Safer Roads - A Smarter Way to Target Investment: The Gold Coast Experience

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ABSTRACT

The Queensland Main Roads South Coast Hinterland District manages over 1,000 kilometres of road that spreads across the high volume, high growth Gold Coast region and into the adjoining hinterland regions with lower volume, lower standard networks.

The targeting of road safety investment to ensure the maximum reduction in road trauma requires a new and focussed approach to help push the road toll downwards once again. The Road Safety Risk Management methodology developed by ARRB in collaboration with the Main Roads and LGAQ Roads Alliance initiative is now helping the District achieve this goal.

District staff have applied the Road Network Safety Assessment tool across the whole region to identify road safety hot-spots where the road authority needs to pay particular attention. The tool is based on the assessment of critical road engineering issues (e.g. roadside hazards, alignment, right turn provision and cross section) in a quick and efficient manner to ensure the model is resource friendly.

With the high risk sections identified, District staff have then identified potential treatments and assessed the BCR of those treatments using the Road Safety Risk Manager. The end result is a well prioritised road safety works program targeting interventions at high risk locations.

The paper will outline the approach taken and how the project has helped Main Roads provide better road safety outcomes in the South Coast Hinterland District.

1 INTRODUCTION

The mission of the Queensland Department of Main Roads is to plan, deliver and manage a road system that improves liveability of communities, affords safe travel conditions for all road users, supports economic development in a cost effective way, reduces transport costs for industry and promotes environmentally sustainable transport solutions.

The South Coast Hinterland District (SCHD) manages total resources of approximately 130 full time employees and an annual budget of around $180 million. The Traffic Operations Unit of the district undertakes operational management of the road network to enhance road safety and traffic efficiency. The district manages over 1,000 kilometres of road that spreads across the high volume, high growth Gold Coast region and into the adjoining hinterland regions with lower volume, lower standard networks. With ever growing population and car travel in the region, Main Roads must endevour to reduce the road toll and crash rate.

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
Fatal Crashes	44	32	30	31	39	33	34	32	35	34	**344**
Total Crashes	2,323	2,191	2,220	2,187	2,310	2,738	2,874	2,922	2,905	2,768	**25,438**

Table 1. Crash Statistics within SCHD

The effective management of road safety issues is a critical role for the District to ensure the road toll is minimised and road safety targets are acheived. ARRB and Main Roads embarked on a joint project to target road safety investment in the District as part of the “Safer Roads Sooner” campaign and other ongoing initiatives.

Map 1. South Coast Hinterland District Map

2 BACKGROUND TO THE PROCESS

ARRB in collaboration with the Main Roads and LGAQ Roads Alliance initiative have developed a "Road Safety Risk Management" procedure and supporting software that has been part of a state-wide rollout to all Councils and Main Roads Districts across Queensland. The key components of the approach are:

- A network level risk assessment is completed to focus attention on those locations where road features could play a significant role in influencing the likelihood or severity of a crash.
- The high risk sections are then investigated in greater detail to locate specific hazards and the preferred treatment option. The individual treatments are analysed using the 'Road Safety Risk Manager' to prioritise all potential treatments across the District or Region to ensure the highest value projects are completed first.

The process provides a quick and easy way for an authority to understand the safety performance of their road network and ensure the organisation is appropriately managing their duty of care. The primary outcome is a "helicopter view" of the road safety features of a network and a prioritised works program detailing where the greatest value for money road safety improvements exist.

Road safety engineering works generally fall into two categories – reactive and proactive. South Coast Hinterland District has tradionally concentrated on accident reduction by the treatment of road locations with a history of high accident frequency through "Black Spot" and other minor works programs. With officers receiving training in road safety auditing in more recent times and the introduction of the Targeted Road Safety Initiative in 2003 the District has begun to embrace a more proactive approach in programming road safety engineering works.

The Network Wide Safety Assessment process was adopted to enable both proactive and reactive safety treaments to be programmed to facilitate a safer state controlled network within the District.

