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Brief Overview of ALCAM

Australian Level Crossing Assessment Model

Introduction

- What does ALCAM look at
- How can ALCAM be used
- How do we apply ALCAM
- What are the changes (existing vs new)
- How can ALCAM risk reports be accessed
- ALCAM Existing/New Database
- ALCAM identified - Safety improvements
- Train/road vehicle collisions

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What does ALCAM look at?

Controls

- Half-arm barrier
- Road markings
- Signage

Characteristics

- Proximity to a station
- Number of tracks
- Train volume
- Train speed
- Visibility of train

Accident Mechanism

- Drives around or through boom gates
- Road user is distracted
- Road user fatigued

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How can ALCAM be used?

- To identify key potential risks at level crossings
- Quantify the expected consequences of an accident
- Quantify the probability of an accident
- To compare relative risk between crossings within a region or jurisdiction
- Model the effect of treatments to address these risks
- Assists in the prioritisation of crossing upgrades
- Assists in the decision making for level crossings safety improvements

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How do we apply ALCAM

ALCAM cannot be applied in isolation, any risk assessment and treatment needs to consider:

- Sound engineering judgement applied by road and railway engineers
- Collision and near-collision history
- Local knowledge of driver or pedestrian behaviour
- Social and economic assessment
- Standards and international best practice

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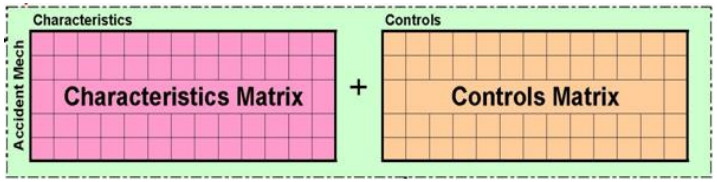
CURRENT ALCAM

Structure of Current ALCAM



Likelihood Factor x **Exposure Factor** x **Consequence Factor** = **ALCAM Risk Score (ARS)**

172 x (Trains 40 x Vehicles 2,500) x 10 = 172,000,000

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CURRENT ALCAM

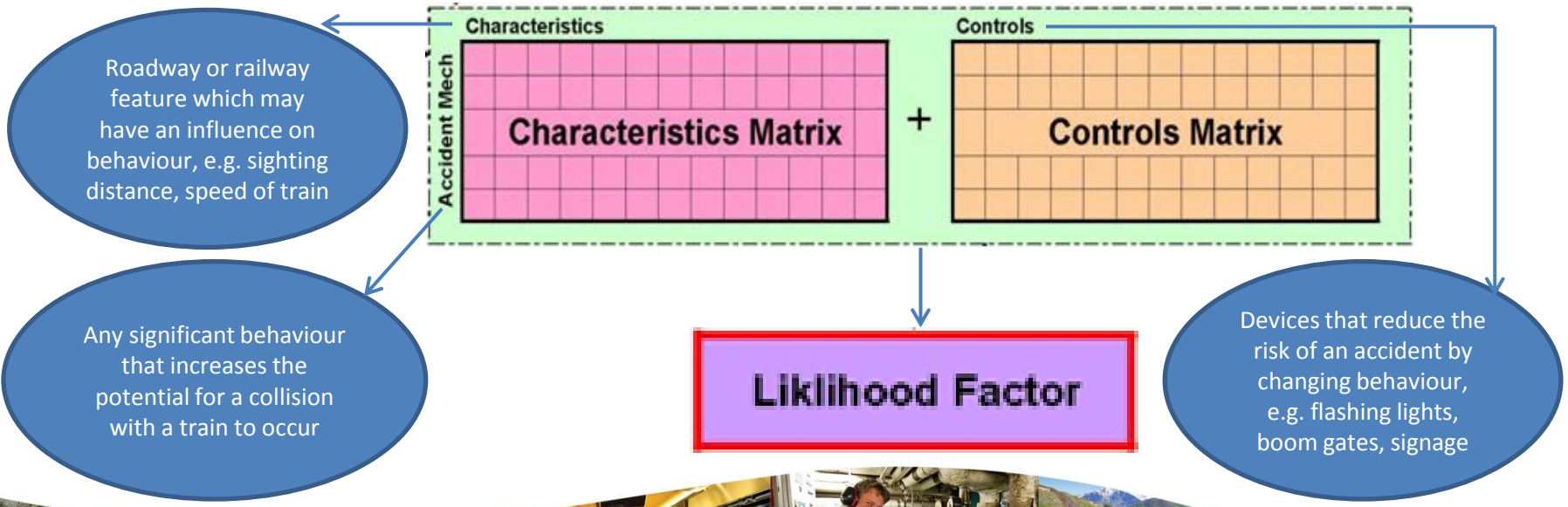
Likelihood Factor

Characteristics Matrix

Determines the effect that each characteristic would have on each accident mechanism

