Technical Memorandum

3 March 2023

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From:	s 9(2)(a)
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Subject:	SH2 Liverton Road / Hebden Crescent Safe System Assessment

Document History and Status

Revision	Date	Author	Reviewed by	Approved by	Status
0	13/01/23	s 9(2)(a)	s 9(2)(a)	s 9(2)(a)	Draft
1	02/03/23	s 9(2)(a)	s 9(2)(a)	s 9(2)(a)	Final

Revision Details

Revision	Details
0	Draft for client review
1	Final for issue

Summary

Based on the safe system assessment the proposed change to make the Liverton Road intersection with SH2 left-in left-out, the closure of the Hebden Crescent intersection with SH2 and with the associated rerouting of traffic will result in an overall safer outcome.

The safe system assessment shows that:

- Removing the right turn movement from the Liverton Road / SH2 intersection will result in a significant reduction in road safety risk.
- The quantum of additional traffic which may use one of the alternative routes is insufficient to change risk in the safe system assessment.

The following other findings are noted:

- The section of Hebden Crescent between its intersection with SH2 and the SH2/58 Haywards Interchange section could result in increased risk if the available traffic counts underrepresent current use, however, the increase in risk would be relatively low.
- Based on the safe system assessment, the Gurney Road / Major Drive alternative route is the least safe of the three alternative routes but is unlikely to be an attractive route. As noted above, the additional traffic on this route is insufficient to change the safe system assessment risk on this route. The project plans to include signage to discourage the use of this route and Direct vehicles wishing to turn right out of Liverton Road to head north on SH2 to turn around at the SH2/SH58 Haywards Interchange which is the safest of the three routes.

Introduction

The purpose of this memo is to undertake a safe system assessment of the planned works to close the intersection of Hebden Crescent and SH2 and convert the intersection of Liverton Road and SH2 to a left-in left-out intersection.

The Safe System Assessment seeks to assess the degree to which the existing facilities and the proposed options align with the Safe System.

The proposed works would require vehicles travelling south to use one of three alternatives (shown below in Figure 1):

- Travel along Hebden Crescent to the SH2/58 Haywards interchange before travelling south on SH2 (solid blue line in figure below);
- Turn left out of Liverton Road and travel north on SH2 before turning south (on SH2) at the SH2/58 Haywards interchange (dashed blue line heading north then solid blue line heading south in figure below) **[Preferred Route]**; and
- Travel along Gurney Road and Major Drive before joining SH2 at its intersection with Major Drive (orange line in figure below) **[Signage will be used to discourage this route].**

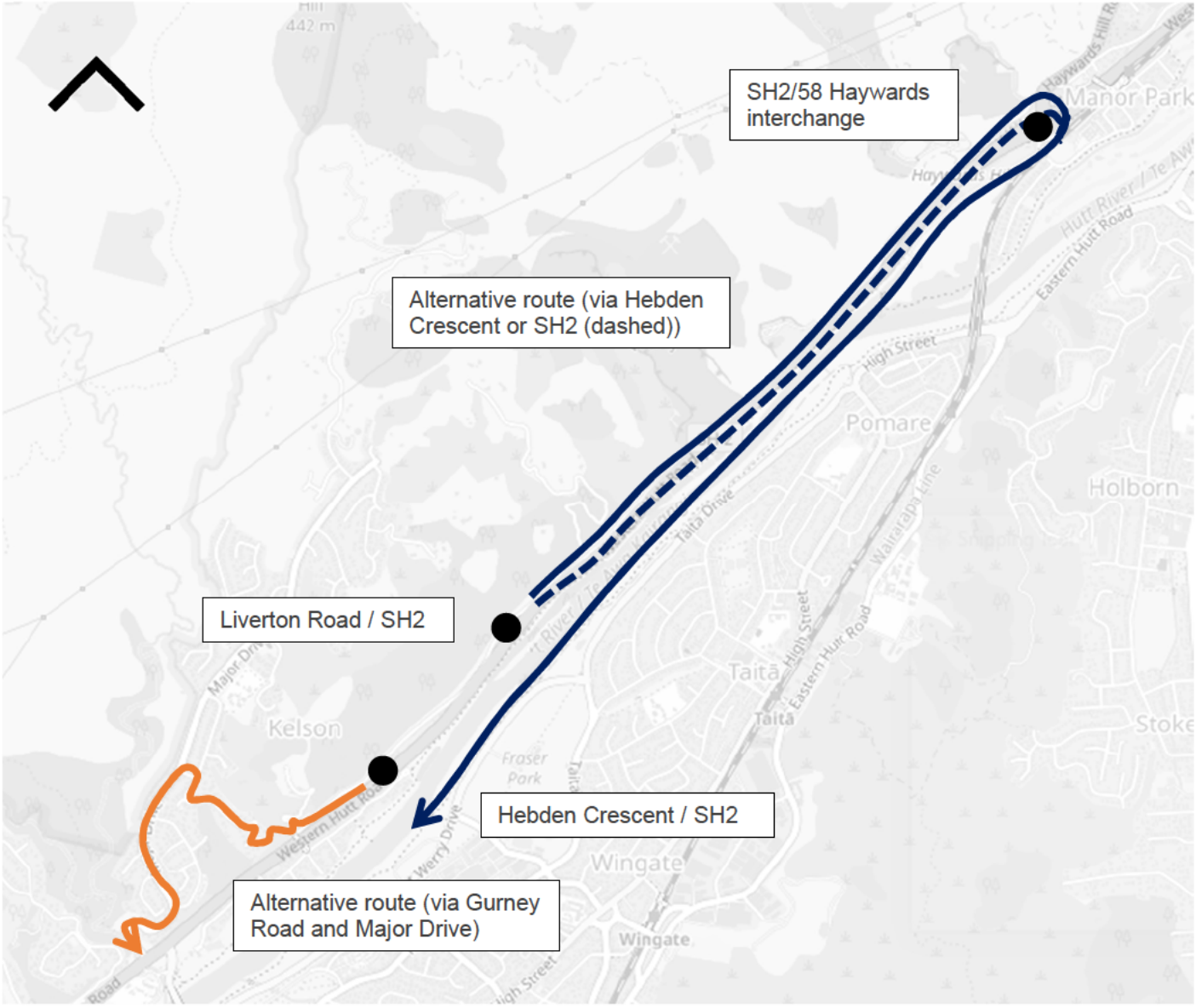


Figure 1: Overview of area

In addition to the safe system assessment, this memo also provides:

- Supporting information about the current road safety metrics along the relevant sections; and
- A discussion on the types / severity of crashes expected on the relevant sections.

Safe System Assessment

What is a safe system assessment?

A safe system assessment is a tool to help assess how closely road design and operation align with the safe system principles:

- We promote good choices but plan for mistakes.
- We design for human vulnerability.
- We strengthen all parts of the road transport system.
- We have a shared responsibility for achieving a Safe System

The safe system assessment has been undertaken in accordance with the following international and national guidance:

- Austroads Research Report AP-R509-16 Safe System Assessment Framework
- Waka Kotahi Safe System Audit guidelines (August 2022)

The safe system assessment calculates a score for major crash types by multiplying the scores for exposure, likelihood and severity. Each sub-aspect is scored out of four, as a result the highest score (least safe) for each crash type is 64 and the lowest (safest) is zero. The change in score for different crash types can be used to determine the difference between options / scenarios.

Guidance on what constitutes a sub-aspect score (exposure, severity and likelihood) is provided in the Austroads guidance and includes quantitative and qualitative criteria. Each is described below at a high level:

- Exposure is based on the number of users exposed to a potential crash;
- Likelihood is based on the probability of a crash occurring and considers a range of factors including road environment, controls and behaviour; and
- Severity is based on the likelihood of a crash resulting in a fatality or serious injury.

In this assessment, in most locations, the only factor changing is the exposure resulting from rerouted traffic.

