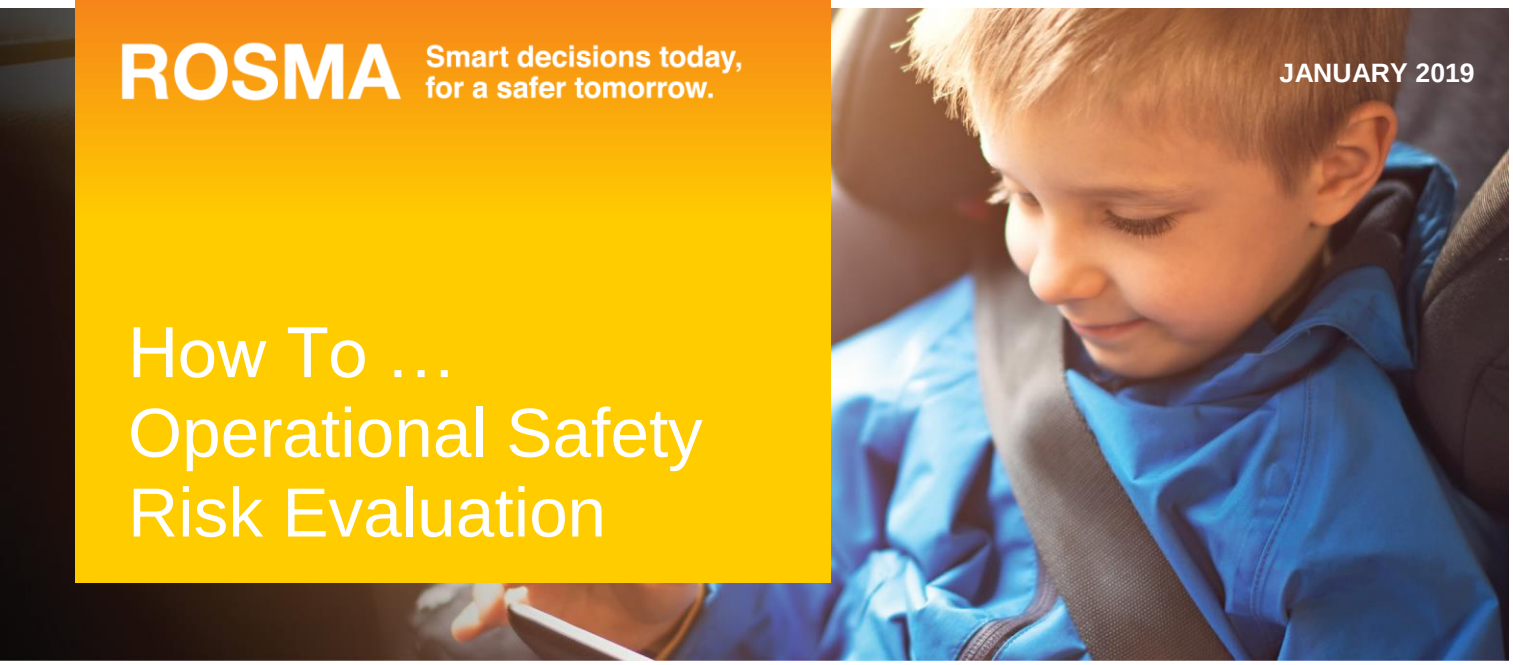
ROSMA Smart decisions today, for a safer tomorrow.

JANUARY 2019



How To … Operational Safety Risk Evaluation

This document provides a step-by-step guide on how to carry out an Operational Safety Risk Evaluation. If you require further help after reading this How To or if you have any questions please contact roadsafety@mainroads.wa.gov.au

About Operational Safety Risk Evaluation

Operational Safety Risk Management supports the road trauma assessment and treatment selection stages of the Road Trauma Reduction Process (D15#686631). It provides an alternative, hazard analysis based approach for determining the road trauma reduction potential of projects that involve some form of operational change (e.g. converting an emergency lane into a trafficked lane). It can also be used to assess the road trauma impact of novel treatments, where the associated crash reduction factor is unknown, or where Killed and Seriously Injured crash risk cannot be determined.

Operational Safety Risk Evaluation within ROSMA

The Operational Safety Risk Evaluation activities undertaken within ROSMA are:

Hazard Assessment (carried out during the Road Trauma Assessment stage of ROSMA)

- *Hazard identification* – identifying existing and potential hazards associated with the 'baseline' and 'project' respectively, and recording them within a hazard log. (The 'baseline' is the part of the existing road network affected by the project.)
- *'Baseline' Safety Risk Profile* – allocating safety risk scores to each hazard and summing them together to produce a safety risk profile (a chart showing the relative risk of each hazard).

Treatment Evaluation (carried out during the Treatment Selection stage of ROSMA)

- *Impact on Hazard Safety Risk* – determining the change in safety risk for each hazard that applies when the project becomes operational. This is used to determine whether or not the project is likely to meet its Road Trauma Reduction Target.

Definitions

Baseline	The part of the existing road network affected by the Project. That is, the before situation against which the change in safety risk will be measured.
Cause	Something that leads to a Hazard, e.g. running out of fuel may Cause a 'Vehicle to stop on the Emergency Stopping Lane' and become a Hazard.
Event Hazard	A Hazard that happens quickly, i.e. it does not persist for a period of time, e.g. Driver losses control of a vehicle.
Hazard	Something that can lead to a consequence (an Incident) resulting in harm, e.g. Vehicle stopped on the emergency lane. It comes about because of a Cause or a number of Causes. The hazard in itself may or may not lead to an Incident.
Hazard Group	A grouping of Hazards that share certain attributes, E.g. involving Pedestrians, involving Motorcyclists, involving Maintenance etc.
Hazard Index Score	A score allocated to a Hazard based upon: • How often it occurs or how long it persists • How often is it likely to lead to an Incident • When it does lead to an incident, how severe (on average) is the Incident It is a step towards determining the Safety Risk Score (see below)
Incident	Something that results in harm, e.g. Vehicles colliding in Emergency Lane.
Project	In the context of this document, a generic term for the change to the Baseline that is being evaluated. This may or may not be a physical road project. It could be a change in the way things are done and/or operated.
Safety Risk	The risk of personal harm or property damage posed by a Hazard
Safety Risk Profile	The summation of the Safety Risk Scores for all the Hazards that apply to the Baseline or Project. Usually presented in the form of a chart.
Safety Risk Score	The Safety Risk associated with a Hazard or Hazard Group. It is derived from the Hazard Index Score using the following formula: Safety Risk Score = $10^{\wedge(\text{Hazard Index Score})}$

State Hazard	A hazard that can persist for a period of time e.g. Debris on the carriageway

Principles

Operational Safety Risk Evaluation determines the safety risk reduction potential of a 'Project' as measured against the current situation (the 'Baseline'). This is achieved by identifying all the Hazards that are present on the 'Baseline' and assigning them individual safety risk scores. These are then added together to form a Safety Risk Profile which is displayed on a chart.

The change in safety risk for each hazard brought about by the 'Project' is then determine and used to produce a 'Project' Safety Risk Profile. The percentage difference between the two profiles is then compared with project's road trauma reduction target.

If the road trauma reduction target is not met, the project is refined so that either the target is met or all reasonable measures have been undertaken to reduce the safety risk of the project as low as reasonably practicable.

The process of Operational Safety Risk Evaluation can therefore be summarised as:

1) Identify all the hazards that are present in the 'Baseline' and after implementation of the 'Project'.
2) Determine the Safety Risk Score for each 'Baseline' hazard and added them together to create a 'Baseline' Safety Risk Profile.
3) Determine the effect of the 'Project' on the Safety Risk Score associated with each hazard, thus creating a 'Project' Safety Risk Profile.
4) Determine the percentage increase or decrease in safety risk score between the two profiles and compare these with the Road Trauma Reduction Target.

Use

Operational Safety Risk Evaluation should be used for:

- Projects that involve an operational change (e.g. converting an emergency lane into a trafficked lane)
- Projects that rely heavily on technology to direct/inform road users
- Operational changes to works practices for those who work on the road (Maintainers, Recovery Operators and Emergency Services etc.)
- Novel designs or treatments where the associated crash reduction factor is unknown, or where Killed and Seriously Injured crash risk cannot be determined

Preparation

If you have not done so already, carry out these stages of the ROSMA process:

1) Download a copy of the Road Trauma Reduction Report which will be used to record the results of the Operational Safety Risk Evaluation. Complete Section 1 with details of the project.

2) Determine the Road Trauma Reduction target by using the Reduction Target Tool. Refer to the "How To… Reduction Target Tool" Guide for instructions on how this can be achieved. Complete Sections 2 and 3.

Download a copy of the Operational Safety Risk Evaluation Hazard Log Template (D17#425975).

Users external to Main Roads can obtain the all the above documentation from this webpage:

https://www.mainroads.wa.gov.au/OurRoads/RoadSafety/Pages/managementsystem.aspx

Hazard Identification

Hazard Identification is an essential part of Operational Safety Risk Evaluation. Various methods can be used for hazard identification, often using a workshop type environment where participants work through a number of potential scenarios. Road Safety Branch roadsafety@mainroads.wa.gov.au can advise on this if required. However, to assist hazard identification, a comprehensive list of known road hazards has been devised and incorporated into the Operational Safety Risk Evaluation Hazard Log Template**.**

The "Incident-Cause-Haz-Haz_Group" worksheet within the Operational Safety Risk Evaluation Hazard Log Template contains a table that shows:

- A list of known road hazards
- The incidents that can result from those hazards (i.e. road crashes or collisions)
- The causes of those hazards (e.g. Driver tiredness, inattention, Debris on the carriageway etc.)
- Which Hazard Group they belong to

To simplify recording of an Operational Safety Risk Evaluation, individual hazards have been assigned into the various Hazard Groups as shown on the "Hazard Groups" worksheet.

An alternative way of viewing which hazards are within each Hazard Group can be found on the "Narratives" worksheet (starting at Row 33).

33	Haz_01 Loss of vehicle control by driver	Haz_02 Rubber-necking	Haz_03 Conflicting Movements
36	⊟Event	⊟State	⊟Event
37	⊞H001 Driver falls asleep	⊞H003 Rubbernecking	⊞H005 Unsafe entry into Intersection
38	⊞H002 Health deterioration of vehicle occupant		⊞H006 Unsafe traverse of Intersection
39	⊞H007 Driver loses control of vehicle		⊞H051 Unsafe turn across carriageway
40			⊞H097 Unsafe U-turn
41			⊟State
42			⊞H005 Unsafe entry into Intersection

For example, in the above it can be seen that Hazard Group "Haz_01 Loss of vehicle control by driver" is made up of three hazards:

- *H001 Driver falls asleep*
- *H002 Health deterioration of vehicle occupant*
- *H007 Driver loses control of vehicle*

To see the causes leading to a Hazard, click on the "+" sign next to the hazard name. In the example below, the causes associated with "H007 Driver loses control of vehicle" are displayed. (Click on the "-"sign to hid them again.)

Haz_01 Loss of vehicle control by driver
⊟Event
⊞H001 Driver falls asleep
⊞H002 Health deterioration of vehicle occupant
⊟H007 Driver loses control of vehicle
C010 Driving too fast
C013 Influence of drugs and alcohol
C015 Slippery roadway surface
C018 Use of mobile phone while driving
C019 Vehicle mechanical fault
C023 Driver distracted (other causes)
C035 Driver distracted by reading road/rail signs and signals
C036 Driver over-reaction
C037 Debris or obstruction on roadway
C038 Encounters abnormal/Oversize load
C039 Encounters Emergency Service Vehicle on Call
C040 Pedestrian crossing roadway
C047 Pedestrian in/on roadway (not crossing)
C109 Derailment

To see the Incidents resulting from a Hazard go to the top of the "Narratives" worksheet (starting at Row 4).

