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Analysing safety and Geometric elements

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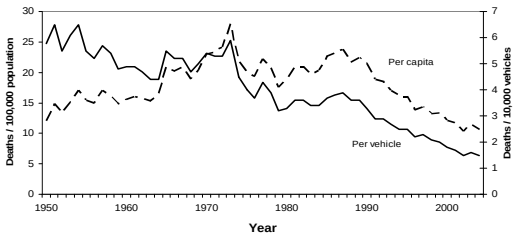
Overview

- Part of a University of Auckland research project
- Sites selected, not a CRS site
- Combining the influence of road geometrics, skid resistance with safety rather than looking in isolation
- Two sites with different characteristics
  - **SH14 : High number of run-off road crashes resulting in serious / fatal injury**
  - SH12 : Isolated curvilinear section with crashes resulting in minor injury
- Economic viability of treatment options
- Methodology for analysis

Road Fatalities in NZ

Figure 2
Deaths per vehicle and per capita



Examples of National crash reduction targets

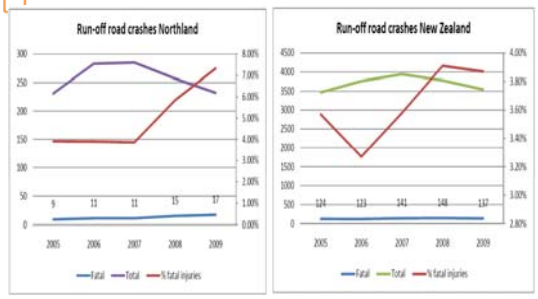
Table 2-6 Examples of quantified accident reduction targets

COUNTRY	MAIN TARGET	PERIOD FROM	PERIOD TO
AUSTRALIA (NSW)	50% reduction – fatalities	2000	2010
CANADA	30% reduction – fatalities and serious injuries	1996-2001 (average of)	2008-2010 (average of)
DENMARK	40% reduction – fatalities and serious injuries	2000	2012
FINLAND	65% reduction – fatalities		2005
GREAT BRITAIN	40% reduction – fatalities and serious injuries	1994-1998 (average of)	2010
NETHERLANDS	50% reduction – fatalities and injuries	compared to 1986-1998	2010
POLAND	20% reduction – fatalities		2001
SWEDEN	50% reduction – fatalities	1998	2007
EUROPEAN UNION	50% reduction – fatalities	2002	2010

TARGETS — Must be measurable, achievable and acceptable to the community at large

NZ target – by 2040 Road Fatalities will be down to 200 per year and 2,500 hospitalisations.

Northland Vs New Zealand



Site selection

- RAMM data and CAS data plotted in the form of a colour coded strip chart
- High Speed Video analysis for the shortlisted sites
- Discussions with PSMC Northland team
- Not a CRS site
- Test sites selected

SH 14 RS 15 / 1300m to 4300m

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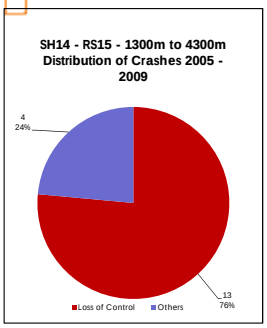
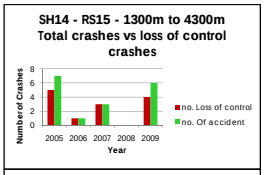
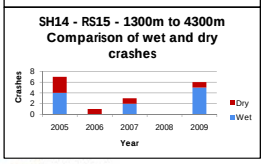
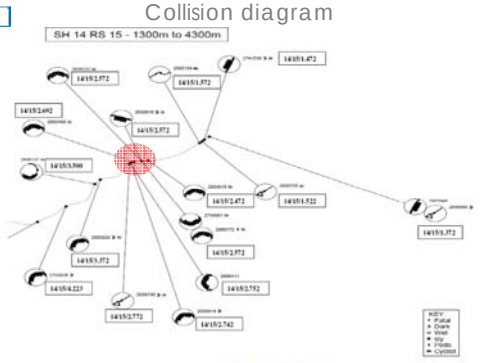
Crash Analysis





