Road Safety Trends, Targets and Safety Programs in New Zealand

by Dr Shane Turner

Beca

New Zealand


Europe
Asia
North America
Africa
Caribbean
Middle East
Central America
Pacific
South America
Antarctica


Auckland
Nelson
Wellington
Christchurch
Dunedin
Invercargill

Kiwi's vs Aussies

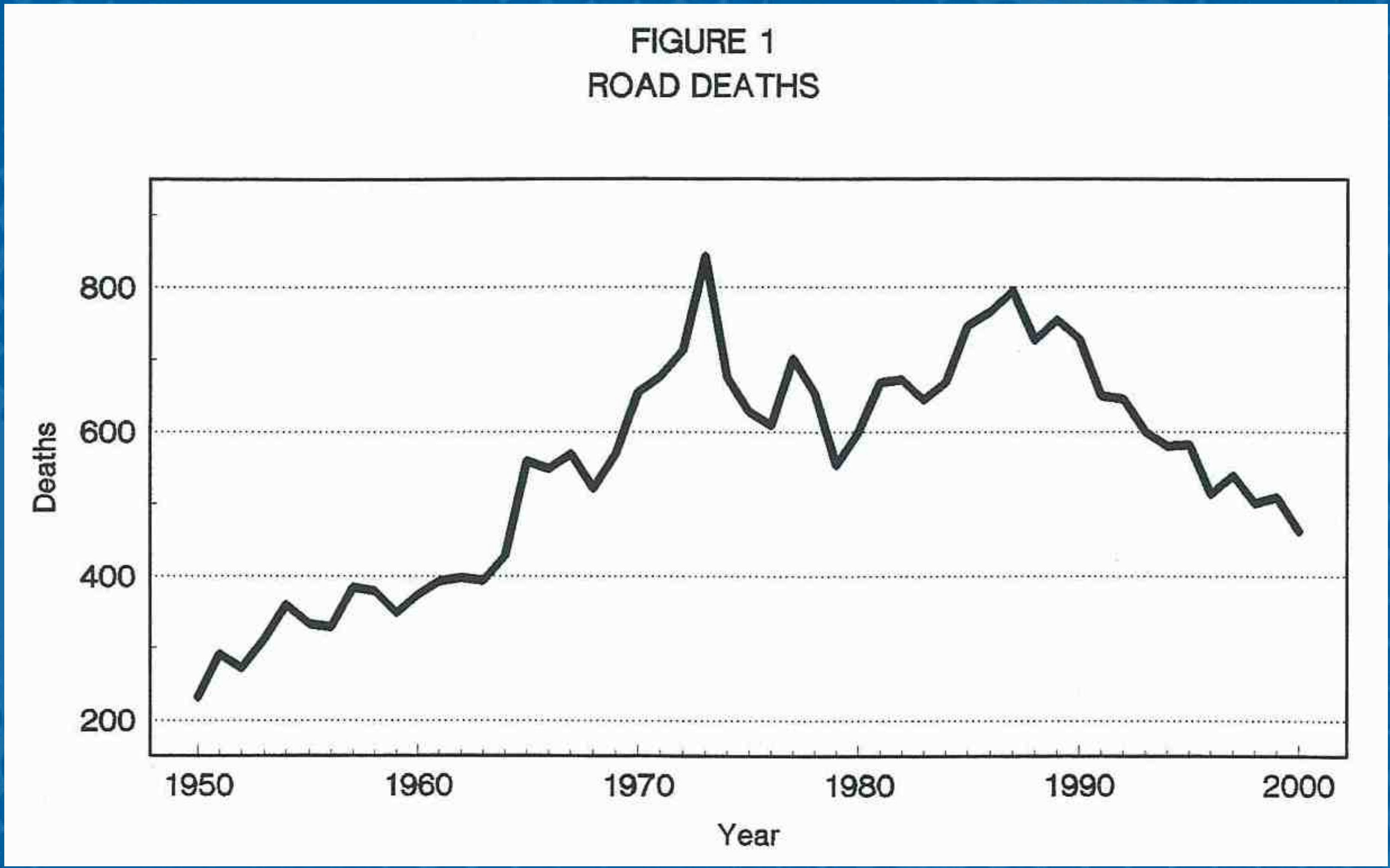
Outline

- Land transport organisations
- NZ & US crash/accident trends
- NZ safety targets & priorities
- Road Safety Auditing
- Road infrastructure safety assessment (RISA)
- Safety management systems
- NZ and Australia road safety toolkits
- Crash (Accident) prediction models
- Some recent projects
  - Rural intersection models
  - Roundabout Models
- Applications of models in Economic Evaluation

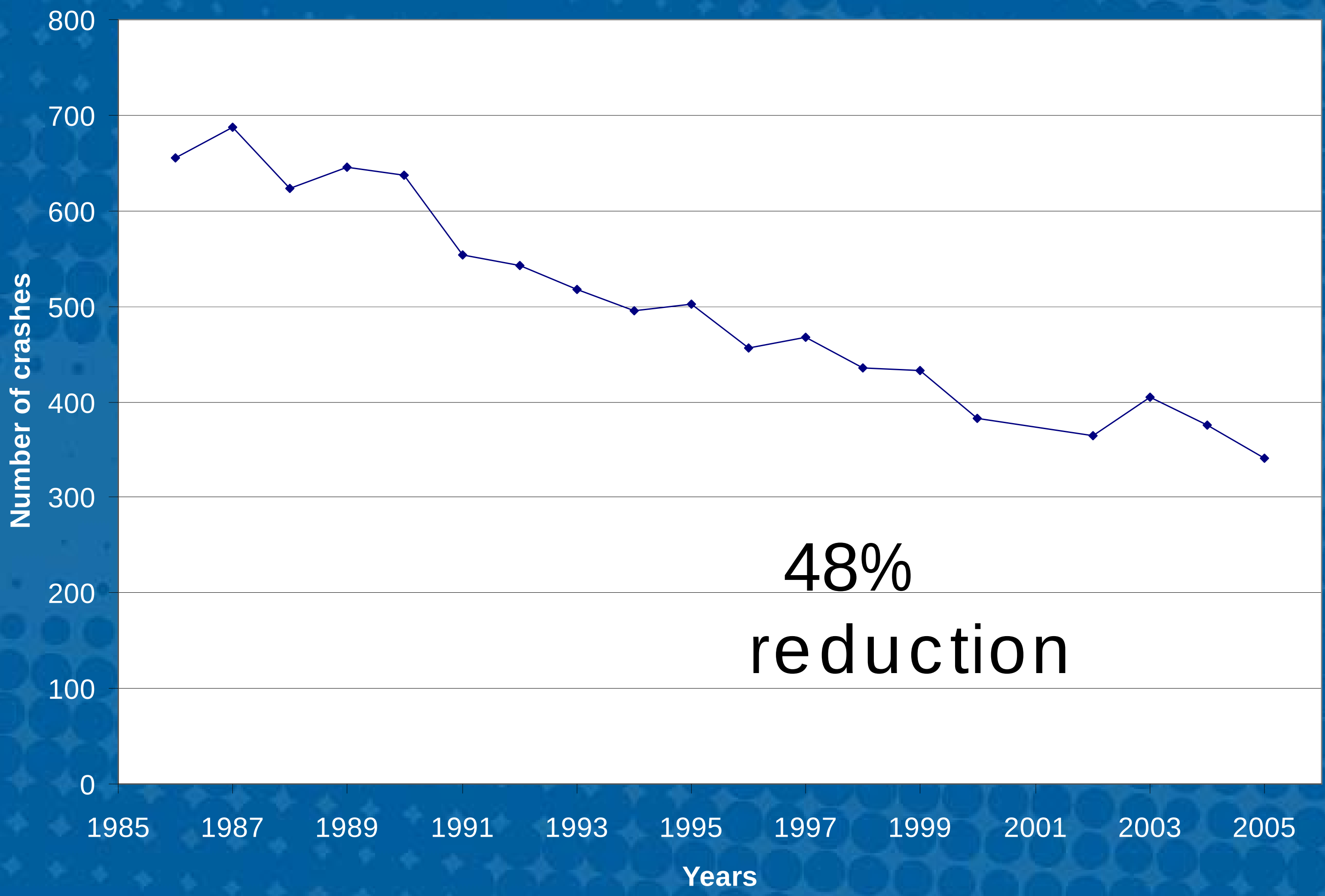
Land Transport Organisations

- Central Government
  - Land Transport NZ – funding, guidelines & research
  - Ministry of Transport – big picture (2010 RS targets)
- Regional Councils
  - Regional Transport Strategies
  - Regional Transport Committees
- Road Controlling Authorities
  - Transit NZ – State Highways
  - Local Authorities – District & City Councils
- Consultants – Opus, Beca & MWH
- Universities – Auckland & Canterbury

