost

	Period	1	2	3	4	5
	Period start year	2	10	18	26	34
	Period end year	9	17	25	33	40
	Midpoint at end of year	5	13	21	29	37
	Duration of period	8	8	8	8	7
1	Do-minimum travel time cost at midpoint	47,418.78	48,557.91	49,961.93	51,426.64	52,719.26
2	Option travel time cost at midpoint	51,351.55	51,885.78	52,449.42	53,127.73	53,678.44
		c^1	c^2	c^3	c^4	c^5
3	Midpoint benefits **(1) - (2)**	-3,932.8	-3,327.9	-2,487.5	-1,701.1	-959.2
4	PV travel time cost savings	-23,510	-12,482	-5,854	-2,512	-777

5 Travel time cost savings

$= [c^1 + c^2 + c^3 + c^4 + c^5]$ = $ -45,135 **C**

Transfer the PV travel time cost savings, **C** for the preferred option to **C** on worksheet 1

SP5 Isolated intersection improvements

Spreadsheet v 2 (01-July-13)

Worksheet 5 - Vehicle operating cost savings

This worksheet is used for calculating vehicle operating cost savings from modifying or changing the control of an intersection eg, from priority control to traffic signals. Intersection analysis requires modelling to be used for both the do minimum and project option.

The annual VOC for the do minimum and the project option are to be calculated either using direct output from a suitable computer programme (such as SIDRA, INTANAL or SCATES) or by aggregating outputs for representative time periods. Output and notes should be attached. Alternatively, fill in the tables in worksheet 5 as per the instructions below.

For intersections, VOC are not directly proportional to growth in traffic volumes. Hence, the calculations of VOC savings are undertaken in eight yearly steps and the discounted values are summed to more accurately reflect the savings over the 40 year evaluation period.

The VOC calculations start at the beginning of year 2 (following completion of construction works in year 1) and finish at the end of year 40.

Annual VOC

	Period	1	2	3	4	5
	Period start year	2	10	18	26	34
	Period end year	9	17	25	33	40
	Mid point at end of year	5	13	21	29	37
	Duration of period	8	8	8	8	7
1	Do-minimum VOC at midpoint	59,019.59	59,610.85	60,206.21	60,838.73	61,433.87
2	Option VOC at midpoint	59,718.44	60,340.77	60,955.38	61,555.11	62,192.40
		c^1	c^2	c^3	c^4	c^5
3	Midpoint benefits **(1)** - **(2)**	-698.9	-729.9	-749.2	-716.4	-758.5
	PV VOC and CO2 savings	-4,178	-2,738	-1,763	-1,058	-615

4 VOC and CO_2 savings

$= [c^1 + c^2 + c^3 + c^4 + c^5] \times 1.04$ = $ -10,765 **D**

Transfer the PV of VOC and CO_2 savings, **D** for the preferred option to **D** on worksheet 1.

SP5 Isolated intersection improvements

Spreadsheet v 2 (01-July-13)

Worksheet 6 - Crash cost savings

These simplified procedures are suitable only for **crash–by–crash analysis** (method A in appendix A6). There must be 5 years or more crash data for the site and the number and types of crashes must meet the specifications set out in appendix A6.1 and A6.2. If not, either the crash rate analysis or weighted crash procedure described in appendix A6.2 should be used. The annual crash cost savings determined from such an evaluation are multiplied by the appropriate discount factor and entered in worksheet 1 as total E. Evidence to support alternative analysis must be attached.

	Movement category	All movements	Vehicle involvement	All Vehicles	
1	Do-minimum mean speed	70	Road category	Rural strategic	
	Posted speed limit	70	Traffic growth rate	0.13%	%
2	Option mean speed	70			

	Do-minimum	**Severity**			
		Fatal	**Serious**	**Minor**	**Non-injury**
3	Number of years of typical crash rate records	5			
4	Number of reported crashes over period	1	2	8	6
5	Fatal/serious severity ratio (tables A6.19(a) to (c))	0.18	0.82	1.0	1.0
6	Number of reported crashes adjusted by severity **(4)** x **(5)**	0.54	2.46	8	6
7	Crashes per year = **(6)/(3)**	0.11	0.49	1.60	1.20
8	Adjustment factor for crash trend (table A6.1(a))	0.95			
9	Adjusted crashes per year = **(7)** x **(8)**	0.103	0.467	1.520	1.140
10	Under-reporting factors (tables A6.20(a) to (b))	1	1.5	2.75	7
11	Total estimated crashes per year = **(9)** x **(10)**	0.103	0.701	4.180	7.980
12	Crash cost, 100km/h limit (tables A6.21(e) to (h))	3,800,000	405,000	24,000	2,400
13	Crash cost, 50km/h limit (tables A6.21(a) to (d))	3,350,000	360,000	21,000	2,100
14	Mean speed adjustment = (**(1)** - 50)/50	0.4			
15	Cost per crash = **(13)** + **(14)** x [**(12)** - **(13)**]	3,530,000	378,000	22,200	2,220
16	Crash cost per year = **(11)** x **(15)**	362,178	265,016	92,796	17,716
17	Total cost of crashes per year (sum of columns in row **(16)** fatal + serious + minor + non-injury)	$737,705			
	Option				
18	Percentage crash reduction	70	70	50	50
19	Percentage of crashes 'remaining' [100 - **(18)**]	30	30	50	50
20	Predicted crashes per year **(11)** x **(19)**	0.031	0.210	2.090	3.990
21	Crash cost, 100km/h limit (tables A6.21(e) to (h))	3,800,000	405,000	24,000	2,400
22	Crash cost, 50km/h limit (tables A6.21(a) to (d))	3,350,000	360,000	21,000	2,100
23	Mean speed adjustment = (**(2)** - 50)/50	0.4			
24	Cost per crash = **(22)** + **(23)** x [**(21)** - **(22)**]	3,530,000	378,000	22,200	2,220
25	Crash cost per year = **(20)** x **(24)**	108,653	79,505	46,398	8,858
26	Total cost of crashes per year (sum of columns in row **(25)** fatal + serious + minor + non-injury	$243,414			
27	Annual crash cost savings = **(17)** - **(26)**	$494,291			
28	PV crash cost savings = **(27)** x DF	$6,323,685			E

Transfer PV of crash cost savings, E for the preferred option to E on worksheet 1