Collision data: How to analyse data at a national level

Desmond O'Connor: Data Analyst at TII

- My alternative title for the topic ….

  Working with large volumes of data, covering a large area over a long time; which you're sure is not 100% complete or 100% accurate but there is an expectation that robust results will be delivered because there is a substantial programme dependent on the outcome of the analysis.

- *"It is impossible to make perfect representations of the world, so uncertainty about it is inevitable"*

Longley et al. (2001)
Geographic Information Systems and Science

Collision data: How to analyse data at a national level

- Data analysis is a type of story telling
- Picking out the numbers to tell the story we want told
- A detailed picture of the current safety situation with numbers and statistics is a nontrivial task

Mark Twain popularized the saying

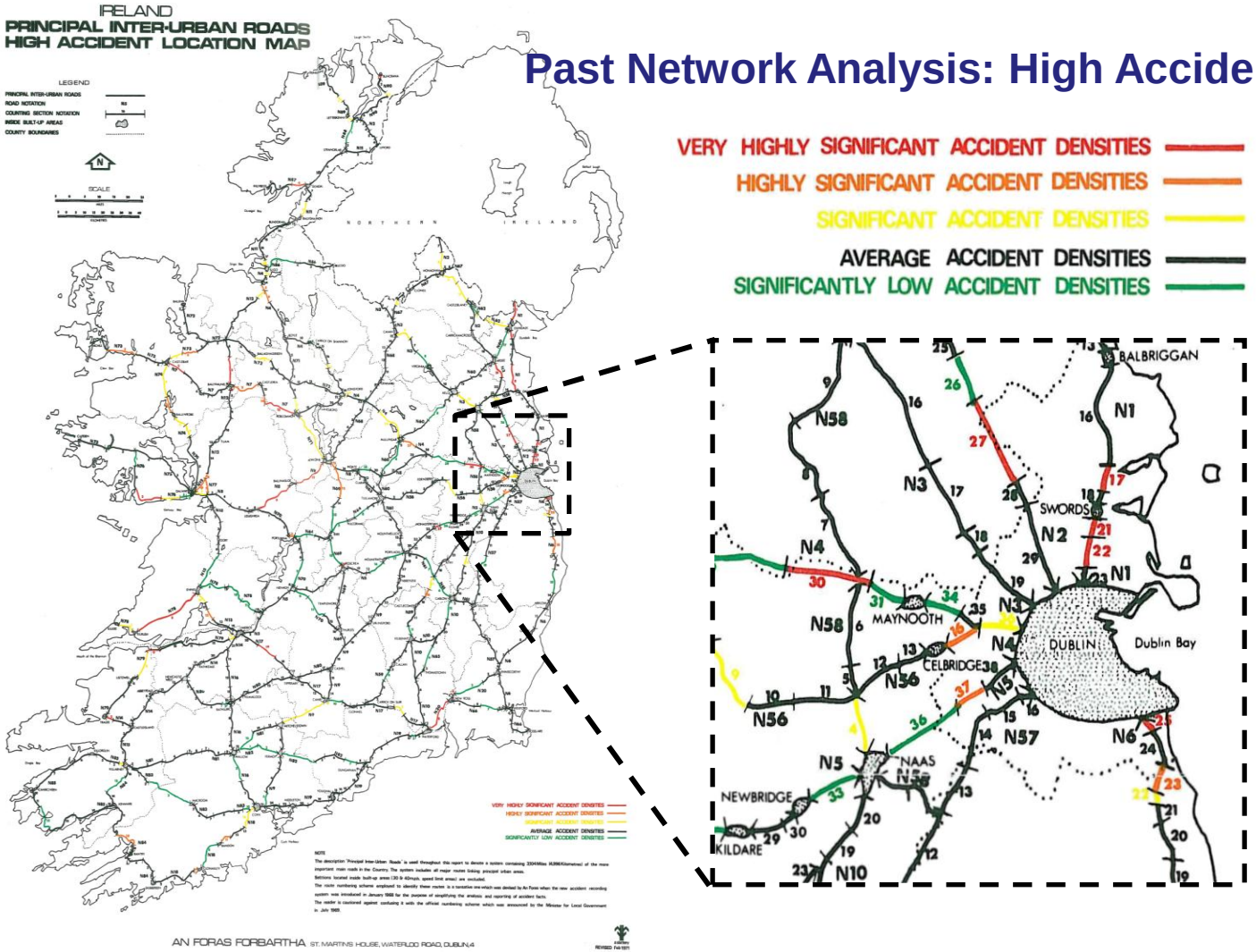
> *"Figures often beguile me,"* he wrote, *"particularly when I have the arranging of them myself; in which case the remark attributed to Disraeli would often apply with justice and force: '**There are three kinds of lies: lies, damned lies, and statistics**'"*