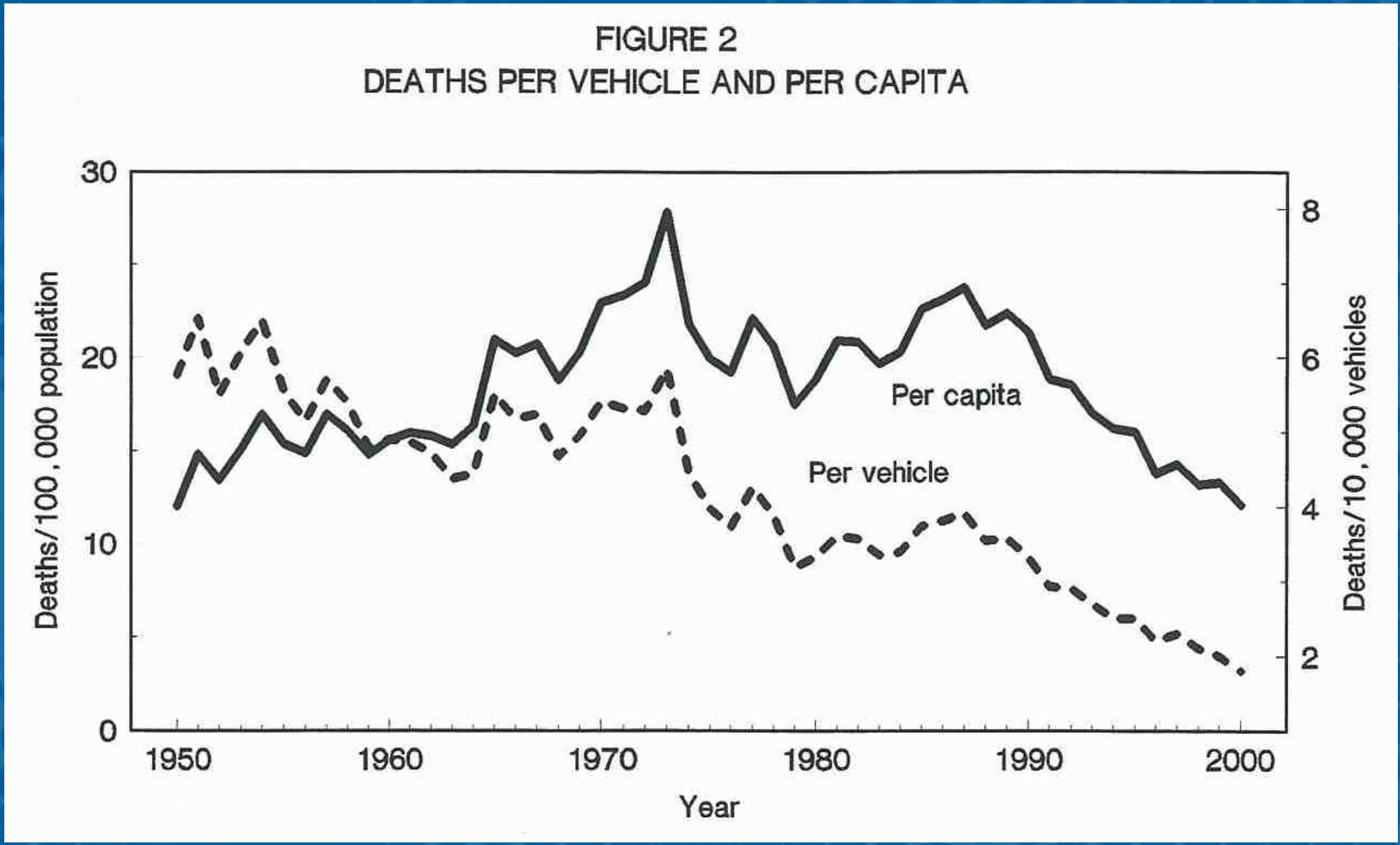
Trend in NZ Fatalities



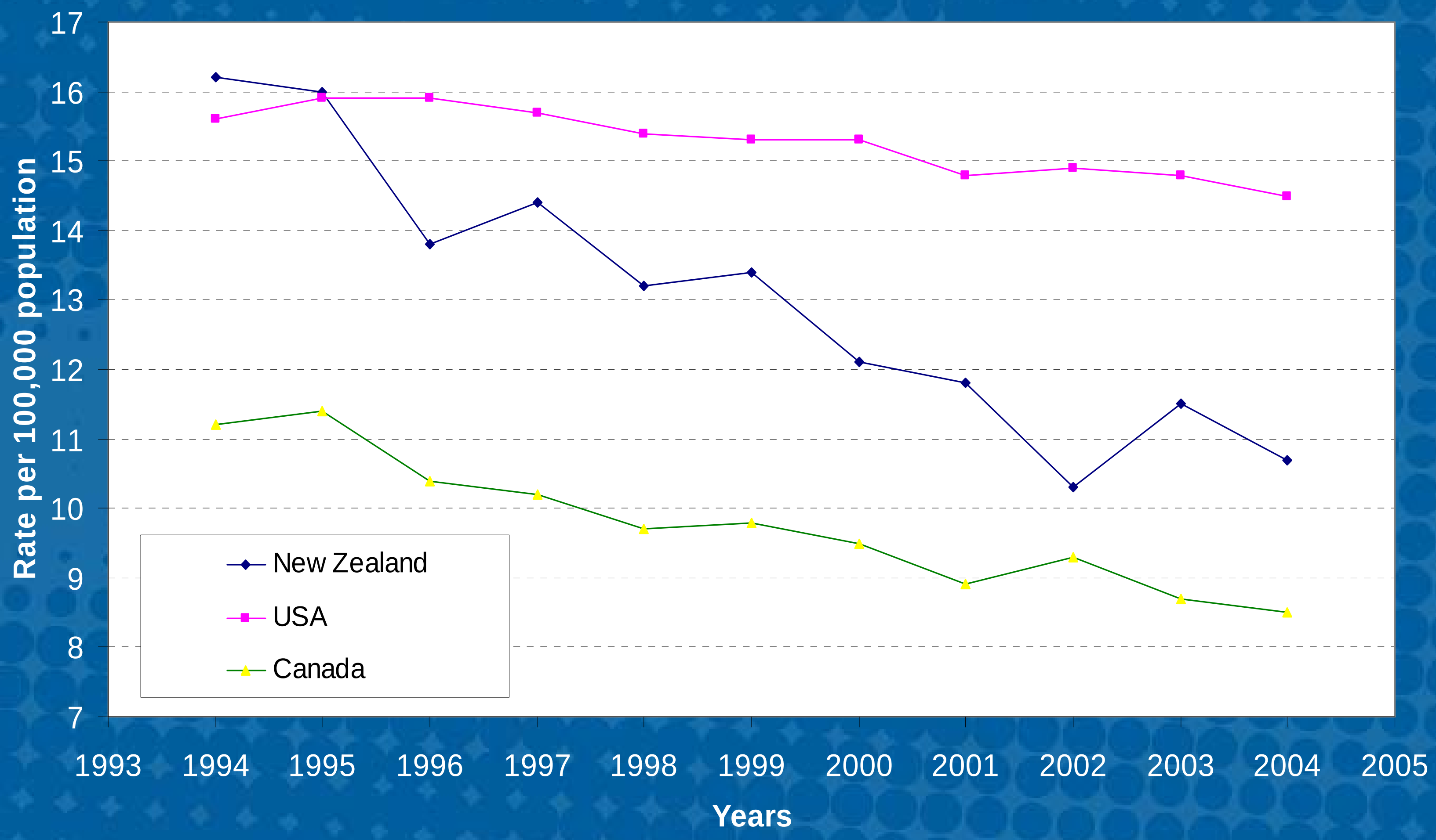
Number of fatal crashes in last 20 years from 1986 to 2005



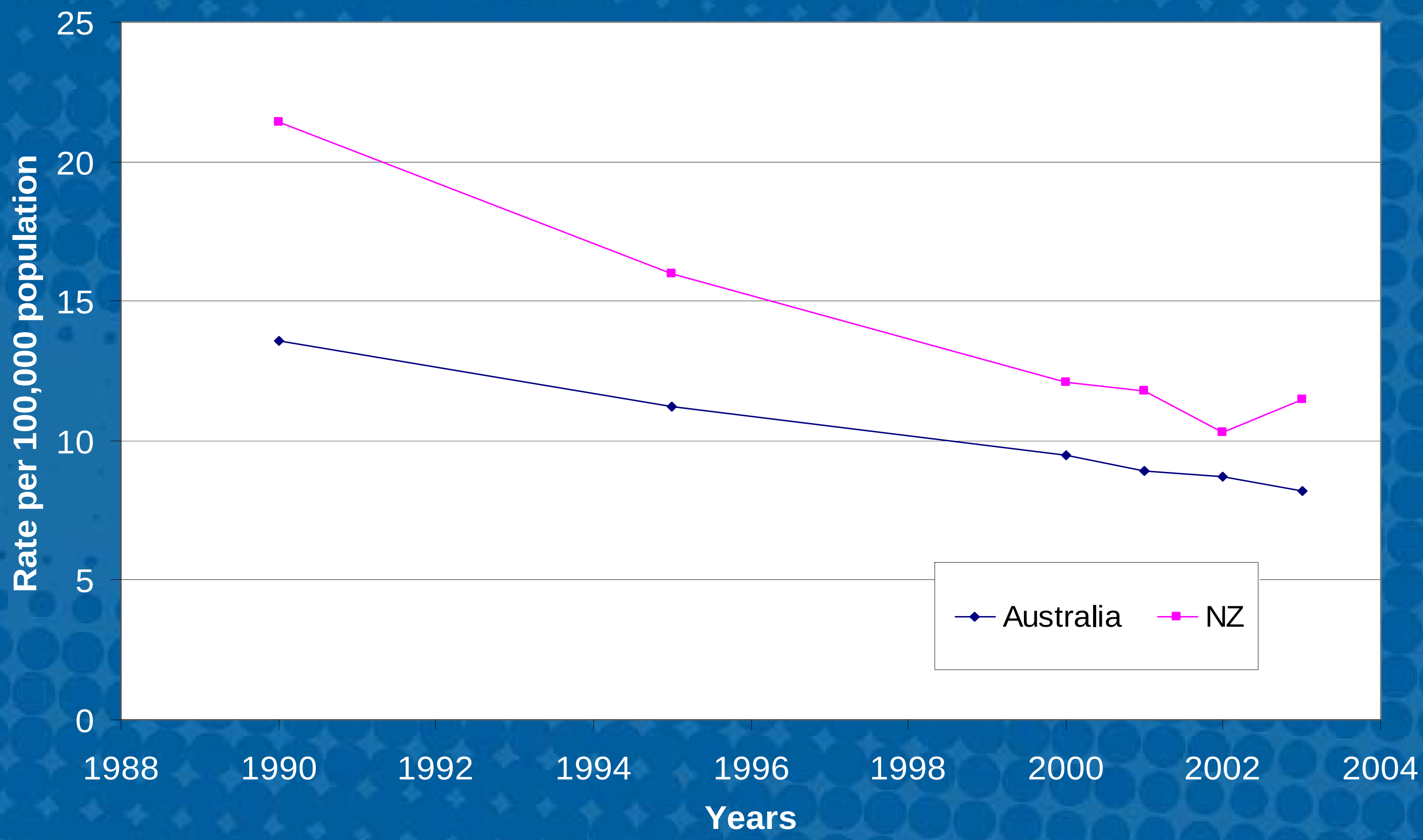
Fatal Indices



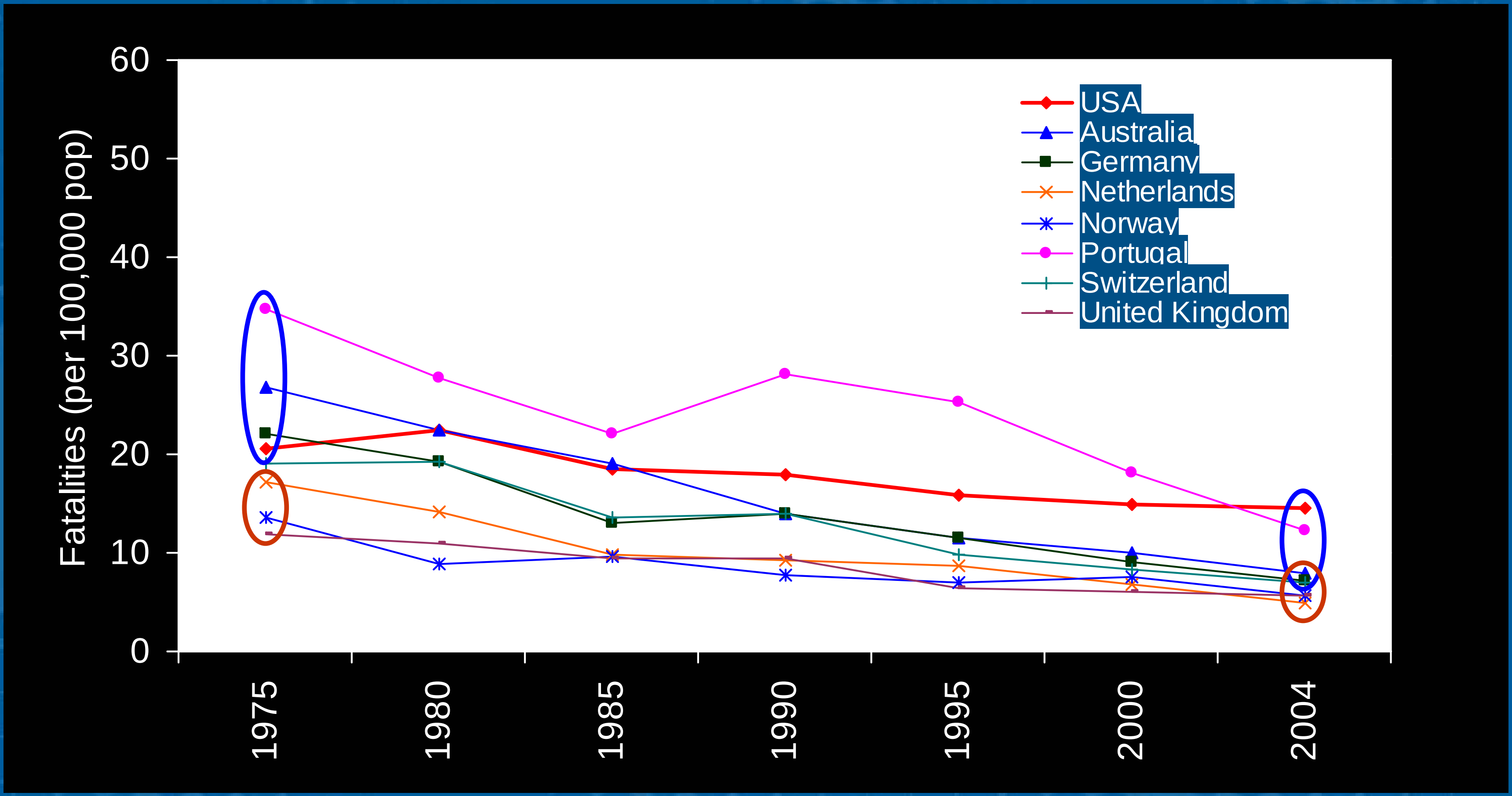
Trends in deaths per 100,000 population in NZ, USA and Canada