Controls Matrix

Determines the effect that controls will have on reducing the likelihood of an accident mechanism occurring



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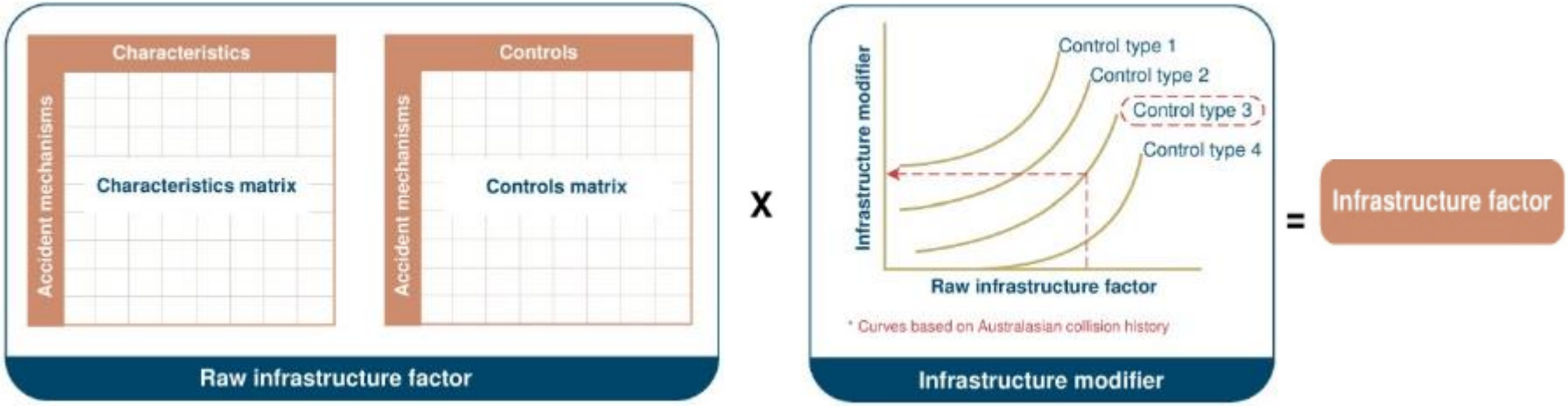
NEW ALCAM

Infrastructure Factor

- Characteristics and Controls Matrix now becomes a **Raw Infrastructure Factor**
- An **Infrastructure Modifier** turns the **Raw Infrastructure Factor** into a real accident probability or **Infrastructure Factor**



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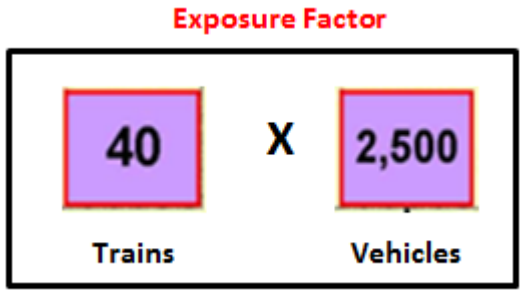
Exposure Factor

- Produced by multiplying the road traffic volume (V) and rail traffic volume (T) of a level crossing



- Gave traffic volumes the most influence on ranking crossings

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NEW ALCAM

Exposure Factor

- Study investigated exposure modelling used in Australia, UK, and US
- Compared predictions Australian/New Zealand level crossing crash data
- Found the conventional **(V x T)** did not replicate the observed collision record
- ALCAM adopted the ***Peabody-Dimmick Formula***. An accident predication model used in the US
- Apply an ***adjustment factor*** to the result in order to produce more contemporary crash rate predictions and uses 10 years of Australian/New Zealand crash data

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CURRENT ALCAM

Consequence Factor

Relationship between an **environmental factors** and **train speed factor**

- Is a modification factor to inflate or deflate the exposure factor (V x T)

Factors affecting Consequences		Speed				
		0 - 60	61 -80	81 - 100	101 - 120	> 120
Environmental Factors	Index	1	2	3	4	5
Curve within stoping distance & Points in direction of travel	1	4	10	10	10	10
Road under bridge or river bridge	2	4	10	10	10	10
Steep embankment 3m +	3	4	4	10	10	10
Multiple track	4	3	4	10	10	10
School bus route	5	3	4	10	10	10
High proportion of heavy vehicles using the level crossing +10%	6	0.1	3	4	10	10
Tunnel within the stopping distance	7	0.1	3	3	10	10
Medium embankment	8	2	3	3	4	4
Curve within stopping distance & No other environmental concerns	9	1	2	3	3	3
Straight track + passengers	10	1	1	3	3	3
Straight track + freight only	11	0.1	1	1	3	3

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Consequence Factor

- An **event tree** is used to estimate the likelihood that level crossing collision will escalate into more serious consequences.