Proactive Measures	Reactive Measures
• Network Wide Safety Assessment • Road Safety Audits (RSAs) • Speed Reviews • Safer Roads Sooner Program (Proactive)	• Black Spot Program • Fatal Accident Investigation Recommendations • Public Feedback/Minor works • Safer Roads Sooner Program (KSI - reactive)

Table 2. Proactive & Reactive Tools used by the SCHD

3 THE ROAD SAFETY REVIEW

3.1 Road Network Safety Assessment

The Road Network Safety Assessment model has been based on the research behind the Road Safety Risk Manager and was designed to meet the specific needs of the Queensland Roads Alliance.

The process involves the review of key engineering features along the road, and rating only those sections that have "triggered" due to the condition of one or more of those features (refer Figure 1).

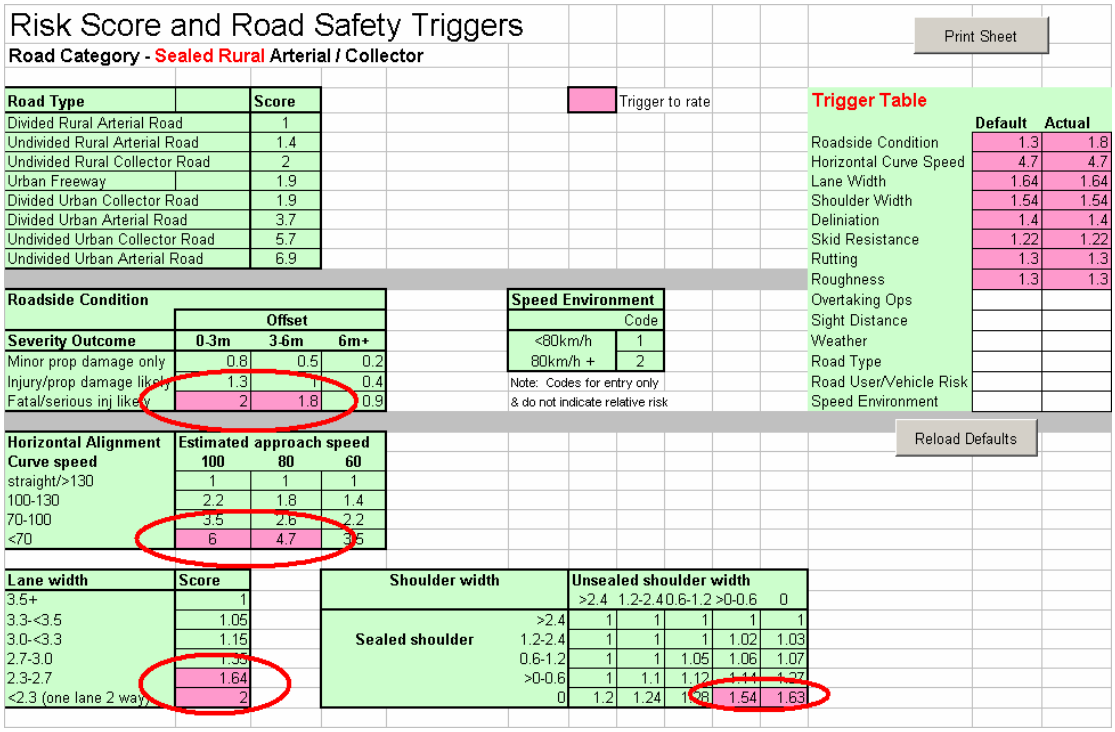

Figure 1: Sample Road Safety Triggers – Sealed Rural Roads

For example based on the triggers circled above the road sections would be rated if the following conditions existed:

- Hazards likely to cause fatal and/or serious injury outcomes exist within 6 metres of the road, or
- Horizontal alignment is such that safe speeds of <70km/h are required along road sections with approach speeds of 80km/h or higher, or
- Lane widths are less than 2.7 metres, or
- Shoulder widths are less than 0.6m (sealed or unsealed).