1	**Baseline**	**Baseline**
2	Haz_01 Loss of vehicle control by driver	Haz_02 Rubber-necking
3	This hazard group concerns the driver losing control of the vehicle either through personal factors (inattention or illness) or through encountering something on the carriageway. It does not include drifting off the carriageway due to inattention which is covered in Haz_14 Vehicle drifts off carriageway, but it can result in the vehicle leaving the carriageway.	This hazard group concerns drivers being distracted while passing an incident usually in the other carriageway.
4	**Related Incidents**	**Related Incidents**
7	I1 Vehicles collide in/on roadway	I1 Vehicles collide in/on roadway
8	I2 Vehicle leaves roadway - exits carriageway	
9		
10		

For example, in the above it can be seen that Hazard Group "Haz_01 Loss of vehicle control by driver" can lead to:

- *I1Vehicles collide in/on roadway*
- *I2 Vehicle leaves roadway – exits carriageway*

The information in the "Narratives" worksheet (and "Incident-Cause-Haz-Haz_Group" worksheet) should be reviewed to ensure that all relevant incidents, hazards and causes that apply to both the 'Baseline' and the 'Project' are covered (in the vast majority of cases this will be the case). If there is any concern, Road Safety Branch roadsafety@mainroads.wa.gov.au will be able to provide advice.

Building the ‘Baseline’ Safety Risk Profile

This section describes how the Hazard Log Template is used to build the ‘Baseline’ Safety Risk Profile.

All the information used to determine the ‘Baseline’ Safety Risk Profile is entered on the “Narratives” worksheet. As shown below, the “Narratives” worksheet contains a table where each column denotes a Hazard Group.

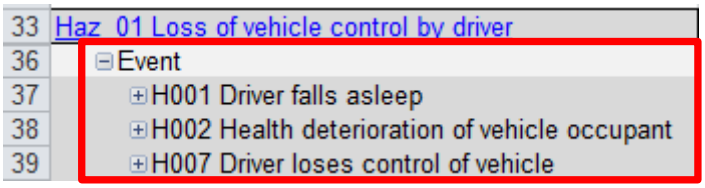
	B	C
1	**Baseline**	**Baseline**
2	Haz_01 Loss of vehicle control by driver	Haz_02 Rubber-necking
3	This hazard group concerns the driver losing control of the vehicle either through personal factors (inattention or illness) or through encountering something on the carriageway. It does not include drifting off the carriageway due to inattention which is covered in Haz_14 Vehicle drifts off carriageway, but it can result in the vehicle leaving the carriageway.	This hazard group concerns drivers being distracted while passing an incident usually in the other carriageway.
4	**Related Incidents**	**Related Incidents**
7	I1 Vehicles collide in/on roadway	I1 Vehicles collide in/on roadway
8	I2 Vehicle leaves roadway - exits carriageway	
9		
10		
17	**Exposure**	**Exposure**
18		
19	Enter Event Frequency Here	
20		Enter State Duration Here
21	**Likelihood**	**Likelihood**
22		
23	Enter Likelihood Here	Enter Likelihood Here
24	**Severity**	**Severity**
25		
26	Enter Severity Here	Enter Severity Here
27	**Hazard Index Score**	**Hazard Index Score**
28	0	0
29	**Change in Risk**	**Change in Risk**
30		
31		
32		
33	Haz_01 Loss of vehicle control by driver	Haz_02 Rubber-necking
36	⊟Event	⊟State
37	⊞H001 Driver falls asleep	⊞H003 Rubbernecking
38	⊞H002 Health deterioration of vehicle occupant	
39	⊞H007 Driver loses control of vehicle	

Towards the top of the table, the name of the Hazard Group is presented along with a short description.

To build the ‘Baseline’ Safety Risk Profile, undertake the following steps for each relevant Hazard Group.

Step 1: Review which hazards are within the Hazard Group

Review the hazards that are present within each Hazard Group. These are shown below each Hazard Group within the "Narratives" worksheet (Row 33 onwards).

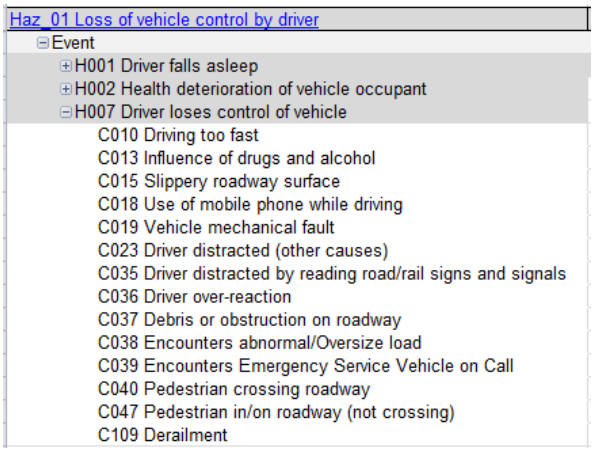


In this case it can be seen that the hazards in this group are:

- H001 Driver falls asleep
- H002 Health deterioration of vehicle occupant
- H007 Driver loses control of vehicle

Note: whether or not these hazards are considered Events or States[1] is also shown.

As noted previously the causes leading to a hazard can be viewed by clicking the "+" sign next to the hazard name. In the example below, the causes associated with "H007 Driver loses control of vehicle" are displayed.



Step 2: Enter information to support the Exposure Index Score

For each of the Hazards within the Hazard Group, enter information that indicates the level of exposure associated with that hazard. For Event hazards, this is how often it will happen per year per km, for State hazards this is how long it is present for per year per km. The justification is highly dependent upon the characteristics of the project. Where possible, observations and/or evidence should be used to justify how often or how long the hazard persists.

Examples are shown overleaf.

[1] An Event Hazard happens quickly, i.e. it does not persist for a period of time, e.g. Driver losses control of a vehicle.

A State Hazard persist for a period of time e.g. Debris on the carriageway.

	B	C
1	**Baseline**	**Baseline**
2	Haz_01 Loss of vehicle control by driver	Haz_02 Rubber-necking
4	**Related Incidents**	**Related Incidents**
7	I1 Vehicles collide in/on roadway	I1 Vehicles collide in/on roadway
8	I2 Vehicle leaves roadway - exits carriageway	
9		
10		
17	**Exposure**	**Exposure**
	H001 - Driver falls asleep. While it is possible for this to happen the road is an urban environment and fatigue has not been recorded as a cause in any crashes on this section. H002 - Health deteriation of vehicle occupant. While this is possible, it is not likely to happen more than a handful of times per year. H007 - Driver losses control of vehicle. There have been a number of loss of control crashes on this section over the past 5 years. Given the volume of traffic 15,000 vehicles per day, it is highly likely that there could be at least a few drivers lossing control per day per km.	H003 - Rubbernecking. Review of crash data shows that there have been 5 crashes per km on this section during a 5 year period. Another reason for rubbernecking is a vehicle breakdown. A local breakdown serivce provider has indicated that this happens once a week per km on this road. Assuming that a crash would be present for an hour before being cleared and a breakdown 1/2 hour before being cleared, incidents are on this road for typically 1+ 52*(0.5) = 27 hours per year .
18	This would equate to in excess of 700 per year.	
19	Enter Event Frequency Here	
20		Enter State Duration Here

Once the justification has been entered, go to the “Enter Event Frequency Here” drop-down box (Row 19) and select the value that most closely matches the justification. In the example below, for “HAZ_01 Loss of vehicle control by driver”, “Very frequent – 600 per year per km: 6” is being selected.

	B	C
1	**Baseline**	**Baseline**
2	Haz_01 Loss of vehicle control by driver	Haz_02 Rubber-necking
4	**Related Incidents**	**Related Incidents**
7	I1 Vehicles collide in/on roadway	I1 Vehicles collide in/on roadway
8	I2 Vehicle leaves roadway - exits carriageway	
9		
10		
17	**Exposure**	**Exposure**
	H001 - Driver falls asleep. While it is possible for this to happen the road is an urban environment and fatigue has not been recorded as a cause in any crashes on this section. H002 - Health deteriation of vehicle occupant. While this is possible, it is not likely to happen more than a handful of times per year. H007 - Driver losses control of vehicle. There have been a number of loss of control crashes on this section over the past 5 years. Given the volume of traffic 15,000 vehicles per day, it is highly likely that there could be at least a few drivers lossing control per day per km.	H003 - Rubbernecking. Review of crash data shows that there have been 5 crashes per km on this section during a 5 year period. Another reason for rubbernecking is a vehicle breakdown. A local breakdown serivce provider has indicated that this happens once a week per km on this road. Assuming that a crash would be present for an hour before being cleared and a breakdown 1/2 hour before being cleared, incidents are on this road for typically 1+ 52*(0.5) = 27 hours per year .
18	This would equate to in excess of 700 per year.	
19	Enter Event Frequency Here	
20	Enter Event Frequency Here Very frequent - 600 per year per km: 6 Between Very Frequent and Frequent - 200 per year per km: 5.5 Frequent - 60 per year per km: 5 Between Frequent and Probable - 20 per year per km: 4.5 Probable - 6 per year per km: 4 Between Probable and Occasional - 2 per year per km: 3.5 Occasional - 0.6 per year per km: 3	ter State Duration Here
21		**kelihood**
22		incident on the opposite carriageway is a distraction m the driving task. While drivers are likely to be aware at they should driver with more care during these conditions, it is judged that collisions will occationally occur.

In the further example below, for the Hazard Group “HAZ_02 Rubber-necking”, “Present 1.15 days per year per km: 3.5” is being selected from the “Enter State Duration Here” drop-down box (Row 20).

1	**Baseline**	**Baseline**
2	Haz_01 Loss of vehicle control by driver	Haz_02 Rubber-necking
3	This hazard group concerns the driver losing control of the vehicle either through personal factors (inattention or illness) or through encountering something on the carriageway. It does not include drifting off the carriageway due to inattention which is covered in Haz_14 Vehicle drifts off carriageway, but it can result in the vehicle leaving the carriageway.	This hazard group concerns drivers being distracted while passing an incident usually in the other carriageway.
4	**Related Incidents**	**Related Incidents**
7	I1 Vehicles collide in/on roadway	I1 Vehicles collide in/on roadway
8	I2 Vehicle leaves roadway - exits carriageway	
9		
10		
17	**Exposure**	**Exposure**
18	H001 - Driver falls asleep. While it is possible for this to happen the road is an urban environment and fatigue has not been recorded as a cause in any crashes on this section. H002 - Health deteriation of vehicle occupant. While this is possible, it is not likely to happen more than a handful of times per year. H007 - Driver losses control of vehicle. There have been a number of loss of control crashes on this section over the past 5 years. Given the volume of traffic 15,000 vehicles per day, it is highly likely that there could be at least a few drivers lossing control per day per km. This would equate to in excess of 700 per year.	H003 - Rubbernecking. Review of crash data shows that there have been 5 crashes per km on this section during a 5 year period. Another reason for rubbernecking is a vehicle breakdown. A local breakdown serivce provider has indicated that this happens once a week per km on this road. Assuming that a crash would be present for an hour before being cleared and a breakdown 1/2 hour before being cleared, incidents are on this road for typically 1+ 52*(0.5) = 27 hours per year .
19	Very frequent - 600 per year per km: 6	
20		Enter State Duration Here
21	**Likelihood**	Enter State Duration Here At least 1 occurrence present at any one time - 1 per year per km: 6 Present 115 days - 0.316 per year per km: 5.5 Present 36.5 days - 0.1 per year per km: 5 Present 11.5 days - 0.0316 per year per km: 4.5 Present 3.65 days - 0.01 per year per km: 4 Present 1.15 days - 0.00316 per year per km: 3.5 Present 9 hours - 0.001 per year per km: 3
22		
23	Enter Likelihood Here	
24	**Severity**	
25		

Please note that the frequency of Event hazards are entered in Row 19, while the duration of State hazards is entered in Row 20. This is because some Hazard Groups (for example Haz_18 Pedestrians) have both Event and State Hazards which means values for both need to be entered.