Deaths per 100,000 population in NZ and Australia



Worldwide Comparison

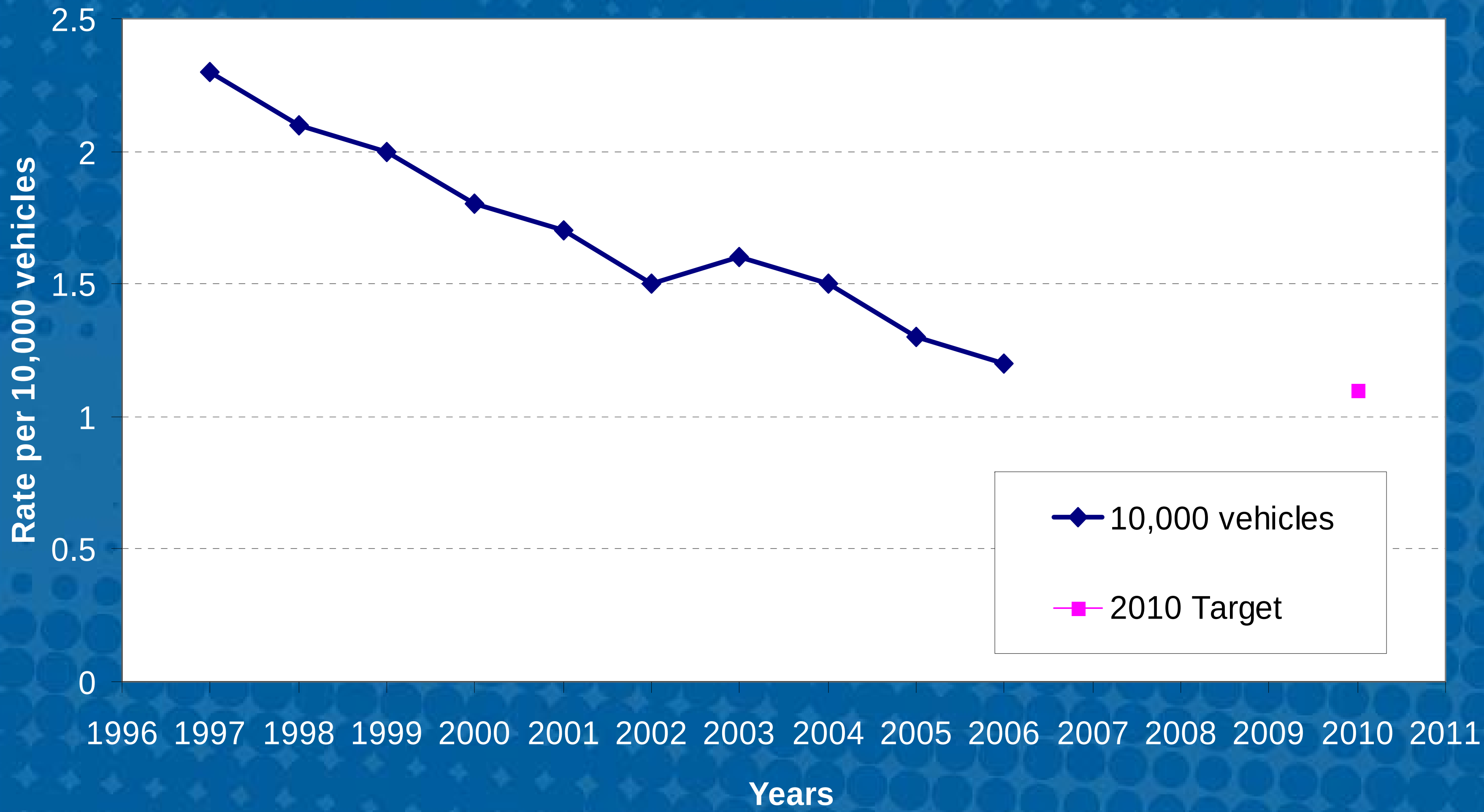


Source: OECD & IRTAD

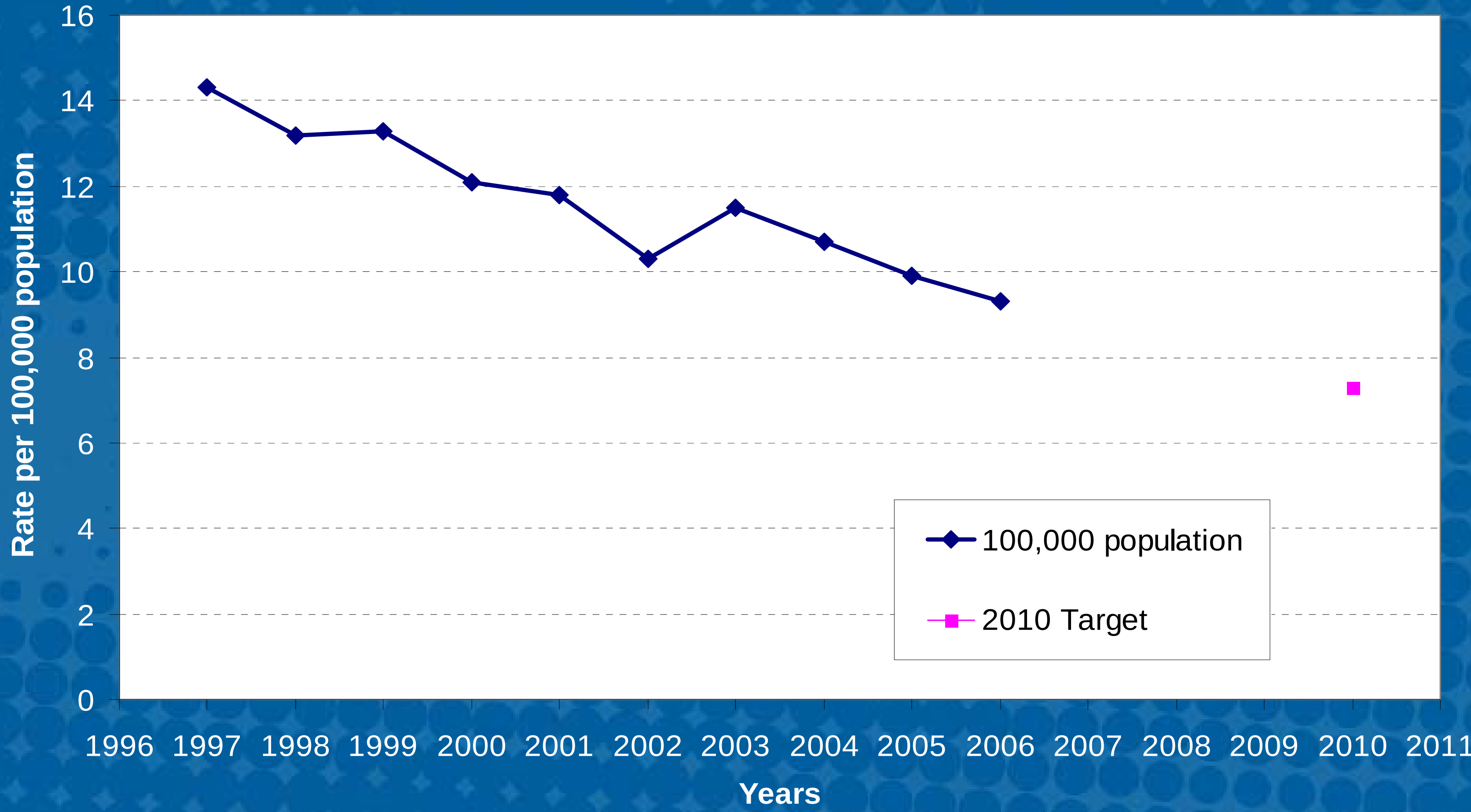
Road Safety Strategy 2010

- Aims
  - To reduce road casualties to no more than 300 deaths and 4,500 hospitalisation a year by 2010.
- Key priority area for action
  - Engineering safer roads
  - Reducing speed
  - Combating drink driving
  - Dealing with serious offenders
  - Encouraging the use of safety belt
  - Improving safety for pedestrians and cyclists
  - Improving the vehicle fleet
  - New and better targeted education initiatives.

Road deaths per 10,000 vehicles and 2010 target in New Zealand



Road deaths per 100,000 population and 2010 target in New Zealand

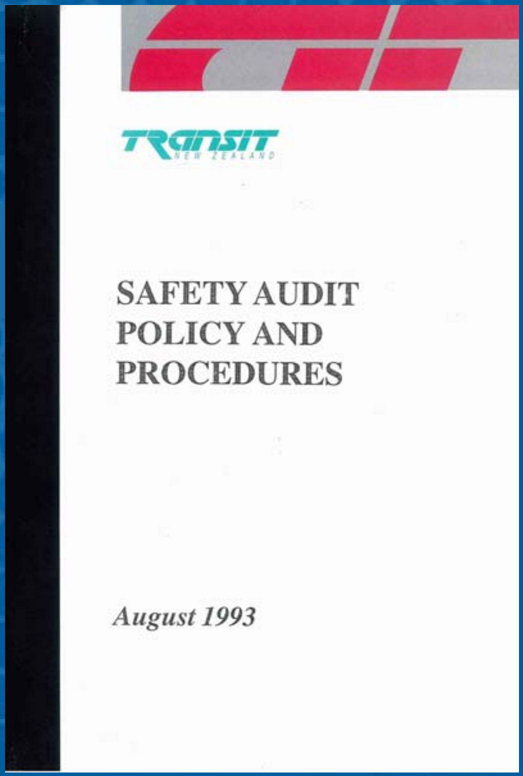


Road Safety Auditing

- Teams of 2 or more
  - Road safety engineers & designers
  - Lead auditor, auditors & observers
- Four stages
  - Feasibility
  - Concept Design
  - Detailed Design
  - Post-Construction/Pre-opening
- Introduced nationwide in early 1990's
- Mandatory for government funding

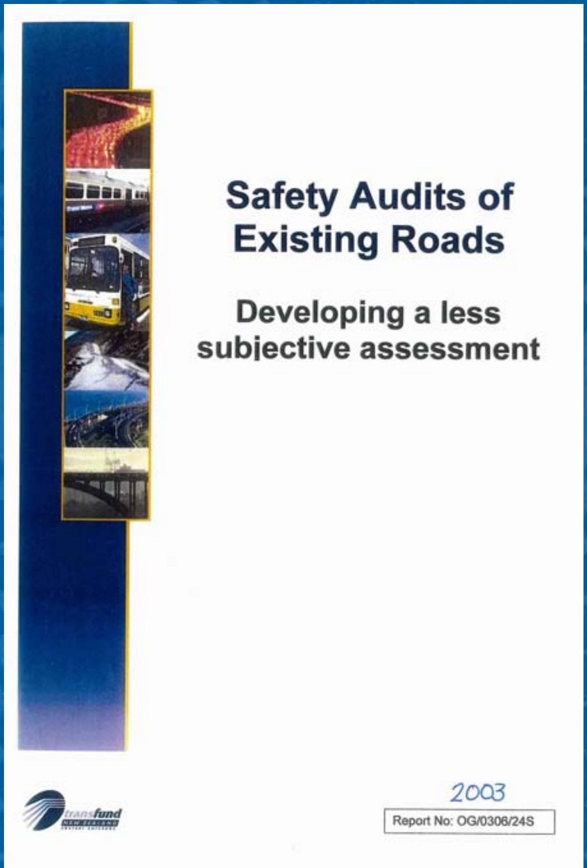
Road Safety Auditing

- Existing road audits – Stage 5 audits
- Use detailed checklists
- Current developments:
  - Themed audits – delineation
  - Road-works site audits
  - Pedestrian and cycle focused
  - Development audits



Road Infrastructure Safety Assessments (RISA)

- Safety Assessment of sample of local council roads
- Removes subjective assessment of previous methods – where some key issues missed
- Current focus is on rural routes (to be extended to urban routes in 2 to 3 years)



Road Infrastructure Safety Assessments (RISA)