Approach to the assessment

The route has been split into homogeneous sections (sections which have similar characteristics e.g. cross section, operating speed) for the purpose of the safe system assessment. The following sections have been assessed:

- Right turn out of Liverton Road
- Hebden Crescent to SH2/58 Haywards Interchange
- SH2/58 Haywards Interchange
- SH2 southbound
- Left turn out of Liverton Road and SH2 northbound
- Gurney Road
- Major Drive
- Major Drive / SH2 intersection

The following section summarises the safe system assessment score for each homogenous section. For simplicity, only the most applicable crash types have been considered for each section. For example, roads where there is no or very low exposure or likelihood of a crash type these have been excluded (e.g. Pedestrians on SH2). Cyclist and motorcyclist crash types have not been considered as the demand for either travel type is not expected to change as a result of this project and typically have very similar metrics to pedestrians (which have been considered where applicable).

The estimated traffic at the intersection between Liverton Road and SH2 is 368[1], it has been conservatively assumed approximately half of this (180 vehicles per day) are vehicles turning right out of Liverton Road. For the purpose of the

[1] Refer Aurecon Memorandum dated 2023-01-10 - Traffic Impacts of Closing Hebden Cres intersection with SH2 and removing Right Turns from intersection of Liverton Road and SH2

assessment a worst-case approach has been taken to the exposure component of the assessment (i.e.it is assumed that all vehicles that currently turn right out of the Liverton Road intersection use each of the alternative routes).

Crash type and severity

Considering the potential crash types and severity is an integral part of undertaking the safe system assessment.

The table below is extracted from the Waka Kotahi Safe System Audit guidelines (August 2022) and shows the boundary or threshold speed where a type of conflict is to result in an unacceptable risk of a fatality or serious injury resulting if the speed is exceeded.

Table 1: Safe impact speeds for different situations

Road and section types combined with road users	Target Safe System speed
Roads and sections used by cars and vulnerable users	30km/h
Intersections with possible side-on conflicts between cars	50km/h
Roads with possible frontal conflicts between cars	70km/h
Roads with no possible frontals or side-on conflicts between vehicles and no vulnerable road users	>100km/h

Source: ECMT, 2006

The table below shows that the crash types most likely to result in a fatality or serious injury are those involving vulnerable users (pedestrians, cyclists and motorcyclists) on higher speed roads such as SH2 and Hebden Crescent and those involving side impact crashes on high speed roads such as SH2.

Link section	Operating Speed	Conflicts with vulnerable users	Side impact crashes	Head-on (and rear-end type crashes
Hebden Crescent to SH2/58 Haywards interchange	40-79 km/h	30 km/h	50 km/h	70 km/h
SH2	>95 km/h	30 km/h	50 km/h	70 km/h
Gurney Road	<30 km/h	30 km/h	50 km/h	70 km/h
Major Drive	40-49km/h	30 km/h	50 km/h	70 km/h

The table above indicates that conflicts involving right turns into and out of intersections on SH2 (such as Liverton Road) are likely to result in a fatality or serious injury.

The safe system assessment uses information like that shown in the above tables to inform the severity score which is then combined with the exposure and likelihood scores to indicate an overall score. These severity scores are documented in the safe system assessment documented in the tables in Appendix A.

Summary of Assessment

The following table summarise the change in safe system assessment scores, the full detail is provided in Appendix A:

Route	Section	Current Operation	Proposed Operation	Worst Crash Type
Current Route	Right turn out of Liverton Road	48	0	Intersection
Alternative Route 1	Hebden Crescent to SH2/58 Haywards Interchange	9	9	Run-off Road
	SH2/58 Haywards Interchange	12	12	Intersection
	SH2 southbound	4	4	Run-off Road
Alternative Route 2	Left turn out of Liverton Road and SH2 northbound	16	16	Intersection
	SH2/58 Haywards Interchange	12	12	Intersection
	SH2 southbound	4	4	Run-off Road
	Gurney Road	32	32	Pedestrian
Alternative Route 3	Major Drive	36	36	Pedestrian
	Major Drive / SH2 intersection	32	32	Intersection

The following conclusions can be drawn from the assessment:

- Preventing the right turn out of Liverton Road results in a significant reduction (-48) in road safety risk using the safe system assessment.
- The road safety risk using the safe system assessment along Hebden Crescent is relatively low due to the low exposure to the risk which remains unchanged as a result of the rerouted traffic. This section is where the potential increased traffic is closest to changing the exposure risk rating in the safe system assessment (more information is provided on the likelihood of this in the next section). However, the risk would still be relatively low.
- The road safety risk using the safe system assessment along at the SH2/58 Haywards interchange is relatively low due to the form of the intersection which is safe system compliant. The exposure risk remains unchanged as a result of the rerouted traffic.
- The road safety risk using the safe system assessment along SH2 northbound and southbound is very low. The exposure risk remains unchanged as a result of the rerouted traffic.
- The road safety risk using the safe system assessment along Gurney Road is relatively low for vehicles but high for pedestrians. The exposure risk remains unchanged as a result of the rerouted traffic due to the low current traffic volumes and the low potential future traffic volumes as outlined in the sections below.
- The road safety risk using the safe system assessment along Major Drive is moderately low for vehicles but moderately high for pedestrians. The exposure risk remains unchanged as a result of the rerouted traffic.
- The road safety risk using the safe system assessment at the Major Drive /SH2 intersection is moderately high. The exposure risk remains unchanged as a result of the rerouted traffic.

The safe system assessment shows that the removing the right turn movement from the Liverton Road / SH2 intersection will result in a significant reduction in road safety risk. The assessment also shows that the quantum of additional traffic which may use one of the alternative routes is insufficient to change the exposure risk in the safe system assessment. It should be noted that based on the safe system assessment, the Gurney Road / Major Drive alternative route is the least safe of the alternatives. The project plans to include signage to discourage the use of this route. In addition, signage will direct vehicles wishing to turn right out of Liverton Road to head north on SH2 to turn around at the SH2/SH58 Haywards Interchange which is the safest of the three routes.

As the assessment shows, for almost all sections considered there is no change in the safe system assessment score which indicates that the assumption to exclude certain crash types (as noted above) would not have influenced the assessment.

The left turn into and out of Hebden Crescent have not been assessed as the risk profile for the current operation would be very similar to the proposed operation with a left turn into and out of Liverton Road. The exposure and severity scores would be the same with a potential improvement in likelihood with the proposed operation due to the improved sight distance and road geometry at the Liverton Road intersection.

Accuracy of traffic count data

The most up to date traffic count data has been used to inform this assessment some of which was captured over 10 years ago. The following information considers the quantum of rerouted traffic that would be required to change the exposure rating in the safe system assessment.

The bands for the exposure score used in the safe system assessment for vehicles are shown below:

0	1	2	3	4
No exposure	1-999 vehicles per day	1,000-4,999 vehicles per day	5,000-9,999 vehicles per day	More than 10,000 vehicles per day

The table below shows the current estimated demand / exposure category and the estimated future demand / exposure category. These exposure categories are used in the safe system assessment documented in the tables in Appendix A.

As noted above, the Hebden Crescent to SH2/58 Haywards Interchange section is where the potential increased traffic is closest to changing the exposure risk rating in the safe system assessment. The current estimated traffic on Hebden Crescent is ~670 vehicles per day with approximately 180 vehicles per day expected to be rerouted. The estimated future demand is 850 vehicles per hour which is still below the 1,000 vehicle per day threshold to change the exposure category.