Step 3: Enter the Likelihood and Severity justifications and index scores.

Repeat the process described in Step 2 for the Likelihood and Severity factors.

1	**Baseline**	**Baseline**
2	Haz_01 Loss of vehicle control by driver	Haz_02 Rubber-necking
3	This hazard group concerns the driver losing control of the vehicle either through personal factors (inattention or illness) or through encountering something on the carriageway. It does not include drifting off the carriageway due to inattention which is covered in Haz_14 Vehicle drifts off carriageway, but it can result in the vehicle leaving the carriageway.	This hazard group concerns drivers being distracted while passing an incident usually in the other carriageway.
4	**Related Incidents**	**Related Incidents**
7	I1 Vehicles collide in/on roadway	I1 Vehicles collide in/on roadway
8	I2 Vehicle leaves roadway - exits carriageway	
9		
10		
17	**Exposure**	**Exposure**
18	H001 - Driver falls asleep. While it is possible for this to happen the road is an urban environment and fatigue has not been recorded as a cause in any crashes on this section. H002 - Health deteriation of vehicle occupant. While this is possible, it is not likely to happen more than a handful of times per year. H007 - Driver losses control of vehicle. There have been a number of loss of control crashes on this section over the past 5 years. Given the volume of traffic 15,000 vehicles per day, it is highly likely that there could be at least a few drivers lossing control per day per km. This would equate to in excess of 700 per year	H003 - Rubbernecking. Review of crash data shows that there have been 5 crashes per km on this section during a 5 year period. Another reason for rubbernecking is a vehicle breakdown. A local breakdown serivce provider has indicated that this happens once a week per km on this road. Assuming that a crash would be present for an hour before being cleared and a breakdown 1/2 hour before being cleared, incidents are on this road for typically 1+ 52*(0.5) = 27 hours per year .
19	Very frequent - 600 per year per km: 6	
20		Present 1.15 days - 0.00316 per year per km: 3.5
21	**Likelihood**	**Likelihood**
22	Loss of vehicle control is something that is though to occur on a regular basis. In the vast majority of cases the driver is able to recover. Therefore the Likelihood is judged to be remote.	An incident on the opposite carriageway is a distraction from the driving task. While drivers are likely to be aware that they should driver with more care during these conditions, it is judged that collisions will occationally occur.
23	There is a remote chance of a collision: 1	A collision will occasionally happen: 2
24	**Severity**	**Severity**
25	Loss of control by a driver is one of the most significant causes of crashes on the network. It would therefore be reasonable to assume that it has an Average level of severity	The most likely type of collision is a rear-end at low speed. Severity is considered less than average.
26	Average: 1	Lower than average: 0.5
27	**Hazard Index Score**	**Hazard Index Score**
28	8	6

Repeat **Steps 1, 2 and 3** for each relevant Hazard Group.

Hazard Index Score

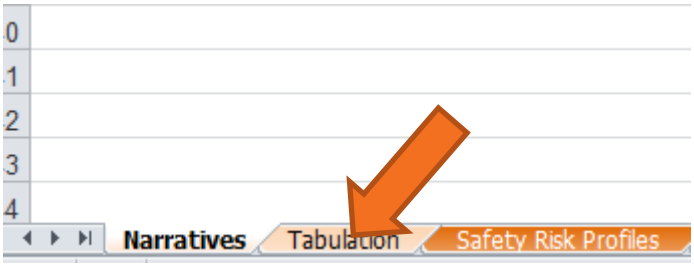
The Hazard Log Template automatically calculates a Hazard Index Score for each Hazard Group. This is simply the sum of the numbers shown at the end of each drop-down box[2].

Hazard Index Score is used to provide a quick comparison between the safety risk associated with different Hazard Groups. A difference of 1 in the Hazard Index Scores is equal to a difference of 10 in safety risk. A difference of 2 in the Hazard Index Scores is equal to a difference of 100 in safety risk and so on.

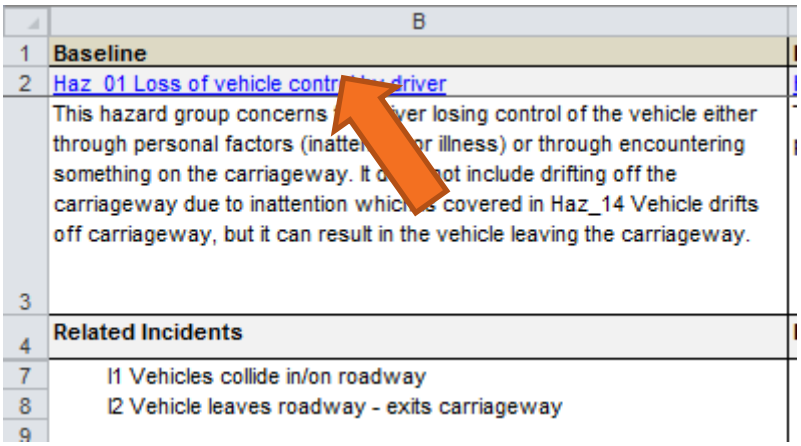
So in the previous example it can be seen that "HAZ_01 Loss of vehicle control by driver" with a Hazard Index Score of "8" has 100 times more risk than "HAZ_02 Rubber-necking" which has an index score of "6". The colour assigned to each Hazard Index Score also indicates the level of safety risk (going from red, through yellow to green for the lowest safety risk).

Viewing the Baseline Safety Risk Profile in tabular and chart form

The Hazard Log Template generates a summary of the 'Baseline' safety risk on the "Tabulation" worksheet. There are two ways of viewing the "Tabulation" worksheet. Either click on the "Tabulation" tab at the bottom of the worksheet:



Or click on any Hazard Group name:



The information in the "Tabulation" worksheet will look similar to that shown overleaf.

[2] More information about this can be found in Appendix A of this "How to…"

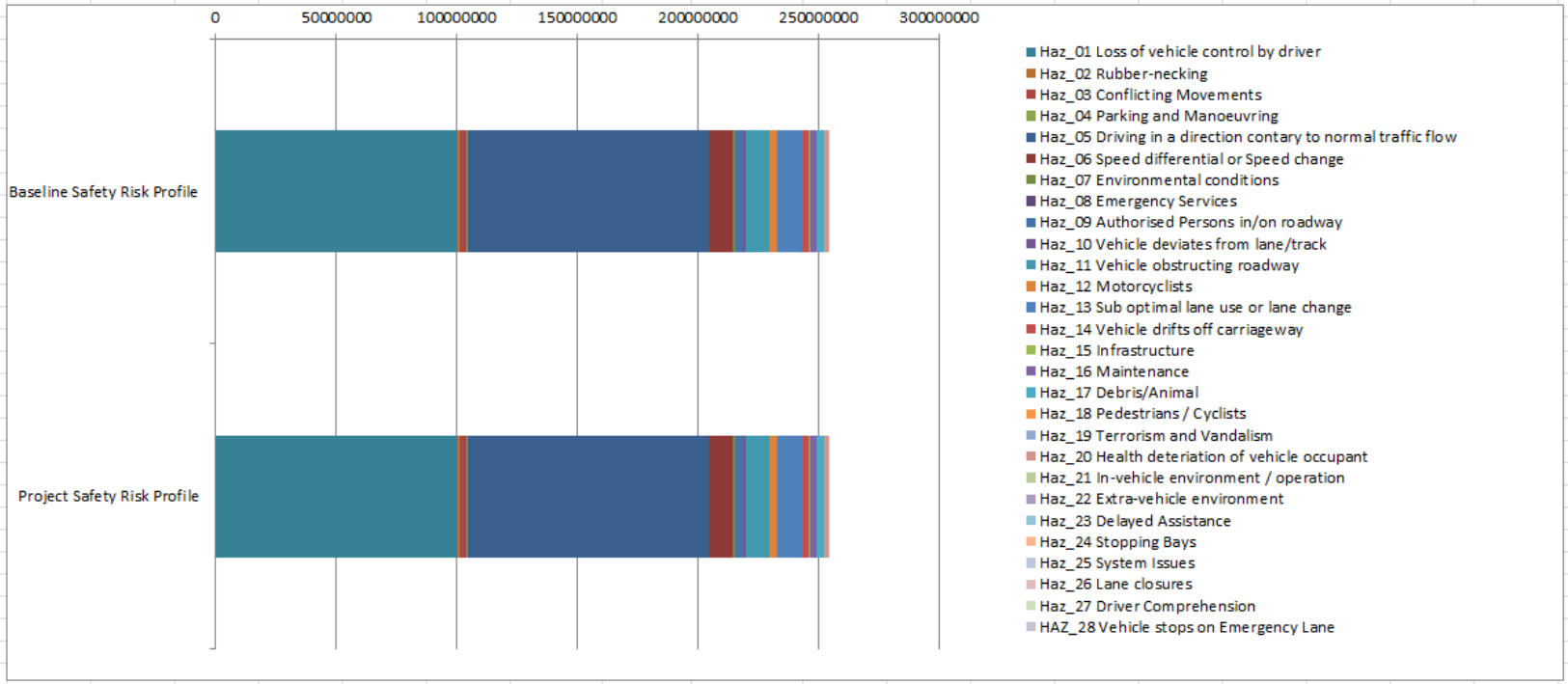
	A	C	D	E	F	G	J	K	L
1	Safety Risk Profiles								
2									
3	**Hazard Groups**	**Event Exposure Index**	**State Exposure Index**	**Likelihood Index**	**Severity Index**	**Index**	**Baseline Safety Risk Profile**	**Baseline Safety Risk %age**	**Change in Risk (%)**
4	Haz_01 Loss of vehicle control by driver	Very frequent - 600 per year per km: 6	0	There is a remote chance of a collision: 1	Average: 1	8	100000000	39.4%	0%
5	Haz_02 Rubber-necking	0	Present 9 hours - 0.001 per year per km: 3	A collision will occasionally happen: 2	Average: 1	6	1000000	0.4%	0%
6	Haz_03 Conflicting Movements	Remote - 0.06 per year per km: 2	Present 15 minutes - 0.0000316 per year per km: 1.5	A collision will occasionally happen: 2	Average: 1	6.5	3162277.66	1.2%	0%
7	Haz_04 Parking and Manoeuvring	Between Probable and Occasional - 2 per year per km: 3.5	0	There is a remote chance of a collision: 1	Minor: 0	4.5	31622.7766	0.0%	0%
8	Haz_05 Driving in a direction contary to normal traffic flow	Between Frequent and Probable - 20 per year per km: 4.5	Present 90 seconds - 0.00000316 per year per km: 0.5	A collision will occasionally happen: 2	Average: 1	8	100000000	39.4%	0%
9	Haz_06 Speed differential or Speed change	Probable - 6 per year per km: 4	Present 5 minutes - 0.00001 per year per km: 1	There is a remote chance of a collision: 1	Average: 1	7	10000000	3.9%	0%
10	Haz_07 Environmental conditions	0	Present 9 hours - 0.001 per year per km: 3	A collision will occasionally happen: 2	Average: 1	6	1000000	0.4%	0%
11	Haz_08 Emergency Services	Between Probable and Occasional - 2 per year per km: 3.5	0	There is a remote chance of a collision: 1	Average: 1	5.5	316227.766	0.1%	0%
12	Haz_09 Authorised Persons in/on roadway	0	Present 3 hours - 0.000316 per year per km: 2.5	A collision will occasionally happen: 2	Severe: 2	6.5	3162277.66	1.2%	0%
13	Haz_10 Vehicle deviates from lane/track	Between Frequent and Probable - 20 per year per km: 4.5	0	There is a remote chance of a collision: 1	Lower than average: 0.5	6	1000000	0.4%	0%
14	Haz_11 Vehicle obstructing roadway	Frequent - 60 per year per km: 5	0	There is a remote chance of a collision: 1	Average: 1	7	10000000	3.9%	0%
15	Haz_12 Motorcyclists	Probable - 6 per year per km: 4	Enter State Duration Here	There is a remote chance of a collision: 1	Higher than average: 1.5	6.5	3162277.66	1.2%	0%
16	Haz_13 Sub optimal lane use or lane change	Between Very Frequent and Frequent - 200 per year per km: 5.5	0	There is a remote chance of a collision: 1	Lower than average: 0.5	7	10000000	3.9%	0%
17	Haz_14 Vehicle drifts off carriageway	Occasional - 0.6 per year per km: 3	0	A collision will occasionally happen: 2	Higher than average: 1.5	6.5	3162277.66	1.2%	0%
18	Haz_15 Infrastructure	Between Report and Incredible - 0.002 per year per km: 0.5	Enter State Duration Here	A collision is probable: 3	Higher than average: 1.5	5	100000	0.0%	0%
19	Haz_16 Maintenance	Between Report and Incredible - 0.002 per year per km: 0.5	Present 9 hours - 0.001 per year per km: 3	There is a remote chance of a collision: 1	Severe: 2	6.5	3162277.66	1.2%	0%
20	Haz_17 Debris/Animal	0	Present 9 hours - 0.001 per year per km: 3	A collision will occasionally happen: 2	Higher than average: 1.5	6.5	3162277.66	1.2%	0%
21	Haz_18 Pedestrians / Cyclists	Improbable - 0.006 per year per km: 1	Present 15 minutes - 0.0000316 per year per km: 1.5	There is a remote chance of a collision: 1	Severe: 2	5.5	316227.766	0.1%	0%
22	Haz_19 Terrorism and Vandalism	Incredible - 0.0006 per year per km: 0	0	A collision is probable: 3	Higher than average: 1.5	4.5	31622.7766	0.0%	0%
23	Haz_20 Health deteriation of vehicle occupant	Occasional - 0.6 per year per km: 3	0	A collision will occasionally happen: 2	Average: 1	6	1000000	0.4%	0%
24	Haz_21 In-vehicle environment / operation	Occasional - 0.6 per year per km: 3	Enter State Duration Here	There is a remote chance of a collision: 1	Average: 1	5	100000	0.0%	0%
25	Haz_22 Extra-vehicle environment	Enter Event Frequency Here	0	Enter Likelihood Here	Enter Severity Here	0	0	0.0%	0%
26	Haz_23 Delayed Assistance	Enter Event Frequency Here	0	Enter Likelihood Here	Enter Severity Here	0	0	0.0%	0%
27	Haz_24 Stopping Bays	Enter Event Frequency Here	Enter State Duration Here	Enter Likelihood Here	Enter Severity Here	0	0	0.0%	0%
28	Haz_25 System Issues	Enter Event Frequency Here	Enter State Duration Here	Enter Likelihood Here	Enter Severity Here	0	0	0.0%	0%
29	Haz_26 Lane closures	Occasional - 0.6 per year per km: 3	0	There is a remote chance of a collision: 1	Average: 1	5	100000	0.0%	0%
30	Haz_27 Driver Comprehension	Enter Event Frequency Here	0	Enter Likelihood Here	Enter Severity Here	0	0	0.0%	0%
31	HAZ_28 Vehicle stops on Emergency Lane	0	Enter State Duration Here	Enter Likelihood Here	Enter Severity Here	0	0	0.0%	0%
32	Haz_01 & Haz_14 Loss of Control/Drift off Carriageway								
34									
35					**Reduction in Safety Risk brought about by Project**				0.00%