e.g. derailment, overturn, and secondary collision

- The end outcome of the event tree has an associated number of fatalities, serious injuries, and minor injuries. When combined are expressed in terms of equivalent fatalities per collision

- The probability of occurrence and possible outcomes used are based on 10 years of Australian/New Zealand level crossing crash data and assumptions from UK data

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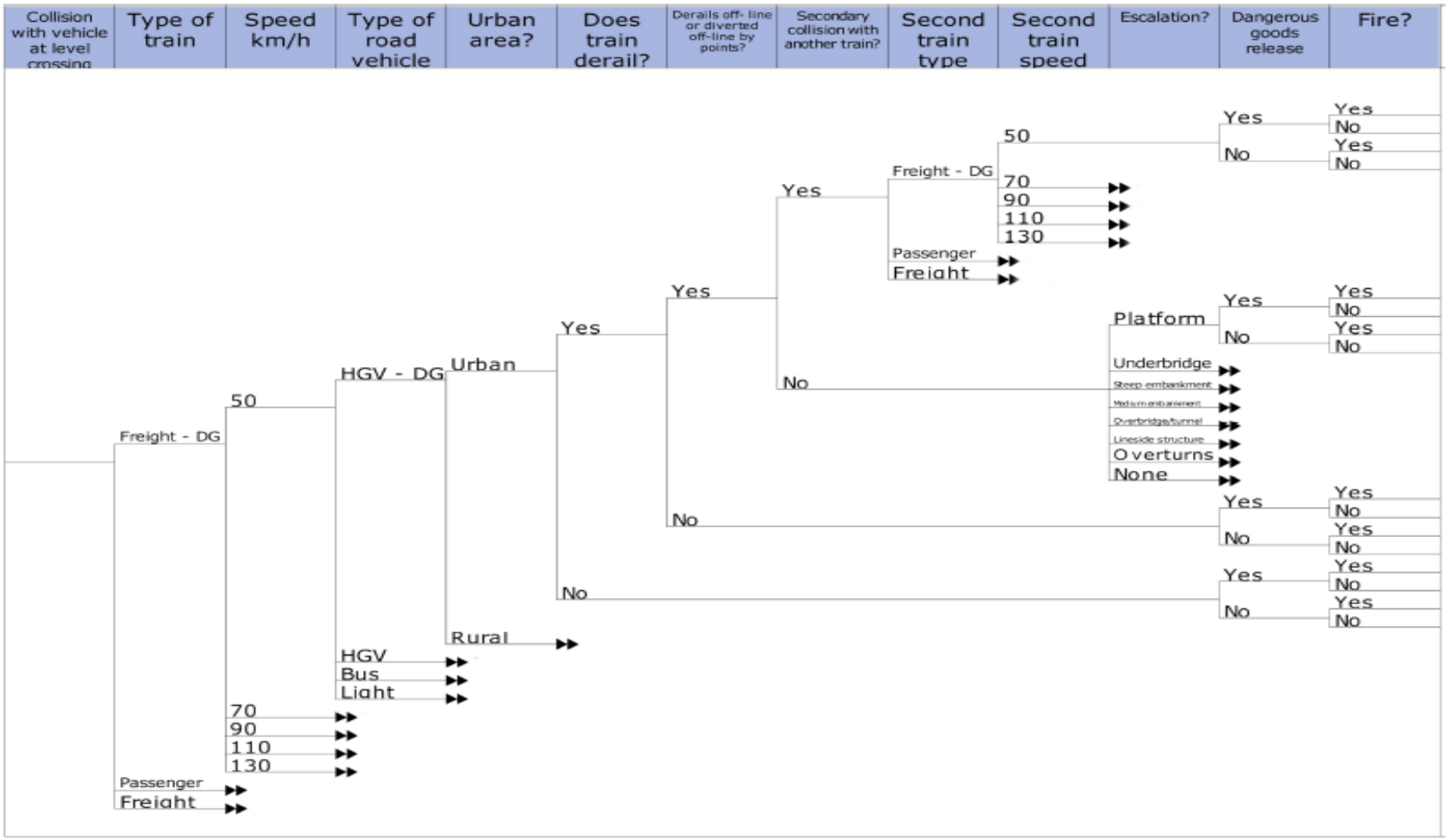
Consequence Factor - Event Tree