Section	Current estimated demand (per day)	Current exposure category	Estimated future demand[2] (per day)	Estimated future exposure category
Right turn out of Liverton Road	> 10,000 on SH2	More than 10,000 vehicles per day	No exposure	No exposure
Hebden Crescent to SH2/58 Haywards Interchange	~670 from MobileRoad	1-999 vehicles per day	~850	1-999 vehicles per day
SH2/58 Haywards Interchange	~8,300 from MobileRoad	5,000-9,999 vehicles per day	~8,500	5,000-9,999 vehicles per day
SH2 southbound	> 10,000 on SH2	More than 10,000 vehicles per day	> 10,000	More than 10,000 vehicles per day
Left turn out of Liverton Road and SH2 northbound	> 10,000 on SH2	More than 10,000 vehicles per day	> 10,000	More than 10,000 vehicles per day
Gurney Road	~100[3]	1-999 vehicles per day	~280[4]	1-999 vehicles per day
Major Drive	~4,800-5,300 from MobileRoad	5,000-9,999 vehicles per day	~5,100-5,500	5,000-9,999 vehicles per day

[2] Refer to estimate of demand in 'Approach to Assessment'
[3] Refer Aurecon Memorandum dated 2023-01-10 - Traffic Impacts of Closing Hebden Cres intersection with SH2 and removing Right Turns from intersection of Liverton Road and SH2
[4] Refer Aurecon Memorandum dated 2023-01-10 - Traffic Impacts of Closing Hebden Cres intersection with SH2 and removing Right Turns from intersection of Liverton Road and SH2

Section	Current estimated demand (per day)	Current exposure category	Estimated future demand[2] (per day)	Estimated future exposure category
Major Drive / SH2 intersection	> 10,000 on SH2	More than 10,000 vehicles per day	> 10,000 (on SH2)	More than 10,000 vehicles per day

If the exposure category for the Hebden Crescent to SH2/58 Haywards Interchange section changed then the safe system assessment score would increase from 9 / 64 to 18 / 64 (for run-off road crashes).

Supporting information

The following information has been extracted from MegaMaps. MegaMaps is a Geographic Information System (GIS) provided by Waka Kotahi which uses various data sources to calculate various risk metrics for New Zealand roads.

Screenshots of the different metrics are included in Appendix B to this note. The first three sub-sections below are rated on five point scale from Low to High as per the colour scale below.

- High
- Medium High
- Medium
- Low Medium
- Low

Collective Risk

The following table shows the collective risk for each of the link sections (excludes intersections) identified in the safe system assessment.

Collective risk (also known as crash density) is a measure of the number of high-severity (fatal and serious) crashes that have happened per kilometre of road per year.

Link section	Collective Risk
Hebden Crescent to SH2/58 Haywards interchange	Low risk (south of quarry)
	Low-medium risk (north of quarry)
SH2 southbound	Medium risk
SH2 northbound	Medium risk
Gurney Road	Low risk
Major Drive	Low-medium risk (north of Sunshine Crescent -south end)
	Low risk (south of Sunshine Crescent -south end)

Personal Risk

The following table shows the personal risk for each of the link sections identified in the safe system assessment.

Personal risk (or crash rate) is a measure of the number of high-severity (fatal and serious) crashes that have happened per 100 million vehicle kilometres of travel on the road

Link section	Personal Risk
Hebden Crescent to SH2/58 Haywards interchange	Low risk (south of quarry)
	Medium risk (north of quarry)
SH2 southbound	Low-medium risk
SH2 northbound	Low-medium risk
Gurney Road	Low risk
Major Drive	Medium risk (north of Sunshine Crescent -south end)
	Low risk (south of Sunshine Crescent -south end)

Infrastructure Risk Rating

The following table shows the infrastructure risk rating for each of the link sections identified in the safe system assessment.

Infrastructure risk rating predicts the underlying level of risk a road presents to an individual road user based on key physical and operational attributes.

Link section	Infrastructure Risk Rating
Hebden Crescent to SH2/58 Haywards interchange	Low risk (south of quarry)
	Low-medium (north of quarry)
SH2 southbound	Low risk
SH2 northbound	Low risk
Gurney Road	Medium risk
Major Drive	Medium risk (between Sunshine Crescent -south end and Levin Grove)
	Low-medium risk (either end of medium risk section)

Operating Speed

The following table shows the operating speed for each of the link sections identified in the safe system assessment.

Link section	Operating Speed
Hebden Crescent to SH2/58 Haywards interchange	40-79 km/h
SH2 southbound	>95 km/h
SH2 northbound	>95 km/h
Gurney Road	<30 km/h
Major Drive	40-49km/h

Discussion

The road safety metrics extracted from Mega Maps are generally consistent with the safe system assessment:

- The infrastructure risk is highest on Gurney Road and Major Drive and lowest on SH2.
- However, the operating speeds are lowest on Gurney Road and Major Drive and highest on SH2.
- Sections of Major Drive have relatively high personal and collective risk which is consistent with the relatively high safe system assessment scores.
- Gurney Road collective and personal risk scores are low which is consistent with the scores for vehicles from the safe system assessment.
- Personal and collective risks on SH2 are relatively higher than indicated by the safe system assessment.

Appendix A – Safe System Assessment Tables

Right turn out of Liverton Road

Only the intersection crash type has been considered for this section.

Current operation

Relevant Crash types	Intersection
Exposure Comments:	AADT > 10,000 on SH2
Exposure Score:	**4/4**
Likelihood Comments:	Crash likely to occur: priority control, requires crossing two opposing lanes of high-speed traffic, risk of masking by left turn slip lane, multiple conflict points
Likelihood Score:	**3/4**
Severity Comments:	Highly likely to result in a fatality or serious injury. Survivable speed for a side impact crash is 50km/h. Posted speed limit is 100km/h.
Severity Score:	**4/4**
Product of scores	**48/64**

Proposed operation

Relevant Crash types	Intersection
Exposure Comments:	Movement not possible
Exposure Score:	**0/4**
Likelihood Comments:	Crash likely to occur: priority control, requires crossing two opposing lanes of high-speed traffic, risk of masking by left turn slip lane, multiple conflict points
Likelihood Score:	**3/4**
Severity Comments:	Highly likely to result in a fatality or serious injury. Survivable speed for a side impact crash is 50km/h. Posted speed limit is 100km/h.
Severity Score:	**4/4**
Product of scores	**0/64**

The risk assessment score is significantly lower for the proposed operation as this movement is no longer possible.

Hebden Crescent to SH2/58 Haywards interchange

Only run-off road and head-on crash types have been considered for this section. Intersections are not relevant due to the minimal side road interactions along this section. Risks for vulnerable users are not expected to change as a result of the proposed works.

Current operation

Relevant Crash types	Run-off Road	Head-on
Exposure Comments:	AADT < 1,000 on Hebden Crescent (673 from MobileRoad)	
Exposure Score:	1/4	1/4
Likelihood Comments:	Crash likely to occur: narrow lanes (no shoulder), high proportion of unprotected hazards (power-poles and drop-offs), mitigated by flat relatively straight road with reasonable forward sight distance	Crash unlikely to occur: narrow lanes, mitigated by flat relatively straight road with reasonable forward sight distance and low traffic volumes
Likelihood Score:	3/4	2/4
Severity Comments:	It is likely to result in a fatality or serious injury. Survivable speed for a frontal or side impact crash are 50km/h and 70km/h respectively. Posted speed limit is 80km/h. Very limited offset to hazards.	It is likely to result in a fatality or serious injury. Survivable speed for a head-on impact crash is 70km/h. Posted speed limit is 80km/h.
Severity Score:	3/4	3/4
Product of scores	9/64	6/64

Proposed operation

Relevant Crash types	Run-off Road	Head-on
Exposure Comments:	AADT < 1,000 on Hebden Crescent (673 from MobileRoad + 180 new vehicles = 853)	
Exposure Score:	1/4	1/4
Likelihood Comments:	Crash likely to occur: narrow lanes (no shoulder), high proportion of unprotected hazards (power-poles and drop-offs), mitigated by flat relatively straight road with reasonable forward sight distance	Crash unlikely to occur: narrow lanes, mitigated by flat relatively straight road with reasonable forward sight distance and low traffic volumes
Likelihood Score:	3/4	2/4
Severity Comments:	It is likely to result in a fatality or serious injury. Survivable speed for a frontal or side impact crash are 50km/h and 70km/h respectively. Posted speed limit is 80km/h. Very limited offset to hazards.	It is likely to result in a fatality or serious injury. Survivable speed for a head-on impact crash is 70km/h. Posted speed limit is 80km/h.
Severity Score:	3/4	3/4
Product of scores	9/64	6/64

The risk assessment score is unchanged as the increased traffic does not change the exposure risk.

SH2/58 Haywards interchange

Only the intersection crash type has been considered for this section.

