Safe System Assessment Guideline

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DEPARTMENT OF PLANNING, TRANSPORT AND INFRASTRUCTURE

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A	First Issue	20/03/19	J Davies	Safety Strategy Section

Document Management

Contents

Austroads has released the Guide to Road Design and all road agencies across Australasia have agreed to adopt the Austroads guides to provide a level of consistency and harmonisation across all jurisdictions.

This agreement means that the new Austroads guides and the Australian Standards, which are referenced in them, will become the primary technical references for use within South Australia.

This supplement is issued to clarify, add to, or modify the Austroads Guides

To be read in conjunction of Safe System Assessment:

Internal	Knet# 13551920
External	https://www.dpti.sa.gov.au/standards/roads-all#roaddesignoutputs

Safe System Assessment

1 Safe System Assessment

1.1 Safe System Assessment (SSA) is a tool that has been developed to assess the extent to which a proposed infrastructure project aligns with Safe System principles and the objective to eliminate fatal and serious injuries. The process allows project options to be compared with a base case (i.e. existing conditions) and with each other. A SSA will identify areas where the risk of fatal and serious injury (FSI) crashes is high and identifies design changes which, if adopted, would improve alignment with the Safe System approach. If Safe System principles are being followed and applied correctly, there should be a trend towards zero in the SSA scores when progressing from existing conditions to the initial design options and, finally, to the adopted design.

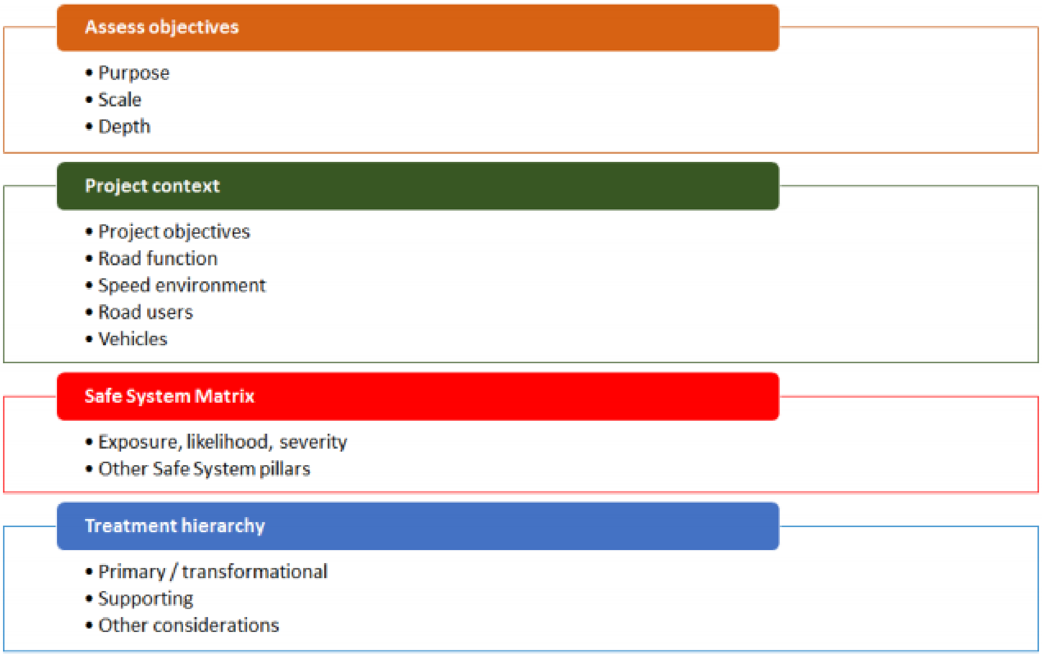
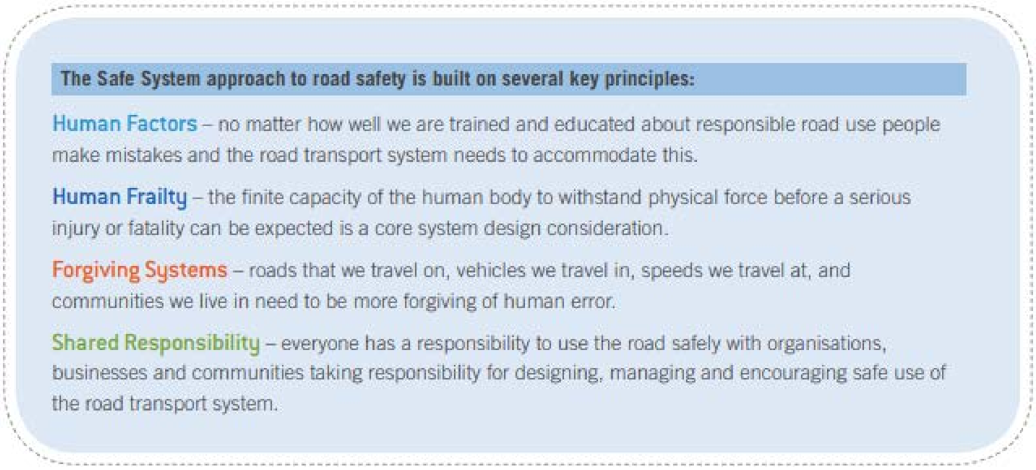