- Produces list of key issues that need to be addressed by local councils, such as
  - Poor delineation
  - High number of roadside hazards
- Analysis uses crash rates and AMFs (in future CPMs will replace rates)
- Involves three day survey, overnight analysis and reporting to council

Audit	Name	Date	Rd Name	Terrain	AADT	Length	Rd Type	**RISK**

CROSS SECTION

Item		0 km		1km		2km		3km		4km		5km Exposure Length (km)	Relative Risk	Risk Score
One Lane Bridge w/warning (BEM)													60	
One Lane Bridge w/out warning													80	
Hazards within 6m	Point												20	
	Recoverable length												10	
	Non-recoverable length												15	
Unsealed Shoulder													5	
Shoulder width	Very wide (only Road Type 1)												-20	
	Wide (only Road Types 1,2)												-10	
	Narrow (only Rd Types 2-6)												10	
	Very narrow (only RTs 3-6)												20	
Lane width	Narrow												10	
	Very narrow												20	
Lane width	Very narrow												20	
	Narrow												10	
Shoulder width	Very narrow (only RTs 3-6)												20	
	Narrow (only Rd Types 2-6)												10	
	Wide (only Road Types 1,2)												-10	
	Very wide (only Road Type 1)												-20	
Unsealed Shoulder													5	
Hazards within 6m	Non-recoverable length												15	
	Recoverable length												10	
	Point												20	
		5km		4km		3km		2km		1km		0 km	Sheet Total	

Figure 6 Cross Section Field Sheet

Guidelines for developing a

safety management system

for road controlling authorities

land transport safety authority

Holistic Approach to Road Safety

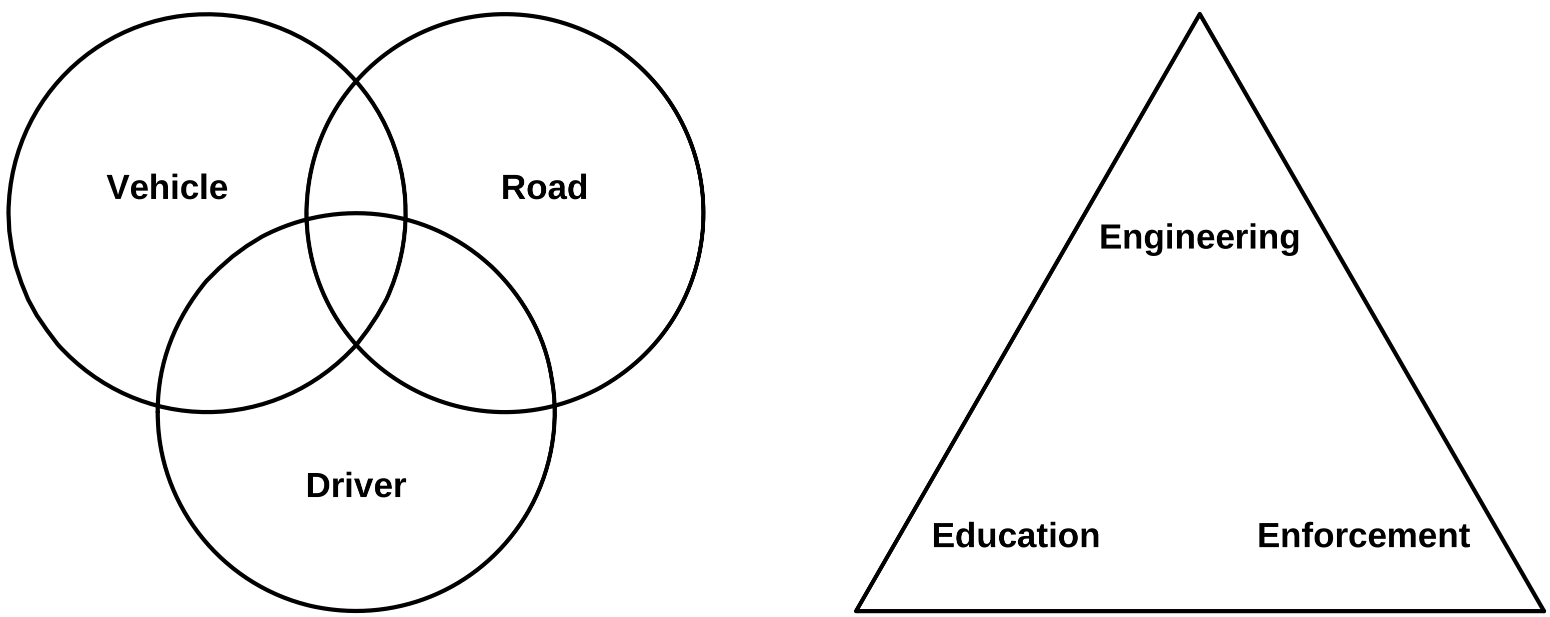
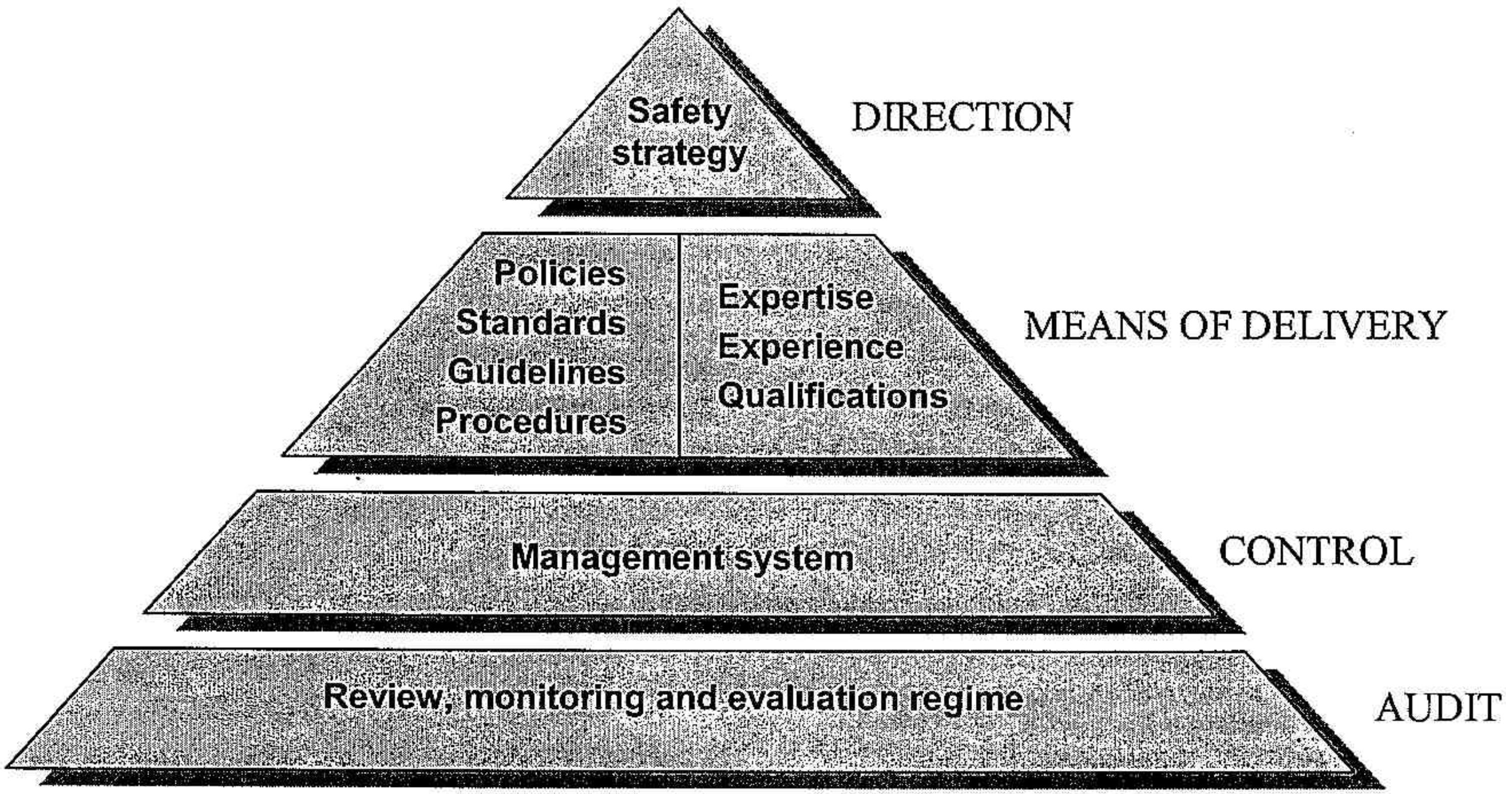


Figure 1: Safety management system (SMS) structure



Safety Management Systems

- Based on systems developed by Railways and Aviation
- SMS are required to make sure that the safety systems are right and consistent. Examples:
  - Temporary traffic control systems (e.g. events)
  - Safety auditing of all schemes
  - Identifying and removing roadside hazards
  - Raising community awareness of Road Safety
  - Enforcement of traffic rules (e.g. speeding)
  - Communication between road safety partners

Safety Management Systems

- Desire to develop a ‘safety culture’ within local councils and within wider community
- Need to make safety a focus at the ‘grass routes’ (Councils) if national safety targets (2010) are to be met:
  - Adequate funding
  - Adequate staffing
  - Upskilling of current staff

Crash Reduction Studies in Auckland

- Focus on blackspots on State Highway and motorway (freeway) networks
- Annual study (monitoring) of sites
- Desktop analysis of crash trends
- Add and remove sites based on crash clustering
- Day and night-time inspections of sites
- Tracking and reviewing low cost road safety improvements
- Development of improvement programmes

Rural BlackRoute Studies (SHs)

- Identification of 10 worst performing rural road sections – by crash rate
- Target high crash rate roads using 3'E'; Engineering, Enforcement, Education
  - Improved safety engineering of the road
  - Comprehensive road safety education
  - Effective enforcement
- Formation of road safety task force

  - Transit NZ, Police, LTNZ local council, Road safety coordinators & Specialised road safety consultants

