SAFE SYSTEM ASSESSMENT

SH2-MELLING INTERSECTION IMPROVEMENTS

PREPARED FOR NZ TRANSPORT AGENCY

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Stantec

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Abbreviations

AADT	annual average daily traffic (from a full year's data)
ADT	average daily traffic (from less than a full year's data)
CAS	Crash Analysis System
DSI	death or serious injury
HCV	heavy commercial vehicle
TCR	traffic crash report

NZ Transport Agency

SH2 Melling Intersection Improvements

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1 Introduction

1.1 Description of Site

The project is a proposed replacement of the two at-grade signalised intersections on the SH2 expressway through Hutt City at Harbour View Road/Melling Link and Tirohanga Road/Block Road with a grade separated interchange.

1.2 Process

This Safe System assessment framework analysis has been undertaken to assess the level of alignment of this project to the Safe System objectives. The existing intersection will be compared against the future interchange.

1.3 Project Background

The SH2 Melling Intersection Improvements project seeks to remove the existing two signalised intersections on SH2 at the Melling Link/Harbour View intersection and the Tirohanga Road / Block Road intersection and replace them with a grade separated interchange. The project location is shown in Figure 1 below:

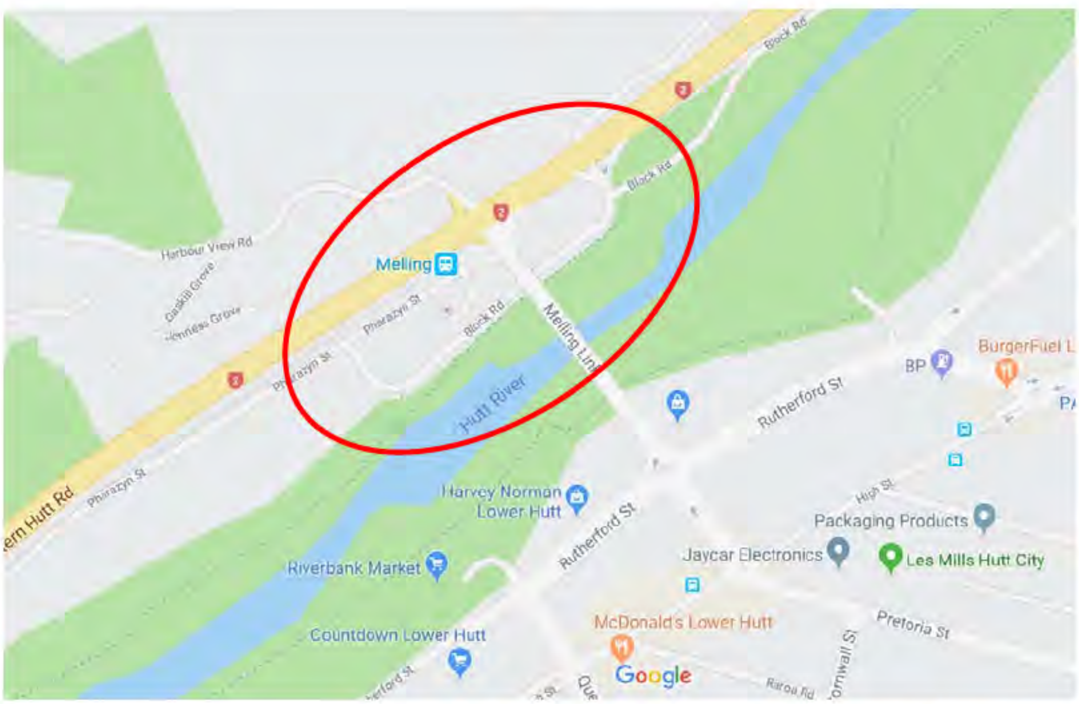

Figure 1: Map showing location of the site under assessment (source: GoogleMaps)

1.3.1 Road Network

SH2 in the vicinity of the Melling Link carries approximately 20,000 vpd in each direction (refer to Section 1.5 below).

The speed limit on SH2 is 100 km/h with speed limits of 50 km/h on the side roads.

