9th International Conference on MANAGING PAVEMENT ASSETS (ICMPA9)

Delivering a Risk-based Skid Resistance Strategy for a Roading Network

SIMON HUNT

AASHTO THE VOICE OF TRANSPORTATION

VirginiaTech Transportation Institute

TRB

U.S. Department of Transportation Federal Highway Administration

WORLD ROAD ASSOCIATION MONDIALE DE LA ROUTE 1909-2009 AIPCR PIARC

VDOT Virginia Department of Transportation

Skid Resistance Strategy

Why did we develop new technologies & systems

- Changes to road asset management since 1995
  - All road construction and maintenance activities in New Zealand had to be outsourced
  - Emphasis on providing appropriate level of skid resistance to reduce accidents
  - Constrained road maintenance budgets
  - Encouraged innovation by industry

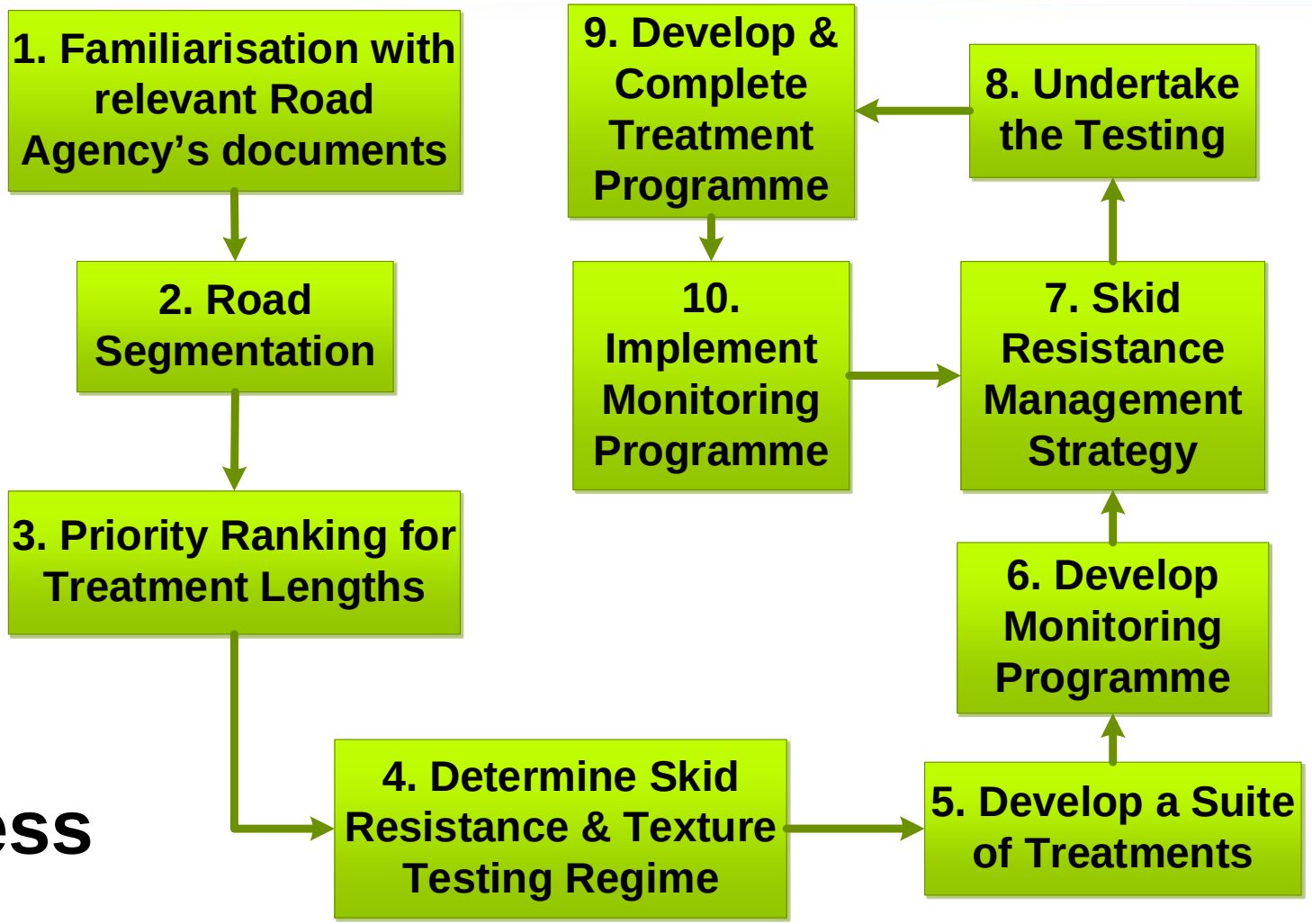
Skid Resistance Strategy

Approach #1

Skid Resistance Strategy

- Cannot rely on legal immunity (nonfeasance)
- **Approach #2 – a risk-based skid resistance strategy**

Skid Resistance Strategy



The Process

Skid Resistance Strategy

Relevant Documentation

- NZTA T10: Specification for State Highway Skid Resistance Management (including ‘Notes’)
- Road agency’s Long Term Plan (10 years) and Annual Plan (including the roading programme)
- Road Safety Management Strategy
- NZTA Maintenance Guidelines for Local Roads

Skid Resistance Strategy

Extract from 'NZTA Maintenance Guidelines for Local Roads'

SAFETY MEASURES					
Measures	**Explanation**	**Method of Measurement**	**Target values by road group**		**Related *NLTP work category**
			Urban	**Rural**	
Adequate skid resistance on all sealed roads	No section with a skid resistance insufficient for location	Visual inspection of suspect sites identified from desktop analysis (see Appendix A)	All road groups: Number of wet weather (skid-related) crashes for the network trending down. All sites identified without an adequate level of skid		Resurfacing; Sealed pavement maintenance

*NTLP = National Land Transport Programme

Skid Resistance Strategy

Slippery Seals?

95% of all sealed roads in New Zealand are chipseal over unbound granular pavements

Skid Resistance Strategy

Road Segmentation – why is it important?

Different Risks!