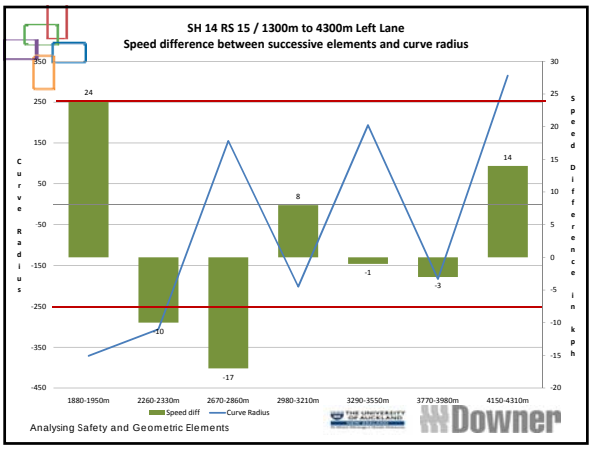


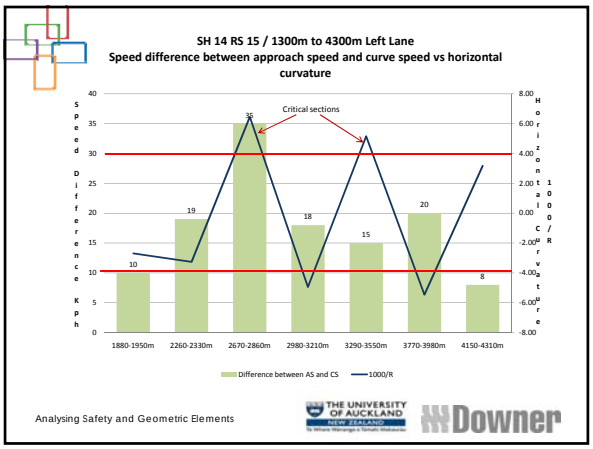
Collision diagram



Crash rate as per EEM accident prediction model
SH 14 RS 15 / 1300m to 4300m

No of crashes	AADT	Length (km)	Study period (Yrs)	Exposure X	b_o	S_{adj}	Injury crashes
9	1811	0.3	5	0.002	16	1.22	4
Crash rate as per EEM AT	X x b_o x S_{adj}		**0.039**				
Actual crash rate	Reported Injury crashes / year		**0.8**	Actual crash rate is much higher than the crash rate as per EEM for the study period			





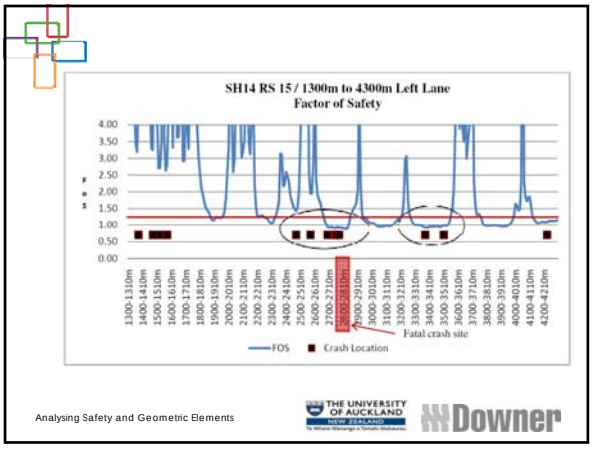
Factor of safety in Speed

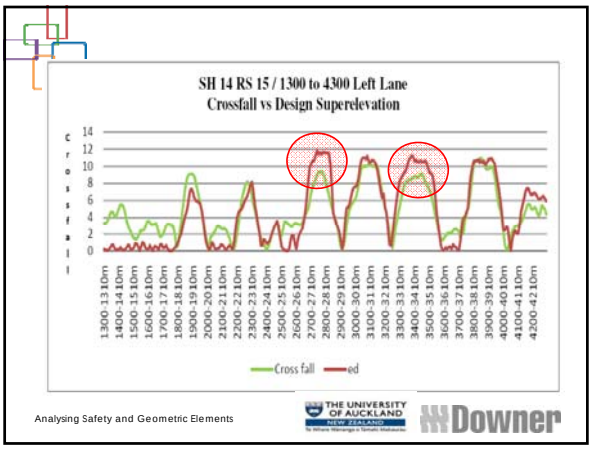
- The safe curve speed is calculated by applying the following equation:

$$V_{safe} = \sqrt{127 * R_{actual} * (e_{actual} + f_{max})}$$

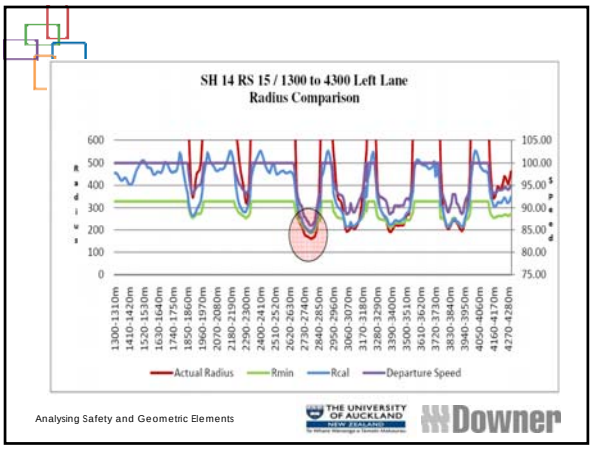
Where, R_{actual} = Actual radius of the curve
e_{actual} = Actual super elevation on the existing alignment
f_{max} = Maximum friction demand corresponding to the departure speed V, from Table 2.6 SHGDM.

Factor of safety = V_{safe} / V_{Design}





Analysing Safety and Geometric Elements



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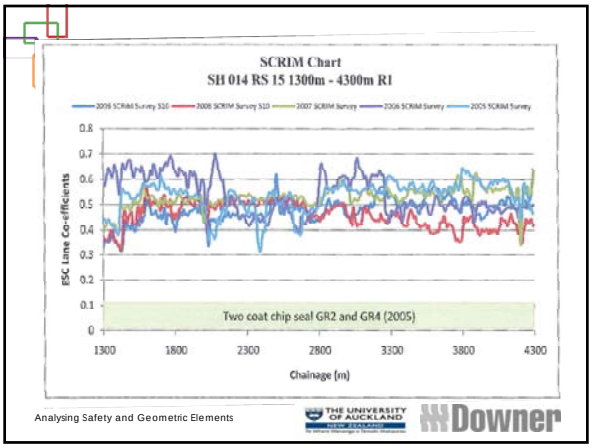

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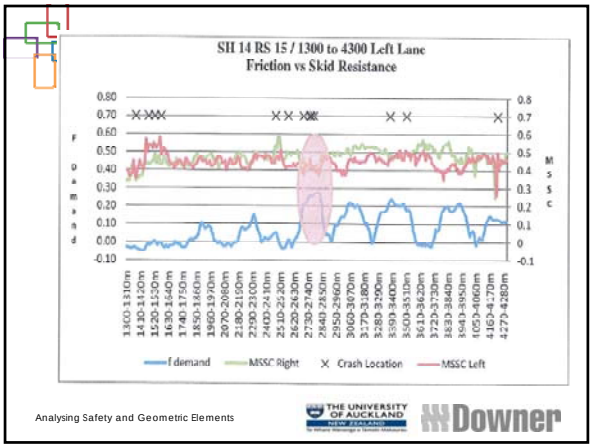


Analysing Safety and Geometric Elements

SH 14 – Economic analysis

Details	Improvements		
	Low cost	Medium cost	High cost
Annual maintenance cost	4,400	4,400	4,400
% Reduction in accidents	6%	20%	50%
PV of Accident cost savings	809,344	2,697,814	6,744,534
Benefits	809,344	4,958,485	9,005,205
Cost	92,100	574,760	1,450,000
Provisional BCR	**8.79**	**8.63**	**6.21**

% Reduction in accidents is taken as per Table A6.18(d) of EEM

Incremental BCR for SH14

Option	Benefits	Costs	BCR	Base option for comparison	Next higher cost option	Incremental BCR
Low	$ 809,344	$ 92,100	8.79	Low	Medium	8.60
Medium	$ 4,958,485	$ 574,760	8.63	Medium	High	4.62
High	$ 9,005,205	$ 1,450,000	6.21			