The South Coast Hinterland District triggers were reviewed in a joint workshop involving key stakeholders from the District to ensure the priority safety issues were addressed and the number of road sections and intersections flagged for further investigation were at a manageable level. In this way an authority can set the triggers to reflect their local constraints and upgrade the triggers over time as their network improves.

Tailored models are provided for each typical road environment (urban intersection, urban mid-block, rural intersection, rural sealed road section and rural unsealed road section) to reflect the primary road safety features relevant to that location.

On completion of the rating the values are entered into the Road Network Safety Assessment software and a "Network Risk Score" calculated for each of the sections of road that has triggered. The higher the risk score the greater the risk at the location and the greater the potential for improvements in road safety

3.2 Data Collection Methodologies

Queensland Main Roads regularly collects and maintains video data on the road network using the Digital Video Road (DVR) technology. The Network Survey Vehicle captures video images in four directions - forward, rear, left and right sides. The resulting videotapes are then converted to digital files and can be viewed using the Digital Video Road Viewer (DVR Viewer) at a desk-top computer. Users can choose to simultaneously play any or all of the directional views and easily arrange their layout by simply dragging and dropping the required image. Both forward and reverse play directions are available.

All rating activities for the South Coast Hinterland project were completed using the DVR Viewer as an office based exercise. This provided a much safer alternative for the data collection phase and enabled improved time, cost and quality outcomes (refer Figure 2).

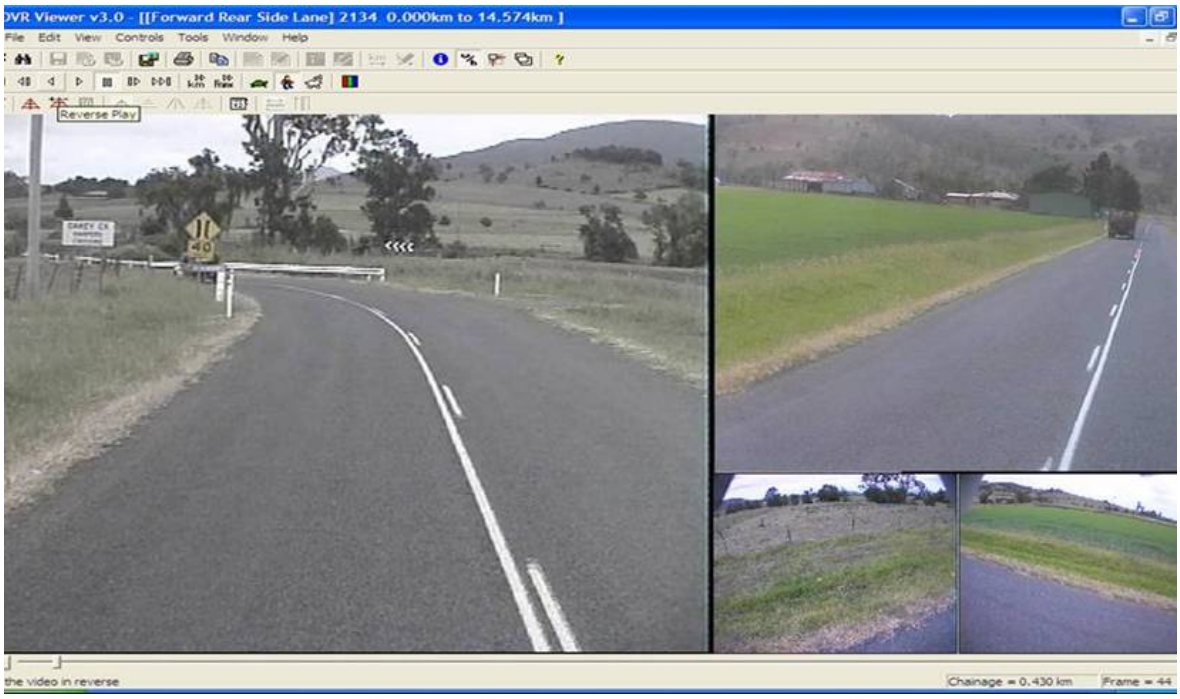

Figure 2 – Main Roads DVR typical screen layout

3.3 Rating a Road Section

For the purposes of this project video data of the entire road network was reviewed and those sections where road features exceeded the pre-determined triggers were rated. For example, in figure 2 above the road section was triggered as a result of the following attributes:

- horizontal alignment (the tight curve)
- roadside condition (fish tail guardrail, bridge barrier and power poles)
- lane width and
- shoulder width

Once a section triggers all features at that location are rated to produce a "Network Risk Score" as shown in Figure 3.

Mid-block Risk Assessments

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Clear

R led Rural Arterial / Collector

Road Name		2134 Mount Alford Road	LRRS Road	Yes	(Yes or No)
Functional Class		Undivided rural collector	Volume	230	(AADT)
Location	From	0.43	Length	0.51	(km)
	To	0.94			
Rated By		Derek Grant	Date	27/07/05	

Safety Triggers

Roadside Condition, Horizontal Alignment, Lane Width, Shoulder Width,

Road Type

Issue	Weight	(range)*	Risk Score	Weighted Risk
Road Type	100%	100%	2	2
			SUB-TOTAL	2

Severity

Factors selected automatically impact severity calculations related to each deficiency below

Estimated Speed Environment	80km/h +	2	(<80 = "1", 80km/h + = "2")
		Sev Adj	
Roadside condition		1.8	

Road Engineering Features / Likelihood

Issue	Weight	(range)*	Sub-Issue	Weight	(range)*	Risk Score	Severity	Weighted Risk
Geometric	60	(40-80)	**Horizontal Alignment**	25	(20-40)	4.7	8.82	4.90
			Lane Width	25	(20-40)	1.64	8.82	0.85
			Shoulder width	25	(20-40)	1.63	8.82	0.83
			Delineation	25	(20-40)	1.2	8.82	0.26
			Overtaking Opps	0	(0-20)	0	7.76	0.00
			Sight Distance	0	(0-20)	0	4.85	0.00
Surface	20	(10-30)	**Skid Resistance**	50	(30-50)	1	8.82	0.00
Condition			**Weather**	50	(30-50)	1.2	8.82	0.18
			Rutting	0	(0-20)	0	7.65	0.00
			Roughness	0	(0-20)	0	7.65	0.00
Roadside	20	(10-30)	**Road user/vehicle risk**	100	(100)	1.00	9.18	1.84
						SUB-TOTAL		8.86
						NETWORK RISK		17.71

Comments: Carneys Creek Bridge - Ch 0.520. Curved approaches (tight curves), energex pole close to bridge & road. Energex pole close to road on western approach. Fish tail guardrail ends, and no chevron alignment markers.

Figure 3: Sample Mid-block Risk Assessment – Sealed Rural Roads

3.4 Extent of Network Analysis

Experienced traffic engineers carried out the network safety assessment over a period of twelve weeks. This was completed in conjunction with their normal activities rather than as a dedicated full time project to reduce assessor "fatigue" and ensure appropriate data quality was maintained.

The extent of the network assessed and approximate time taken is shown in Table 3 & 4.

Mid-block Sections				
Road Type	Length (km)	% of network	Triggered (km)	% Triggered
urban (divided)	156.9	16.21%	123.6	78.77%
urban (undivided)	66.6	6.88%	15.1	22.64%
Total Urban	**223.5**	**23.10%**	**60.0**	**26.83%**
rural (divided)	0.0	0.00%	0.0	0.00%
rural (undivided)	744.2	76.90%	515.9	69.32%
Total Rural	**744.2**	**76.90%**	**576.6**	**77.48%**
Combined Total	**967.8**		**636.6**	
Overall % Triggered	**65.78%**			
Intersections (State Controlled to State Controlled)				
No of intersections	No of intersections triggered		% Triggered	
84	26		31.0%	