The two intersections with SH2 in this vicinity are signal controlled.

There are dominant right turn flows both from SH2 to the south turning right into Melling Link to access Lower Hutt and from Melling Link turning right into SH2 to the north to access Upper Hutt and the Wairarapa as well as SH58 to link into SH1 and the western side of the lower north island.

1.3.2 Proposed Interchange

The proposed design provides for a signalised diamond interchange at SH2 south of the current signalised intersections. This will replace the existing at-grade signalised intersections.

The interchange will link directly to the Hutt City intersection at Queens Drive/Rutherford Street via a new bridge over the Hutt River. The existing Melling Link river bridge will be demolished. The eastern intersection of the interchange is to be a five-leg signalised intersection as it incorporates access to/from the relocated Melling railway station via Pharazyn Street. On Harbour View Road, approximately 30 m west of the western intersection of the interchange, will be a priority T-intersection to provide a link to Tirohanga Road.

Cyclists southbound on the SH2 expressway will be provided with an off-road path to negotiate the interchange. Shared paths are proposed to facilitate safe access across the interchange and on to the Queens Drive/Rutherford Street intersection.

1.4 Traffic Counts

1.4.1 Motorised vehicles

Annual average daily traffic (AADT) traffic counts and heavy vehicle percentages were obtained from MobileRoad and are detailed in the table below.

Table 1-1: AADT and HV% traffic data for the roads within the project extent

Road Description	AADT (vpd)	HV%
Harbour View Road	1,387	1
Tirohanga Road	1,952	0
Block Road	6,701	4
Pharazyn St	2,360	4
Melling Link	20,237	4
SH2 Northbound (North of Melling)	20,966	4.4
SH2 Northbound (South of Melling)	18,115	4.4
SH2 Southbound (North of Melling)	19.501	3.9
SH2 Southbound (South of Melling)	20,895	4.4

1.4.2 Pedestrians

Recently surveyed pedestrian data at the SH2 / Melling Link intersection amounted to 1132 between 7 am and 7 pm excluding the period 10 am to 2 pm on a Wednesday.

1.4.3 Cyclists

Recently surveyed cyclist data at the SH2 / Melling Link intersection amounted to 51 between 7 am and 7 pm excluding the period 10 am to 2 pm on a Wednesday.

1.5 Five-year Crash History

A search was made of the NZ Transport Agency's Crash Analysis System (CAS) for all reported crashes within a 250 m radius of the SH2 Melling Intersection during the full five-year period from 2014 to 2018 and all available crash records from 2019.

The search revealed a total of 116 crashes over the search period including five serious injury crashes and 14 minor injury crashes. The remaining 97 crashes were classified as non-injury crashes.

The location of the 19 injury crashes is illustrated in the crash diagram in Figure 2.

The recorded crashes can be broken down as follows.

- 17 crashes were over-taking type crashes;
- Six crashes were straight road / lost control / head on type crashes;
- Seven crashes were bend – lost control/head on type crashes;
- 67 crashes were rear-end type crashes;
- 19 crashes were crossing/turning type crashes;
- There were no pedestrian related crashes;
- There was one minor injury crash which involved a cyclist.