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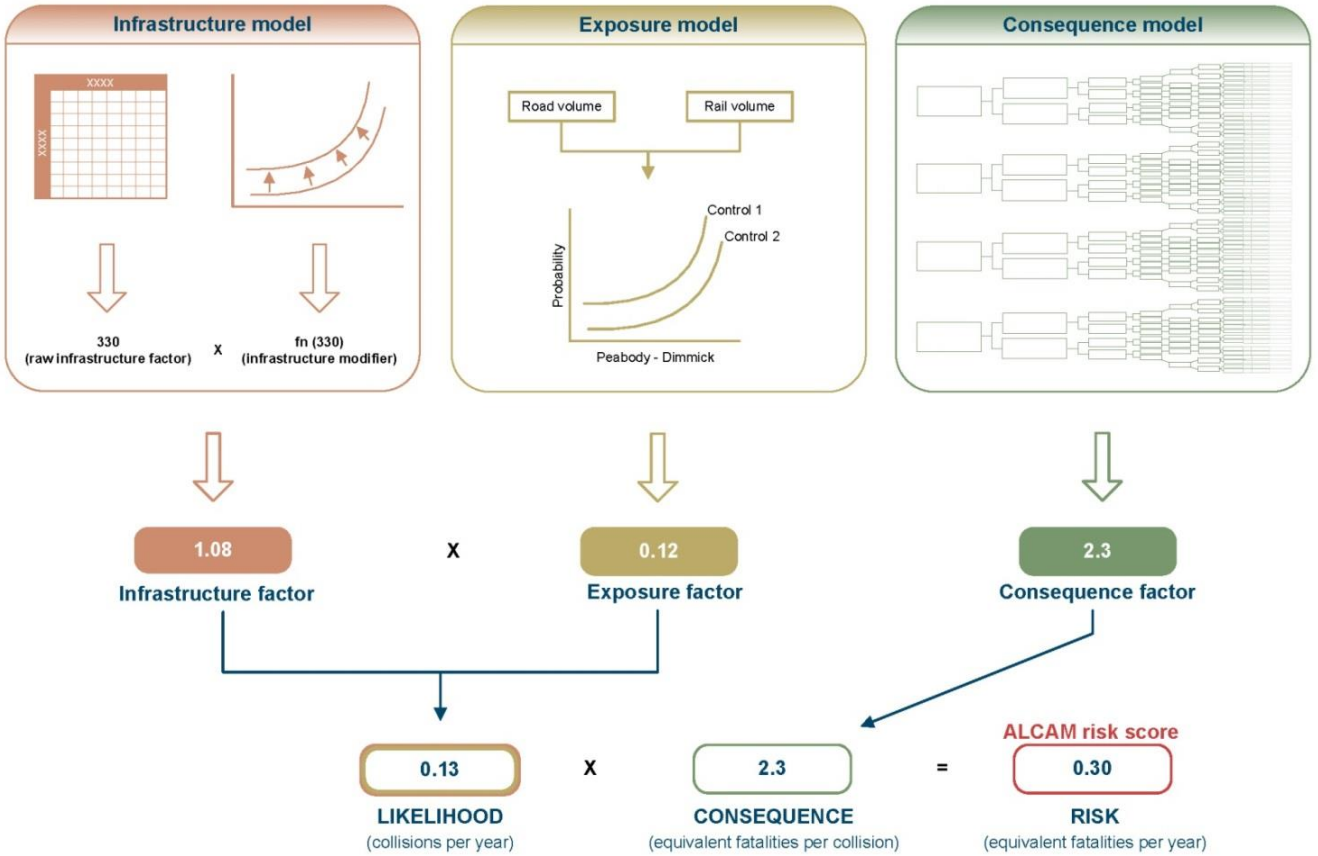
NEW ALCAM

Structure of New ALCAM



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Existing/New ALCAM Databases

CURRENT ALCAM

Microsoft Access
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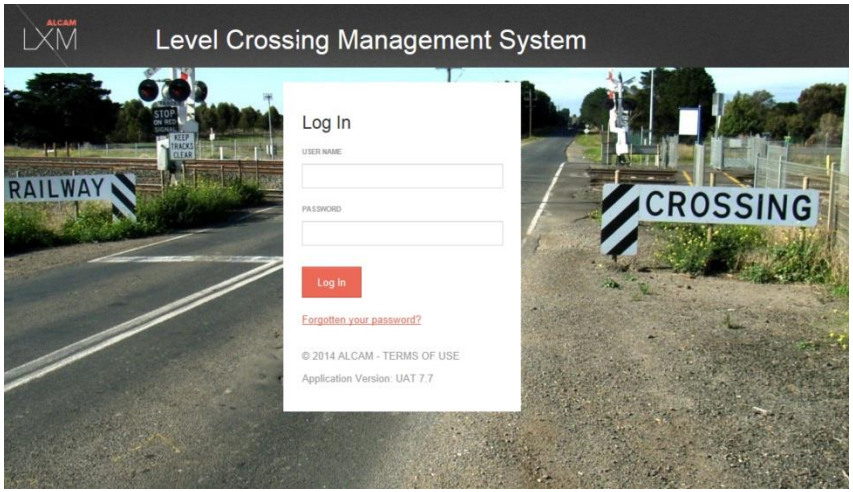
NEW ALCAM



internet Interface
Available to all KiwiRail/Roading authorities/NZ Transport Agency