Current operation

Relevant Crash types	Intersection
Exposure Comments:	5000 < AADT < 10,000 around interchange (~8,300 from MobileRoad)
Exposure Score:	**3/4**
Likelihood Comments:	Crash unlikely to occur: safe system intersection with reduced conflict points
Likelihood Score:	**2/4**
Severity Comments:	Unlikely to result in a fatality or serious injury. Low angle side impact or rear-end crashes most likely, impact speeds expected to be below survivability thresholds based on expected operating speeds.
Severity Score:	**2/4**
Product of scores	**12/64**

Proposed operation

Relevant Crash types	Intersection
Exposure Comments:	5000 < AADT < 10,000 around interchange (~8,300 from MobileRoad + 180 new vehicles)
Exposure Score:	**3/4**
Likelihood Comments:	Crash unlikely to occur: safe system intersection with reduced conflict points
Likelihood Score:	**2/4**
Severity Comments:	Unlikely to result in a fatality or serious injury. Low angle side impact or rear-end crashes most likely, impact speeds expected to be below survivability thresholds based on expected operating speeds.
Severity Score:	**2/4**
Product of scores	**12/64**

The risk assessment score is unchanged as the increased traffic does not change the exposure risk.

SH2 southbound

Only the run-off road crash type has been considered for this section. Head-on or intersection crashes are not relevant due to the absence of intersections and the presence of the median barrier. Risks for vulnerable users are not expected to change as a result of the proposed works.

Current operation

Relevant Crash types	Run-off Road
Exposure Comments:	AADT > 10,000 on SH2
Exposure Score:	4/4
Likelihood Comments:	Crash highly unlikely to occur, high standard of road with good geometric alignment, shoulders and delineation
Likelihood Score:	1/4
Severity Comments:	It is highly unlikely to result in a fatality or serious injury. Flexible median and edge barriers will dissipate forces on vehicle occupants to survivable levels. Limited high-risk hazards beyond barriers.
Severity Score:	1/4
Product of scores	4/64

Proposed operation

Relevant Crash types	Run-off Road
Exposure Comments:	AADT > 10,000 on SH2
Exposure Score:	4/4
Likelihood Comments:	Crash highly unlikely to occur, high standard of road with good geometric alignment, shoulders and delineation
Likelihood Score:	1/4
Severity Comments:	It is highly unlikely to result in a fatality or serious injury. Flexible median and edge barriers will dissipate forces on vehicle occupants to survivable levels. Limited high-risk hazards beyond barriers.
Severity Score:	1/4
Product of scores	4/64

The risk assessment score is unchanged as the increased traffic does not change the exposure risk.

Left turn out of Liverton Road and SH2 northbound

Only intersection and run-off road crash types have been considered for this section. Head-on are not relevant due to the presence of the median barrier. Risks for vulnerable users are not expected to change as a result of the proposed works.

Current operation

Relevant Crash types	Intersection	Run-off Road
Exposure Comments:	AADT > 10,000 on SH2	AADT > 10,000 on SH2
Exposure Score:	**4/4**	**4/4**
Likelihood Comments:	Crash unlikely to occur: priority control, single conflict point, high speed with sub-standard acceleration lane	Crash highly unlikely to occur, high standard of road with good geometric alignment, shoulders and delineation
Likelihood Score:	**2/4**	**1/4**
Severity Comments:	Unlikely to result in a fatality or serious injury. Low angle side impact or rear-end crashes most likely, impact speeds expected to be close to survivability thresholds.	It is likely to result in a fatality or serious injury. Flexible median barrier will dissipate forces on vehicle occupants to survivable levels. Limited edge barrier with retaining walls and banks within run-off area. Limited high-risk hazards.
Severity Score:	**2/4**	**3/4**
Product of scores	**16/64**	**12/64**

Proposed operation

Relevant Crash types	Intersection	Run-off Road
Exposure Comments:	AADT > 10,000 on SH2	AADT > 10,000 on SH2
Exposure Score:	**4/4**	**4/4**
Likelihood Comments:	Crash unlikely to occur: priority control, single conflict point, high speed with sub-standard acceleration lane	Crash highly unlikely to occur, high standard of road with good geometric alignment, shoulders and delineation
Likelihood Score:	**2/4**	**1/4**
Severity Comments:	Unlikely to result in a fatality or serious injury. Low angle side impact or rear-end crashes most likely, impact speeds expected to be close to survivability thresholds.	It is likely to result in a fatality or serious injury. Flexible median barrier will dissipate forces on vehicle occupants to survivable levels. Limited edge barrier with retaining walls and banks within run-off area. Limited high-risk hazards.
Severity Score:	**2/4**	**3/4**
Product of scores	**16/64**	**12/64**

The risk assessment score is unchanged as the increased traffic does not change the exposure risk.

Gurney Road

All crash types have been considered for this section except for cyclists and motorcyclists, the risks for these crash types are not expected to change as a result of the proposed works and are expected to be similar to the risks for pedestrians.

Current operation

Relevant Crash types	Run-off Road	Head-on	Intersection	Pedestrian
Exposure Comments:	AADT < 1,000 on (105[5])	AADT < 1,000 on (105)	AADT < 1,000 on (105)	>100 pedestrians per day (assumed – worst case)
Exposure Score:	**1/4**	**1/4**	**1/4**	**4/4**
Likelihood Comments:	Crash likely to occur: narrow carriageway (no shoulder, not wide enough for two vehicles to pass), unprotected hazards (power-poles and drop-offs), limited delineation and no lighting, mitigated by low operating speeds	Crash likely to occur: narrow carriageway (no shoulder, not wide enough for two vehicles to pass), mitigated by low operating speeds	Crash likely to occur, priority control at all side roads, restricted visibility, mitigated by low operating speeds	Crash highly likely to occur, sections without footpath or adequate shoulder, no formal crossing facilities, restricted visibility in some locations, no lighting along majority of length.
Likelihood Score:	**3/4**	**3/4**	**3/4**	**4/4**
Severity Comments:	Unlikely to result in a fatality or serious injury. Impact speeds expected to be below survivability thresholds.	Unlikely to result in a fatality or serious injury. Impact speeds expected to be below survivability threshold (70km/h) based on expected operating speeds.	Unlikely to result in a fatality or serious injury. Impact speeds expected to be below survivability threshold (50km/h) based on expected operating speeds.	It is unlikely to result in a fatality or serious injury. Impact speeds likely to be around 30km/h.
Severity Score:	**2/4**	**2/4**	**2/4**	**2/4**
Product of scores	**6/64**	**6/64**	**6/64**	**32/64**

Proposed operation

Relevant Crash types	Run-off Road	Head-on	Intersection	Pedestrian
Exposure Comments:	AADT < 1,000 on (105+ 180 new vehicles)	AADT < 1,000 on (105+ 180 new vehicles)	AADT < 1,000 on (105+ 180 new vehicles)	>100 pedestrians per day (assumed – worst case)
Exposure Score:	**1/4**	**1/4**	**1/4**	**4/4**

[5] Refer Aurecon Memorandum dated 2023-01-10 - Traffic Impacts of Closing Hebden Cres intersection with SH2 and removing Right Turns from intersection of Liverton Road and SH2

Relevant Crash types	Run-off Road	Head-on	Intersection	Pedestrian
Likelihood Comments:	Crash likely to occur: narrow carriageway (no shoulder, not wide enough for two vehicles to pass), unprotected hazards (power-poles and drop-offs), limited delineation and no lighting, mitigated by low operating speeds	Crash likely to occur: narrow carriageway (no shoulder, not wide enough for two vehicles to pass), mitigated by low operating speeds	Crash likely to occur, priority control at all side roads, restricted visibility, mitigated by low operating speeds	Crash highly likely to occur, sections without footpath or adequate shoulder, no formal crossing facilities, restricted visibility in some locations, no lighting along majority of length.
Likelihood Score:	**3/4**	**3/4**	**3/4**	**4/4**
Severity Comments:	Unlikely to result in a fatality or serious injury. Impact speeds expected to be below survivability thresholds.	Unlikely to result in a fatality or serious injury. Impact speeds expected to be below survivability threshold (70km/h) based on expected operating speeds.	Unlikely to result in a fatality or serious injury. Impact speeds expected to be below survivability threshold (50km/h) based on expected operating speeds.	It is unlikely to result in a fatality or serious injury. Impact speeds likely to be around 30km/h.
Severity Score:	**2/4**	**2/4**	**2/4**	**2/4**
Product of scores	**6/64**	**6/64**	**6/64**	**32/64**

Major Drive

All crash types have been considered for this section except for cyclists and motorcyclists, the risks for these crash types are not expected to change as a result of the proposed works and are expected to be similar to the risks for pedestrians.