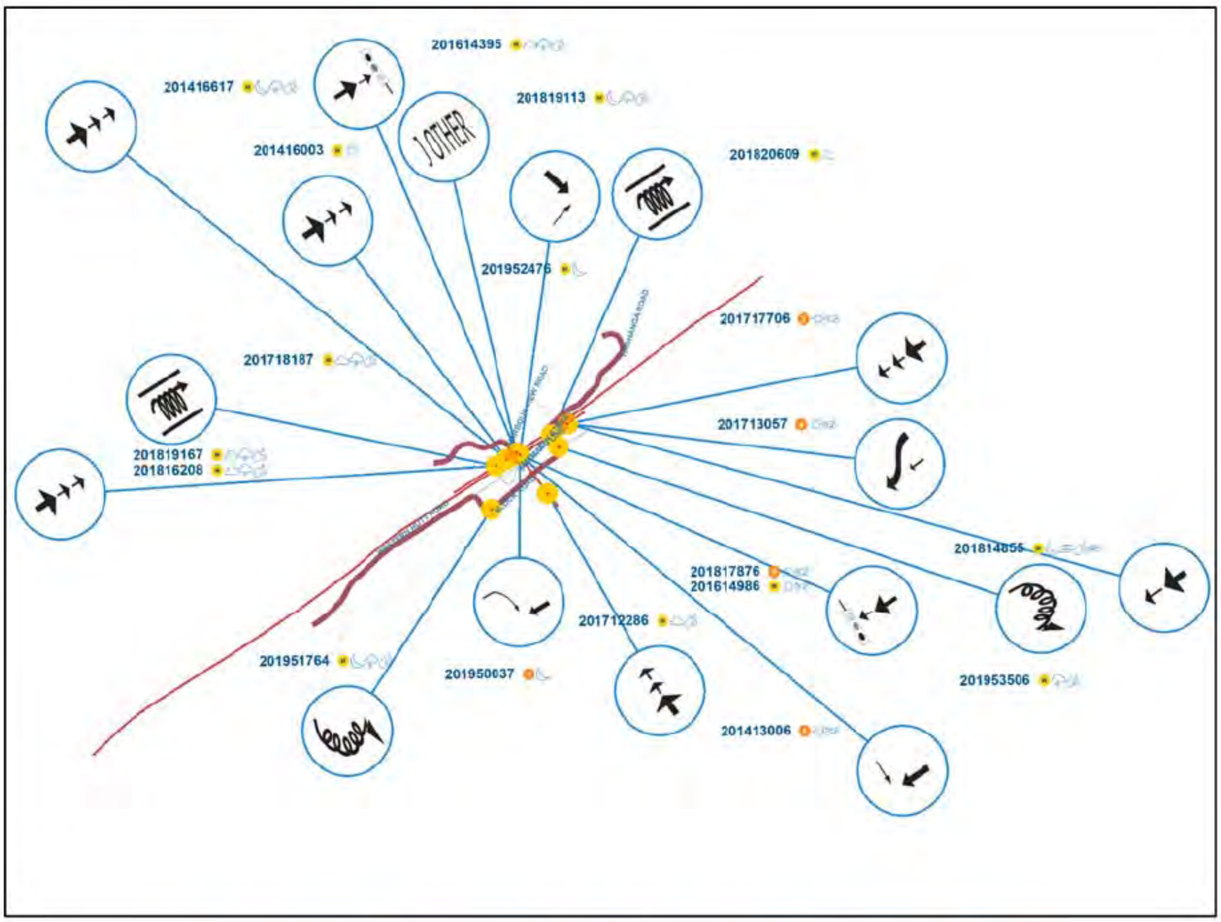

Figure 2: SH2 Melling Intersection and environs crash diagram 2014 - 2019

2 Safe System Assessment Framework

2.1 Common Safe System Components and Crashes

The Safe System has five interrelated components: safer people, safer roads and roadsides, safer vehicles, safer speeds, and safer maintenance and post-crash care.

This Safe System assessment of the existing intersection and the proposed interchange as described in Section 1 is a comparative assessment of how well or badly each fits within the Safe System. This will be used to assess how well the proposed interchange aligns with a safe system.

2.2 Safe System Matrix Scoring

This assessment is based on the Safe System Assessment Framework matrix in Table 2-1 using the scoring system in Table 2-2. (Austroads, 2016, pp. 12-13) Scores close to zero indicate close alignment with the Safe System. Scores equal to zero for either exposure, likelihood, or severity indicate that the Safe System has been achieved for that component.