Table 3: Percentage of network triggered – Mid-block sections

Urban Mid Block Analysis

Total time	22.7 hr
Total distance	213.3 km
Analysis rate	9.5 km/hr

Rural Mid Block Analysis

Total time	57.7 hr
Total distance	754.5 km
Analysis rate	17.5 km/hr

Table 4: Analysis Rate

3.5 Network Assessment Results

Following the completion of the network assessment the 20 segments and intersections with the highest risk score were identified for further investigation. It is interesting to note that several of the segments are located on low volume roads with very low crash rates and are subsequently prone to be overlooked in more common reactive road safety treatment assessments. Also of note is that most of these links can be treated with relatively low cost treatments that significantly increase the safety of the road.

Summary Page - Top Ranked 20 Sections

Urban & Rural Midblock Sections (of the 295 midblock segments triggered)

		Location						
Rank	Road Name	From	To	LRRS	Volume	Length	Triggers	Network Risk
1	2102 Kalbar Connection Road	0.29	0.8	Yes	460	0.51	Roadside Condition, Horizontal Alignment, Lane Width,	**22.26**
2	216 Warril View-Peak Crossing Rd	0.04	0.869	Yes	250	0.829	Roadside Condition, Horizontal Alignment,	**21.21**
3	216 Warril View-Peak Crossing Rd	2.638	3	Yes	250	0.362	Roadside Condition, Horizontal Alignment,	**21.21**
4	2141 Lake Moogera Road	17.666	17.915	Yes	230	0.249	Roadside Condition, Horizontal Alignment,	**20.93**
5	202 Beaudesert-Nerang road	19.4	19.7	No	200	0.3	Roadside Condition, Carriageway Width, Delineation,	**20.81**
6	2025 Lamington National Park Road	9.027	35.75	Yes	1000	26.723	Roadside Condition, Horizontal Alignment, Lane Width, Shoulder Width, Delineation, Skid Resistance,	**20.42**
7	2141 Lake Moogerah Road	22.58	23.659	Yes	230	1.079	Roadside Condition, Horizontal Alignment, Lane Width,	**20.39**
8	305 Rosewood-Warrill Road	2.238	2.528	Yes	200	0.29	Roadside Condition, Horizontal Alignment,	**19.55**
9	213 Boonah-Rathdowney Road	39.505	39.955	Yes	350	0.45	Roadside Condition, Horizontal Alignment, Lane Width, Delineation,	**19.20**
10	1003 Stapylton-Jacobs Well Road	4.011	11.886	Yes	2000	7.875	Roadside Condition, Horizontal Alignment,	**19.07**
11	2021 Binna Burra Road	1.123	10.79	Yes	700	9.667	Roadside Condition, Horizontal Alignment, Lane Width, Delineation,	**18.98**
12	2041 Advancetown-Mudgeeraba Rd	0	2.877	Yes	2500	2.877	Roadside Condition, Horizontal Alignment, Lane Width,	**18.62**
13	2141 Lake Moogerah Road	22.14	22.58	Yes	230	0.44	Roadside Condition, Horizontal Alignment, Shoulder Width,	**18.55**
14	213 Boonah-Rathdowney Road	23.706	24.056	Yes	350	0.35	Roadside Condition, Horizontal Alignment, Lane Width, Shoulder Width,	**17.91**
15	2134 Mount Alford Road	0.43	0.94	Yes	230	0.51	Roadside Condition, Horizontal Alignment, Lane Width, Shoulder Width,	**17.71**
16	2133 Maroon Dam Road	0	2.34	Yes	160	2.34	Roadside Condition, Horizontal Alignment,	**17.66**
17	2021 Binna Burra Road	0	0.569	Yes	700	0.569	Roadside Condition, Horizontal Alignment,	**17.57**
18	2050 Tamborine-Nerang Road	0	10.9	Yes	3000	10.9	Roadside Condition, Horizontal Alignment,	**17.34**
19	2020 Beechmont Road	12.171	12.492	Yes	2000	0.321	Roadside Condition, Horizontal Alignment,	**16.99**
20	2013 Tallebudgera Connection Road	3.378	5.297	Yes	3000	1.919	Roadside Condition, Horizontal Alignment,	**16.87**