In the above, information has been entered for most of the Hazard Groups. The Hazard Index Scores are shown in Column G. These have been converted to actual safety risk scores (Column J) using the follow formula:

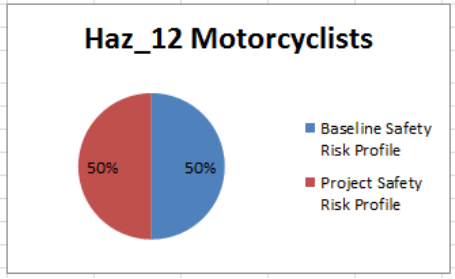
Safety Risk Score = $10^{\text{(Hazard Index Score)}}$

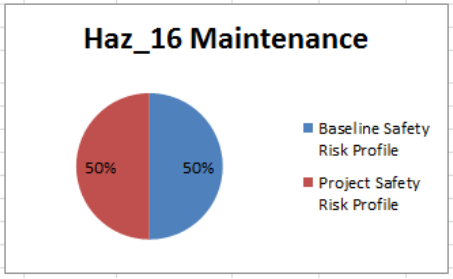
To view the 'Baseline' Safety Risk Profile, click on the "Safety Risk Profiles" button at the top-left of the "Tabulation" worksheet or click on the "Safety Risk Profiles" tab. Charts similar to those shown overleaf are displayed.

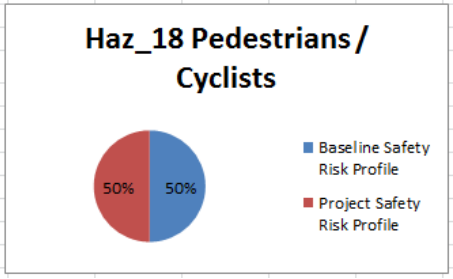
Tabulation Narratives



Reduction in Safety Risk brought about by Project	0.00%







In the example shown, it can be seen that most of the safety risk on the 'Baseline' is associated with two Hazard Groups:

- HAZ_01 Loss of vehicle control by driver
- HAZ_05 Driving in a direction contrary to normal traffic flow

(The "Tabulation" Worksheet shows that they each account for just less than 40% of the 'Baseline' safety risk.)

The following should also be noted:

- A 'Project' Safety Risk Profile is also displayed in anticipation of changes in safety risk being entered. As no changes have been entered at this stage it is the same as the 'Baseline' Safety Risk Profile .
- Three pie-charts are also displayed for three key Hazard Groups that involve vulnerable road users. The 'Project' should avoid increased safety risk for these Hazard Groups.

Building the 'Project' Safety Risk Profile

This section describes how the Hazard Log Template is used to build the 'Project' Safety Risk Profile. It assumes that the 'Baseline' Safety Risk Profile has already been built.

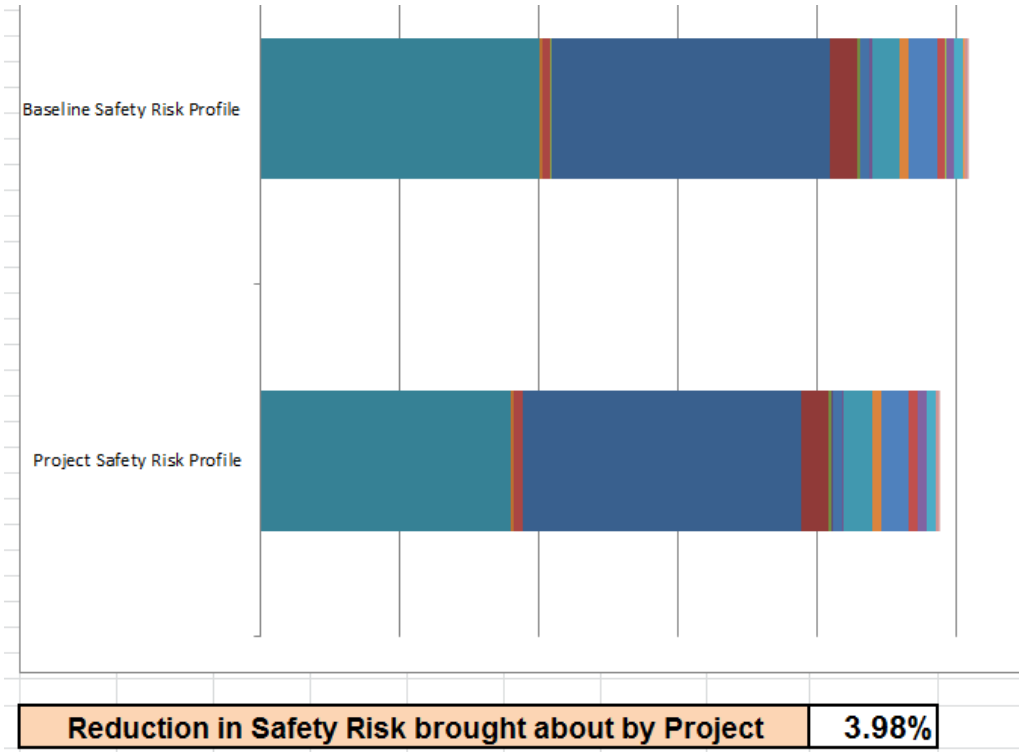
On the "Narratives" worksheet, enter the likely effect of the project on Row 30 and assign a percentage change in Row 31.

28	8	6
29	**Change in Risk**	**Change in Risk**
30	The introduction of Lane Signaling should reduce the instances of drivers lossing control of a vehicle due to congestion. Although considered very effective, the signals will only activate during congested conditions so the benefit of these is estimated as 10%	Lane use management signals will reduce incidents by 10%
31	-10%	-10%
32		
33	Haz_01 Loss of vehicle control by driver	Haz_02 Rubber-necking
36	⊟Event	⊟State
37	⊞H001 Driver falls asleep	⊞H003 Rubbernecking
38	⊞H002 Health deterioration of vehicle occupant	
39	⊞H007 Driver loses control of vehicle	

The change in risk is automatically reflected in the "Tabulation" worksheet.

Index	Baseline Safety Risk Profile	Baseline Safety Risk %age	Change in Risk (%)	Project Safety Risk Profile
8	100000000	39.4%	-10%	90000000
6	1000000	0.4%	-10%	900000

It is also automatically shown in the "Safety Risk Profiles" spreadsheet.



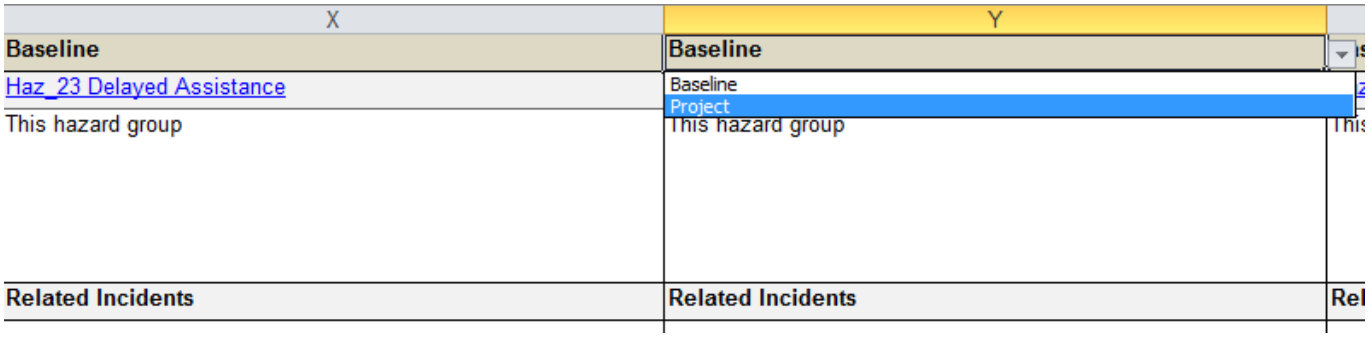
In this case the reduction in Safety Risk brought about by the Project is only about 4%.