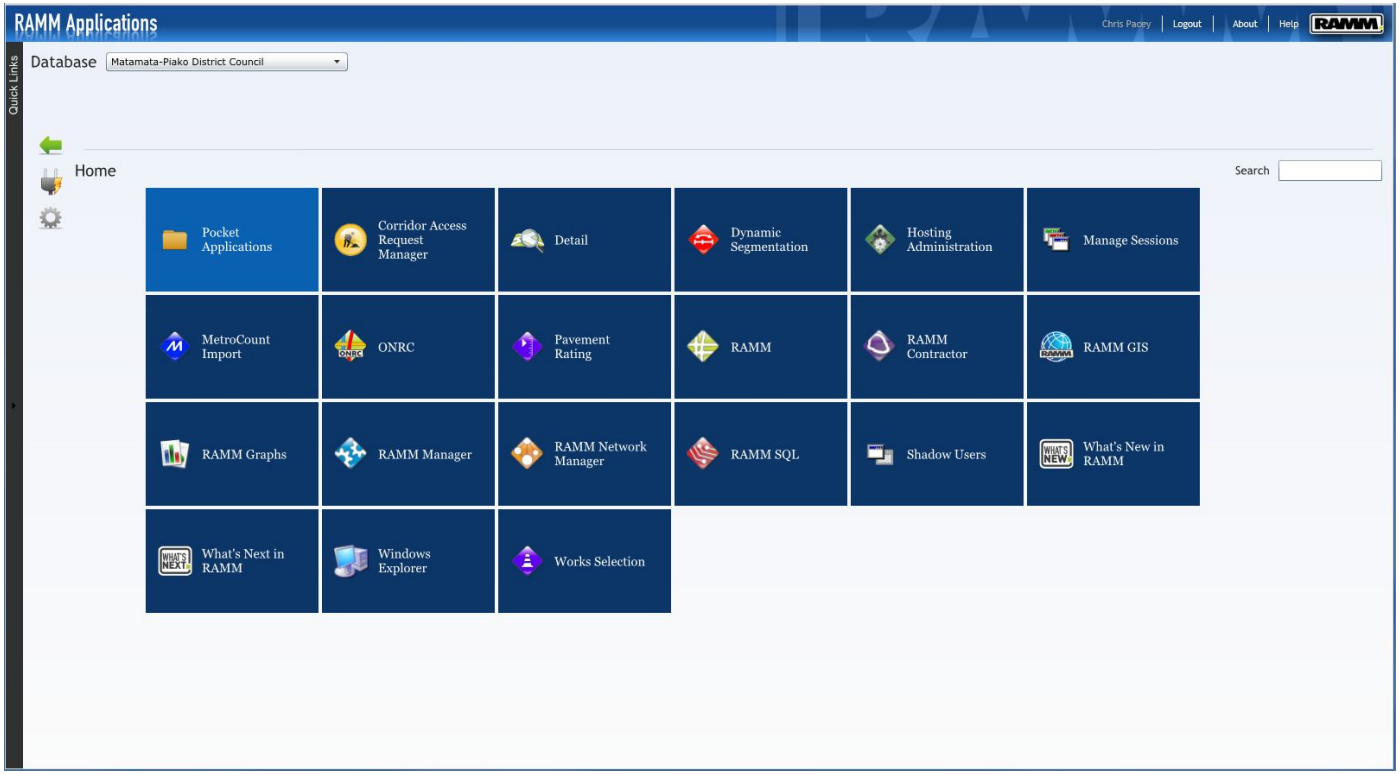
Skid Resistance Strategy

RAMM (Road Asset & Maintenance Management) Database

- National database operated by all Road Controlling Authorities (RCAs) in New Zealand
  - 67 City and District Councils (Local Roads)
  - NZTA (State Highways)
- Contains:
  - Road construction history
  - Performance data
  - Maintenance history
- Controlled access granted to anyone who requires it