Table 4: Top 20 Ranked Sections

4 WHERE TO FROM HERE

Following the completion of the network level analysis, the high risk sections are subject to further investigation with a particular focus on the issues that triggered. Candidate treatments are identified at the high risk locations (e.g. delineation, roadside hazard treatments, widening, line-marking, right turn provision) and assessed using the Road Safety Risk Manager (RSRM).

Figure 4 below provides a sample output of the Road Safety Risk Manager based on a proposed treatment to install chevron alignment markers on Mount Alford Road on the approach to Carneys Creek (as shown in Figure 2). Based on the RSRM assessment the project provides a benefit cost ratio of 2.0 and should be considered for funding.

The RSRM assessments provide the ability to determine those projects that represent good value for money and warrant implementation in addition to those projects where poor road safety returns suggest the investment is not warranted. In this way Main Roads will be able to target investment to those locations where the greatest potential for road trauma reduction exists. The organisation will also have a well documented rational assessment of those sites where no action is planned or warranted.

Individual Hazard and Treatment Report

Including assumptions and detail of action taken

Report generated on 24 Aug 2006 11:00 **by** Rob McInerney

Project No: SCH1 Investigation Date: 17 Aug 2006

Road Name: Mount Alford Road

ID# ARRB01_17082006_230

Hazard: Poor delineation of curve
Proposed Treatment: Install CAMs
Chainage: 0.430
Location: Carneys Creek

Exposure Calculation

	Hazard (before case)	Treatment (after case)
Traffic Volume	230	230
Volume Adjustment Factor	1.00	1.00
EXPOSURE	230	230

Likelihood Calculation

	Hazard (before case)	Treatment (after case)
Length	0.10	0.10
Road Type and Crash Risk	Undivided Local Road: Open Area 2.00	Undivided Local Road: Open Area 2.00
Issue Type	Delineation: Chevrons	Delineation: Chevrons
Relative Risk (Primary)	1.300	1.000
Influencing Factors		
Skid Resistance (surface): Mid-Block 0.20 Horizontal Alignment (curve radius) 0.40 Lane Width 0.15 Shoulder Width 0.15 Weather 0.10	1.000 4.700 1.640 1.630 1.298	1.000 4.700 1.640 1.630 1.298
Relative Risk (Influencing Factors)	2.700	2.700
LIKELIHOOD	0.702	0.540

Severity Calculation

	Hazard (before case)	Treatment (after case)
Site Location	open	open
	crash type; proportion; relative severity	crash type; proportion; relative severity
Crash Types	Off road - curve 0.90 5.13 Head On 0.10 7.40	Off road - curve 0.90 5.13 Head On 0.10 7.40
SEVERITY	5.36	5.36

Risk Reduction Cost Ratio Calculation

Hazard Risk Score	865	Initial Cost	$ 1200
Treatment Risk Score	665	Ongoing Cost	$ 0
Treatment Life	5 years	Salvage Value	$ 0
Discounted Risk Reduction	818	Discounted Costs	$ 1200
Discount Rate	7.00	Status	Action Pending
Hazard Risk Score / km	8,650		
Treatment Risk Score / km	6,654		
		Risk Reduction Cost Ratio	**0.68**
		Benefit Cost Ratio	**2.0**

Figure 4: Sample Road Safety Risk Manager assessment

Assumptions

Hazard Assumptions
Black and white hazard board present although relatively ineffective - risk of 1.3 assumed for before case. Curve speed approx 60 - risk of 4.7 (note bridge advisory speed of 40km/h). Narrow lanes and shoulder width effectively zero due to edge drop and poor condition of surface.
Treatment Assumptions Install 4 CAMs to appropriate standard at a cost of $1200. Life of 5 years based on Qld help files (signage).