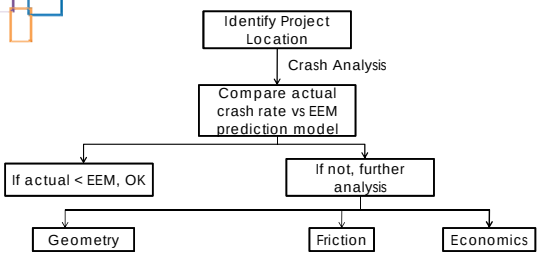
Sensitivity test to Incremental BCR with high cost capped at $1 million

Option	Benefits	Costs	BCR	Base option for comparison	Next higher cost option	Incremental BCR
Low	$ 809,344	$ 92,100	8.79	Low	Medium	8.60
Medium	$ 4,958,485	$ 574,760	8.63	Medium	High	9.52
High	$ 9,005,205	$ 1,000,000	9.01			

SH 14 – Summary of findings

- Crashes are concentrated between 2400 to 2800
- Study section has some geometric deficiencies that needs to be corrected
- Incremental BCR justifies geometric improvements
- Providing clear zoning with geometric improvements in this section will reduce the severity of injuries and improve safety in this unforgiving road section
- Research study developed a methodology that combined geometric analysis and friction demand with the existing High Speed Data Survey

Methodology



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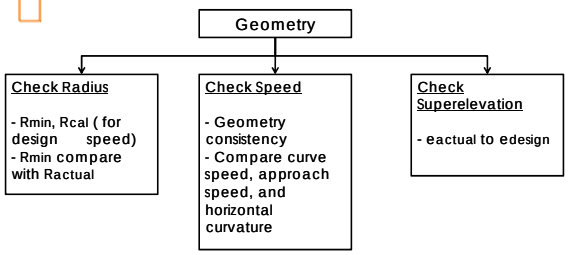

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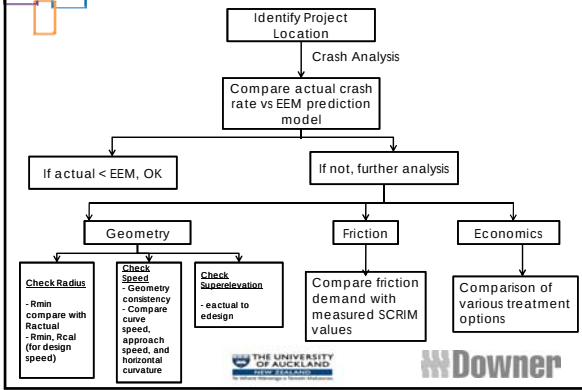
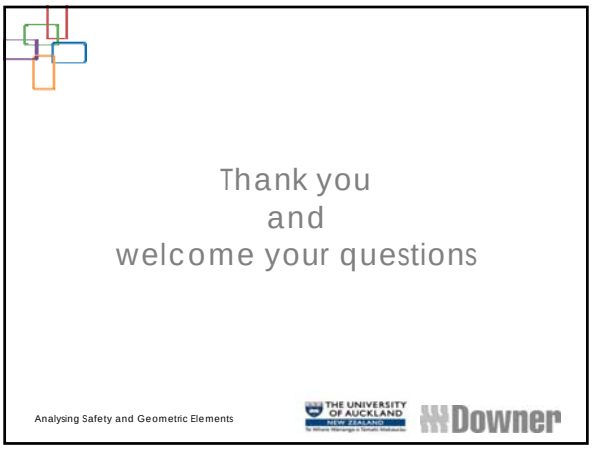


Conclusion

- Case study proved very useful in developing a methodology that combined geometric elements, friction demand to safety
- This methodology can be used by RCA's as a crash prevention study to audit existing infrastructure
- Decision making can be improved by combining these factors which are usually considered separately

Acknowledgements

- PSMC team Northland
- New Zealand Transport Agency
- MWH New Zealand


Thank you
and
welcome your questions
Analysing Safety and Geometric Elements
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