Skid Resistance Strategy

Road Segmentation – gather existing data

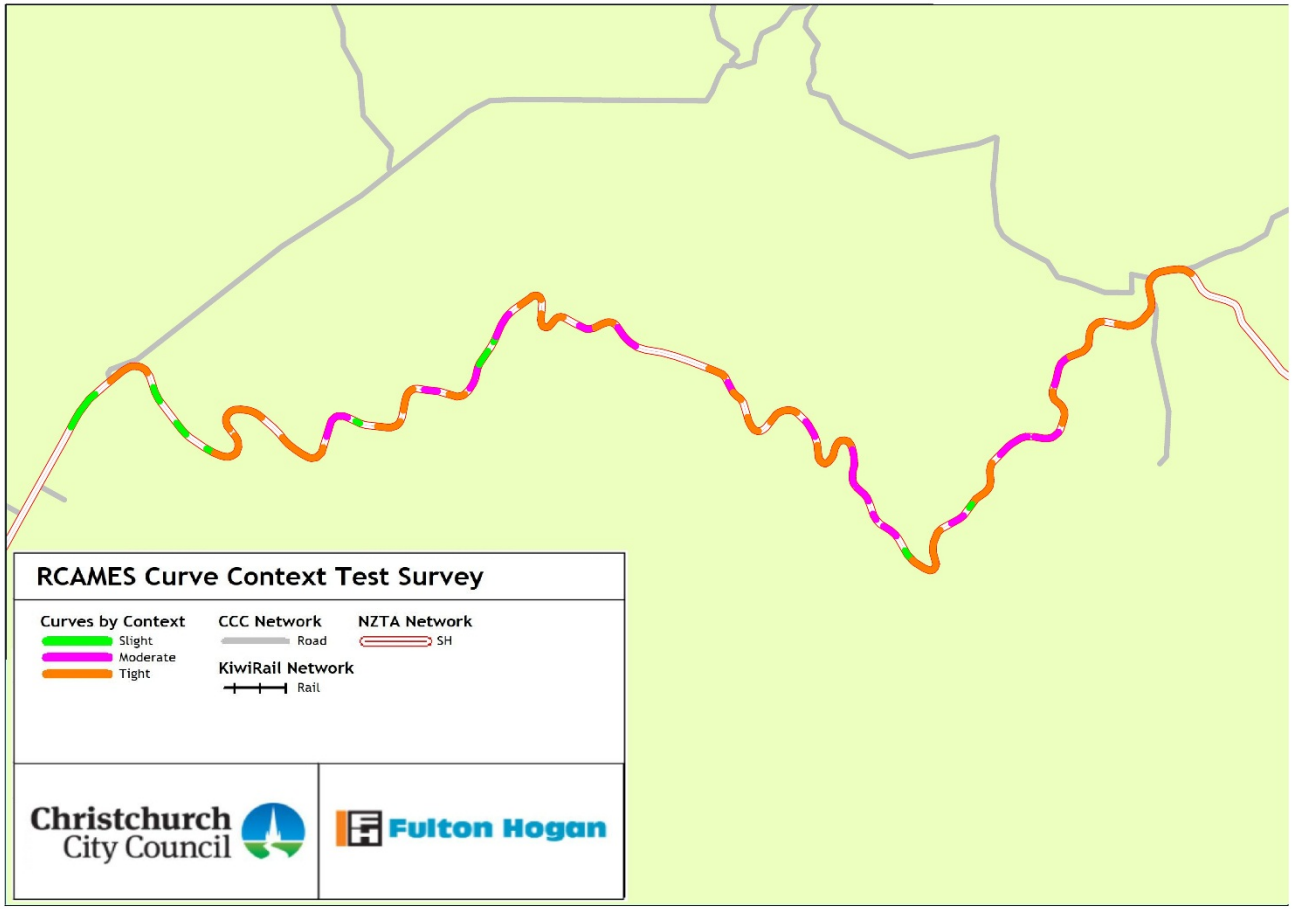


Asset Database

- Current surface
- Signs & features
- Curve data

Skid Resistance Strategy

RCAMES Data Survey – GPS-enabled Survey



Road
Corridor
Assessment
Maintenance
Evaluation
System

- Curve Extents
- Curve Context
  - Slight, Moderate, Tight
- Consequence of Leaving the Road

Skid Resistance Strategy

RCAMES Data Survey – curve severity

Curve Severity or Context			
Severity	Slight	Moderate	Tight
Descriptor	Gentle bend; little or no change in speed	Moderate braking required. Required to reduce speed by about 20 km / hr to negotiate smoothly	Reasonably hard braking required. The curve surprises you and possibly tightens up as you enter it
Visual Guideline			

Skid Resistance Strategy

RCAMES Data Survey – consequence of leaving the road

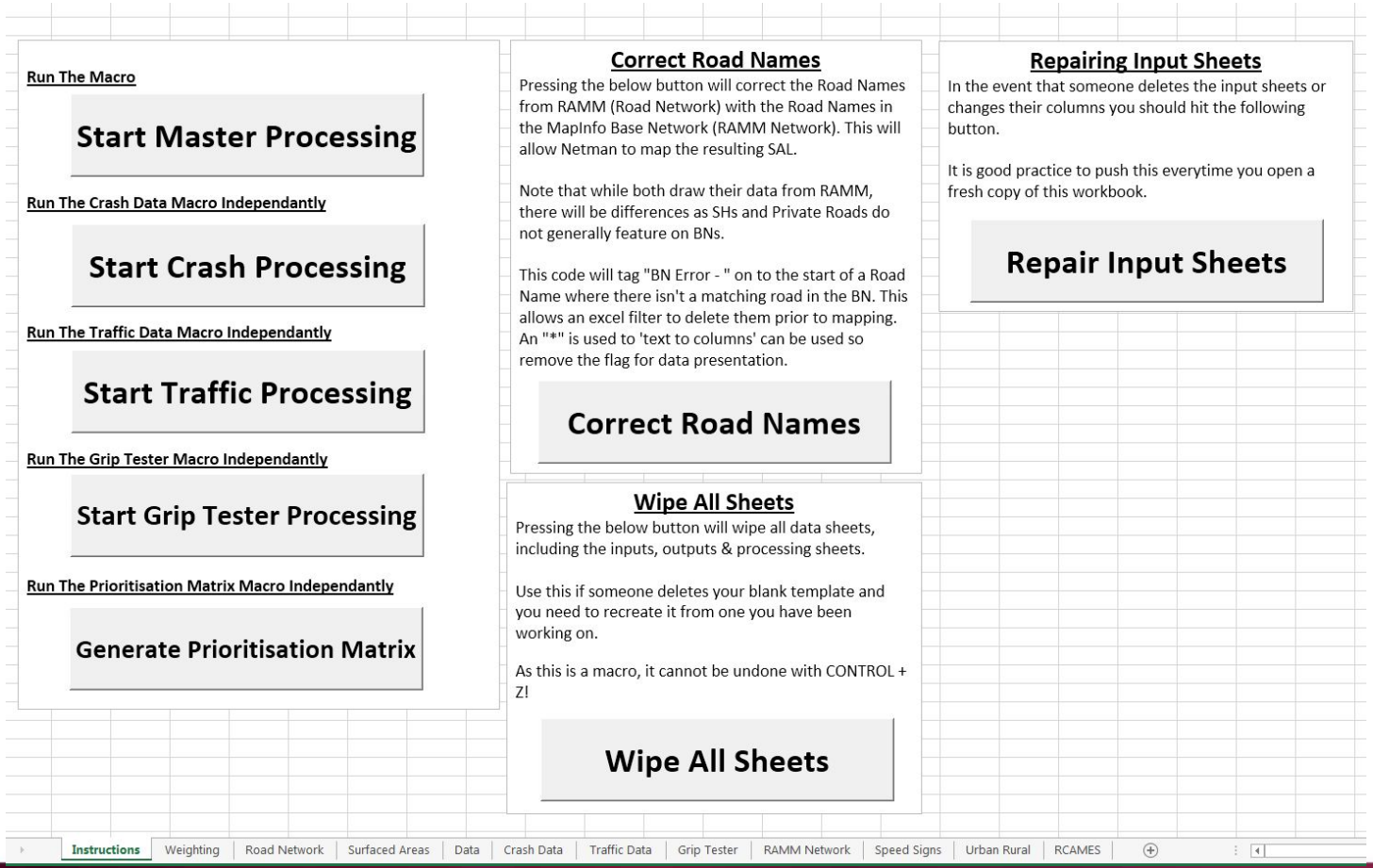
Consequence of Vehicle Leaving the Road (including poor geometry)							
Scoring	**1**	**2**	**3**	**4**		**5**	
Descriptor	**Flat – slight bank, and no objects**	**Moderate bank with no guardrail but dense foliage**	**Moderately sloped bank with no guardrail & no foliage**	**a) Steep bank > 5m from seal edge, no guardrail, or**	**b) Immovable object > 5m e.g. large tree; bank, wooden power pole, retaining wall**	**a) Steep bank < 5m from seal edge, no guardrail, or**	**b) Immovable object < 5m e.g. large tree; bank, wooden power pole, retaining wall**
Visual Guideline							