Figure 1 - Safe System Framework (Austroads, 2016)



The Safe System approach to road safety is built on several key principles:

Human Factors – no matter how well we are trained and educated about responsible road use people make mistakes and the road transport system needs to accommodate this.

Human Frailty – the finite capacity of the human body to withstand physical force before a serious injury or fatality can be expected is a core system design consideration.

Forgiving Systems – roads that we travel on, vehicles we travel in, speeds we travel at, and communities we live in need to be more forgiving of human error.

Shared Responsibility – everyone has a responsibility to use the road safely with organisations, businesses and communities taking responsibility for designing, managing and encouraging safe use of the road transport system.

South Australia 'Towards Zero Together South Australia's Road Safety Strategy 2020'

2 Timeframes of Assessment

2.1 SSAs are conducted within the early stages of a project as they can be easily accommodated. SSA and road safety audits should be conducted during the early stages to maximise safety outcomes.

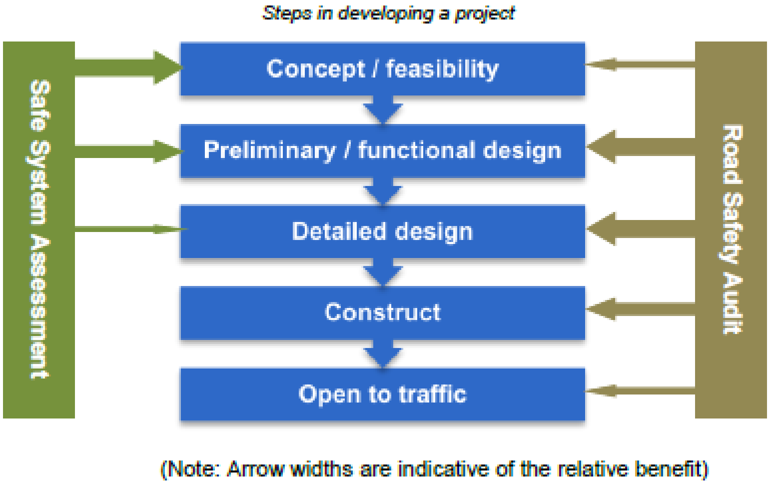


Figure 2 - When to Undertake Safe System Assessments and Road Safety Audits (VicRoads, 2018)

3 When to Undertake A SSA – Budget Requirements

3.1 The assessment will be required for all projects (except SSA's are optional for projects under <$2M.)

Safe System assessments are to be undertaken in accordance with the table below.