Accident
Investigation
Monitoring
Analysis

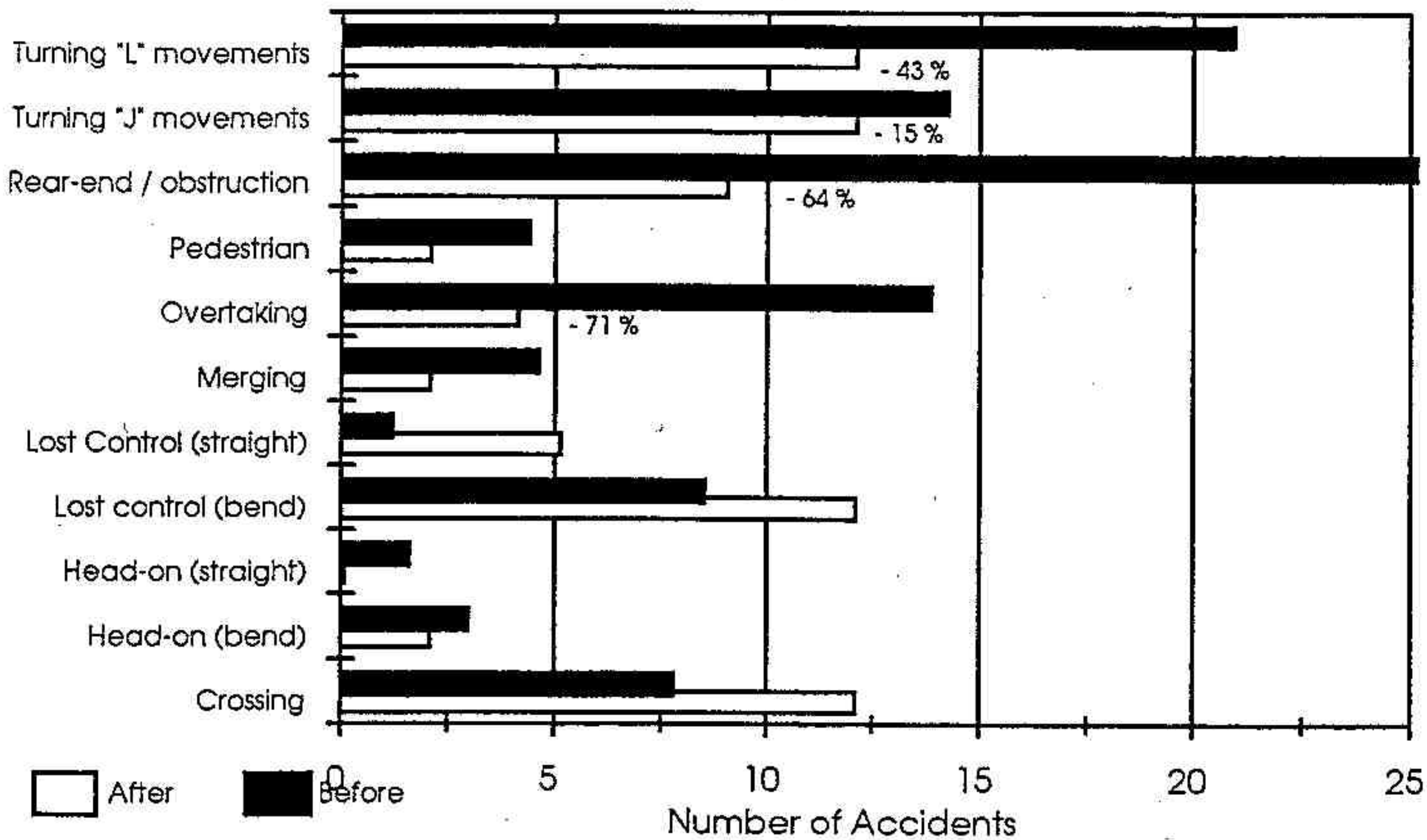
Land transport safety Authority

Accident Monitoring Database

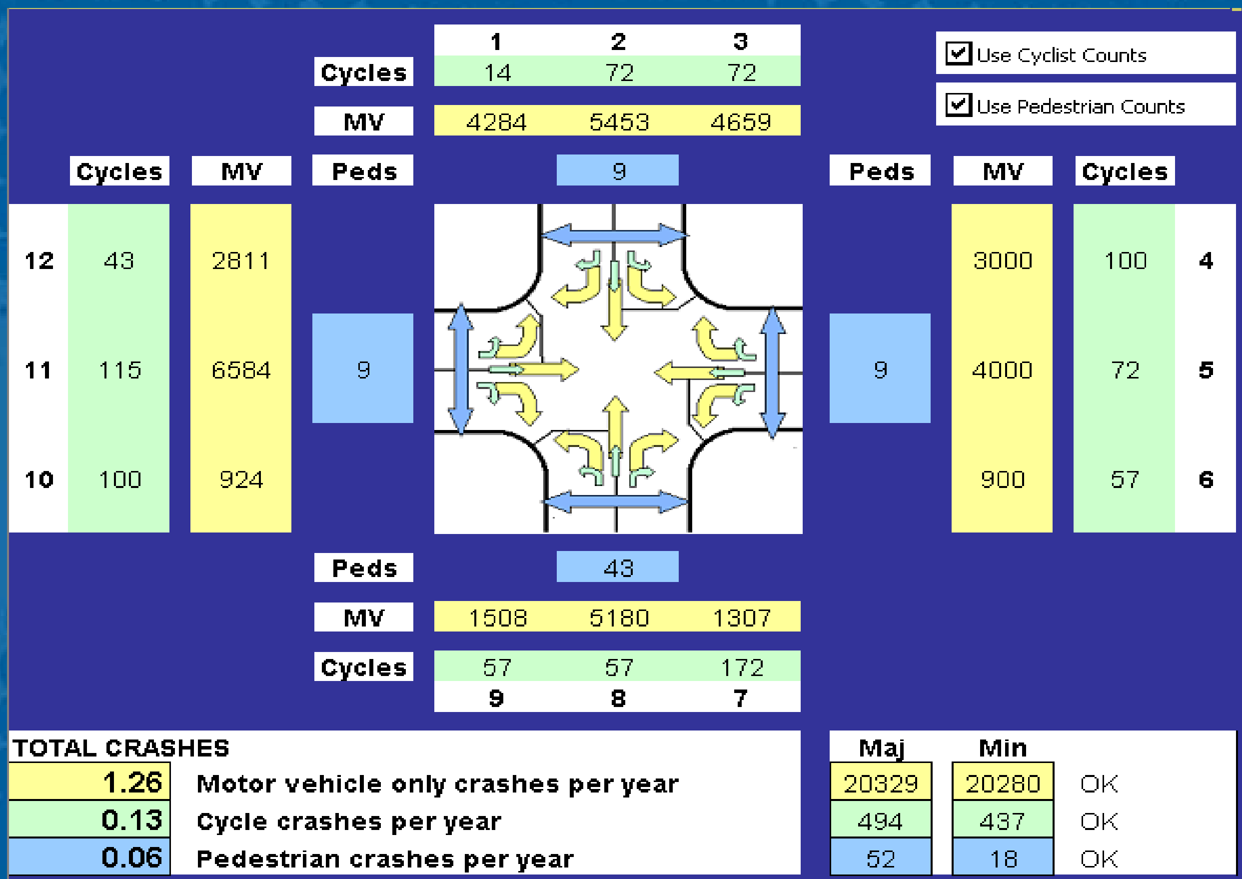
- Developed in late 1980's
- Local councils and their consultants submit data forms on low cost safety projects
- Most projects developed in crash reduction studies and safety audits
- Analysis of sites by LTNZ/LTSA after 5 years of after data
- Well over 1000 sites in database

Change in Accidents

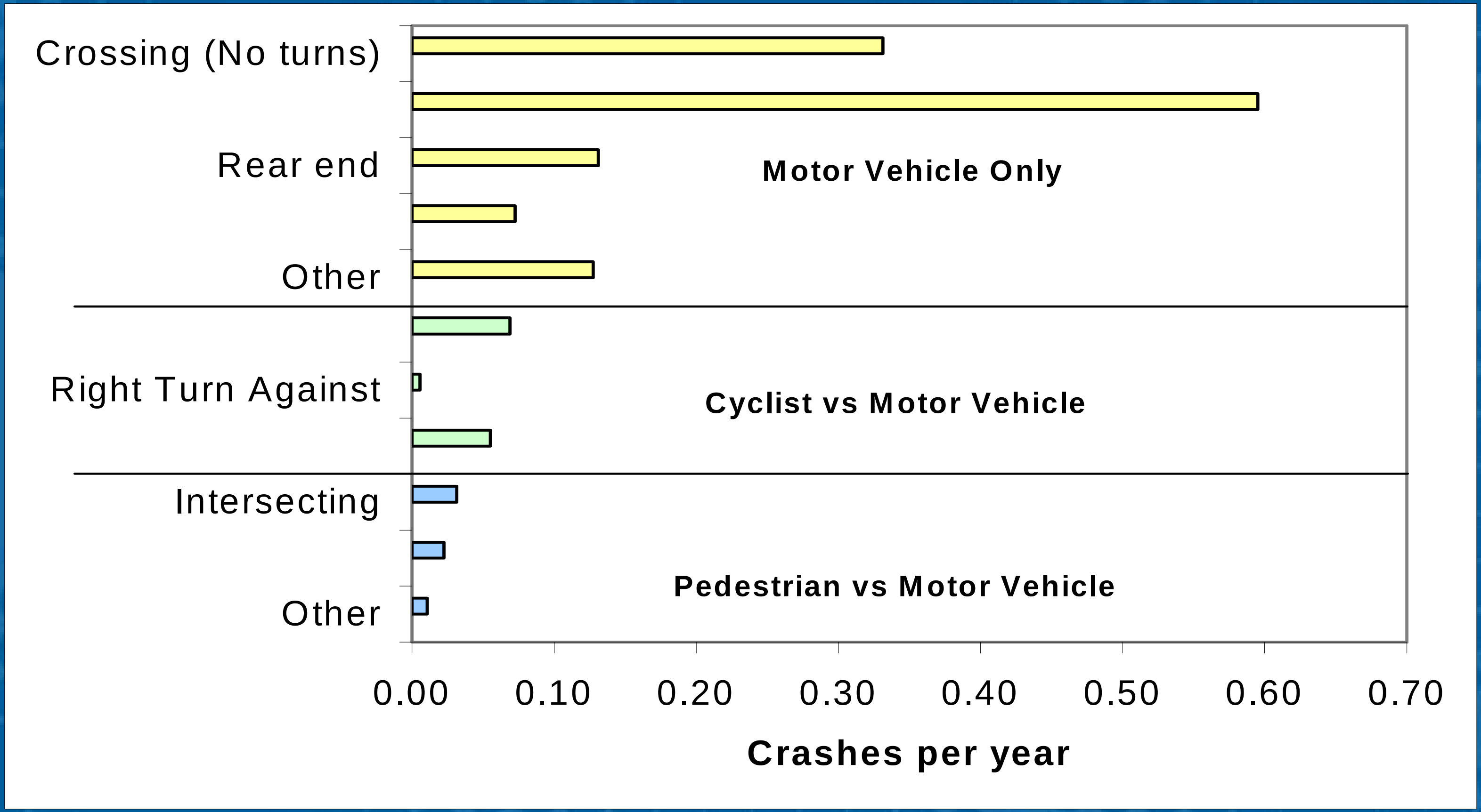
by Accident Type



Beca Road Safety Toolkit



Beca Road Safety Toolkit



ARRB's Safety Analysis Tools

- Road Safety Risk Manager
  - Windows based tool for selecting and ranking road safety improvements at a site
  - Uses relative risk before and after improvement compare with base-line road segment
  - Based on before and after studies including NZ data – accident monitoring database
- NetRisk
  - Network Screening Tool
  - Ranking of sites for treatment