Skid Resistance Strategy

RCAMES Data Survey – GPS-enabled video

Skid Resistance Strategy

Road Segmentation – getting the SALs from the **Data**



Macro-controlled so less time to process the data

Process Uses:

- Access Database
- Excel processing template

Skid Resistance Strategy

Road Segmentation – getting the SALs from the Data

Road ID	Road Name	Offset Start	Offset End	Class	Type	Legend	IL	Site Class	Material	Surface Date	Design Life	Total Crashes	Wet Crashes	AADT	%HCV
1	ALAMEIN AVE	0	121	Sign	Sign	[Sign]	0.55	1	SEAL 1	1/01/2000	25	0	0	50	14
2	ALEXANDRA AVE	0	82	Open Road	Sealed	Sealed Road IL	0.35	5	SEAL 1	1/01/2000	25	0	0	500	14
2	ALEXANDRA AVE	82	142	Sign	Sign	[Sign]	0.55	1	SEAL 1	1/01/2000	25	0	0	450	
2	ALEXANDRA AVE	142	202	Sign	Sign	[Sign]	0.55	1	SEAL 1	1/01/2000	25	0	0	450	
2	ALEXANDRA AVE	202	302	Open Road	Sealed	Sealed Road IL	0.35	5	SEAL 1	1/01/2000	25	0	0	715	5
2	ALEXANDRA AVE	302	451	Open Road	Sealed	Sealed Road IL	0.35	5	SEAL 1	1/01/2000	25	0	0	715	5
3	PIONEER RESERVE RD	0	100	Open Road	Sealed	Sealed Road IL	0.35	5	SEAL 1	1/01/2000	25	0	0	15	19
3	PIONEER RESERVE RD	100	160	Open Road	Sealed	Sealed Road IL	0.35	5	SEAL 1	1/01/2000	25	0	0	15	19
4	ALEXANDRA RD	0	100	Corner	Corner	[Corner]	0.55	1	SEAL 1	1/01/2000	25	1	0	1200	
4	ALEXANDRA RD	100	180	Open Road	Sealed	Sealed Road IL	0.35	5	SEAL 1	1/01/2000	25	1	0	1348	8
4	ALEXANDRA RD	180	280	Open Road	Sealed	Sealed Road IL	0.35	5	SEAL 1	1/01/2000	25	2	0	1348	8

