# Reducing Speed Limits to Support Lower Skid Resistance Investigatory Levels

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# Presentation Outline:

- Background
- Research questions
- Requirements of analysis framework
- Key steps in analysis framework
- Case study
- Concluding remarks

# Background (1):

- NZ Transport Agency instigated research project
- NZTA Project Manager, Fergus Tate
- Research Team, Peter Cenek and Robert Henderson, Opus

# Background (2)

- ~40% of open road injury crashes involve loss of control on a bend
- Strong dependency between curve context and crashes
- T10 specification assigns SCRIM skid resistance investigatory levels on rural curves on the basis of crash-risk

| Site category | Skid site description | Investigatory level (IL), units ESC | | | | | |
|---|---|---|---|---|---|---|---|
| | | 0.35 | 0.40 | 0.45 | 0.50 | 0.55 | 0.60 |
| 1 | Approaches to:<br>a) Railway level crossings<br>b) Traffic signals<br>c) Pedestrian crossings<br>d) Stop and Give Way controlled intersections (where state highway traffic is required to stop or give way)<br>e) Roundabouts.<br>One lane bridges:<br>a) Approaches and bridge deck. | | | | | | |
| 2 | a) Urban curves <250m radius | | | | | | |
| | b) Rural curves <250m radius | | | L | M | H | |
| | c) Rural curves 250-400m radius | | L | L | M | H | |
| | a) Down gradients >10%.<br>b) On ramps with ramp metering. | | | | | | |
| 3 | a) State highway approach to a local road junction.<br>b) Down gradients 5-10%<br>c) Motorway junction area including on/off Ramps<br>d) Roundabouts, circular section only. | | | | | | |
| 4 | Undivided carriageways (event-free). | | | | | | |
| 5 | Divided carriageways (event-free). | | | | | | |

# Background (3):

- Financial and resource constraints
  - not always possible to provide high quality aggregates
- There are strong relationships between crashes on curves and
  a. Wet surface friction (SCRIM)
  b. Vehicle speed
- In response, could look to lower speeds at specific curves or potentially along a route to allow use of local aggregate sources.

# Research questions:

1. *If lower SCRIM skid resistance investigatory values are to be adopted what reduction in speed would be needed to achieve the same curve crash risk ?*

2. *What would be the impact of these lower speeds on road users?*

# Requirements of analysis framework (1):

- All required inputs must be available from existing SH data sources e.g. RAMM.

- Utilise relationships derived from NZ research for:
  - skid resistance of the road surface and curve crash risk
  - horizontal radius of curvature and expected service life of the road surface
  - posted speed limits and mean and 85$^{th}$ %ile speeds

# Requirements of analysis framework (2):

- Where possible, procedures provided in the Transport Agency's Economic Evaluation Manual for calculating the costs of benefits and dis-benefits must be incorporated.

- Able to be delivered in the form of a spreadsheet-based tool.

# Key steps in analysis framework (1):

1. Determine the curve crash risk associated with the current T10 skid resistance investigatory levels using 85th %ile speeds for curves/route of interest.

2. Analyse the impact of reduced 85th %ile speeds in increments of 5 km/h on curve crash risk assuming an investigatory skid resistance value of 0.4 ESC, this being the average skid resistance level achieved on SH's when local aggregates are used.

# Key steps in analysis framework (2):

3. Determine reduced route mean speed/speed limit that achieves T10 levels of curve crash risk but with a reduced skid resistance of 0.4 ESC.

4. Determine associated impacts of the reduced traffic speed on:
   - Travel time
   - Vehicle operating costs
   - Crash cost savings
   - Life of surfacing
   - $CO_2$ emissions

# Case study (1):

- Open speed limit (100km/h) section of SH58.
- 10 km length containing 28 high risk curves (horizontal radius of curvature ≤ 400m)
- 19 of these high risk curves managed to IL ≥0.5 ESC
- AADT = 13766
- Existing average annual crash density is
  - 0.72 all injury crashes per km
  - 0.34 wet road injury crashes per km

# Case study (2):

Example of a SH58 curve that is being managed to a skid resistance investigatory level of 0.55 ESC

(RS 3.69 km to 3.76 km)

# Case Study (3):

***Identifying new speed limit on basis of predicted collective curve crash risk***

| Statistic | Predicted Collective Curve Crash Risk (annual all injury crashes per curve) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Target (IL met)** | Maximum 85 percentile speed (skid resistance = 0.4 ESC) | | | | | | | | | | |
| | | 100 km/h | 95 km/h | **90 km/h** | 85 km/h | 80 km/h | 75 km/h | 70 km/h | 65 km/h | 60 km/h | 55 km/h | 50 km/h |
| Max | **0.46** | 0.50 | 0.47 | **0.45** | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 |
| Mean | **0.24** | 0.28 | 0.25 | **0.23** | 0.22 | 0.21 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 |
| Median | **0.22** | 0.26 | 0.22 | **0.20** | 0.20 | 0.20 | 0.20 | 0.19 | 0.19 | 0.19 | 0.19 | 0.19 |
| Total No. | **6.79** | 7.91 | 6.98 | **6.40** | 6.03 | 5.79 | 5.68 | 5.59 | 5.53 | 5.48 | 5.45 | 5.43 |

Actual annual all injury crash number over period 2011-2016 = 7.2

# Case Study (4):

*Increase in Travel Time:*

- Reducing the open road speed limit from 100 km/h to 90 km/h over the 9.946 km route was shown to increase the travel time by 0.66 minutes in the increasing direction and 0.67 minutes in the decreasing direction.
- The cost associated with these increases in travel time was calculated to be $1,930,569.60 assuming an AADT of 14,254 vehicles per day and a composite value of travel time (all occupants and vehicle types combined) of $33.48c/hr (July 2015).

# Case Study (5):

*Comparison of Benefits/Disbenefits*

| Component | Calculated Annual Cost ($) |
|---|---|
| **Disbenefit:** | |
| **Travel Time** | $1,930,569.60 |
| **Benefit** | |
| **Curve Crashes** | $228,150.00 |
| **Severity of Crashes** | $118,609.00 |
| **Base VOC** | $198,856.35 |
| **Speed Change Cycle** | $3,264,682.09 |
| **$CO_2$ Emissions** | $7,954.25 |
| **Extended Seal Life** | $506.12 |
| **Subtotal:** | $3,818,757.81 |
| **Benefit-Disbenefit:** | $1,888,188.21 |

# Concluding Remarks

- Reducing the open road speed limit has been shown to be a very effective safety measure if the skid resistance of high risk curves cannot be maintained at or above their recommended investigatory level.

- However, there is a valid concern when lowering speed limits that, while the mean and 85th percentile speeds appropriately lower, the variability in speeds increase and the upper 15th percentile speeds remain high.