- **Full SSA** **All sections to be completed within Safe System Assessment**
- **Quick SSA** **Complete section 1, 2, 3, 4 & 6 within Safe System Assessment**

Project Cost	SSA Requirements	Type of Assessment
>5 million	A SSA **must** be conducted	Full SSA for all projects. A quick SSA may be considered (for the final option or the business case option) if a full SSA has been undertaken at an earlier stage to refine the short listed options.
Between $2 to $5 million	A SSA is **desirable** and is preferred method to consider alignment of the project and design options with safe system principles. Where a SSA is not undertaken, documentation is required of how the project has considered safe system principle into the alignment and design.	Full SSA is : Complex projects Projects with a significant risk of fatal and serious injury crashes Infrastructure trial projects Quick SSA for: Projects with low risk of FSI crashes (e.g. shoulder sealing) Repeat assessments for projects for which full SSA has been undertaken at an earlier stage.
<$2 million	A SSA is **optional**. The benefits of conducting a SSA and the risk factors[1] associated with the project should be considered in determining the need of the SSA.	Quick SSA where it has been determined that a formal assessment is required.

	Where a SSA is not undertaken, documentation of how the project has considered safe system principles shall be provided.	

Notes[1]: Examples of risk factors that might warrant an SSA (but should not be limited to):

- A History of FSI crashes
- Repeated community complaints regarding safety
- High number of vulnerable road users
- High volume of heavy vehicles
- Treatment options that are trial or complex

4 Undertaking a SSA

4.1 Figure 3 outlines the steps in undertaking a SSA.

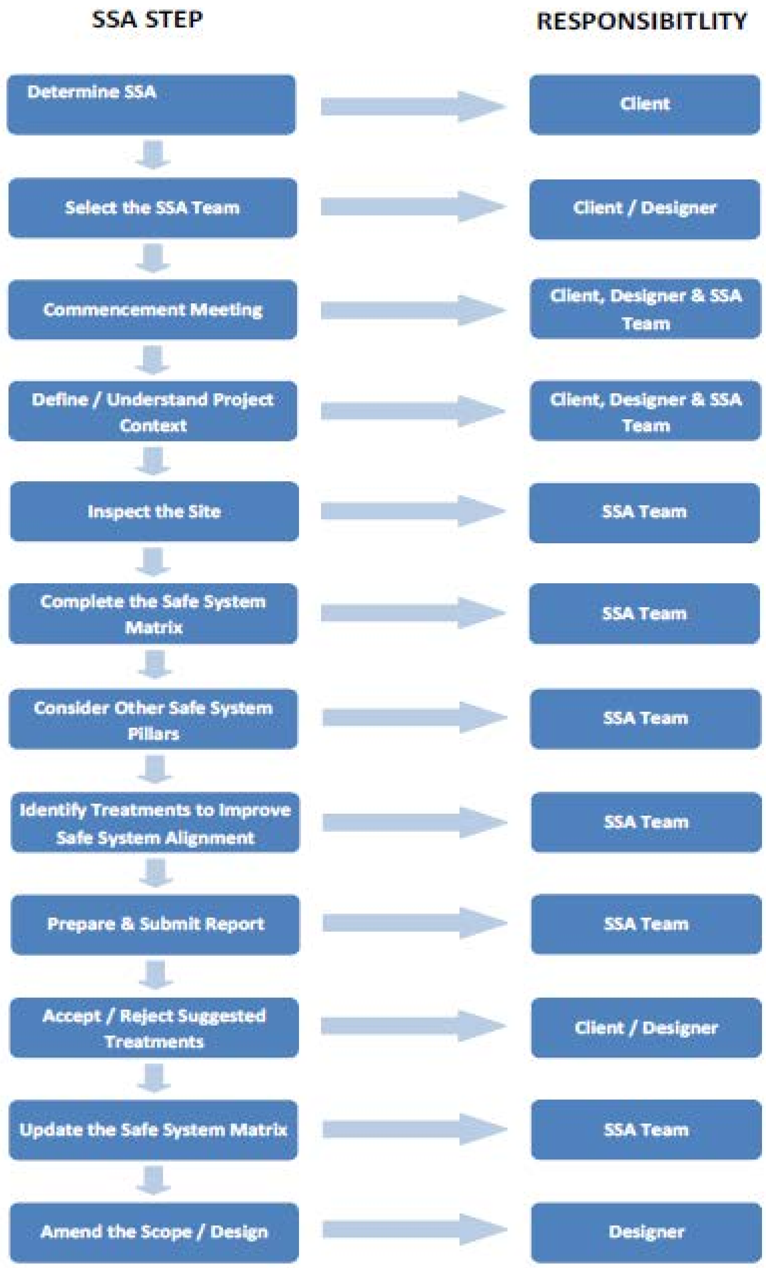


Figure 3: Steps to SSA (VicRoads, 2018)