Crash Prediction Models - Model Form

- Typical Multiplicative Form

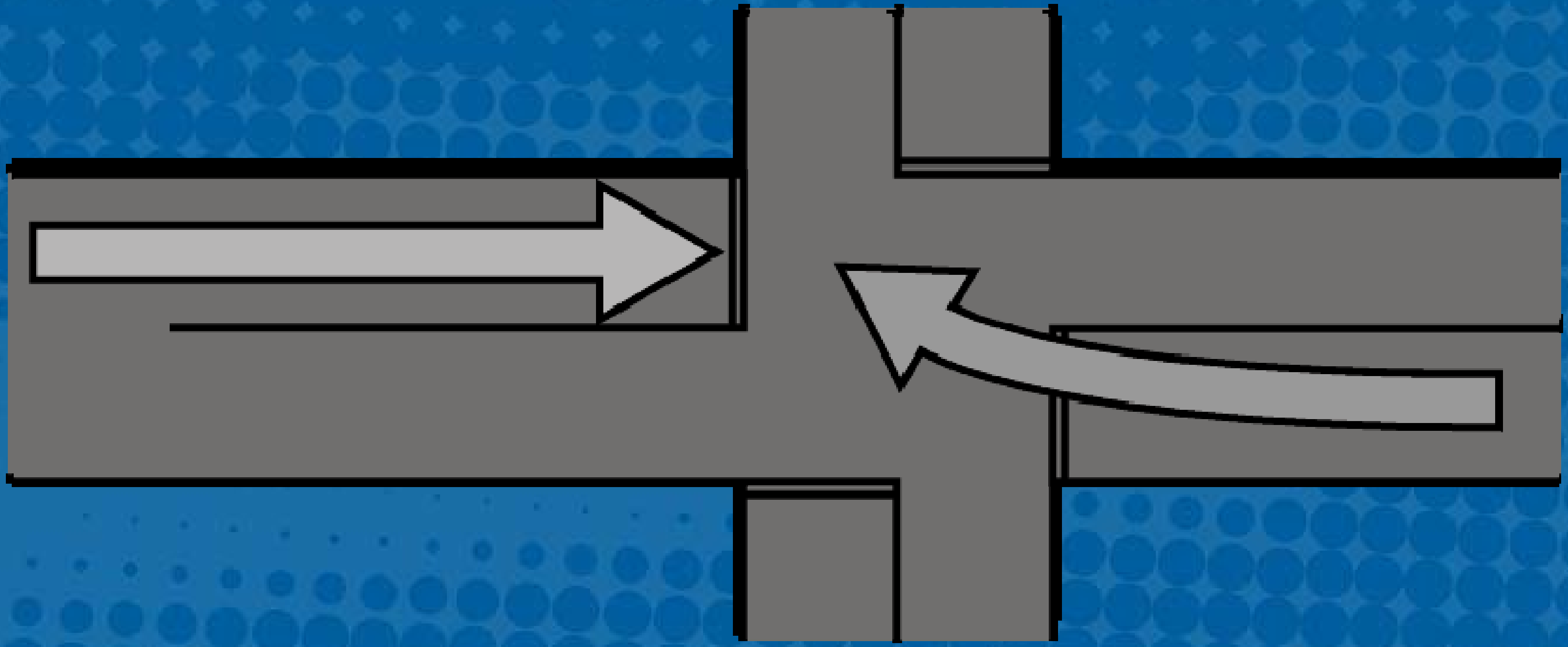
$$A_T = b_0\, Q_1^{\,b1}\, Q_2^{\,b2}$$

- Assume Crashes have a Poisson or Negative Binomial Distribution

Model Types - Disaggregation

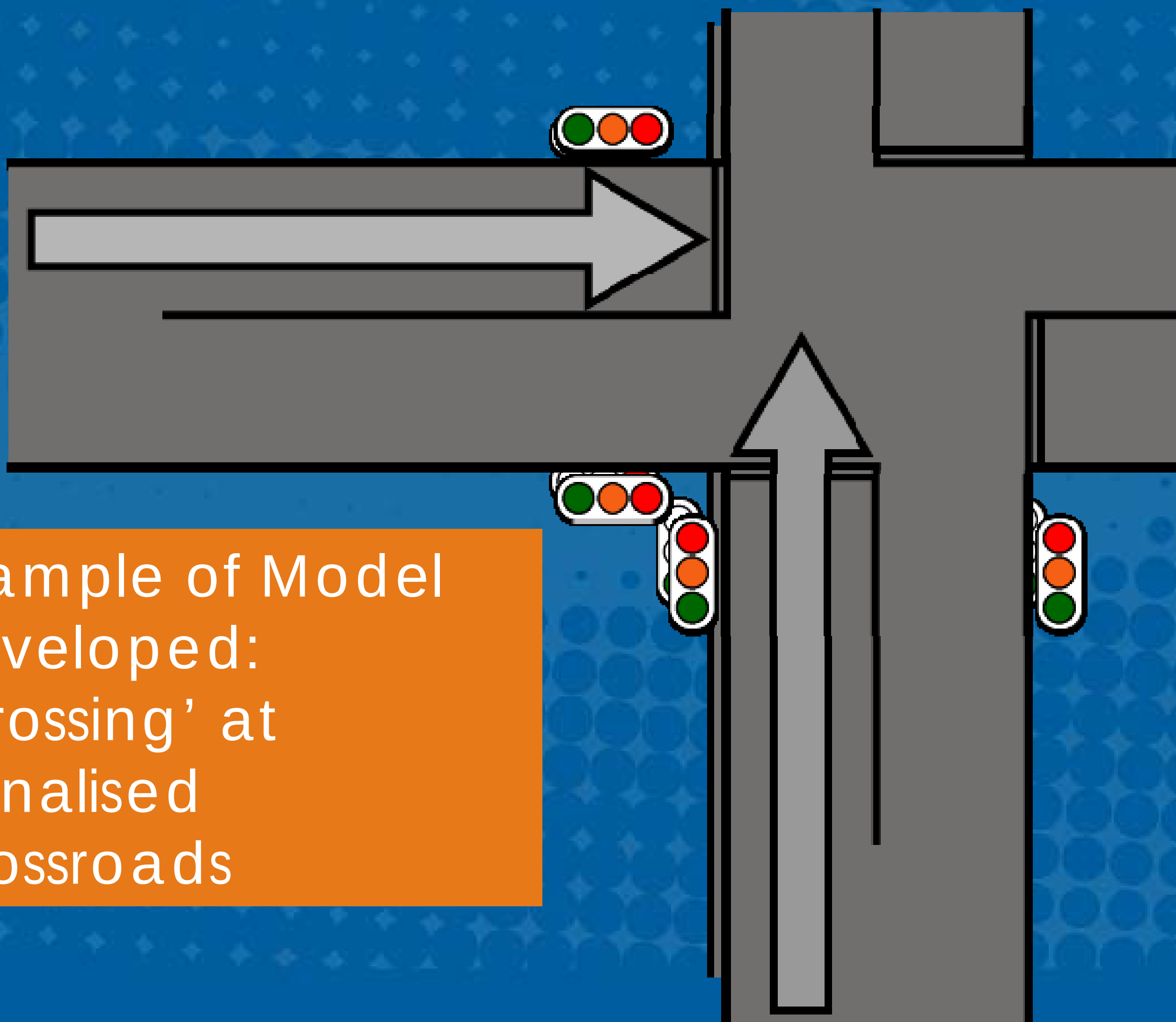
- Disaggregate Crash Data
  - Intersection/link type
  - Crash type (eg. LB – right-turn-against)
  - By time of day (eg. AM Peak)
  - By city (eg. Christchurch)
- Covariates
  - Location and features e.g.
    - $A_{chch} = b_{01}\, Q_1^{\,b1}\, Q_2^{\,b2}$
    - $A_{wgtn} = b_{02}\, Q_1^{\,b1}\, Q_2^{\,b2}$
- Issues with Scarcity of Data

Accident Prediction Models (2000)



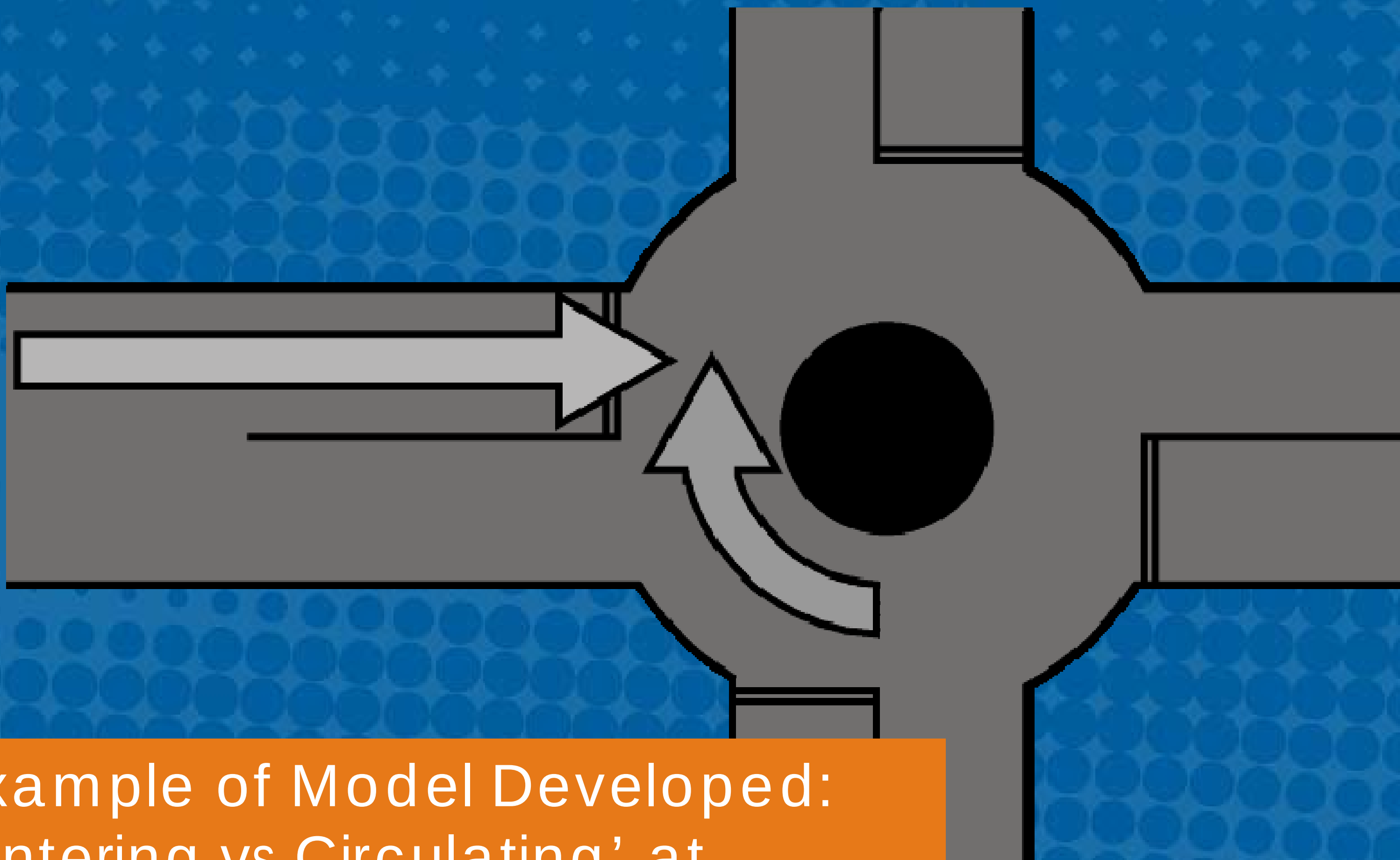
Example of Model Developed: Right-turn-against at Signalised Crossroads

Accident Prediction Models (2000)



Example of Model Developed: ‘Crossing’ at Signalised Crossroads

Accident Prediction Models (2000)



Example of Model Developed:
'Entering vs Circulating' at
Roundabout Crossroads

Two Current Studies

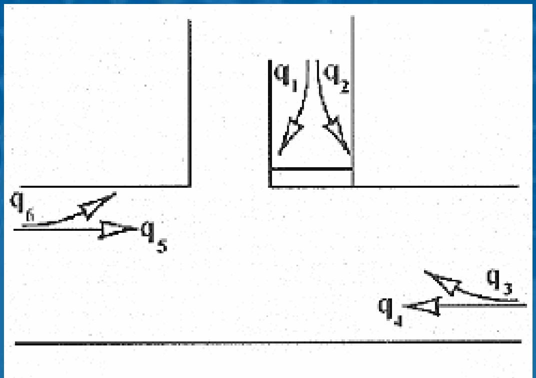
- Rural & High Speed Intersections (Stop, Yield, Signals and Roundabouts)
- Urban Roundabouts
- Some results…..