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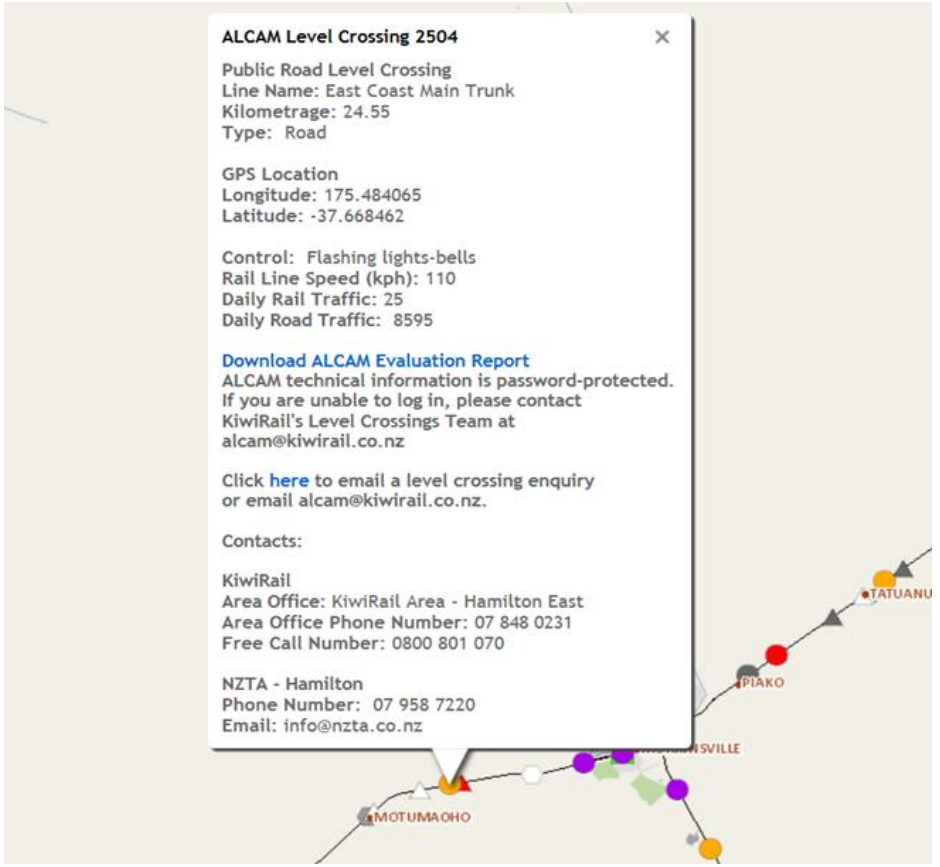
How can we access the reports

- Available on the KiwiRail website

Maintaining the data

- Road/pedestrian level crossing survey form
- Level crossing sketch
- Photos
- Input into ALCAM database
- Road and Rail Access into database



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ROAD

Level crossing controls

Equipment or tools that reduce the risk of an accident by changing pedestrian or driver behaviour. A control could also include education and law enforcement campaigns

- Grade separation
- Active control - half boom, flashing lights *
- Active control - full boom, flashing lights
- Active control - primary flashing lights *
- Flashing light enhanced stop sign
- Audible warning
- Passive control - stop signs *
- Passive control - give way signs *
- Passive control - position markers only
- Rail operated gates
- "Keep Tracks Clear" signs and cross hatching of crossing
- Backing boards / LED lights
- Hump / dip advisory sign to road user
- R6-25 signage (confederate flag)
- Train speed advisory sign to road users
- Overhead mounted (mast arm) traffic control
- RX-9 Railway Crossing Width Marker Assembly
- Standard advanced warning (W7-4 or W7-7) *
- Train activated advanced warning (e.g. flashing lights)
- Large passive advanced warning *
- Passive tactile advanced warning (e.g. rumble strips)
- Visual road marking (stripes)
- Reduced speed zone in vicinity of crossing
- Rail-X pavement marking
- Localised public education strategies
- Enforcement camera
- CCTV surveillance
- Hand signaller (flagman)
- Public response phone number
- Reschedule train to avoid conflict
- Whistle board / location board for train
- Reduce train speed sign to achieve S2 or S3
- Street lighting at crossing
- Maintenance program for vegetation on rail
- Maintenance program for vegetation on road
- Extra lanes over crossing
- Central barrier posts/median on road approach
- Address short stacking - infrastructure
- Address short stacking - alternate access
- Short stacking sign
- Vehicle escape zones
- Control of crossing (CCTV or on-site)
- Coordination with adjacent traffic signal
- Sign (active) for downstream queue warning
- sign (active) for second oncoming train warning
- Detectors in crossing conflict zone
- Road traffic signals (active)
- Variable message sign (active)
- Healthy state monitoring
- Queue relocation

* Additional weighting where control is duplicated on site

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Level crossing characteristics

A characteristic is defined as any feature of a roadway or railway which may influence on pedestrian or driver behaviour (accident mechanisms).