Client	Queensland Main Roads
Study Area	South Coast Hinterland District
Purpose of Assessment	Safer Roads Sooner
Investigation Team:	Rob McInerney, Gavin Massingham, Derek Grant, Tricia Oh
Other details	Investigation of high risk sites identified with the Road Network Safety Assessment tool

Status of Works

Action Taken	Date of Update	Status
Put forward for Safer Roads Sooner funding	17/08/2006	Action Pending

Figure 4: Sample Road Safety Risk Manager Assessment (cont.)

5 WHERE TO FROM HERE

The final outcome of the road safety review will be a prioritised list of all of the candidate treatments identified at the high risk sites. The Road Safety Risk Manager will provide a list of all of the potential remedial measures and their associated benefit cost ratio (refer Figure 5 below). Suitable projects can then be submitted for funding in the various programs available. This will ensure that the maximum road safety returns are achieved from the investment levels available.

Multiple Hazard and Treatment Report
Executive Summary

Report generated on 19 Jul 2005 22:35 **by** Rob McInerney

Road Name	The Hazard and ID	Hazard Location	Proposed Treatment	Initial Cost	BCR	Status
Safety Road	Slippery road - no signage	Chilly Hwy, Chainage: 8.500	Sign road as slippery when wet	$1,500	60	Action Complete
Safety Road	Poor advisory signing of approaching intersection (built-up)	Bushy Tree Blvd, Chainage: 8.200	Relocate sign in front of vegetation	$300	28.2	Action Pending
Safety Road	High angle parking	Main Street, Chainage: 0.000	Replace with 30 degree parking	$6,000	26.1	Action Pending
Safety Road	Poor edge lines	Gum Tree Road, Chainage: 342.000	Re linemark edge lines	$8,000	14.7	Action Pending
Safety Road	No CAMS around sharp curve	Slippery Bend, Chainage: 11.400	Install CAMS	$4,000	14.4	Action Complete
Safety Road	Traffic lights obscured by vegetation	Branch road near the weeping willow forest., Chainage: 11.300	Trim tree to make visibility 100%	$1,000	14.1	Action Programmed
Safety Road	4 leg intersection - Inappropriate layout. (local)	Cross Road, Chainage: 1.250	Install roundabout	$95,000	7.5	Partially Complete
Safety Road	No RRPMs - Poor delineation at night / wet	Reflection Road, Chainage: 6.300	Install RRPMs	$3,800	6.6	Action Programmed
Safety Road	Vehicles leaving road - fatigue expected cause	Rumble Hwy, Chainage: 18.200	Install profile edge lines	$18,000	5.1	Action Programmed
Safety Road	Poor skid resistance around corner	Slippery Bend, Chainage: 5.000	Treat flush patches and 10mm reseal	$3,800	3.6	Action Pending
Safety Road	No sealed shoulders	Pasture Drive, Chainage: 11.800	Widen and Construct 0.5m sealed shoulder	$180,000	3	Action Pending

Figure 5 – Hypothetical Road Safety Risk Manager outputs prioritised by BCR

At high risk locations where treatments do not represent a good return on investment (e.g. realignment of a low volume road in mountainous terrain, widening a narrow bridge) lower cost treatments can be considered. The maintenance activities at the locations can also be reviewed to ensure that higher standards of maintenance and inspection frequencies are conducted at the high risk locations. In this way sections of road that are already high risk will not be further complicated by the presence of minor defects such as edge breaks, poor signage or debris on the road and the safety of road users can be maximised.

6 SUMMARY

Strong leadership and management of road safety issues is an important priority for the South Coast Hinterland District. The road safety project described in this paper has provided the district with confidence that the potential road safety issues on their network are being managed, and investment is targeted to maximise the reduction in road trauma.