Current operation

Relevant Crash types	Run-off Road	Head-on	Intersection	Pedestrian
Exposure Comments:	5000 < AADT < 10,000 (~4,800-5,300 from MobileRoad)	5000 < AADT < 10,000 (~4,800-5,300 from MobileRoad)	5000 < AADT < 10,000 (~4,800-5,300 from MobileRoad)	>100 pedestrians per day (assumed)
Exposure Score:	3/4	3/4	3/4	4/4
Likelihood Comments:	Crash unlikely to occur: urban road environment with good delineation and lighting	Crash unlikely to occur: urban road environment with good delineation and lighting	Crash likely to occur, priority control at all side roads, restricted visibility and multiple lanes in some locations.	Crash likely to occur, sections without footpath on one side, no formal crossing facilities, restricted visibility in some locations.
Likelihood Score:	2/4	2/4	3/4	3/4
Severity Comments:	It is likely to result in a fatality or serious injury. Point hazards and steep drop-offs in some locations with downhill grade likely to result in higher impact speeds.	Unlikely to result in a fatality or serious injury. Impact speeds expected to be below survivability threshold (70km/h) based on expected operating speeds.	Unlikely to result in a fatality or serious injury. Impact speeds expected to be around survivability threshold (50km/h) based on expected operating speeds.	It is likely to result in a fatality or serious injury. Impact speeds likely to be greater than 30km/h.
Severity Score:	3/4	2/4	2/4	3/4
Product of scores	18/64	12/64	18/64	36/64

Proposed operation

Relevant Crash types	Run-off Road	Head-on	Intersection	Pedestrian
Exposure Comments:	5000 < AADT < 10,000 (~4,800-5,300 from MobileRoad + 180 new vehicles)	5000 < AADT < 10,000 (~4,800-5,300 from MobileRoad + 180 new vehicles)	5000 < AADT < 10,000 (~4,800-5,300 from MobileRoad + 180 new vehicles)	>100 pedestrians per day (assumed)
Exposure Score:	3/4	3/4	3/4	4/4

Relevant Crash types	Run-off Road	Head-on	Intersection	Pedestrian
Likelihood Comments:	Crash unlikely to occur: urban road environment with good delineation and lighting	Crash unlikely to occur: urban road environment with good delineation and lighting	Crash likely to occur, priority control at all side roads, restricted visibility and multiple lanes in some locations.	Crash likely to occur, sections without footpath on one side, no formal crossing facilities, restricted visibility in some locations.
Likelihood Score:	2/4	2/4	3/4	3/4
Severity Comments:	It is likely to result in a fatality or serious injury. Point hazards and steep drop-offs in some locations with downhill grade likely to result in higher impact speeds.	Unlikely to result in a fatality or serious injury. Impact speeds expected to be below survivability threshold (70km/h) based on expected operating speeds.	Unlikely to result in a fatality or serious injury. Impact speeds expected to be around survivability threshold (50km/h) based on expected operating speeds.	It is likely to result in a fatality or serious injury. Impact speeds likely to be greater than 30km/h.
Severity Score:	3/4	2/4	2/4	3/4
Product of scores	18/64	12/64	18/64	36/64

The risk assessment score is unchanged as the increased traffic does not change the exposure risk.

Major Drive / SH2 intersection

Only the intersection crash type has been considered for this section.

Current operation

Relevant Crash types	Intersection
Exposure Comments:	AADT > 10,000 on SH2
Exposure Score:	**4/4**
Likelihood Comments:	Crash unlikely to occur signal control
Likelihood Score:	**2/4**
Severity Comments:	Highly likely to result in a fatality or serious injury. Survivable speed for a side impact crash is 50km/h. Posted speed limit is 100km/h.
Severity Score:	**4/4**
Product of scores	**32/64**

Proposed operation

Relevant Crash types	Intersection
Exposure Comments:	AADT > 10,000 on SH2
Exposure Score:	**4/4**
Likelihood Comments:	Crash unlikely to occur signal control
Likelihood Score:	**2/4**
Severity Comments:	Highly likely to result in a fatality or serious injury. Survivable speed for a side impact crash is 50km/h. Posted speed limit is 100km/h.
Severity Score:	**4/4**
Product of scores	**32/64**

The risk assessment score is unchanged as the increased traffic does not change the exposure risk.