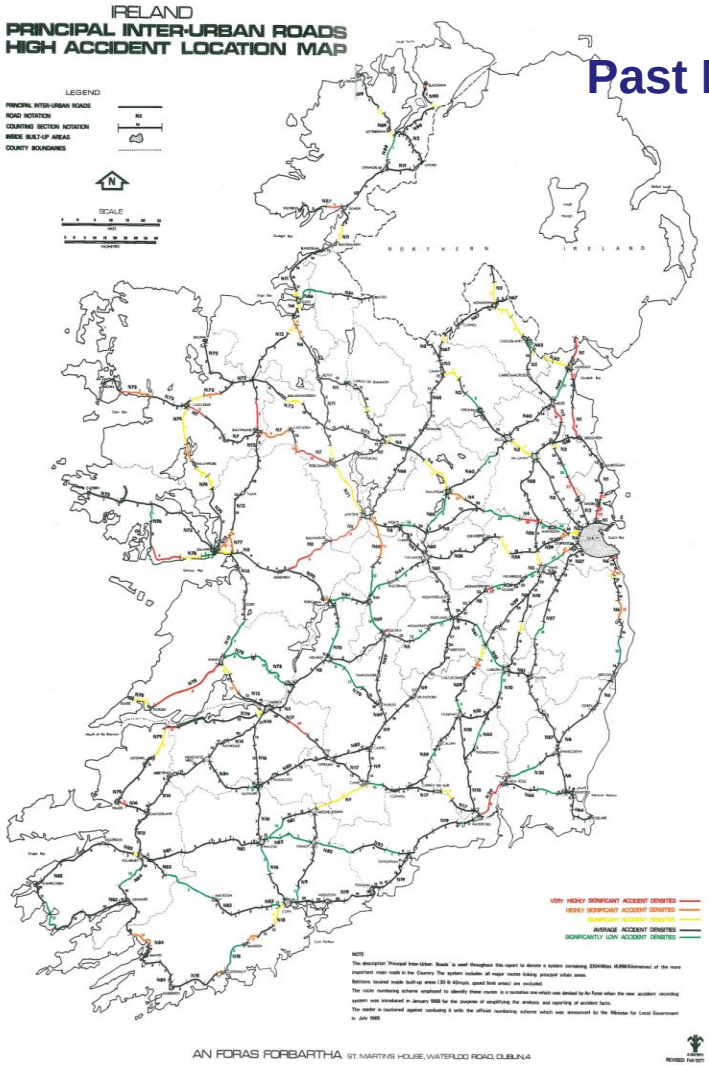
Bonneagar Iompair Éireann
Transport Infrastructure Ireland

Collision data: How to analyse data at a national level

- Topics
  - Network examples from the past
  - HD15 – Network Safety Ranking (reactive)
  - HD17 - Road Safety Inspections (proactive)
  - Future activities (change & progress)

Past Network Analysis: High Accident Location Map 1971





Past Network Analysis: High Accident Location Map 1971

"These [statistical] techniques identify high accident sections and indicate priorities for investigation and improvement. They do not explain why these sections are unsafe, nor do they suggest remedies"