5 Selecting the SSA Team

5.1 SSA to be undertaken by a team of min two members and should include a team member who has knowledge and can demonstrate experience in carrying out safe system assessments. Other team members may be associated with the planning / design of the project or provide a diverse range of experience that may be relevant to the project.

6 Commencement Meeting

6.1 A commencement meeting should be conducted with the project team and provide background to the project. This would include any known issues.

6.2 Information to be provided to the SSA team should include, but not be limited to:

- The project purpose and objectives

- Design plans for each of the options to be assessed
- Traffic and road user data – current and projected volumes for general traffic, heavy vehicles, pedestrians and motorcyclists (estimated if actual data is not available)
- Crash data and any known safety issues
- Road classification / function (e.g. Movement and Place classification, Principal Freight Network route, OD route, Principal Bicycle Network route etc.)
- Any relevant community / stakeholder issues (the SSA team is not expected to engage the community or stakeholders)
- Current / planned land uses (particularly those which generate pedestrians, bicyclists or heavy vehicles) and access requirements.

7 Site Inspection

7.1 A day inspection should be undertaken on all SSA's (desirable). Night-time inspections should be considered especially if there is a high risk of elevated crashes involving road users.

7.2 The team should inspect:

- The road environment beyond the limits of the project. This may include transition points to the existing network, road geometry of adjacent sections and the presence of intersections just beyond the project limits.
- Condition of the road pavement and shoulders.
- Changes to the road environment since time of the feature survey or aerial imagery, including recent barrier installations, new intersections or driveways and new bus stops.
- Presence and approximate numbers of cyclists, pedestrians, heavy vehicles and motorcyclists (particularly important if data is not available).
- Existing provisions for pedestrians and cyclists (footpaths, shared paths, bicycle lanes, pedestrian crossings etc.)
- Presence of schools, childcare centres, retirement villages and other community facilities that might generate high risk or vulnerable road users.
- Presence of local industries or commercial activities that generate freight movements (including provisions for loading and unloading of goods).
- Identification of possible "other" crash types (e.g. involving driveways, wildlife etc.), for consideration when completing the SSA Matrix.
- Identification of any unique road user behaviours such as pedestrians crossing at an uncontrolled location or vehicles 'rat running' through local streets.

8 The Safe System Matrix

8.1 The safe system matrix is used to assess the extent to which existing conditions and project options align with Safe System principles. This is achieved through a scoring system which considers seven crash types and the exposure, likelihood and severity associated with each crash type. Each combination is assigned a score out of four. The exposure, likelihood and severity scores for each crash type are multiplied to give a product out of 64. These are then added to determine the total SSA score, with a maximum of 448. A score of zero or close to zero indicates a high level of alignment with the Safe System.

8.2 It is important to note that while the total score is used to check alignment with Safe System principles, there is a level of subjectivity based on the individuals or groups undertaking the analysis. Thus, scores for different roads or projects **MUST NOT** be compared against one another, but rather the existing conditions and concept design / design options for a single project should be assessed by the same SSA team and compared to determine whether the project is trending towards zero. The existing conditions and concept design(s) are assessed before potential treatments are identified that may be accepted to produce a revised design that is more closely aligned with a Safe System.