The change in safety risk brought about by the project should be determined for all Hazard Groups.

Entering data for a Hazard Group introduced by a Project (but not present on Baseline)

In rare cases, a project may introduce a Hazard Group that is not present in the 'Baseline'. To enable the Hazard Log Template to handle this situation the following procedure is followed:

Step 1: On the "Narratives" worksheet select the drop-down box above the Hazard Group name (Row 1) and change the entry to "Project".



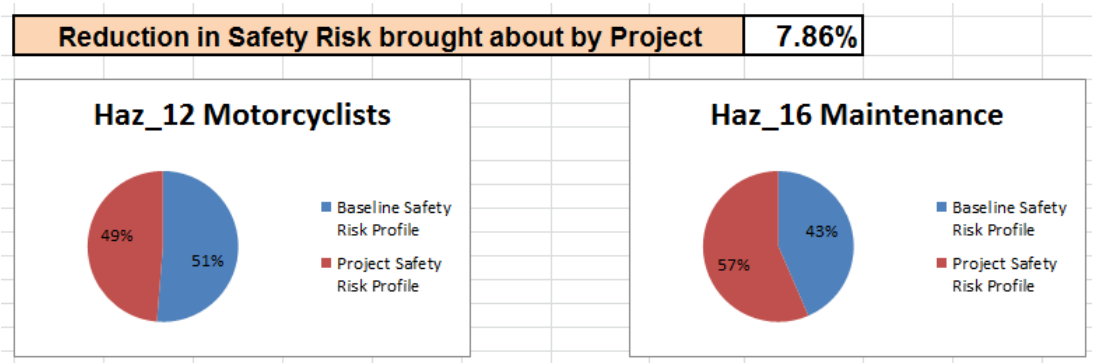
Step 2: Enter the Exposure, Likelihood and Severity data as described in the "Building the 'Baseline' Safety Risk Profile" section.

For the above, the Hazard Log Template will now assume that the safety risk score for this Hazard Group only applies to the 'Project' Safety Risk Profile. It should also be noted that any change in safety risk entered in Row 31 for this Hazard Group will be ignored (as changes only apply to existing Hazard Groups).

Comparison with Road Trauma Reduction Target

The reduction in safety risk should then be compared with the Road Trauma Reduction Target. If the Road Trauma Reduction Target is not met, the project is refined so that either the target is met or all reasonable measures have been undertaken to reduce the safety risk of the project as low as reasonably practicable.

In addition, care should be taken with regard to vulnerable road users. In the example below, a trauma reduction has been achieved however Maintenance safety risk has increased. The project should be modified so that this is not the case.



Recording and endorsement the Operational Safety Risk Evaluation

The outcome of the Operational Safety Risk Evaluation is recorded in the Road Trauma Reduction Report. As per the ROSMA process, this is then forwarded to Road Safety Branch for endorsement.

General Guidance

Level of Operational Safety Risk Evaluation

The level, or intensity, of Operational Safety Risk Evaluation required on project varies depending upon its complexity. There are projects where a more formal approach is only needed in part, either because the necessary standards exist or for other reasons, such as a limited effect on safety from the project being undertaken. Further, the degree of rigour that is necessary varies from project to project, depending on the risk that is involved in the final application. A freeways specific approach to safety risk management needs to possess the necessary flexibility to address such needs. In other words, it needs to be flexible and not over-burden the project if it is not needed.

In addition, any approach to Operational Safety Risk Evaluation has to be able to demonstrate compliance with applicable statutory and other regulatory requirements. In WA there are a number of primary pieces of relevant legislation to take into account:

- Main Roads Act 1930 [1]
- Road Traffic Act 1974 [2]

- Occupational Health and Safety Act 1991 [3]
- Australian Road Rules, Regulations 2006 [4]

These pieces of legislation have implications for the different populations who access the freeways.

The Main Roads Act imposes a duty on MRWA to “manage the State freeway system, including planning, funding, design, supervision, construction, and maintenance and operations in accordance with this Act”. This can be viewed as the primary legislation that affects road users.

The requirement to maintain the freeway is not specified in the same way as the Occupational Health and Safety Act, and while in practice the safety management approach used is the same for the workforce and road users, different types of safety objective need to be considered for these populations.

The Occupational Health and Safety Act [3] has to be applied to all people in their workplace, so MRWA has a responsibility to those it employs to carry out its duties (the workforce) and to control the risks that affect them. This is encapsulated in the phrase “An employer must take all reasonably practicable steps to protect the health and safety at work of the employer’s employees”.

Any process needs to take into account the type of factors that are applicable to Managed Freeways projects, such as use of novel technology, changing driving environment the degree of change in roles and responsibilities for operators and the scale of the project concerned. It should then consider how these factors may be evaluated and how such evaluation may then affect the final decision as to what approach to safety management is appropriate.

Managing the potential for bias in safety risk scoring

Data collection

Where possible, the safety risk scores should be evidence based.

For example, to evaluate the safety risk associated with the hazard group “HAZ_17 Debris/Animal” it is necessary to determine how long debris and animals are present per km per year. Collision records may prove an understanding of how often debris does lead to an incident and, on average, how severe the incident is. Maintenance records may also show how often debris is collected.

These data should be collected within the geographical extent of the project. If that is not possible, data can be used from adjoining parts of the network as long as it is considered that these data are likely to be representative of the project extent. If that is not possible, it may be necessary to use a reasonable estimate.

Stakeholder Reviews

In practice it may only be possible to quantify the frequency or duration of a hazard and to lesser extent the probable severity of the resulting incident. (For example, collisions with vulnerable road users are likely to result in severe consequences.)

For this reason, Operational Safety Risk Evaluation is described as “Semi-Quantitative” as it relies on a combination of quantified values as well as qualitative assessments (i.e. opinions). This means that there is potential for bias in the safety risk scoring (especially when it comes to evaluating the safety risk benefits of a project). This can be mitigated by the use of stakeholder reviews.

The Hazard Log Template should be prepared by the project team to a point where it is considered representative of the ‘Baseline’ Safety Risk Profile. This should then be reviewed by stakeholders independent of the project team. The choice of stakeholder is a decision for the project and depends upon its likely impact. Smaller projects of low complexity may only require review by Road Safety Branch through the normal ROSMA process. Larger more complex projects (e.g. All Lane Running) would most likely involve amongst others:

- Police
- Maintainers
- Road Safety Branch
- Traffic Operations Centre

Road Safety Branch roadsafety@mainroads.wa.gov.au can advise what stakeholders should be involved.

The method of stakeholder review is a decision for the project, but could involve a workshop going through and agreeing the information in the Hazard Log Template. Once the ‘Baseline’ Safety Risk Profile is agreed, the change in safety risk should be determined. This should then be reviewed at a subsequent review session. Stakeholder review should take place as and when required. All stakeholder review sessions must be recorded (see below).

Maintaining the Hazard Log Template

Review Records

The hazard log template must be stored in a records management system (i.e. TRIM/HP Records Manager). This enables each version of the hazard log to be automatically stored. Thus changes to the hazard log can be tracked.

It is good practice to record when changes have been made to the hazard log and what they are. (While TRIM allows you to see that a revision has been made, it does not tell you why the change has been made.)

A “Review Record” worksheet has been incorporated into the Hazard Log Template for this purpose.

	A	B	C
1	Review Date	Details	Notes
2	1/03/2017	Full review of the Basline Safety Risk Profile	Profile agreed by Stakeholders
3	15/05/2017	Updated due to new evidence	ISA have advised a new value for Debris collection. This has been incorporated into the hazard log
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			

Assumptions

In devising the safety risk score certain pieces of information may be referred to a number of times. Rather than having to re-reference the source of this information it is useful to have these all stored in a single place for quick review.

An “Assumptions” worksheet has been incorporated into the Hazard Log Template for this purpose.

	A	B	C	D	E	F
1	ID	Assumption	Value	Units	Related Assumptions	References/Notes
2	A1	Average Annual Daily Traffic Flow	15,000	Vehicles per day		Reporting Centre; recorded at permanent count site - 2016
3	A2	Debris	20	Hours per year		ISA data - D17#12...
4	A3	Minor Collisions	30	per year	A16	CCTV and email from WA police (02/03/2017) - D17#13...
5	A4					
6	A5					

These can then be referred to as shown below:

“H007 - Driver losses control of vehicle. There have been a number of loss of control crashes on this section over the past 5 years. Given the volume of traffic 15,000 vehicles per day **(A1)**, it is highly likely that there could be at least a few drivers losing control per day per km.”

Tasks

Review of the hazard log may lead to certain tasks being required to refine the data.

A “Tasks” worksheet has been incorporated into the Hazard Log Template for this purpose.

	A	B	C	D	E
1	ID	Task	Owner	Status	References/Notes
2	T1	Obtain information about the number of minor incidents in the tunnel from TOC	John Smith	On-going	Email sent 03/04/2017 D17#14..
3	T2				
4	T3				
5	T4				
6	T5				
7	T6				
8	T7				

Requirements

Management or mitigation of a hazard may require certain items to be in place.

A “requirements” worksheet has been incorporated into the Hazard Log Template for this purpose.

	A	B	C	D	E
1	ID	Requirement	Owner	Status	References / Notes
2	R1	Attenuator vehicles to be used for debris collection from live lanes	ISA	Closed	Incorporated into new working practices at ISA D17#20...
3	R2	VMS to be activated during data collection from live lanes	TOC	On-going	Being written into Control System
4	R3				
5	R4				
6	R5				
7	R6				

Validating the Baseline Safety Risk Profile (Optional)

Operational Safety Risk Evaluation determines the ‘Baseline ’Safety Risk Profile. If it is assumed that certain types of hazard give rise to certain types of crash, it is possible to use the existing crash record to validate the ‘Baseline ’Safety Risk Profile. A method of doing this is presented in Appendix B.

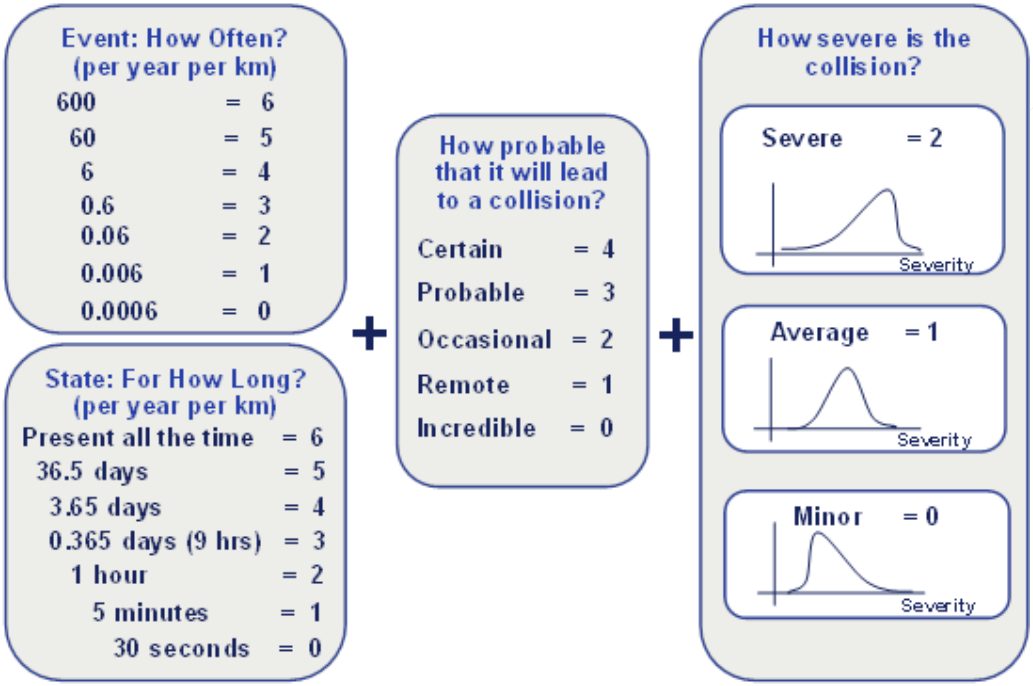
Appendix A: Safety Risk Scoring

Hazard Index Score

The Hazard Index Score is made up of three components:

- Exposure: How often it occurs or how long it persists?
- Likelihood: How often is it likely to lead to an Incident?
- Severity: When it does lead to an incident, how severe (on average) is the incident?