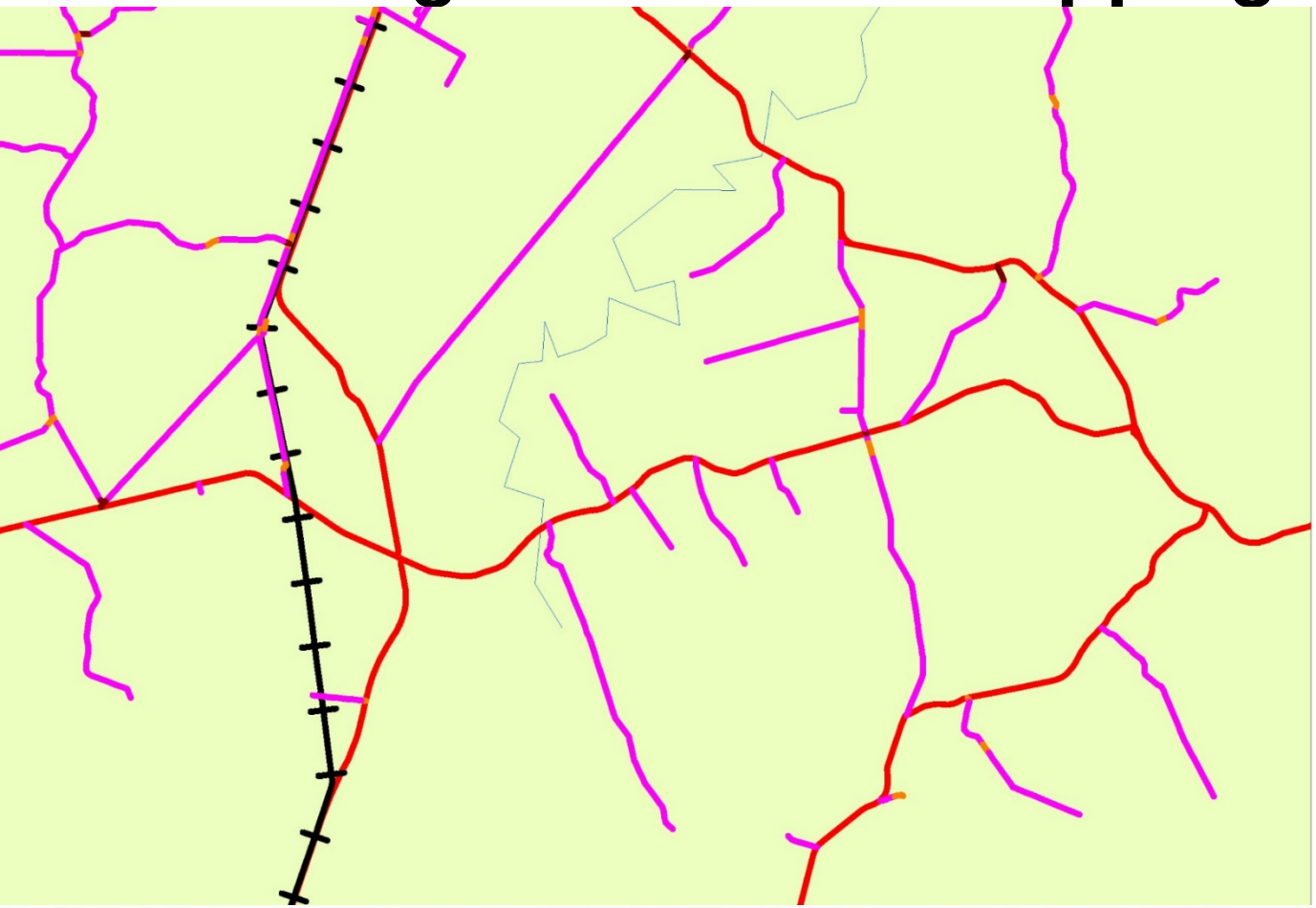
Example of SAL Output

Process Uses:

- Access Database
- Excel processing template

Skid Resistance Strategy

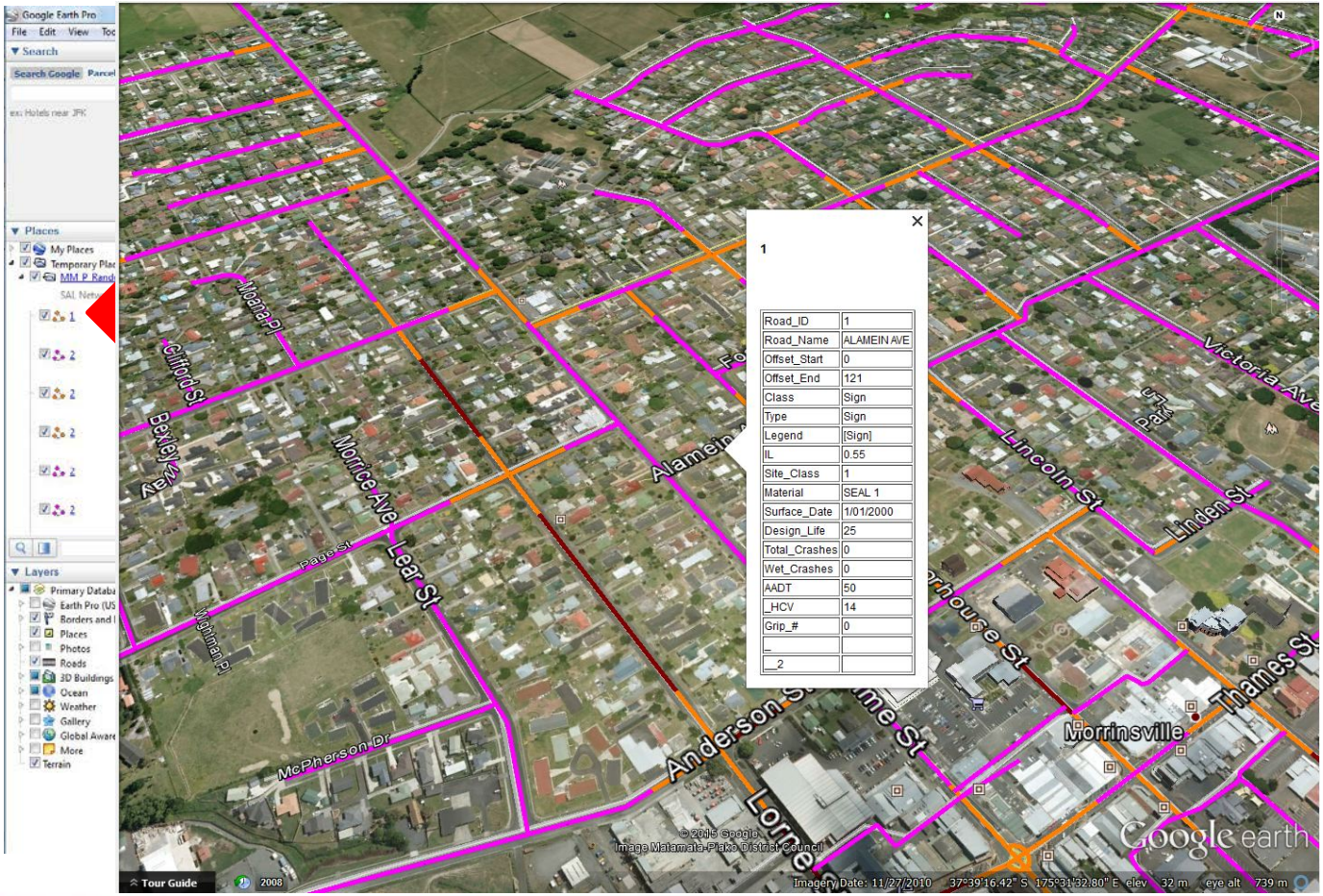
Road Segmentation – mapping the SALs



- MapInfo – thematic maps
- SAL network colour-coded by Investigatory Level (IL)

Skid Resistance Strategy

Road Segmentation – presenting the SALs



- MapInfo can output thematic maps to .KML format – used in Google Earth

Skid Management Strategy

Prioritisation Ranking for Measuring Skid

Prioritisation Criteria	Crash Score	Consequence of Vehicle Leaving the Road	AADT Score	Road Class (RC) Score	AADT & RC Score (2 x RC + AADT)/3	Surface Age	Speed Limit (km/hr)	Total Score
Weighting	**35**	**20**			**20**	**10**	**15**	**100**
Source	***CAS / RAMM**	**Video e.g. Contour, or visual rating using a tablet**	**RAMM**	**RAMM**	**RAMM**	**RAMM**	**RAMM**	
Scoring								
1	0 or 1 wet weather crash in last 10 years	Flat – slight bank, and no objects	< 2,500	Regional Distributor Highway (RDH)		< 5 years	50	
2	1 wet weather crash in last 5 years	Moderate bank with poor quality guardrail or no guardrail but dense foliage	< 5,000	Regional Collector Highway (RCH)		> 5 years	60	
3	2 wet weather crashes in the last 5 years	Moderately sloped bank with no guardrail, no foliage	< 10,000	Regional Strategic Highway (RSH)		> 10 years	70	
4	3 – 4 wet weather crashes in the last 5 years	a) Steep bank > 5m from seal edge , no guardrail, or b) Immovable object > 5m e.g. large tree; bank, wooden power pole, retaining wall	< 20,000	National Strategic Highway (NSH)		> 15 years	80	
5	> 4 wet weather crashes last 5 years	a) Steep bank < 5m from seal edge , no guardrail b) Immovable object < 5m e.g. large tree; bank, wooden	> 20,000	National Strategic Highway High Volume (NSHVH)		> 20 years	100	