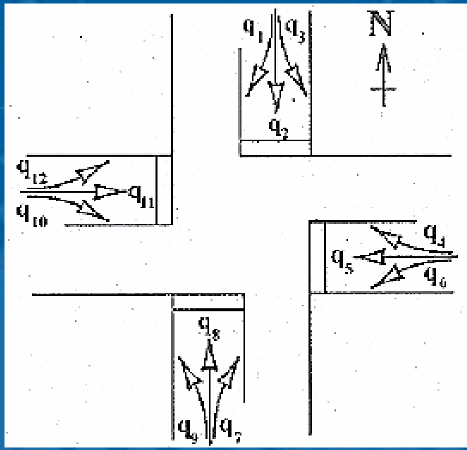
Rural Intersections - Sample Size

Region	Number of Sites	
	Crossroads	**T-junctions**
Auckland	16	15
Waikato	20	10
Bay of Plenty	-	20
Taranaki	23	9
Manawatu-Wanaganui	2	10
Wellington	7	2
Canterbury	33	34
Total	**101**	**100**

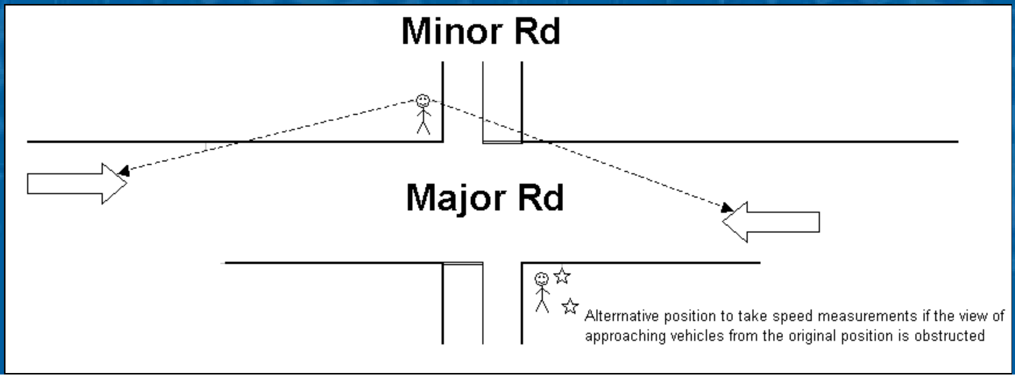
Variables

- Traffic Volume (movement & approach)



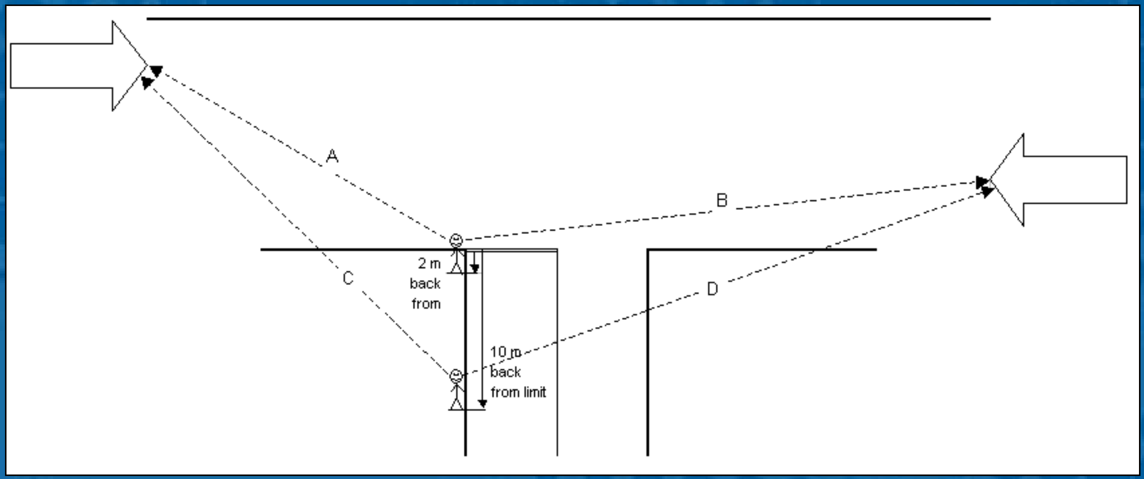


- Speed (mean and standard deviation)



Variables

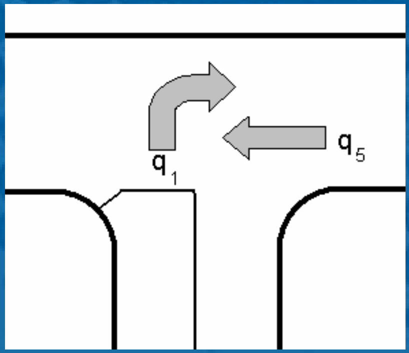
- Visibility (to left and right & combined)



- Comparison with Austroad SD standard
- Right Turn Bay (discrete –large benefit)
- Others (lighting & control type)

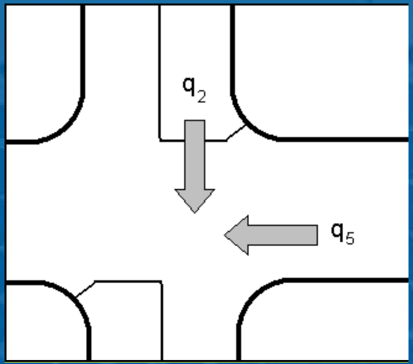
Accident Prediction Models

- Rural Priority T-junctions



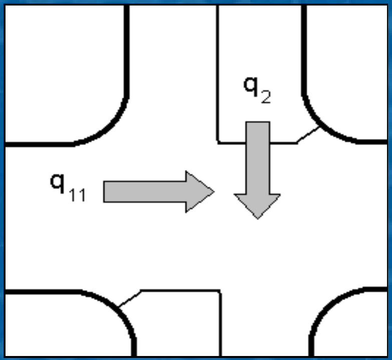
$$A = 5.29 \times 10^{-6} \times q_1^{1.33} \times q_5^{0.15} \times (V_{RD} + V_{LD})^{0.33}$$

- Rural Priority X-Roads



$$A = 1.20 \times 10^{-4} \times q_2^{0.60} \times q_5^{0.40}$$

$$A = 2.05 \times 10^{-4} \times q_2^{0.40} \times q_{11}^{0.44}$$

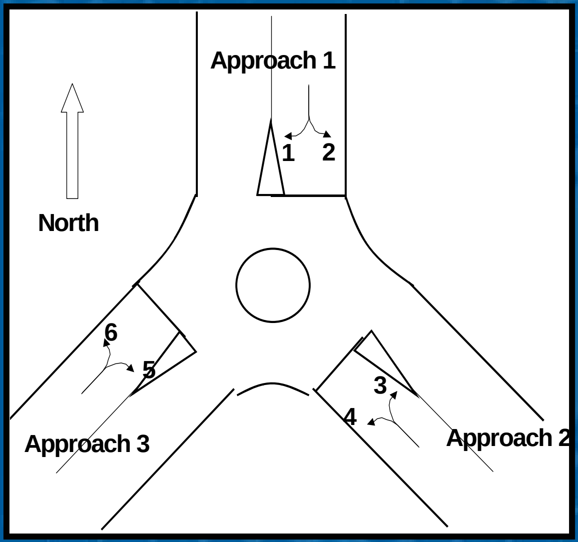


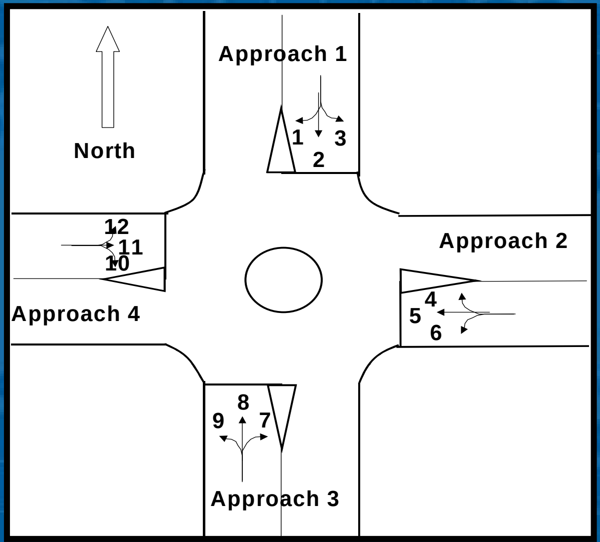
Roundabouts - Data and Sample Size

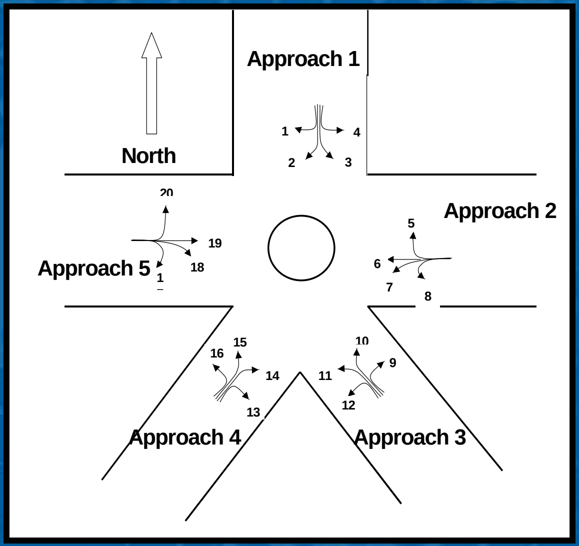
Type	Location			
	Christchurch	Auckland	Palmerston North	Total
Single Lane Circulating				
3-arm	0	2	2	**4**
4-arm	35	22	8	**65**
Two Lane Circulating				
3-arm	0	4	0	**4**
4-arm	4	21	3	**28**
5-arm	0	3	0	**3**
TOTAL	**39**	**52**	**13**	**104**