The scoring system used is summarised below.



For **Event** hazards (i.e. instantaneous hazards), the safety risk score is determined by adding together a score for each of the following three factors:

- The frequency at which the hazard is expected to occur
- The probability that the hazard causes an incident
- The severity of the incident

For **State** hazards (i.e. those that persist over a period of time), the safety risk scores are evaluated by adding together a score for each of the following three factors:

- The likelihood that the hazardous state is present
- The rate at which incidents occur if the hazardous state is present
- The severity of the incident, which is the same as for event hazards

In order to cover a potential wide range of hazard risk scores, an 'Index value' is used for each parameter based on a logarithmic scale. These are as defined in the tables below.

Table 1: Event Hazard 'Frequency' Index Values

Frequency Classification	Nominal Value: per year per km	Index Value
Very frequent	600	6
Between Very Frequent and Frequent	200	5.5
Frequent	60	5
Between Frequent and Probable	20	4.5
Probable	6	4
Between Probable and Occasional	2	3.5
Occasional	0.6	3
Between Occasional and Remote	0.2	2.5
Remote	0.06	2
Between remote and Improbable	0.02	1.5
Improbable	0.006	1
Between Report and Incredible	0.002	0.5
Incredible	0.0006	0

Table 2: State Hazard 'Frequency' Index Values

Likelihood Classification	Interpretation: Per year per km	Nominal value per km	Index Value
Very frequent	At least 1 occurrence present at any one time	1	6
Between Very Frequent and Frequent	Present 115 days	0.316	5.5
Frequent	Present 36.5 days	0.1	5
Between Frequent and Probable	Present 11.5 days	0.0316	4.5
Probable	Present 3.65 days	0.01	4
Between Probable and Occasional	Present 1.15 days	0.00316	3.5
Occasional	Present 9 hours	0.001	3
Between Occasional and Remote	Present 3 hours	0.000316	2.5
Remote	Present 1 hour	0.0001	2
Between remote and Improbable	Present 15 minutes	0.0000316	1.5
Improbable	Present 5 minutes	0.00001	1
Between Report and Incredible	Present 90 seconds	0.00000316	0.5
Incredible	Present 30 seconds	0.000001	0.0

Table 3: Event and State Hazard 'Likelihood' Index Values

Probability that an Event/State causes collisions			
Classification	**Events** **If this hazard occurs then:**	**Value**	**States** **This hazard, if present, will:**
Certain	A collision is certain	4	Definitely causes a collision
Probable	A collision is probable	3	Frequently causes a collision
Occasional	A collision will occasionally happen	2	Occasionally causes a collision
Remote	There is a remote chance of a collision	1	Infrequently causes a collision
Improbable	A collision is improbable	**0**	Rarely causes a collision

Table 4: Event and State Hazard 'Severity' Index Values

Severity Classification	Interpretation	Index Value	Person outside of vehicle	Stationary Vehicle	Motorcycle	Car	Large Vehicle (LHV, HGV, Bus)
Severe	The proportion of crashes that are fatal is expected to be higher than average by at least a factor of 10	2.0	Involved	Involved	Involved	Speed differential approx 95 kph	Speed differential approx 80 kph
Higher than average	The proportion of fatal crashes is expected to be higher than average by a factor between 3 and 10	1.5	No involvement	No involvement	No involvement	Speed differential approx 80 kph	Speed differential approx 65 kph
Average	The distribution of crashes (i.e. ratio of damage-only to fatal) is expected to be similar to the freeway average	1.0	No involvement	No involvement	No involvement	Speed differential approx 65 kph	Speed differential approx 50 kph
Lower than average	The proportion of fatal crashes is expected to be lower than average by a factor between 3 and 10	0.5	No involvement	No involvement	No involvement	Speed differential approx 50 kph	Speed differential approx 30 kph
Minor	The proportion of crashes that are fatal is expected to be lower than average by at least a factor of 10	0.0	No involvement	No involvement	No involvement	Speed differential < 30 kph	Speed differential < 15 kph

Using a logarithmic scale means that a difference of 1 in the 'Index value' implies a 10 times difference in the actual safety risk. This means that it is more appropriate to add the parameter scores together (rather than multiply them) to arrive at an overall Hazard Index Score for each hazard.

Below are examples of safety risk scoring for an Event hazard and a State hazard.

Event

The hazard "Unsafe Lane Changing" is considered an Event as it happens quickly, i.e. it does not persist for a period of time. On a freeway which is reasonably congested it would probably be reasonable to estimate that the hazard occurs more than 600 times per year per km of highway. Referring to Table 1 this equates to an index value of '6'

The values of the last two parameters used are usually obtained through consensus of key stakeholders. In this case it has been estimated that there is only a 'remote' probability that an incident will occur (referring to Table 3 this has an index value of '1') and that the severity will be average (referring to Table 4 an index value of '1'). The Hazard Index Score is 6+1+1 = 8.

State

The hazard "Debris in running lane" is considered a State as the debris can be there for some time. If, say, on average there are 5 pieces of debris per km per year, and each piece is there (on average) for 2 hours, the total time the debris is present is 10 hours per year per km. Referring to Table 2, the closes value is 9 hours which equates to an index value of 3.0. It is estimated (through consensus) that there is an 'Occasional' probability that an incident will occur (referring to Table 3 an index value of '1') and that the severity will be average (referring to Table 4 an index value of '1') The Hazard Index Score is 3+2+1 = 6.

Converting Hazard Index Score to Safety Risk Score

Safety Risk Score = 10^(Hazard Index Score)

For example:

Hazard Index Score	Safety Risk Score
6	1,000,000
7	10,000,000
8	100,000,000
9	1,000,000,000
10	10,000,000,000

Please note that the Safety Risk Score is a relative score for comparing hazards before and after implementation of a project. As a result, they are very project dependent. They must not be used to compare the safety risk of different parts of the network.

Appendix B: Validating the Baseline Safety Risk Profile (Optional)

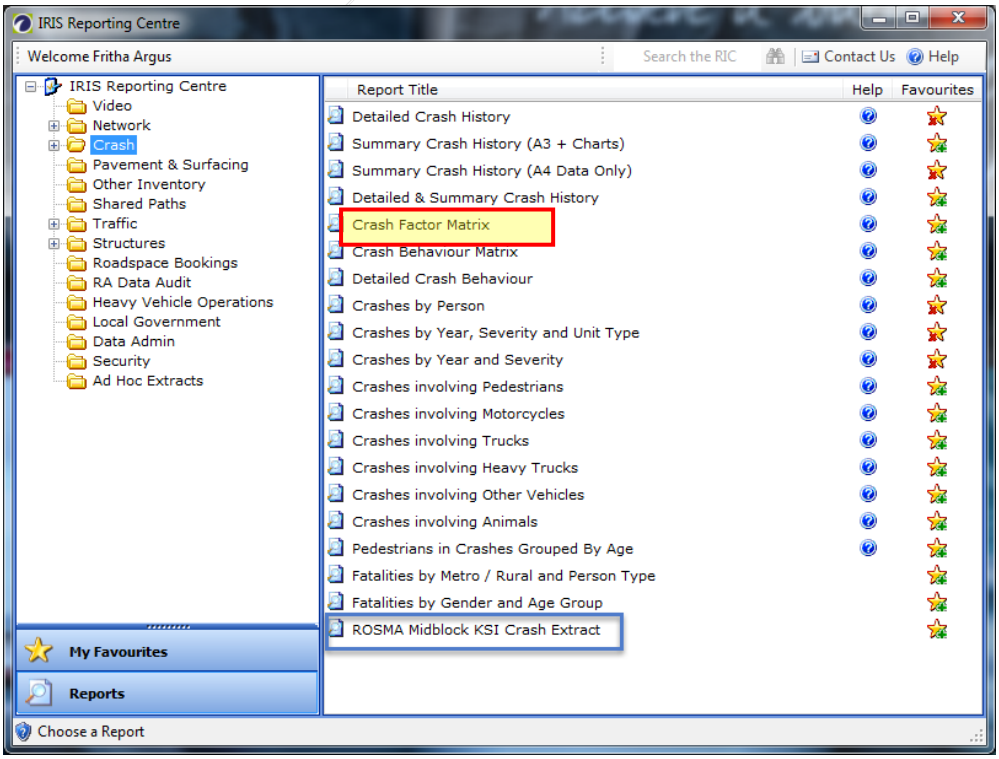
Operational Safety Risk Evaluation determines the 'Baseline 'Safety Risk Profile. If it is assumed that certain types of hazard give rise to certain types of crash, it is possible to use the existing crash record to validate the 'Baseline 'Safety Risk Profile.

A method of doing this is incorporated into the process described here. However, it should be remembered that this form of validation is crude and only intended to only provide a check on the proportion of safety risk associated with the most significant hazards. For this reason validating the 'Baseline 'Safety Risk Profile in this way is optional.

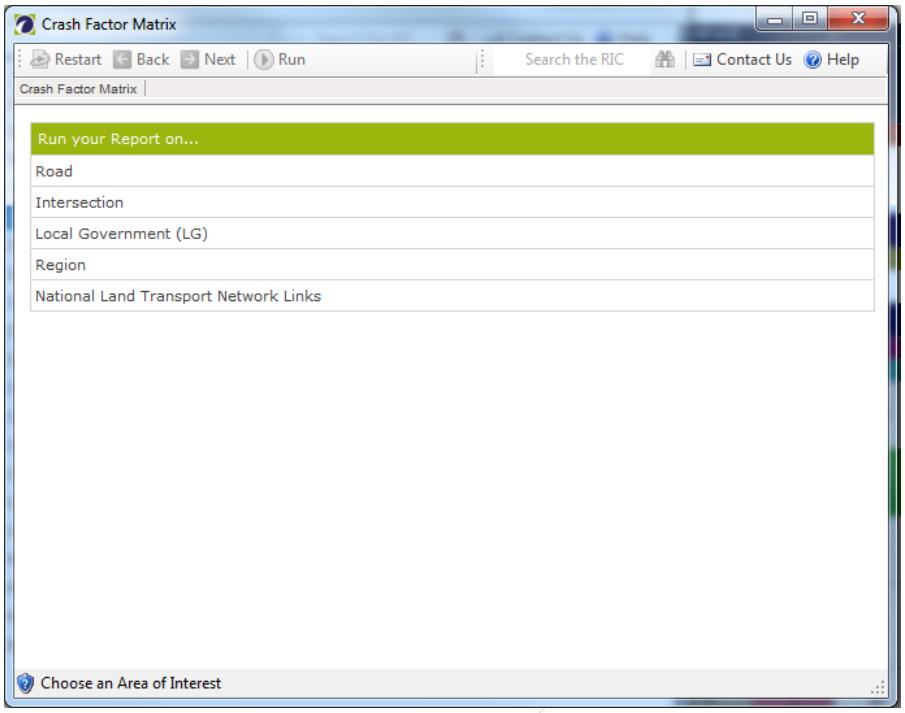
Run a Crash Factor Matrix report from the Reporting Centre

Step 1: Open Reporting Centre from Corporate Applications

Step 2: Find the **"Crash Factor Matrix"** report in the **"Crash"** folder.