Table 2-1: Safe System matrix scoring for safe roads and roadsides and safe speeds

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist	Total score
Exposure	/4	/4	/4	/4	/4	/4	/4	
Likelihood	/4	/4	/4	/4	/4	/4	/4	
Severity	/4	/4	/4	/4	/4	/4	/4	
Product	/64	/64	/64	/64	/64	/64	/64	/448

Product = exposure x likelihood x severity in each column
Total score = sum of products in each column

Table 2-2: Safe System matrix scoring system

Road user exposure	Crash likelihood	Crash severity
0 = there is no exposure to a certain crash type. This might mean there is no side flow or intersecting roads, no cyclists, no pedestrians, or motorcyclists).	0 = there is only minimal chance that a given crash type can occur for an individual road user given the infrastructure in place. Only extreme behaviour or substantial vehicle failure could lead to a crash. This may mean, for example, that two traffic streams do not cross at grade, or that pedestrians do not cross the road.	0 = should a crash occur, there is only minimal chance that it will result in a fatality or serious injury to the relevant road user involved. This might mean that kinetic energies transferred during the crash are low enough not to cause a death or serious injury (DSI), or that excessive kinetic energies are effectively redirected/dissipated before being transferred to the road user. Users may refer to Safe System-critical impact speeds for different crash types, while considering impact angles, and types of roadside hazards/barriers present.
1 = volumes of vehicles that may be involved in a particular crash type are particularly low, and therefore exposure is low. For run-of-road, head-on, intersection and 'other' crash types, AADT is < 1 000 per day. For cyclist, pedestrian and motorcycle crash types, volumes are < 10 units per day.	1 = it is highly unlikely that a given crash type will occur.	1 = should a crash occur, it is highly unlikely that it will result in a fatality or serious injury to any road user involved. Kinetic energies must be fairly low during a crash, or the majority is effectively dissipated before reaching the road user.
2 = volumes of vehicles that may be involved in a particular crash type are moderate, and therefore exposure is moderate. For run-of-road, head-on, intersection and 'other' crash types, AADT is between 1 000 and 5 000 per day. For cyclist, pedestrian and motorcycle crash types, volumes are 10–50 units per day.	2 = it is unlikely that a given crash type will occur.	2 = should a crash occur, it is unlikely that it will result in a fatality or serious injury to any road user involved. Kinetic energies are moderate, and the majority of the time they are effectively dissipated before reaching the road user.
3 = volumes of vehicles that may be involved in a particular crash type are high, and therefore exposure is high. For run-of-road, head-on, intersection and 'other' crash types, AADT is between 5 000 and 10 000 per day. For cyclist, pedestrian and motorcycle crash types, volumes are 50–100 units per day.	3 = it is likely that a given crash type will occur.	3 = should a crash occur, it is likely that it will result in a fatality or serious injury to any road user involved. Kinetic energies are moderate but are not effectively dissipated and therefore may or may not result in an FSI.
4 = volumes of vehicles that may be involved in a particular crash type are very high, or the road is very long, and therefore exposure is very high. For run-of-road, head-on, intersection and 'other' crash types, AADT is > 10 000 per day. For cyclist, pedestrian and motorcycle crash types, volumes are > 100 units per day.	4 = the likelihood of individual road user errors leading to a crash is high given the infrastructure in place (e.g. high approach speed to a sharp curve, priority movement control, filtering right turn across several opposing lanes, high speed).	4 = should a crash occur, it is highly likely that it will result in a fatality or serious injury to any road user involved. Kinetic energies are high enough to cause a DSI crash, and it is unlikely that the forces will be dissipated before reaching the road user.

2.3 Safe System Assessment

2.3.1 Existing Signalised Intersection

The score of 228/448 in Table 2-3 indicates that the existing intersections are far removed from a Safe System.

Table 2-3: Existing Signalised Intersection Safe System scores

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist	Total score
Exposure	4	4	4	4	4	3	4	
Likelihood	3	1	3	2	2	3	3	
Severity	3	3	4	2	4	4	4	
Product	36/64	12/64	48/64	16/64	32/64	36/64	48/64	228/448

Short descriptions of the derivations of the scores in Table 2-3 are given in Sections 2.3.3 to 2.3.9.

2.3.2 Proposed Interchange

The score of 72/448 in Table 2-4 indicates that the proposed interchange is considerably more aligned with a Safe System than the existing signalised intersections. In fact, given the high exposure scores of 4 that cannot be reduced, the overall score is about as close to a Safe System as could be expected practically.