- Effectiveness of equipment inspection and maintenance
- Longest approach warning time
- Proximity to intersection control point
- Proximity to siding/shunting yard
- Proximity to station
- Possibility of short stacking
- Number of lanes or lines of traffic
- Vulnerability to road user fatigue
- Presence of adjacent distractions
- Condition of traffic control at level crossing
- Visibility of traffic control at crossing
- Distance from advance warning to level crossing
- Conformance with Australian Standards (AS 1742.7)
- Heavy vehicle proportion
- Level of service (vehicle congestion)
- Queuing from adjacent intersections
- Sun glare affecting sighting of crossing or approaching train
- Temporary visual impediments - sighting of level crossing or sighting of train
- Road traffic speed (approach speed 85th percentile)
- Train volume - two way (high / low)
- Seasonal / infrequent train patterns
- Slowest train speed at level crossing (typical)
- Longest train length at level crossing (typical)
- High train speed on approach to level crossing
- Number of operational rail tracks
- Condition of road surface on immediate approach/departure (not the crossing panel)
- Level crossing panel on a hump, dip or rough surface
- S1 - advance visibility of level crossing from road
- S2 - approach visibility to train (vehicle approaching crossing)
- S3 - visibility to train (vehicle stopped at level crossing)

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Accident mechanisms

An accident mechanism is any significant pedestrian or driver behaviour that increases the potential for a collision with a train to occur. The road user:

- is distracted
- cannot see control
- cannot see train from road approach (S2) (approach siting)
- cannot see train from at crossing (S3) (restart siting)
- assumes train would stop
- does not expect second train
- finds crossing control is ambiguous
- is fatigued
- is mislead by controls
- is unable to stop in time
- is stuck on tracks
- is stopped on tracks
- is queued on tracks
- overhangs on tracks
- is racing train or misjudged train speed
- drives through passive warning without looking
- drives through flashing lights
- drives around boom gates

Consequence model considerations

An event tree model used to produce a range of outcomes (and associated probabilities) if a collision were to occur. The average output of this model is the Consequence Factor.

- Frequency of passenger trains
- Frequency of freight trains
- Frequency of freight trains (dangerous goods)
- Speed of passenger trains
- Speed of freight trains
- Speed of freight trains (dangerous goods)
- Percentage of buses
- Percentage of light vehicles
- Percentage of HGV vehicles
- Percentage of HGV vehicles (dangerous goods)
- Percentage of loco-hauled passengers trains
- Average bus occupancy;
- Average passenger train occupancy;
- Average freight train cab occupancy;
- Average number of wagons per freight train;
- Number of tracks;
- Track straight or curved;
- Distance to points or crossing;
- Distance to platform;
- Distance to underbridge;
- Distance to steep embankment;
- Distance to medium embankment;
- Distance to overbridge or tunnel.
- Time taken to protect fouled track;
- Potential for derailment in a collision;
- Potential for derailment offline in a collision;
- Potential for secondary collision with another train.

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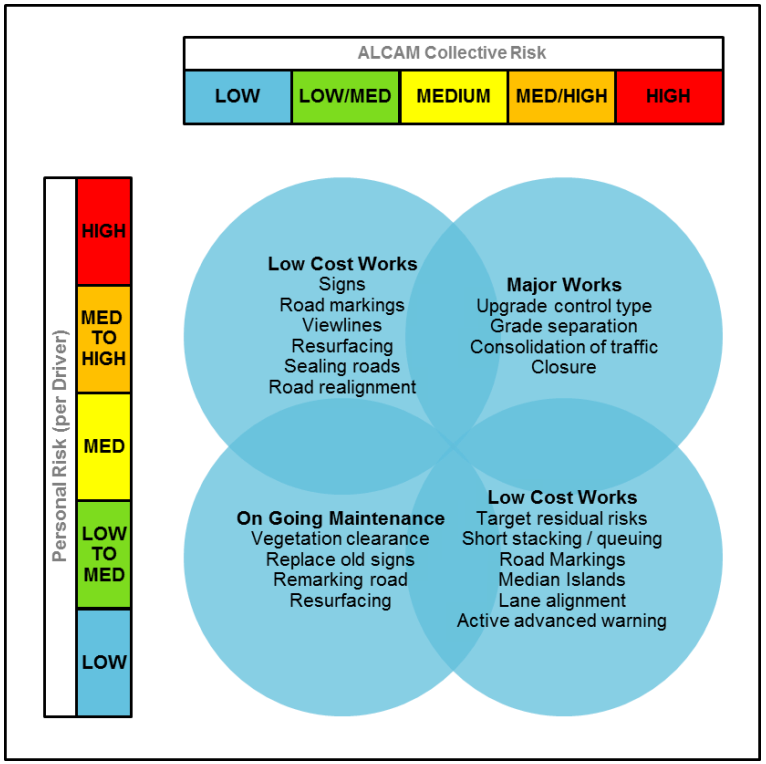
Potential safety improvements