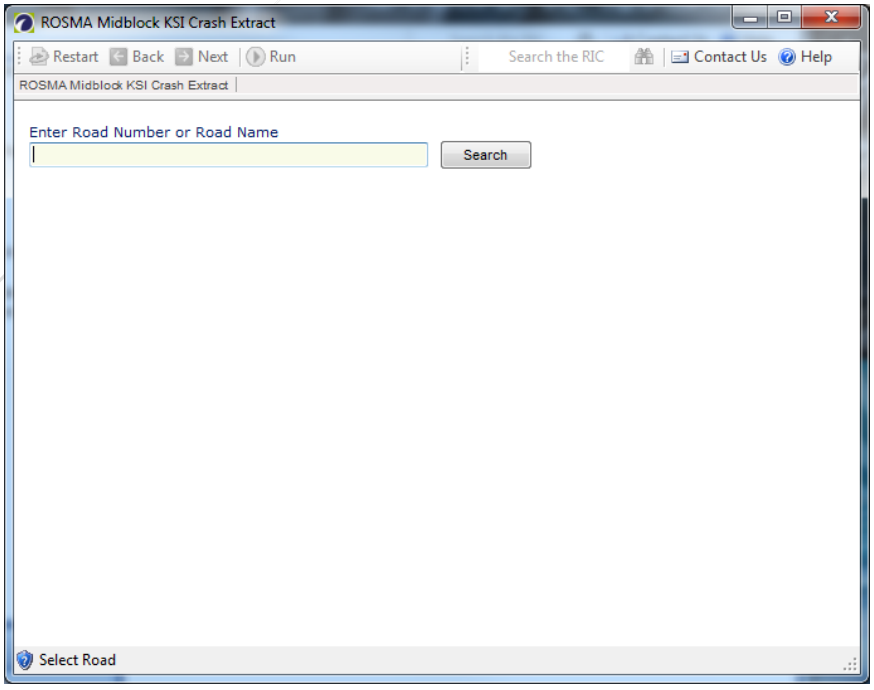


Step 3: Select the appropriate type of feature from the list presented.

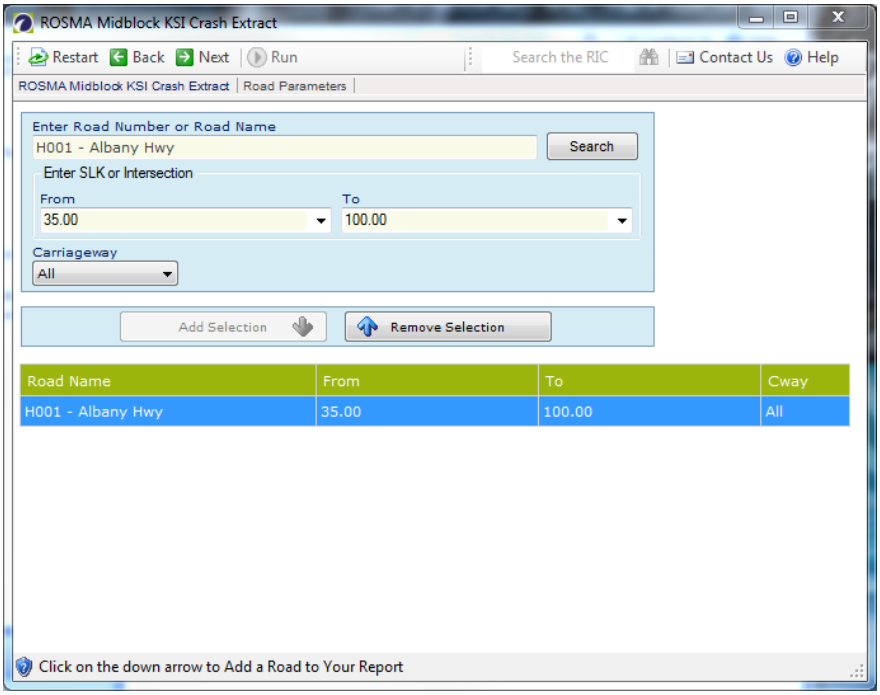


(The following steps assume that the feature selected is a road. Similar principles apply for other types of feature.)

Step 4: Enter road number or road name of interest, and click **"Search"**

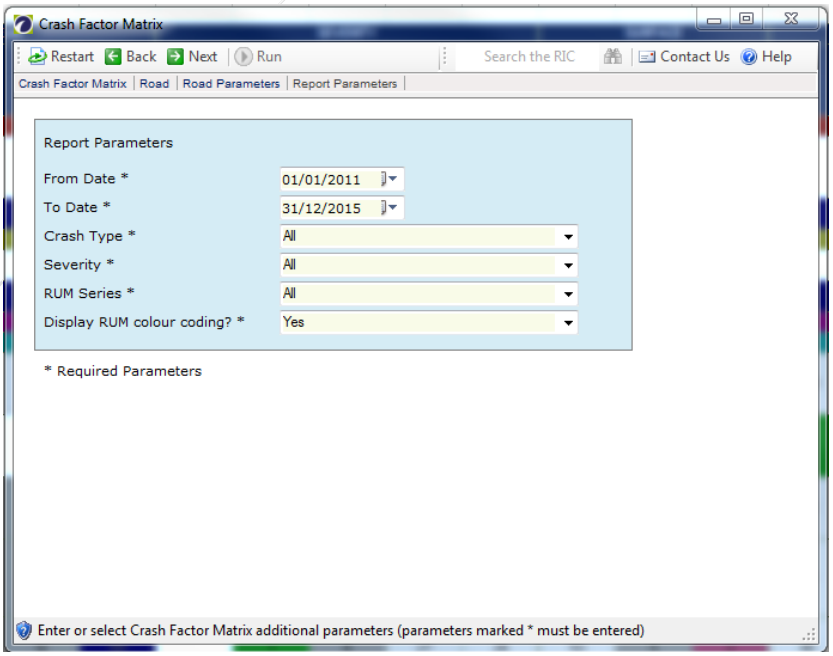


Step 5: Select start and end SLK location, and click **"Add Selection"** so it is listed in the table below.

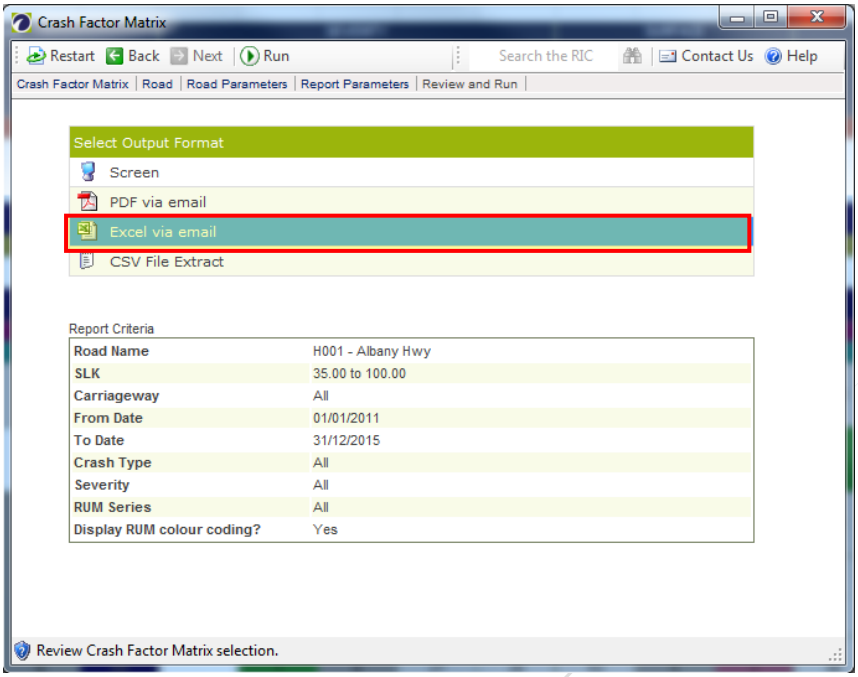


As noted previously, it is possible to define separate sections along the same road. Use **"Add Selection"** to store each section separately for the extract. Use the **"Search"** function to define road sections on another road.

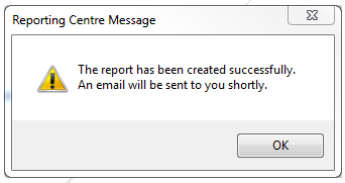
Once you've added all sections of interest, click **"Next"** in the top ribbon. A screen similar to the below is displayed.



Click **"Next"** in the top ribbon and a screen similar to the following is displayed. Ensure "Excel via email" is selected and click **"Run"** in the top ribbon.

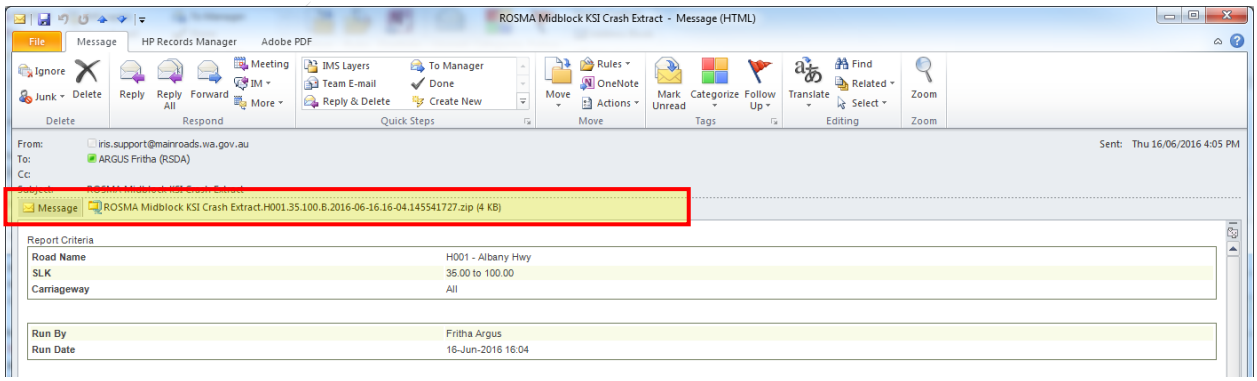


An email will then be sent to you with access to your report.