Table 2-4: Proposed Interchange Safe System scores

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist	Total score
Exposure	4	4	4	4	4	3	4	
Likelihood	0	0	2	1	1	1.5	1	
Severity	1	1	2	1.5	4	4	4	
Product	0/64	0/64	16/64	6/64	16/64	18/64	16/64	72/448

Short descriptions of the derivations of the scores in Table 2-3 are given in Sections 2.3.3 to 2.3.9.

2.3.3 Run-off Road

The exposure is based on the AADT of 20,000 vpd.

The likelihood is based on the straight alignment of the highway, coupled with the presence of power poles, narrow shoulders and interrupted edge barriers along the existing highway. In contrast, the proposed interchange has full and continuous edge barrier protection.

2.3.4 Head-on

The exposure is based on the AADT of 20,000 vpd.

The likelihood is based on the gap in the median protection at the intersection. The proposed interchange has a continuous median barrier.

2.3.5 Intersection

The exposure is based on the AADT of 20,000 vpd.

The likelihood is based on the presence of a signalised intersection on a straight alignment on a high-speed road with a posted speed limit of 100 km/h. There are separated turning and through traffic lanes. There is a high number of conflict points with full movements permitted.

The proposed interchange has the intersection grade separated from the through traffic on a straight alignment with lower speeds. There are additional separate traffic lanes for all movements.

2.3.6 Other

The exposure is based on the AADT of 20,000 vpd.

The assessment of 'other' crashes covers improved legibility of the layout and improved destination signage when compared with two closely spaced intersections serving different destinations.

The likelihood is based on the high-speed environment associated with the high AADT noting that different traffic lanes have been provided for different movements. Currently there is an issue with the right turn lane becoming full and spilling over into the adjacent through lane which necessitates through traffic needing to change lanes. There are reasonable road surface conditions with good sight distance on the straight alignment approaches.

The proposed interchange has the intersection grade separated from the through traffic with appropriate traffic lanes provided with shoulders. There will be improved signage provided at the interchange over the existing intersection.

2.3.7 Pedestrian

The exposure is based on the surveyed pedestrian volumes of 1132.

The likelihood is based on the presence of signalised pedestrian phases at the intersection albeit in a high-speed environment. The proposed interchange has the pedestrian phases grade separated from the through traffic in a lower speed environment.

2.3.8 Cyclist

The exposure is based on the surveyed cyclist volumes of 51.

The likelihood is based on the presence of narrow shoulders and the lack of any cyclist facilities at the intersection in a high-speed environment.

The proposed interchange has wider shoulders through the interchange with designated marked cyclist crossing points on the ramps. There are options for cyclists to travel up the ramps and utilise the cyclist crossing phases at the signalised intersection(s). Additionally, for southbound cyclists there is the option to utilise a shared path which is separate from the adjacent traffic lanes to avoid the grade separated intersection entirely.

2.3.9 Motorcyclist

The exposure is based on the AADT of 20,000vpd and the assumption that there are more than 100 units per day.

The likelihood is based on the signalised intersection located in a high-speed environment. The narrow shoulders, the straight alignment of the highway and the reasonable pavement condition.

The proposed interchange has wider shoulders through the interchange with the whole carriageway being new pavement. At the grade separated signalised intersection the speeds are lower, there are more traffic lanes for the required traffic movements with better signage.

3 Conclusions

Predictably, the proposed grade separated interchange at the SH2 Melling Intersection scoring 72 provides a significant overall improvement over the existing at-grade signalised intersection scoring 228.

The lower the score, the closer the scheme comes to meeting the Safe System objectives.[1]

[1] The scores are quoted here for ease of reference only. Care must be taken not to assign a level of accuracy to the scores that does not exist. The scores should rather be seen as indicating order of magnitude differences.

4 References

Austroads. (2016, February). Safe System Assessment Framework. *Research Report AP-R509-16*. Austroads Ltd.

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