Appendix B - MegaMaps Safety Metrics Screenshots

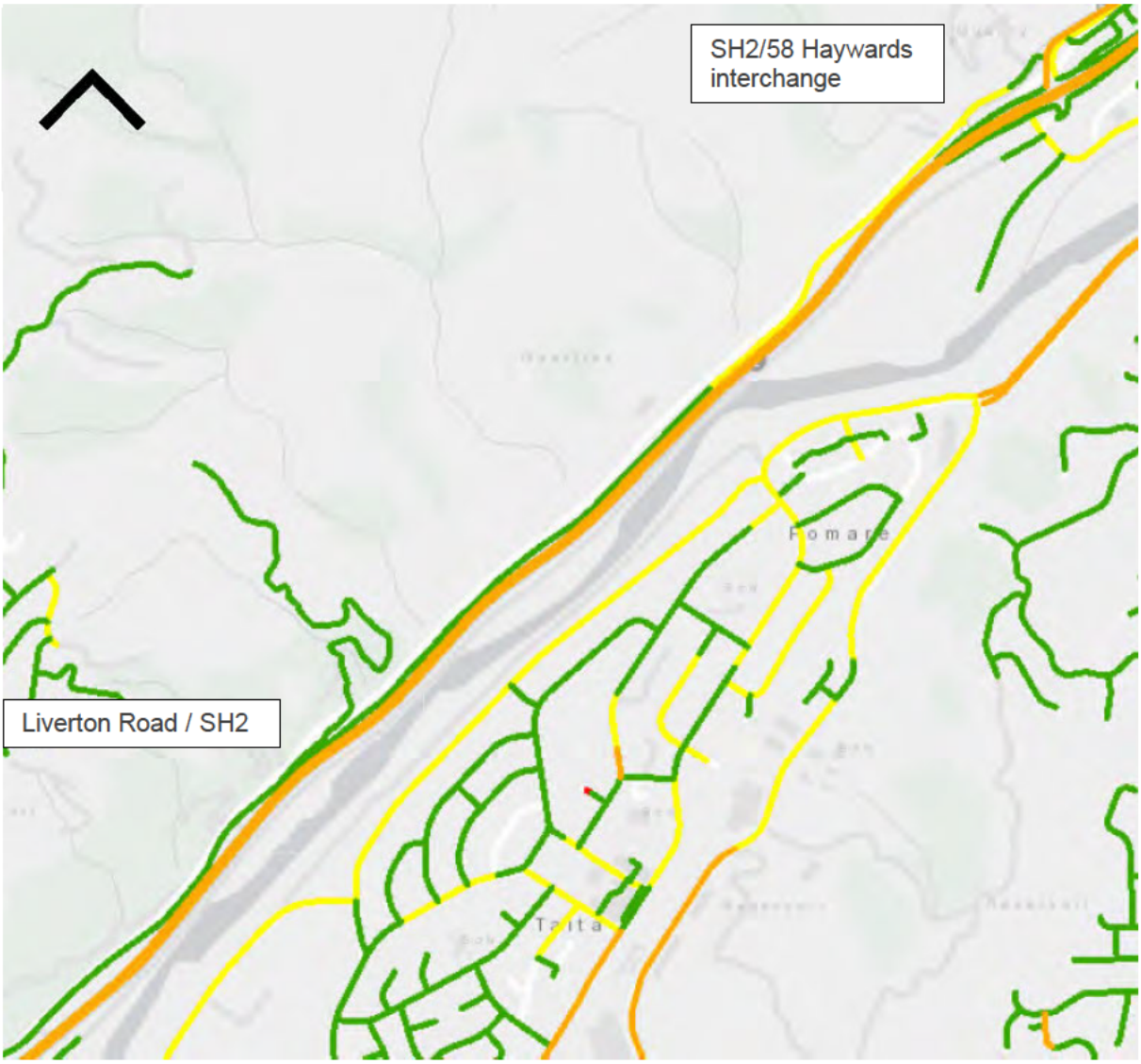
Collective Risk

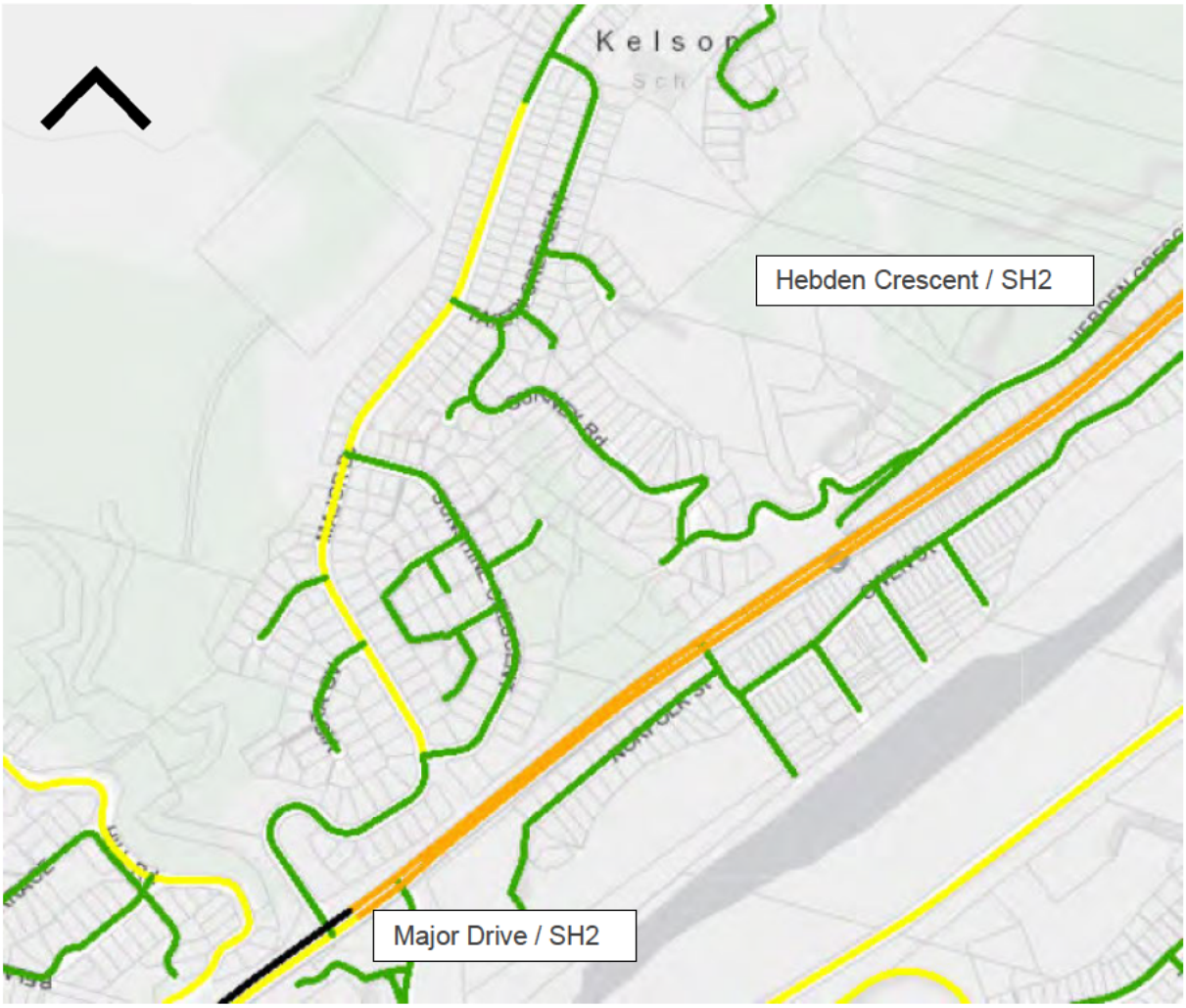
Road Safety Metric

Collective Risk

Collective Risk

- High
- Medium High
- Medium
- Low Medium
- Low




Kelson
Hebden Crescent / SH2
Major Drive / SH2

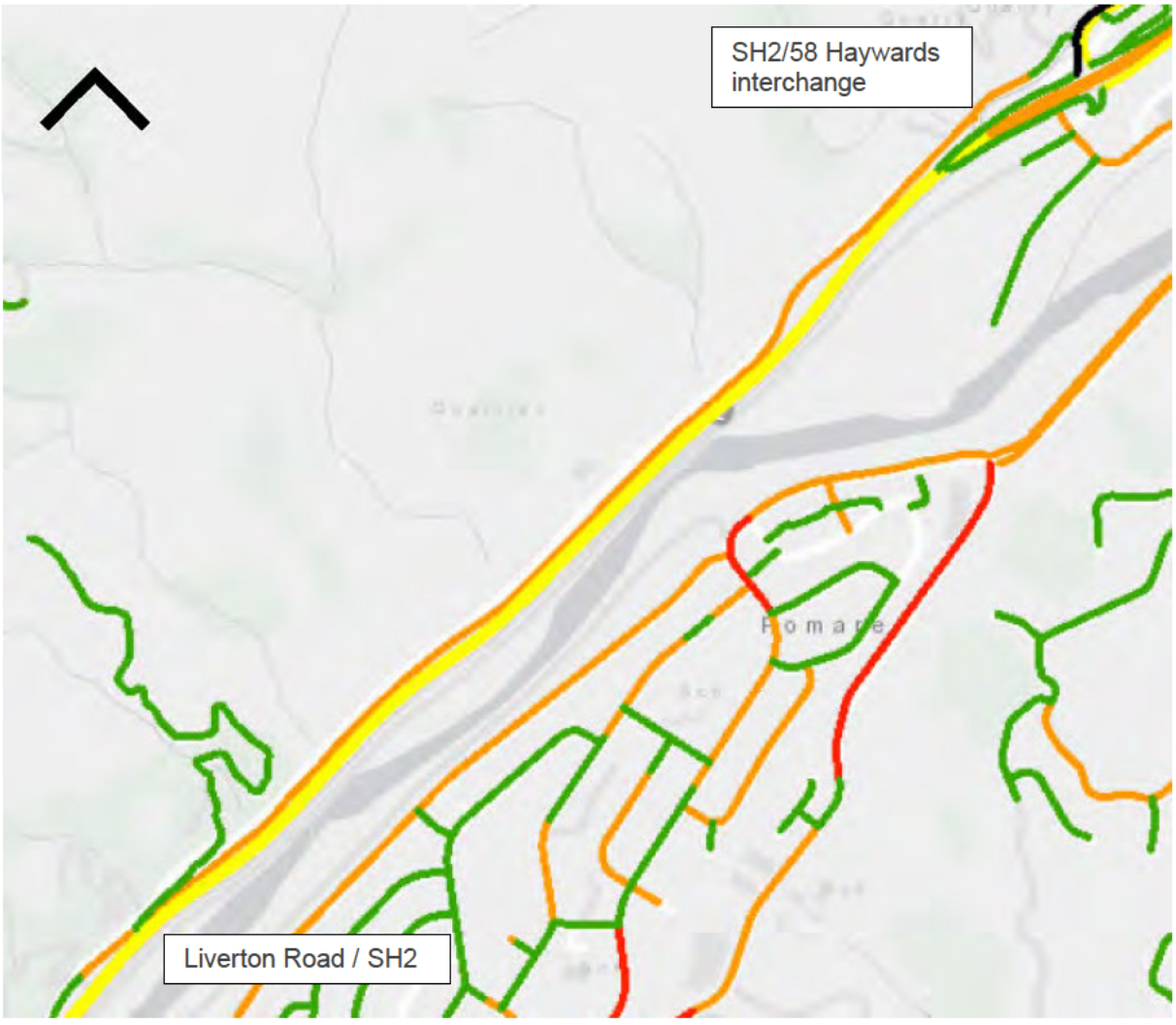
Personal Risk