Personal vs Collective Risk

- **Personal Risk** - to a driver
- **Collective Risk** - of an collision at a crossing

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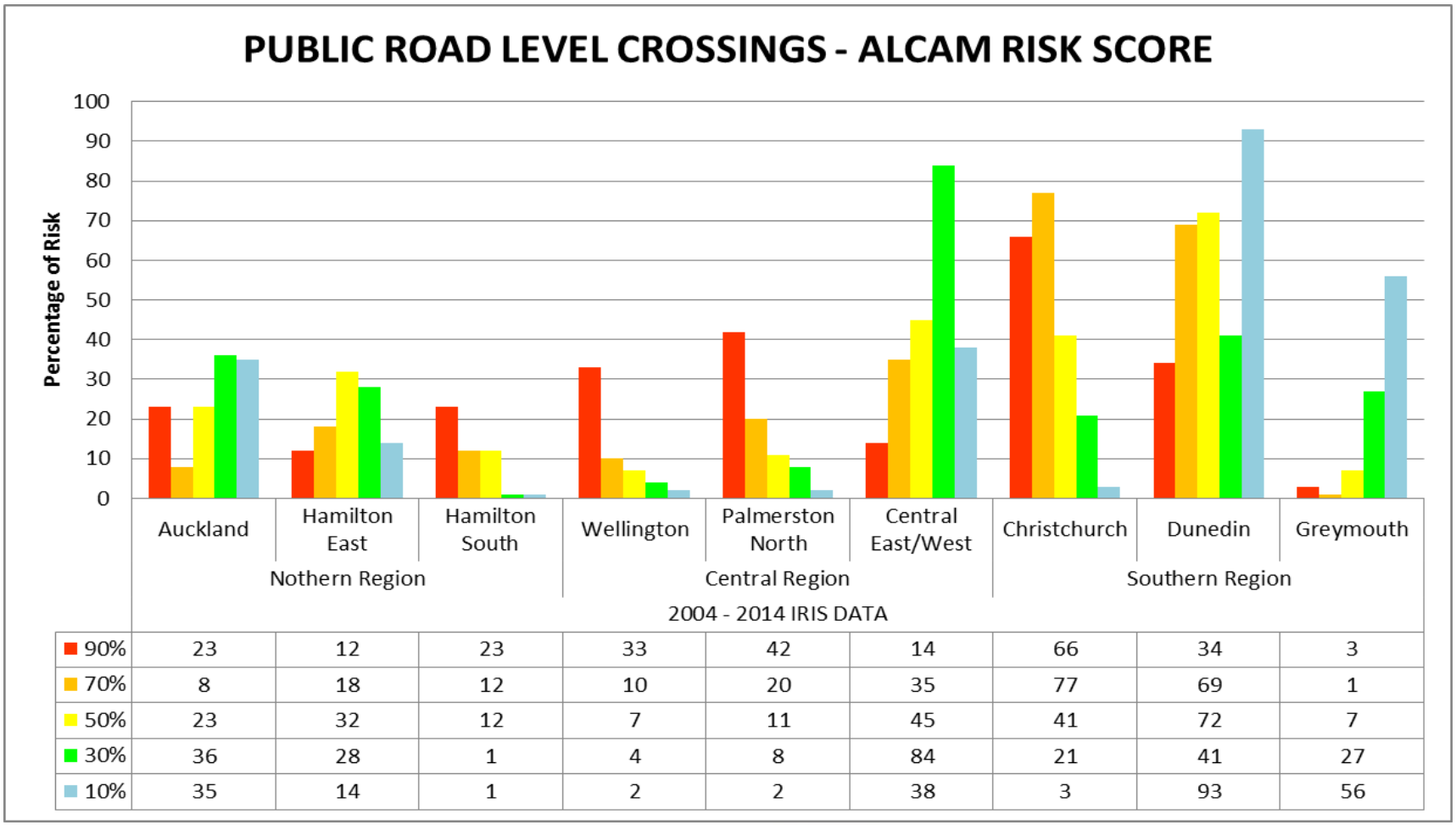
ALCAM Risk - KiwiRail Areas