Variables

- Daily Traffic Volumes

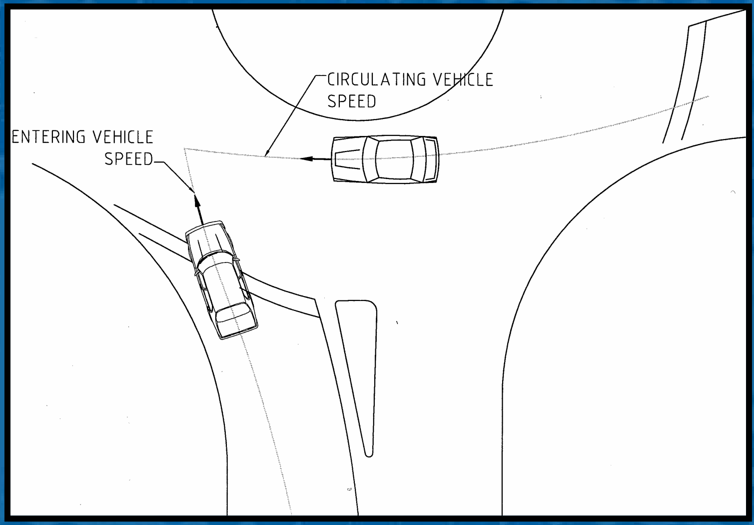


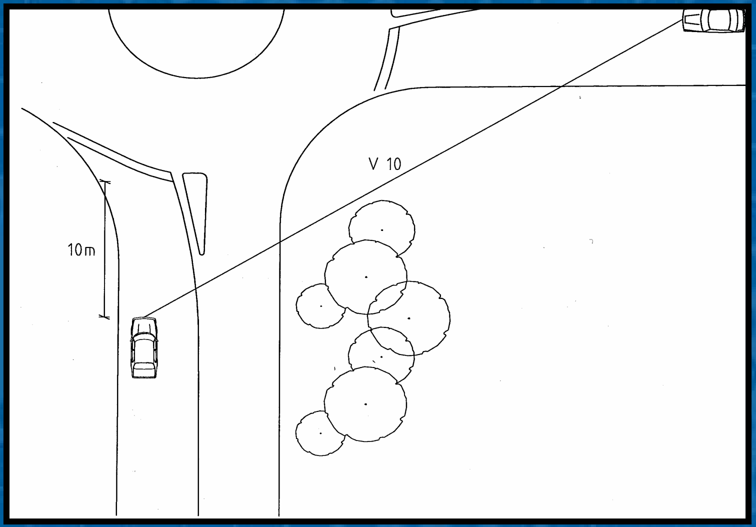




Variables

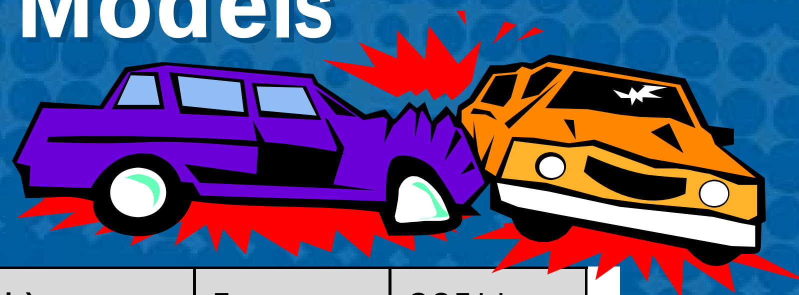
- Speed and Visibility





- Multiple enter lanes (f_{MEL}) & circulating

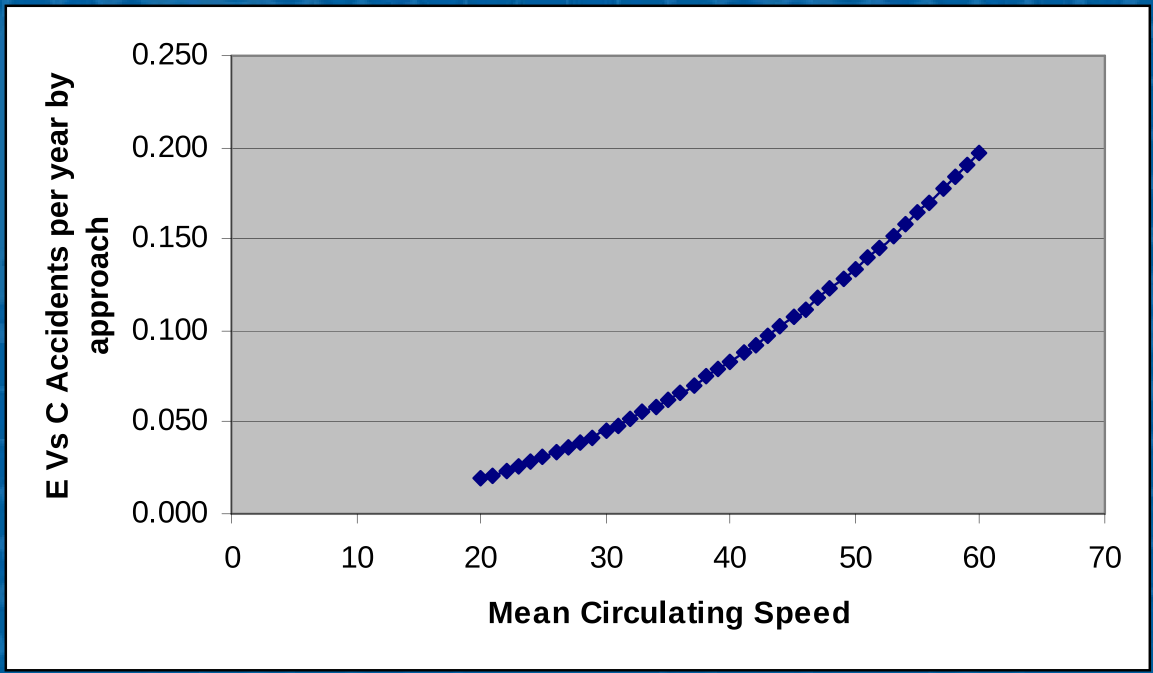
Accident Prediction Models



Crash Type	Equation (crashes per approach)	Error Structure	GOF**
Entering-vs-Circulating (Motor-vehicle only)	$A_{UMAR\ 1} = 6.12 \times 10^{-8} \times Q_e^{0.47} \times Q_c^{0.26} \times S_C^{2.13}$	NB (k=1.3)*	0.26
Rear-end (Motor-vehicle only)	$A_{UMAR\ 2} = 9.63 \times 10^{-2} \times Q_e^{-0.38} \times e^{0.00024\ Q}$	NB (k=0.7)*	0.25
Loss-of-control (Motor-vehicle only)	$A_{UMAR\ 3} = 6.36 \times 10^{-6} \times Q_a^{0.59} \times V_{10}^{0.68}$	NB (k=3.9)*	0.25
Other (Motor-vehicle only)	$A_{UMAR\ 4} = 1.34 \times 10^{-5} \times Q_a^{0.71} \times \phi_{MEL}$ $\phi_{MEL} = 2.66$	Poisson	0.17
Pedestrian	$A_{UPAR\ 1} = 3.45 \times 10^{-4} \times P^{0.60} \times e^{0.000067\ Q_a}$	NB (k=1.0)*	0.17
Entering-vs-Circulating (Cyclist circulating)	$A_{UCAR\ 1} = 3.88 \times 10^{-5} \times Q_e^{0.43} \times C_c^{0.38} \times S_e^{0.49}$	NB (k=1.2)*	0.61
Other (Cyclist)	$A_{UCAR\ 2} = 2.07 \times 10^{-7} \times Q_a^{1.04} \times C_a^{0.23}$	Poisson	0.50

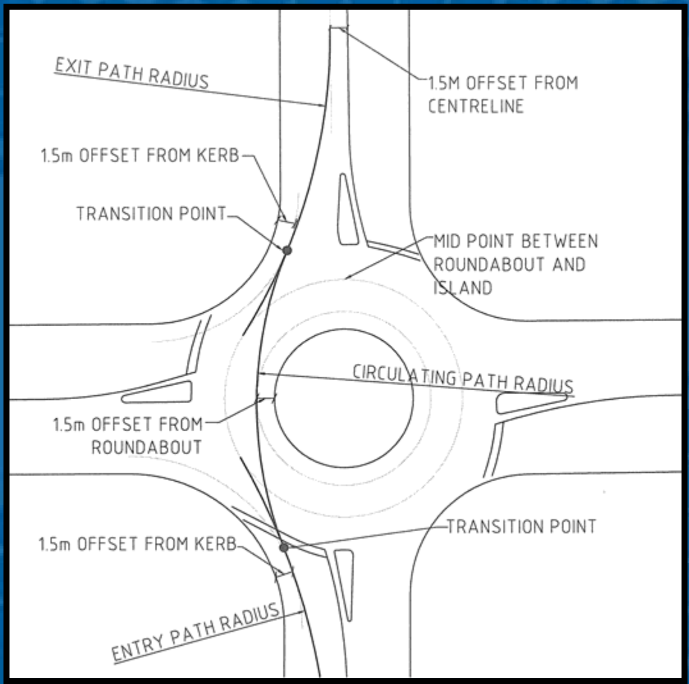
Speed Relationship

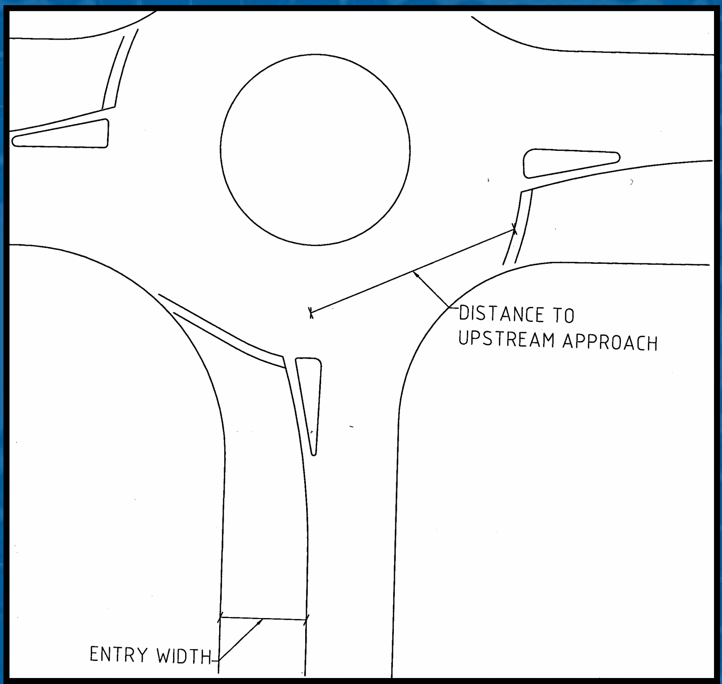
- Impact of circulating speed on E vs C acidents – more benefits of reduction at higher speeds



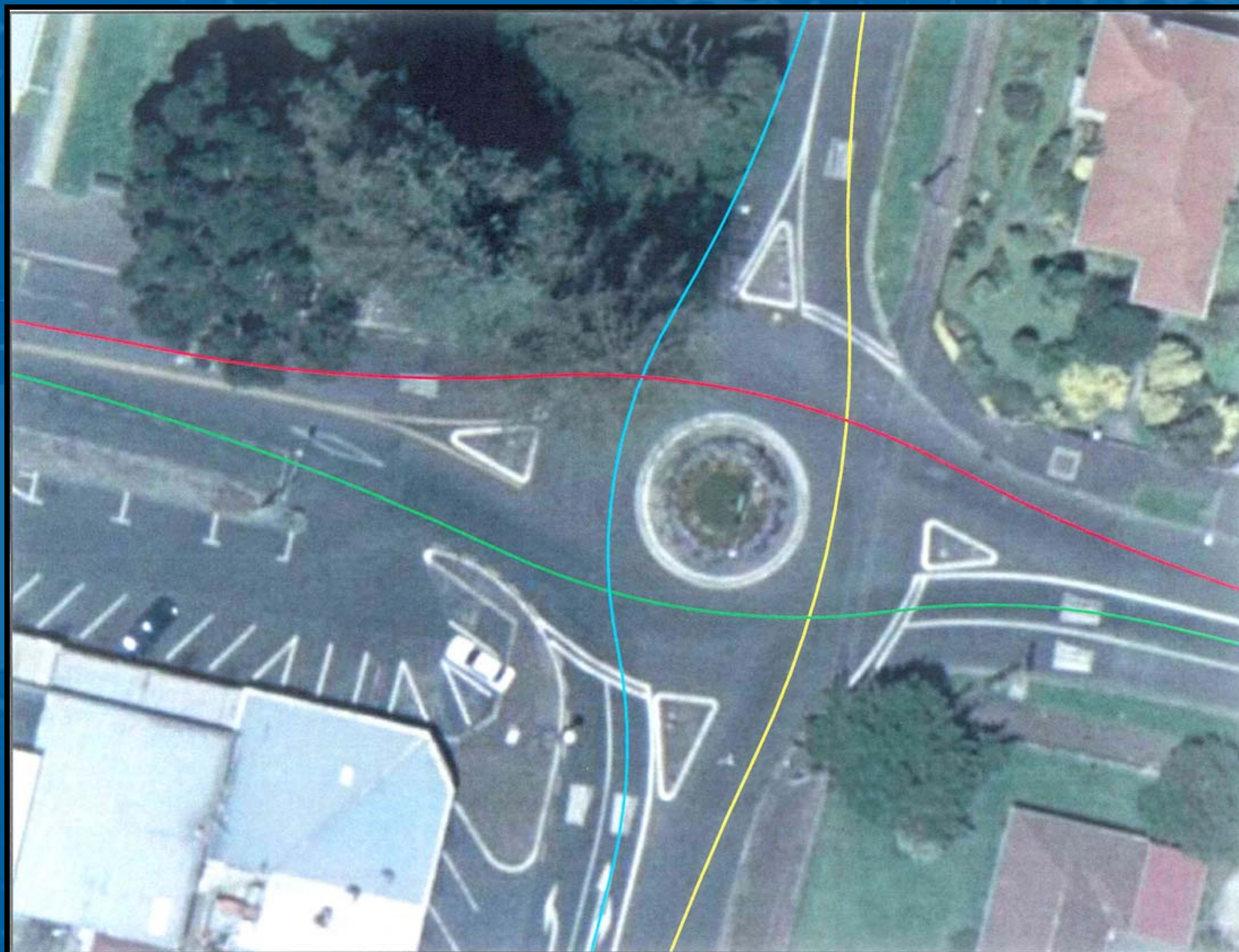
Ongoing Research – Design Factors

- Alignment and Cross-section Data





Ongoing Research



Application – Economic Evaluation

- Economic Evaluation Manual – Appendix 6

$$A_W = w \times A_T + (1 - w) \times A_S$$

- Site Specific Accident Rate

$$A_S = \frac{\text{Accident History}}{\text{Years}}$$

- Typical Accident Rate

$$A_T = b_0 \times Q_1^{b1} \times Q_2^{b2}$$

- Weighting for NB ($0 < w < 1$)

$$w = \frac{k}{(A_T + k)}$$

My Thoughts on Improving Road Safety in USA

- Place emphasis on safety auditing of new projects – learn from mistakes
- To raise profile of road safety need champions at all levels of Government.
- Road safety must be on politician's agenda – use of advocacy groups – community not accepting current loss-of life on roads
- Importance of safety management systems and development of safety culture – road safety committees at all levels
- Safety comparison of states and local councils

Questions