*CAS = Crash Analysis System

Skid Resistance Strategy

Determining Skid Resistance

Possible approaches to measuring Skid Resistance are:

1. Proactive – to measure skid resistance and / or surface texture on a set frequency on all or parts of the network
2. Reactive – to measure skid resistance and / or surface texture at sites where loss of control wet crashes have already occurred
3. No Testing

Or embrace elements of all 3 approaches

Skid Resistance Strategy

Determining Skid Resistance

Decide on testing required:

- Extent – say 50% of the arterials, high-risk crash sites and collectors with a high risk ranking
- Testing, analysis and reporting – annual cost

Use of GripTester, SCRIM Truck, British Pendulum or Norsemeter ROAR

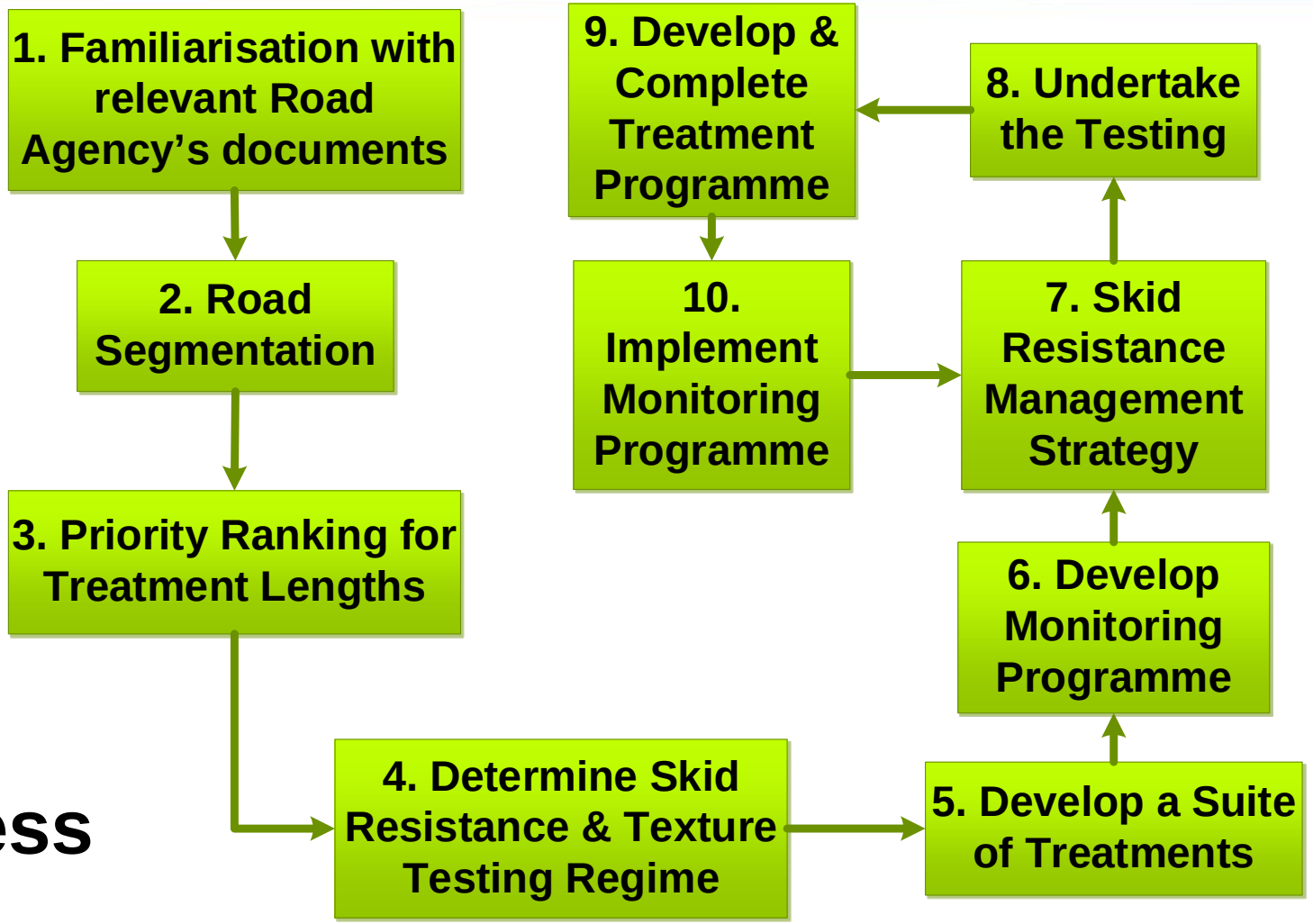
Skid Resistance Strategy

Determining Skid Resistance

Common in NZ

- SCRIM Truck
- GripTester

Skid Resistance Strategy



The Process

Skid Resistance Strategy

Developing a Suite of Treatments

++ Effective Solution i.e. will usually fix the problem

+ Possible Solution - possible short-term treatment or part of treatment

- Not a solution - either not appropriate, or overkill

Microsurface and Macrosurface Issues & Solutions

	Grip testing	Install Slippery Road Sign	Diluent & Chip	Stabilise Small Patches	Milling / Scabbling /Texturing	Chip Sealing	Sandwich Seal	Slurry	Water cutting	Water blasting	Grooving	PAVEtex	Macadam	Porous Asphalt	SMA	Grooved Asphalt	Recycling	Remove & Resurface	AWT	HFS Surfacing
Flushed Chipseal - Volcanoes	-	+	-	-	+	-	+	-	+	+	+	-	-	-	-	-	++	+	++	-
- Embedded chip	-	+	-	+	+	+	+	-	+	+	-	+	+	+	-	-	++	+	-	-
- Multiple Seal Layers	-	+	+	-	+	-	+	-	+	+	+	-	-	-	-	-	++	+	++	-
- Failed Chipseal	-	+	-	-	-	+	+	-	++	+	-	+	+	-	-	-	-	+	-	-
- Carryover bitumen	-	+	+	-	-	-	-	-	++	+	-	+	+	-	-	-	-	-	-	-
Flushed Asphalt	-	+	-	+	+	+	+	-	++	+	+	+	+	+	+	-	+	+	+	-
Flushed Slurry	-	+	-	+	-	-	-	-	++	+	+	+	+	+	-	-	+	+	+	-
Bleeding Patch	-	+	+	+	-	-	+	-	++	+	-	-	-	-	-	-	+	+	+	-
Bleeding Seal	-	+	-	-	-	-	-	-	++	+	-	+	+	+	-	-	-	-	-	-