8.3 Commentary on factors that either increase or decrease the risk should be provided in each cell of the matrix to provide some reasoning behind the adopted scores

9 Scoring

Table 1: SSA Matrix scoring (Austroads, 2016)

Score	Road user exposure	Crash likelihood	Crash severity
0	There is no exposure to a certain crash type. This might mean that there is no side flow or intersecting roads, no cyclists, no pedestrians or no motorcyclists.	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 pedestrians do not cross the road.	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 a crash are low enough not to cause a fatal or serious injury (FSI), or that excessive 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 roadside hazards / barriers that are present.
1	Volumes of vehicles that might be involved in a particular crash type are particularly low, therefore exposure is low. For run-off-road, head-on and "other" crash types, AADT is < 1,000 veh/day For cyclist, pedestrian and motorcycle crash types, volumes are < 10 units/day	It is highly unlikely that a given crash type will occur.	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 are fairly low during a crash or the majority are effectively dissipated before reaching road user.
2	Volumes of vehicles that might be involved in a particular crash type are moderate, therefore exposure is moderate. For run-off-road, head-on and "other" crash types, AADT is between 1,000 and 5,000 veh/day For cyclist, pedestrian and motorcycle crash types, volumes are 10 to 50 units/day	It is unlikely that a given crash type will occur.	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 are effectively dissipated before reaching the road user.
3	Volumes of vehicles that might be involved in a particular crash type are high, therefore exposure is high. For run-off-road, head-on and "other" crash types, AADT is between 5,000 and 10,000 veh/day For cyclist, pedestrian and motorcycle crash types, volumes are 50 to 100 units/day	It is likely that a given crash type will occur.	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 before reaching the road user
4	Volumes of vehicles that might be involved in a particular crash type are very high or the road is very long, therefore exposure is very high. For run-off-road, head-on and "other" crash types, AADT is > 10,000 veh/day For cyclist, pedestrian and motorcycle crash types, volumes are > 100 units/day	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).	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 FSI crash and it is unlikely that the forces will be dissipated before reaching the road user.

Table 2: Exposure Measures and Typical Likelihood Factors (VicRoads, 2018)

Crash Type	Exposure Measures	Typical Likelihood Factors
Run-off-road	Total volume of vehicles (AADT) using the road	Horizontal and vertical alignment Pavement condition Shoulders – width, sealed or unsealed Number, type and offset to roadside hazards such as poles, trees, steep batters etc. Presence of barriers, barrier type and position Speed limit and operating speed, Volume of heavy vehicles Potential for driver fatigue
Head-on	Total volume of vehicles (AADT) using the road	Horizontal and vertical alignment Pavement condition Number and width of lanes Separation between opposing traffic streams Median or centre line barriers Overtaking opportunities Speed limit and operating speed Volume of heavy vehicles Potential for wrong way movements
Intersection	Total volume of vehicles (AADT) entering the intersection	Intersection type – cross, T, multi-leg, grade separated etc. Intersection control – signalised, roundabout, STOP or GIVE WAY Intersection features – dedicated turns lanes, channelization, movement bans etc. Number of conflict points and complexity Minor road volumes and movements Volume of heavy vehicles Right turn volumes
Other	Total volume of vehicles (AADT) using the road	Varies according to the crash type being considered
Pedestrian	Number of pedestrians	Controlled or uncontrolled crossings Crossing type (signalised, zebra, wombat, grade separated etc.) Pedestrian characteristics (young, elderly, mobility impaired, intoxicated etc.) Presence of a refuge or median Volume of traffic Speed of traffic Crossing distance and number of lanes Separation from vehicular traffic, including heavy vehicles
Cyclist	Number of cyclists	Cyclist characteristics (age, commuting, recreational, training etc.) Presence and type cycling infrastructure (separated paths, on-road bicycle lanes, wide kerbside lanes, bike boxes, controlled crossings, refuges etc.) Volume of motorised traffic Separation from motorised traffic, including heavy vehicles Speed limit and operational speed of traffic

Motorcyclist	Number of motorcyclists – assume 1% of AADT if specific data not available	Horizontal and vertical alignment Pavement condition Number and width of lanes Speed limit and operating speed Number and type of roadside hazards Volume of other vehicles Sight line restrictions Right turn control at intersections