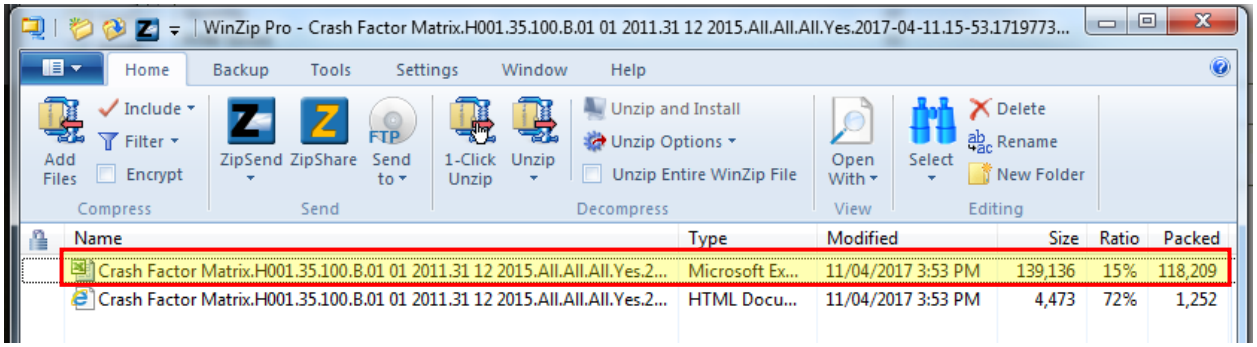


Import the Crash Factor Matrix into the Hazard Log Template

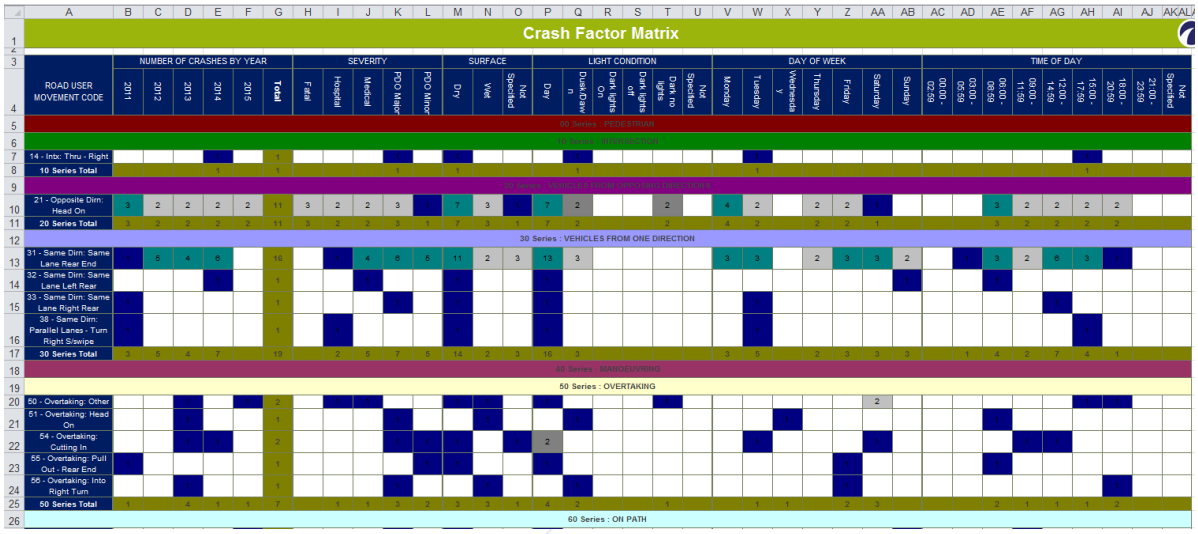
Step 6: Open your email, and click on the Zip file



Then open the Excel file

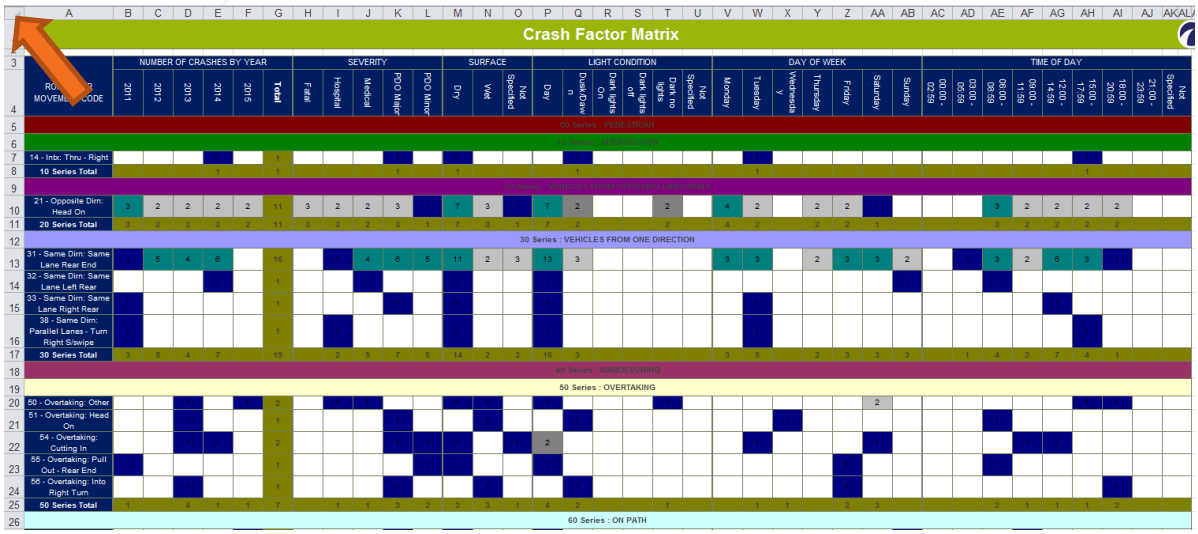


'Sheet 2' of the workbook will look something like this:

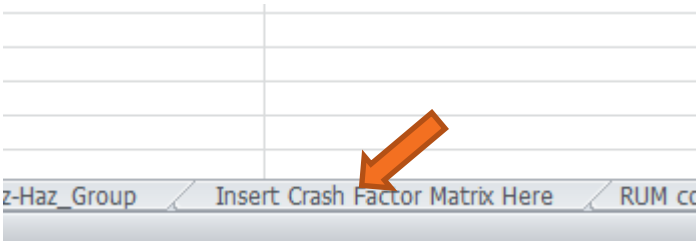


Step 7: Copy the Crash Factor Matrix into the Hazard Log Template.

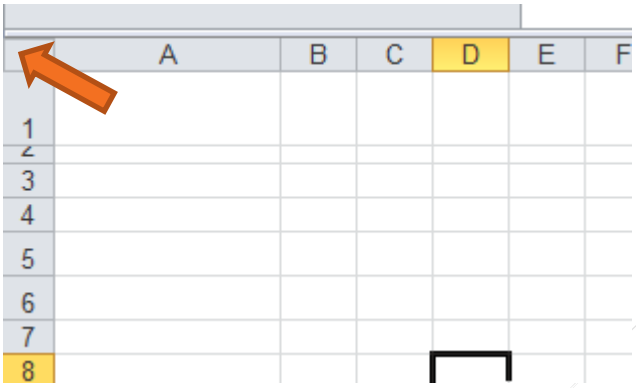
Make sure you are on 'Sheet 2' before continuing. Copy the entire Crash Factor Matrix to the Clipboard. The easiest way to do this is to select the whole sheet by left-clicking the location indicated by the arrow in the figure below and then pressing Ctrl+C or right-clicking and selecting Copy from the dropdown menu.



Open the Hazard Log Template and ensure that you have selected the “Insert Crash Factor Matrix Here” worksheet.



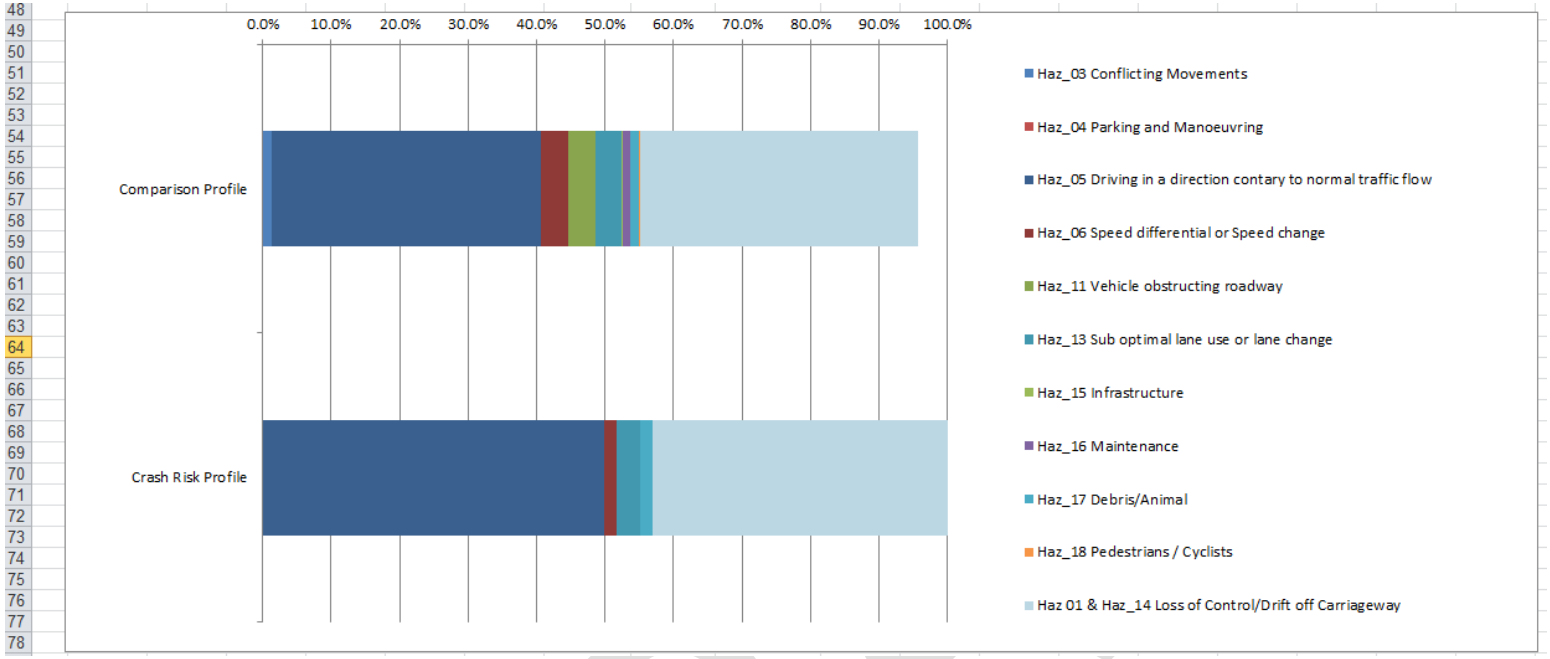
Paste the contents of Crash Factor Matrix Report into this worksheet by selecting the location indicated by the arrow in the figure below and then pressing Ctrl+V or right-clicking and selecting Paste from the dropdown menu.



The Hazard Log Template should now contain an exact copy of the Crash Factor Matrix.

Crash Risk Profile

The Hazard Log Template uses the above data to automatically generate a Crash Risk Profile. This is displayed on the “Narratives” worksheets. An example is shown overleaf



The Crash Risk Profile is generated by converting the RUM (Road User Movement) codes in the Crash Factor Matrix report to Hazard Groups. The conversions used are defined on the "RUM converter" worksheet. In addition the crashes are weighted by severity:

- Fatal Crash: 10
- Hospital: 1
- Medical: 0.1

Please note that Hazard Groups Haz_01 and Haz_14 are combined into a new group "Haz_01 & Haz_14 Loss of Control/Drift off Carriageway". This is because it is not possible to determine which is which (i.e. whether the initial hazard is based on loss of control or drifting off carriageway) based upon RUM code alone. It should also be noted that the crash data is converted only into the Hazard Groups shown above. Above the Crash Risk Profile is a Comparison Profile. This is simply the part of the 'Baseline' Safety Risk Profile that corresponds to the Hazard Groups shown. The ''Baseline' Safety Risk Profile can be considered verified if the two profiles look similar.

References

ROSMA DOCUMENTS

D15#676693	Policy – Road Safety Management for Main Roads
D15#686631	Road Trauma Reduction Guideline
D16#68386	Road Trauma Reduction Report
D16#292663	'How To…'Reduction Target Tool
D17#425975	Operational Safety Risk Evaluation Hazard Log Template

With the exception of the policy document, the above are also available on this webpage:

https://www.mainroads.wa.gov.au/OurRoads/RoadSafety/Pages/managementsystem.aspx

OTHER DOCUMENTS

1.	Main Roads Act 1930, Australia
2.	Road Traffic Act 1974, Australia
3.	Occupational Health and Safety Act 1991, Australia
4.	Australian Road Rules, Regulations 2006