	Auckland	Hamilton East	Hamilton South	Wellington	Palmerston North	Central East/West	Christchurch	Dunedin	Greymouth
90%	23	12	23	33	42	14	66	34	3
70%	8	18	12	10	20	35	77	69	1
50%	23	32	12	7	11	45	41	72	7
30%	36	28	1	4	8	84	21	41	27
10%	35	14	1	2	2	38	3	93	56

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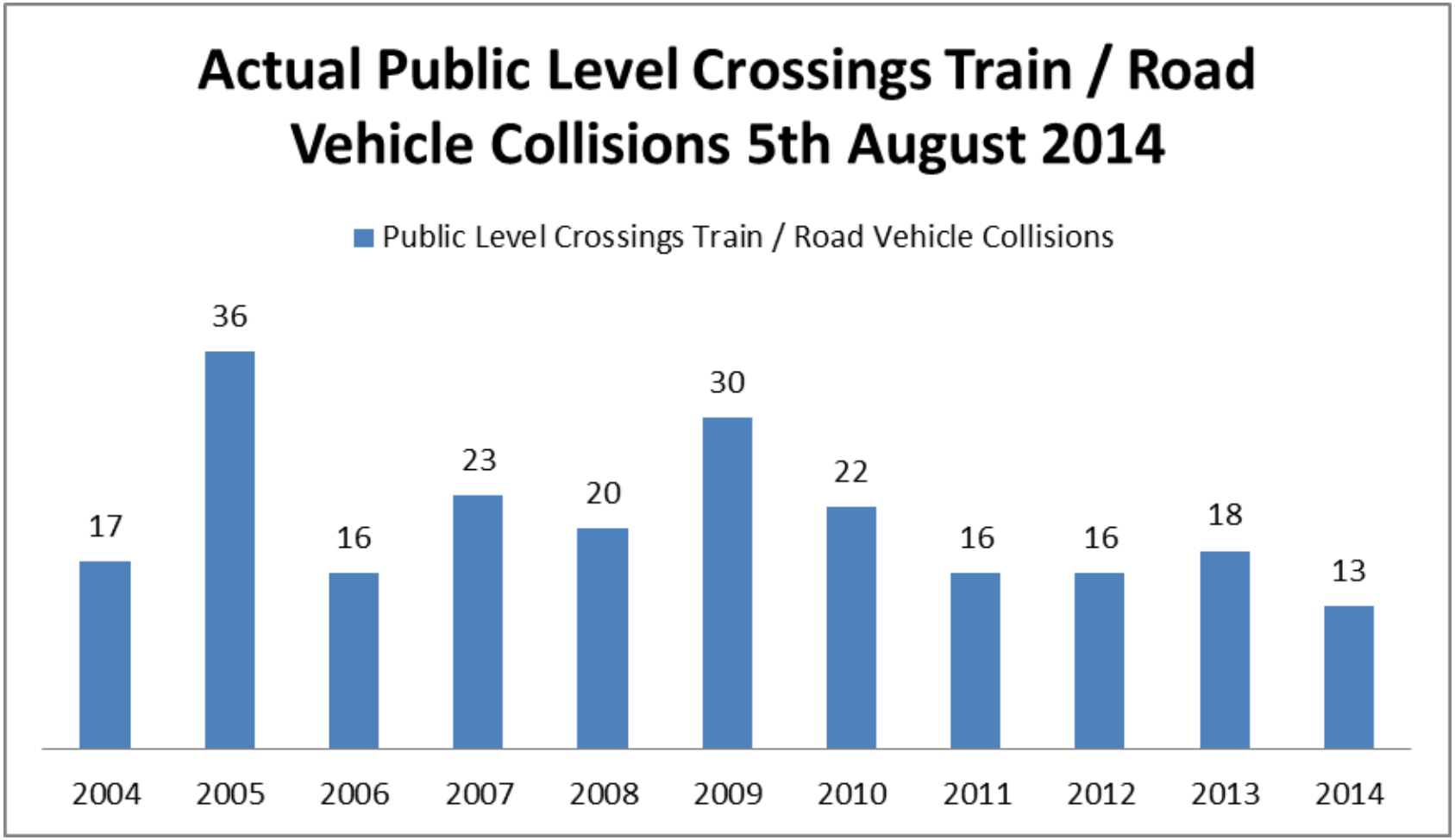
Train / Road Vehicle Collisions



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Conclusion

- Continued cooperation and delivery of improvements with roading authorities and NZ Transport Agency
- ALCAM Risk reports have been available to all roading authorities and NZ Transport Agency
- Availability of ALCAM internet interface by year end
- Training

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Contacts

KiwiRail

Infrastructure & Engineering

Technical Specialist

Brett Williams

Project Engineer

John Costello

Alcam.Levelcrossingprojects@kiwirail.co.nz

NZ Transport Agency

Rail Safety Team

Senior Rail Advisor

Graeme Hudson

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QUESTIONS?

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