10 Primary and Supporting Treatments

10.1 Safe System infrastructure solutions based on major crash types:

Table 3 - Primary and Supporting Treatments (Austroads, 2016)

Crash Type	Example of Primary Safe System Treatments	Example of Supporting Treatments
Run-off-road	• Centre and edge barrier systems (particularly wire-rope barriers) • Clear zone provision	Concentration on high crash locations Lower interim speed limits Improved education of public Improved shoulder provision, audio-tactile edge lines, delineation
Head-on	Median barriers/carriageway duplication.	Vehicle design improvements Shoulder sealing Increased separation between opposing traffic flows (i.e. wider medians) Provision of overtaking lanes Audio-tactile centrelines Improved skid resistance Vehicle activated warning signs at curves Provision of rest areas Improved delineation.
Intersection	Grade separation • Roundabouts • Intersection platforms • Time separation between flows with fully-controlled turning phases.	Restrictions in use of particular intersections (through route guidance, closing of intersections, restricting movements at intersections) ITS systems used to warn road users (e.g. vehicle activated speed limit signs)
Pedestrian	• Grade separation • Raised pedestrian crossings (wombat crossings) and other relevant traffic calming.	Lower interim speed limits Pedestrian signals Pedestrian fencing Medians/refuge islands Electronic warning signs Improved lighting Improved skid resistance Parking restrictions.
Cyclist	Separation from other road users.	Improved road surface Improved clear zones Improved curve alignment Protected right turns (fully controlled) Fixed speed cameras Lower interim speed limits • On-road cycle lanes

11 Treatment Types with Crash Risk

11.1 The tables below provide guidance in relation to how treatment types align with crash risk. These tables should be used as a guide when completing the Safe System Assessment (refer knet # 13551920)

Table 4- Run-off-road (to left or right) treatments

Hierarchy	Treatment	Influence (E = Exposure L = Likelihood S = Severity)
Safe Systems options ('primary' or 'transformational' treatments)	• Flexible roadside and median barriers (or equally/better performing future equivalent) • Very high quality compacted roadside surface, very gentle to flat side slopes and exceptionally wide run-off areas • Very low speed environment/speed limit.	S S L, S
Supporting treatments (compatible with future implementation of Safe System options)	• Wide run-off areas, with well-maintained shallow drainage and gentle slopes • Wide sealed shoulders with audio-tactile edgeline • Lower speed limit	S L L, S
Supporting treatments (does not affect future implementation of Safe Systems options)	• Non-flexible safety barrier • Consistent design along the route (i.e. no out-of-context curves) • Consistent delineation for route • Skid resistance improvement • Improved superelevation • Audio-tactile centreline • Audio-tactile edgeline • Vehicle activate signs	S L L L L L L L
Other considerations	• Speed enforcement • Rest area provision • Lane marking compatible with vehicle-lane-keeping technology	L, S L L

Table 5 - Head-on treatments

Hierarchy	Treatment	Influence (E = Exposure L = Likelihood S = Severity)
Safe Systems options ('primary' or 'transformational' treatments)	• One-way traffic • Flexible median barrier • Very wide median • Very low speed environment/speed limit	L S S L, S
Supporting treatments (compatible with future implementation of Safe System options)	• Wide median • Painted median/wide centrelines	L L
Supporting treatments (does not affect future implementation of Safe Systems options)	• Non-flexible safety barrier • Lower speed environment/speed limit • Ban overtaking • Skid resistance improvement • Audio-tactile centreline • Audio-tactile edgeline • Roadside barriers	S L, S L L L L S

	• Consistent design along the route (i.e. no out-of-context curves) • Consistent delineation for route • Overtaking lanes • Improved superelevation	L L L L
Other considerations	• Speed enforcement • Rest area provision • Lane marking compatible with vehicle-lane-keeping technology	L, S L L