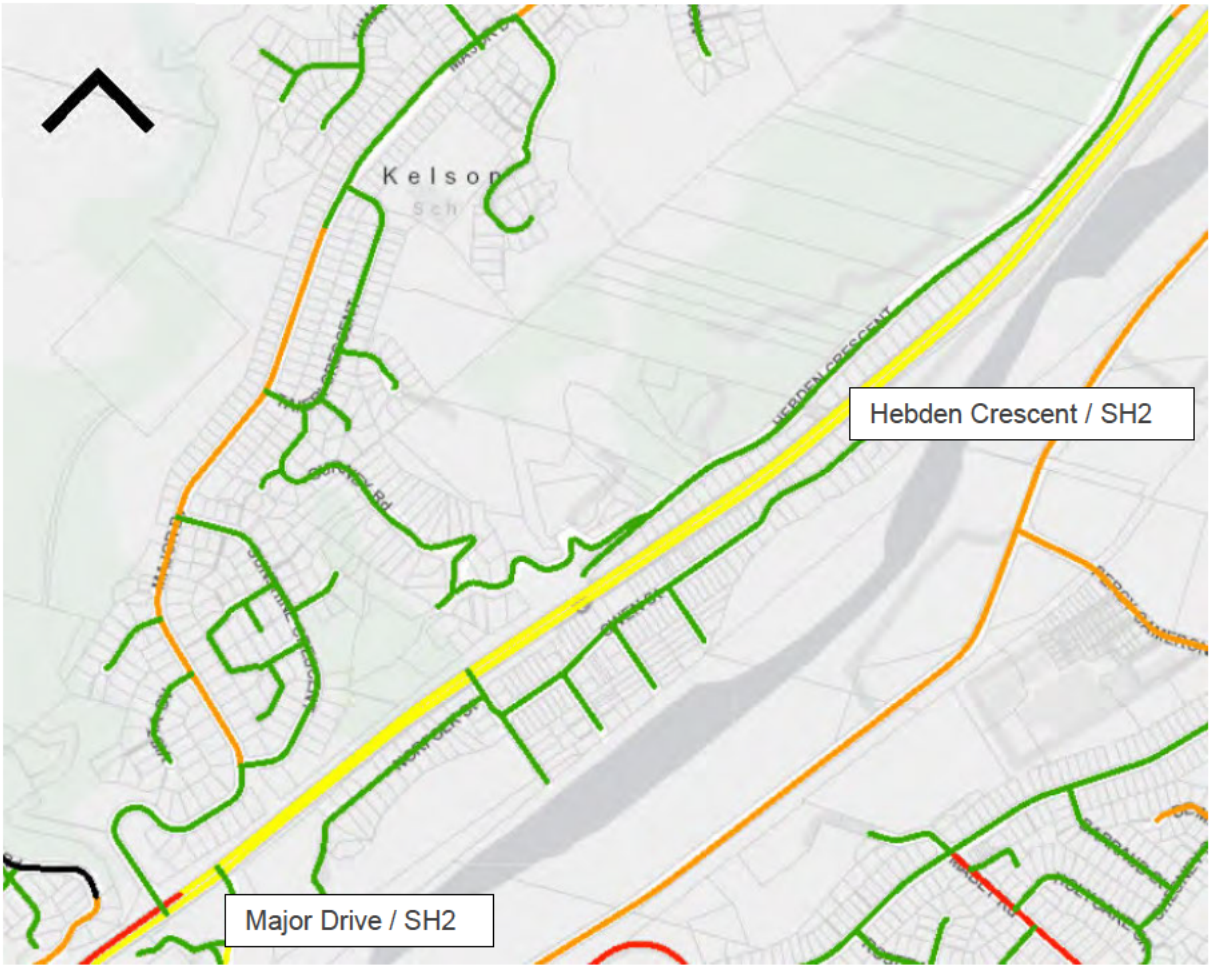
Road Safety Metric

Personal Risk

Personal Risk

- High
- Medium High
- Medium
- Low Medium
- Low




Kelson
Hebden Crescent / SH2
Major Drive / SH2

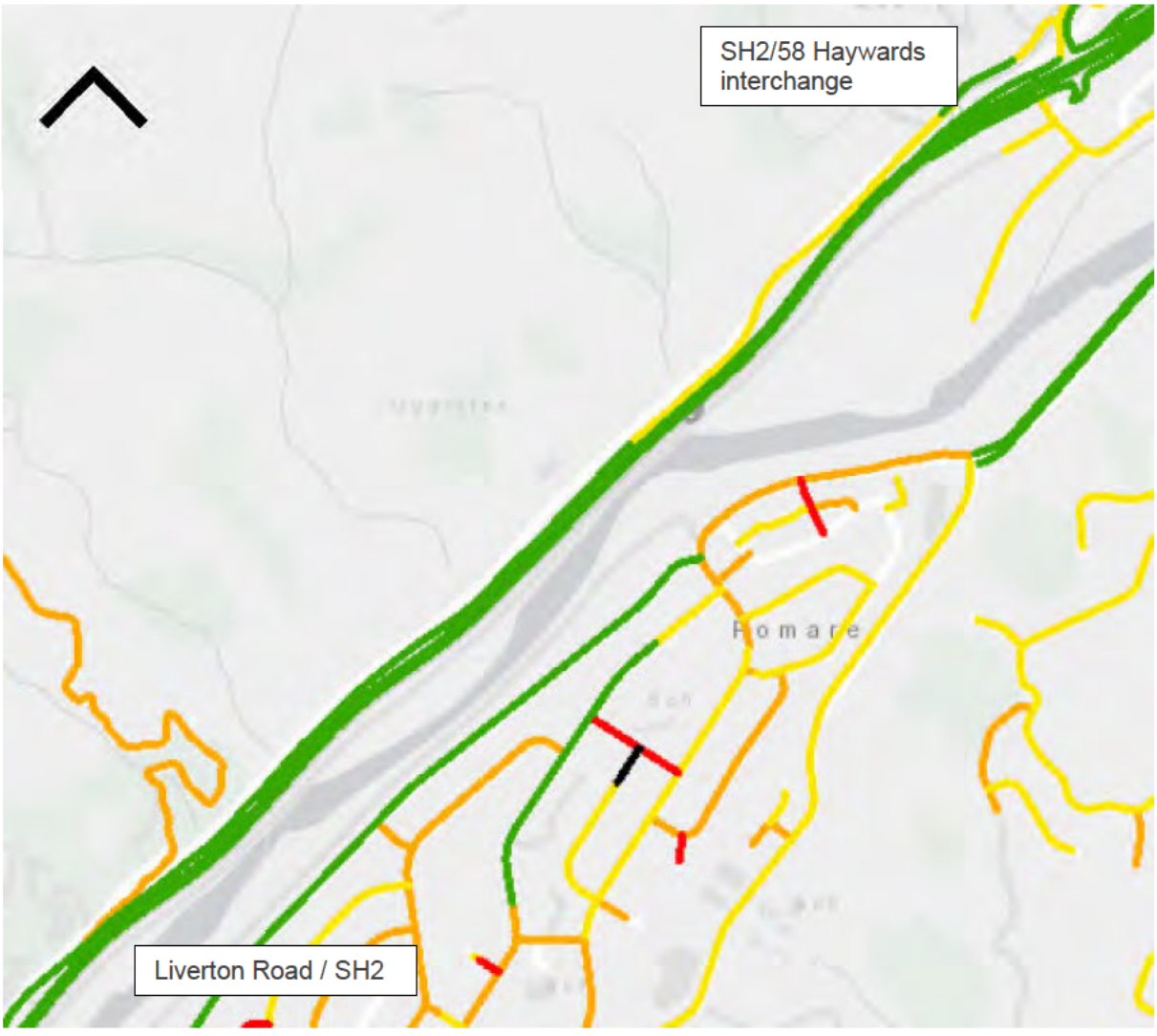
Infrastructure Risk Rating

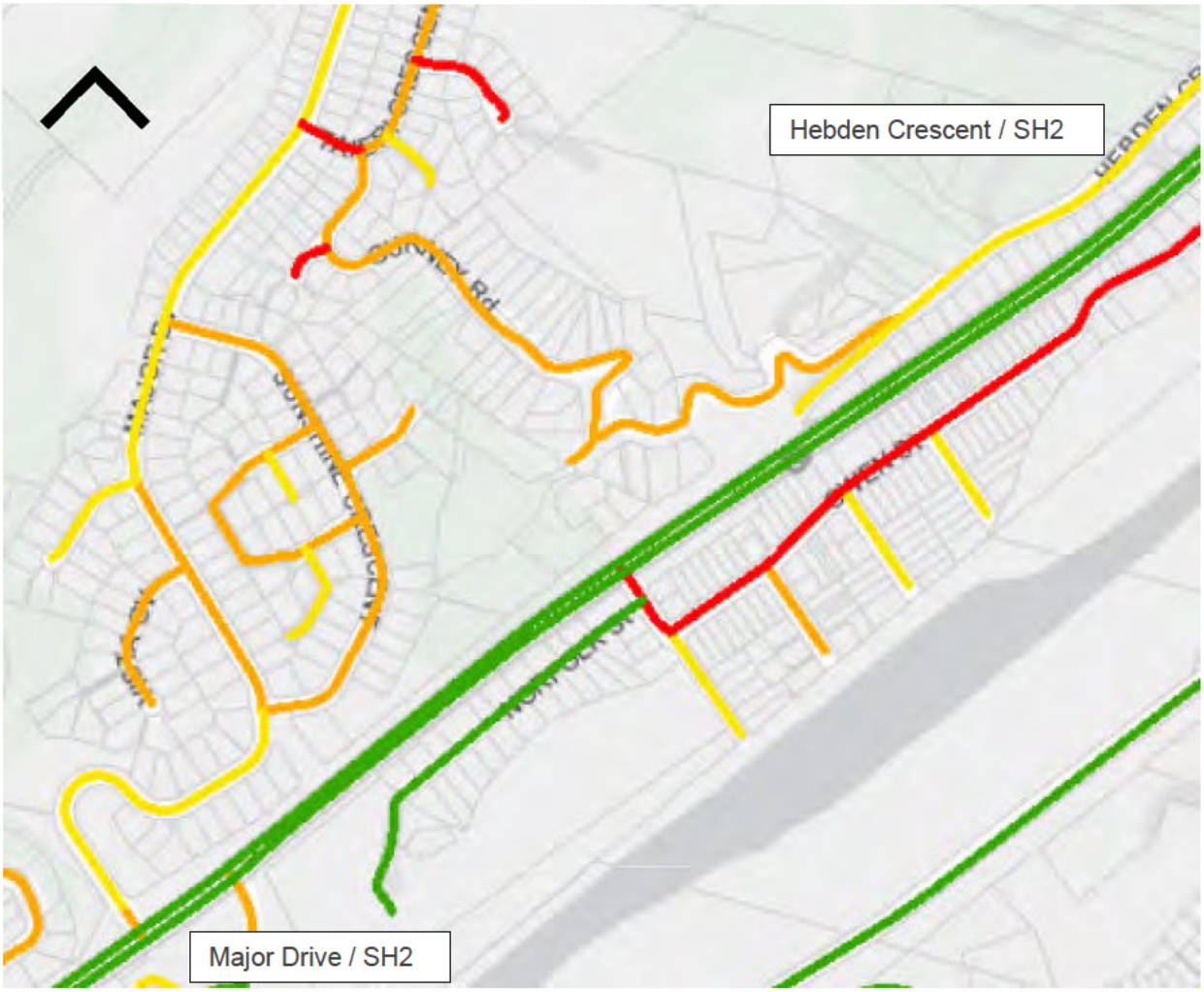
Infrastructure Risk Rating

IRR Band

IRR Band

- High
- Medium High