Spills or Leaks	+	+	-	-	-	-	-	-	++	+	-	-	-	-	-	-	-	+	-	-
Surface Contamination	+	+	-	-	-	-	-	-	++	+	-	-	-	-	-	-	-	-	-	-
Porous Asphalt Clogged	+	+	-	-	+	-	-	-	+	++	+	+	+	+	+	+	-	+	-	-
Polished Surface	+	+	-	-	+	++	+	+	++	+	+	++	++	++	++	++	-	+	-	+
Low Surface Texture	-	+	-	+	+	+	-	-	++	+	++	++	++	++	++	+	-	++	-	+
High proportion of loss of control accidents	+	+	-	-	-	+	-	+	+	-	+	+	+	+	++	++	+	+	+	++
Poor Geometric Shape	-	+	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	++	-
Poor Surface Drainage	-	+	-	+	+	-	-	+	-	-	+	+	+	+	+	+	+	+	++	-
	Wheel tracks	Wheel tracks	Wheel tracks	Isolated patches	Lane width	Edge of Seal	Edge of Seal	Lane width	Wheel tracks	3.0m width	Lane width	Lane width	Lane width	Lane width	Lane width	Lane width	Edge of Seal	Edge of Seal	Edge of Seal	Lane width

Skid Resistance Strategy

Microsurface and Macrosurface Issues & Solutions

	Grip testing	Install Slippery Road Sign	Diluent & Chip	Stabilise Small Patches	Milling / Scabbling / Texturing	Chip sealing	Sandwich Seal	Slurry	Water cutting
Flushed Chipseal - Volcanoes	-	+	-	-	+	-	+	-	+
- Embedded chip	-	+	-	+	+	+	+	-	+
- Multiple Seal Layers	-	+	+	-	+	-	+	-	+
- Failed Chipseal	-	+	-	-	-	+	+	-	++
- Carryover bitumen	-	+	+	-	-	-	-	-	++
Flushed Asphalt	-	+	-	+	+	+	+	-	++
Flushed Slurry	-	+	-	+	-	-	-	-	++
Bleeding Patch	-	+	+	+	-	-	+	-	++
Bleeding Seal	-	+	-	-	-	-	-	-	++
Spills or Leaks	+	+	-	-	-	-	-	-	++
Surface Contamination	+	+	-	-	-	-	-	-	++
Porous Asphalt Clogged	+	+	-	-	+	-	-	-	+

Skid Resistance Strategy

Develop a Monitoring Programme

- Budget and resource constraints
- Monitor the sites that were not treated
- Monitor success of treatment selection and skid resistance strategy

Skid Resistance Strategy

matamata piako district council

Skid Resistance Strategy

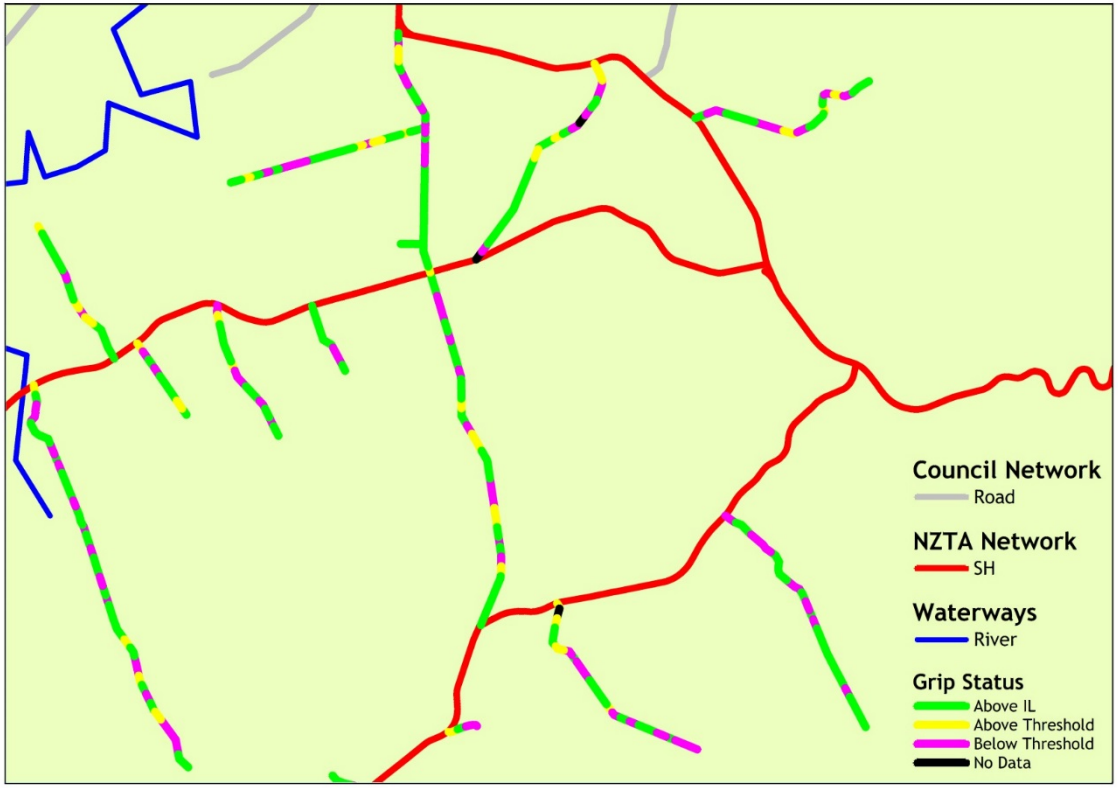
Matamata-Piako District Council's primary road safety goal is to reduce the incidence and severity of crashes in the Matamata-Piako area

Performance measures to be included e.g.