Table 6 - Intersection treatments

Hierarchy	Treatment	Influence (E = Exposure L = Likelihood S = Severity)
Safe Systems options ('primary' or 'transformational' treatments)	• Grade separation • Close intersection • Low speed environment/speed limit • Roundabout • Raised platform	L, S E L, S L, S L, S
Supporting treatments (compatible with future implementation of Safe System options)	• Left-in/left-out, with protected acceleration and deceleration lanes where required • Ban selected movements • Reduce speed environment/speed limit	L, S E L, S
Supporting treatments (does not affect future implementation of Safe Systems options)	• Redirect traffic to higher quality intersection • Turning lanes • Vehicle activated signs • Improved intersection conspicuity • Advance direction signage and warning • Improved sight distance • Traffic signals with fully controlled right turns • Skid resistance improvement • Improved street lighting	E L L L L L L L L
Other considerations	• Speed camera combined with red light cameras	L, S

Table 7 - 'Other' crash type treatments

Hierarchy	Treatment	Influence (E = Exposure L = Likelihood S = Severity)
Safe Systems options ('primary' or 'transformational' treatments)	• Lower speed environment	L, S
Supporting treatments (compatible with future implementation of Safe System options)	• Reduce speed environment/speed limit	L, S
Supporting treatments (does not affect future implementation of Safe Systems options)	• Variable message sign/managed freeway system • Skid resistance improvement • Turning lanes • Overtaking lanes • Improved sight distance/conspicuity • Improved delineation	L L L L L L

Other considerations	• Speed enforcement	L, S

Table 8 - Pedestrian treatments

Hierarchy	Treatment	Influence (E = Exposure L = Likelihood S = Severity)
Safe Systems options ('primary' or 'transformational' treatments)	• Separation (footpath) • Separation (crossing point) • Very low speed environment/speed limit	E L L, S
Supporting treatments (compatible with future implementation of Safe System options)	• Reduce speed environment/speed limit • Pedestrian refuge • Reduce volume traffic	L, S L E, L
Supporting treatments (does not affect future implementation of Safe Systems options)	• Pedestrian signals • Skid resistance improvement • Improved sight distance to pedestrians • Improved lighting • Rest-on-red signals	L L L L L, S
Other considerations	• Speed enforcement	L, S

Table 9 - Cyclist treatments

Hierarchy	Treatment	Influence (E = Exposure L = Likelihood S = Severity)
Safe Systems options ('primary' or 'transformational' treatments)	• Separation (separate cyclist path) • Very low speed environment, especially at intersections	E L, S
Supporting treatments (compatible with future implementation of Safe System options)	• Shared pedestrian/bicycle path • Bicycle lane • Reduce traffic volumes	E L E, L
Supporting treatments (does not affect future implementation of Safe Systems options)	• Separate cyclist signals at intersection • Cyclist box at intersection • Skid resistance improvement	L L L
Other considerations	• Speed enforcement • Enforcement of other regulations	L, S L

Table 10 - Motorcyclist treatments

Hierarchy	Treatment	Influence (E = Exposure L = Likelihood S = Severity)
Safe Systems options ('primary' or 'transformational' treatments)	• Separate motorcycle lane (e.g. on freeways)	E
Supporting treatments (compatible with	• Shared motorcycle/bus/taxi lane (e.g. on freeways)	L

future implementation of Safe System options)		
Supporting treatments (does not affect future implementation of Safe Systems options)	• Consistent design along the route (i.e. no out-of-context curves) • Consistent delineation for route • Skid resistance improvements • Motorcycle-friendly barrier systems	L L L S
Other considerations	• Speed enforcement • Enforcement of other regulations	L, S L

12 Responding to the SSA

12.1 An SSA will usually suggest a number of measures that can increase a project's alignment with Safe System principles. Some of the suggestions may be accepted/considered but it will depend on the feasibility for the project.

12.2 The SSA team should be advised of any design changes in response to the SSA assessment.

12.3 It is the responsibility of the project manager to ensure the design and scope amendments are incorporated within the design before construction commences.

References

Austroads. (2016). Safe System Assessment Framework. Austroads.
VicRoads. (2018, July). Safe System Assessment Guidelines Version 1.