- Medium
- Low Medium
- Low



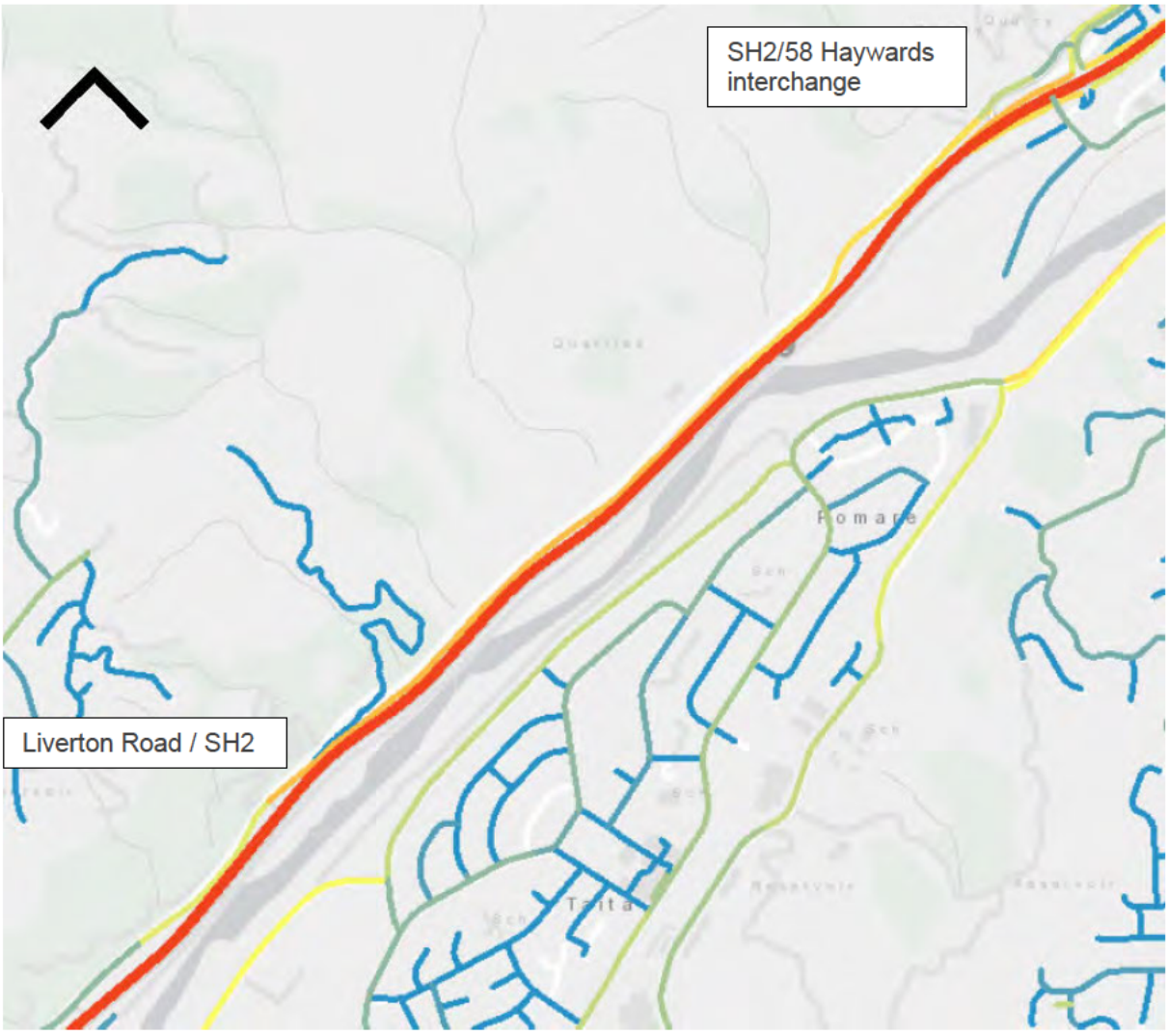

Hebden Crescent / SH2
Major Drive / SH2

Operating Speeds

Mean Operating Speeds

Operating Speed

- < 30
- 30 - 34
- 35 - 39
- 40 - 44
- 45 - 49
- 50 - 54
- 55 - 59
- 60 - 64
- 65 - 69
- 70 - 74
- 75 - 79
- 80 - 84
- 85 - 89
- 90 - 94
- > 95




Kelson
Hebden Crescent / SH2
Major Drive / SH2