- Reducing no of loss of control accidents in wet weather
- Reduced severity of the same

Skid Resistance Strategy

Comparing the measured Skid Resistance to Skid Requirements



Measured Skid Resistance can be plotted against the SAL Network

IL = Investigatory Level

- Where we start being concerned about a section of the network

TL = Threshold Level

- Below this we are forced to address the section as soon as possible

Skid Resistance Strategy

Develop and Implement the Treatment Programme

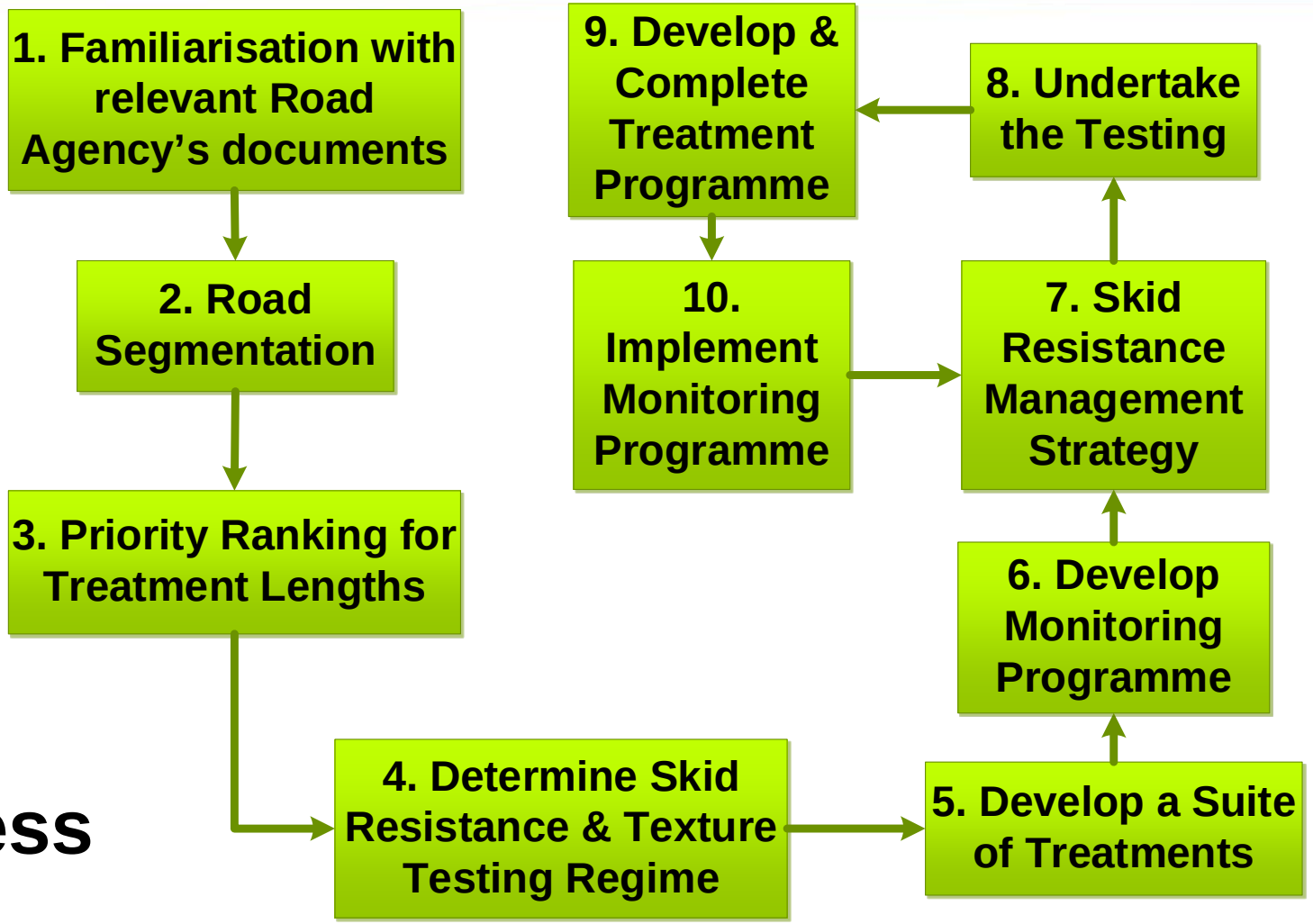
- Treatments are least whole-of-life cost
- Size of programme dependent on available funding and the amount that the skid resistance is below the TL (threshold level)
- Implement the programme

Skid Resistance Strategy

Implement Monitoring Programme

- Autumn / winter – prior to construction season
- Workshop to review success of treatments and treatment selection
- Review Skid Resistance Strategy

Skid Resistance Strategy



The Process

Take-aways

- Cost-effective, risk-based skid resistance strategy
- Aligned to the road agency's strategies and plans
  - You decide level of 'adequate' skid resistance
  - Strategy can be tailored to budget
- Process, data & outputs can be used to develop other strategies e.g. safety, guardrail or surfacing

Take-aways

- Only requires road asset data (already available), video (optional), driveover survey information and mapping software (free)
- Robust prioritisation ranking methodology to determine high-risk sites
- Visually powerful outputs using MapInfo and Google Earth to sell the story to the funding people
- A suite of proven surfacing materials and treatments for different stress situations

Acknowledgements

I would like to acknowledge the following:

- Fulton Hogan
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  - for helping take this process from a paper to a practical user-friendly strategy

Thank you!

Questions?

simon.hunt@fultonhogan.com