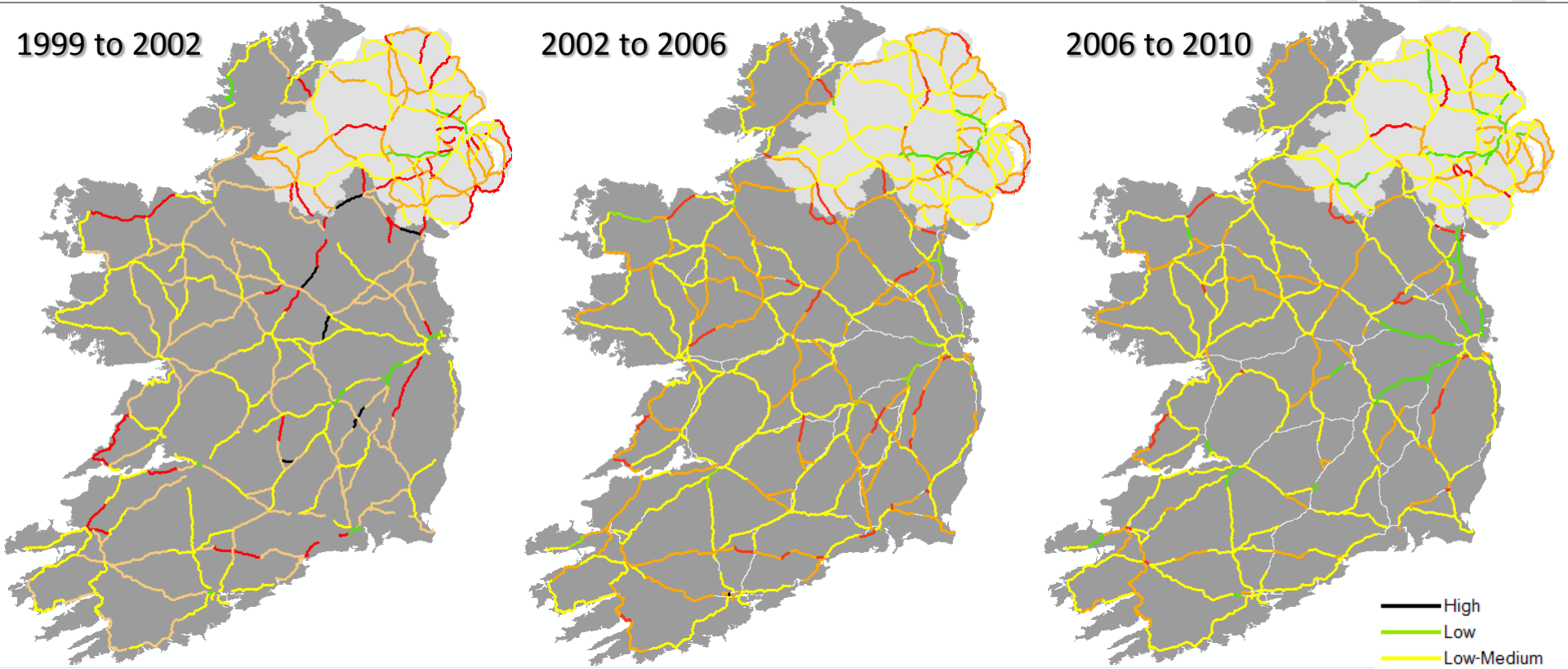
Crowley F, et al. (1980).

Road Safety in Ireland: Characteristics of the problem and the development of research.

"Traffic accidents are complicated events, each one involving a combination of human, vehicular and environmental factors, often of great complexity. On the other hand, the mathematical models used to describe and order the phenomenon are a structure of great simplicity"

An Foras Forbartha. (1984)
High Accident Locations (7): The National Routes (1977 – 1982)

EuroRAP – European **R**oad **A**ssessment **P**rogramme (collision risk maps)



Ireland Report: Proceedings from EuroRAP Seminar (2013)

RISM Directive – Network Safety Ranking & HD15

- RISM Directive (Road Infrastructure Safety Management) requires countries to carry out Ranking of high accident concentration sections:

- HD15 sets out a method to identify, analyse and rank sections of the road network which have been in operation for more than three years.

  - The first iteration of HD15 looked at the period 2003 to 2005 (analysis in 2007)
  - The latest iteration looked at the period 2012 to 2014
  - Exposure data was collected for a variety of sources including TII's own TMUs, short hour counts from the Garda Safety Camera Zones and estimated AADT data form the National Transport Model (NTpM)

HD15: Reference Populations

Population 1 = All Motorway Sites

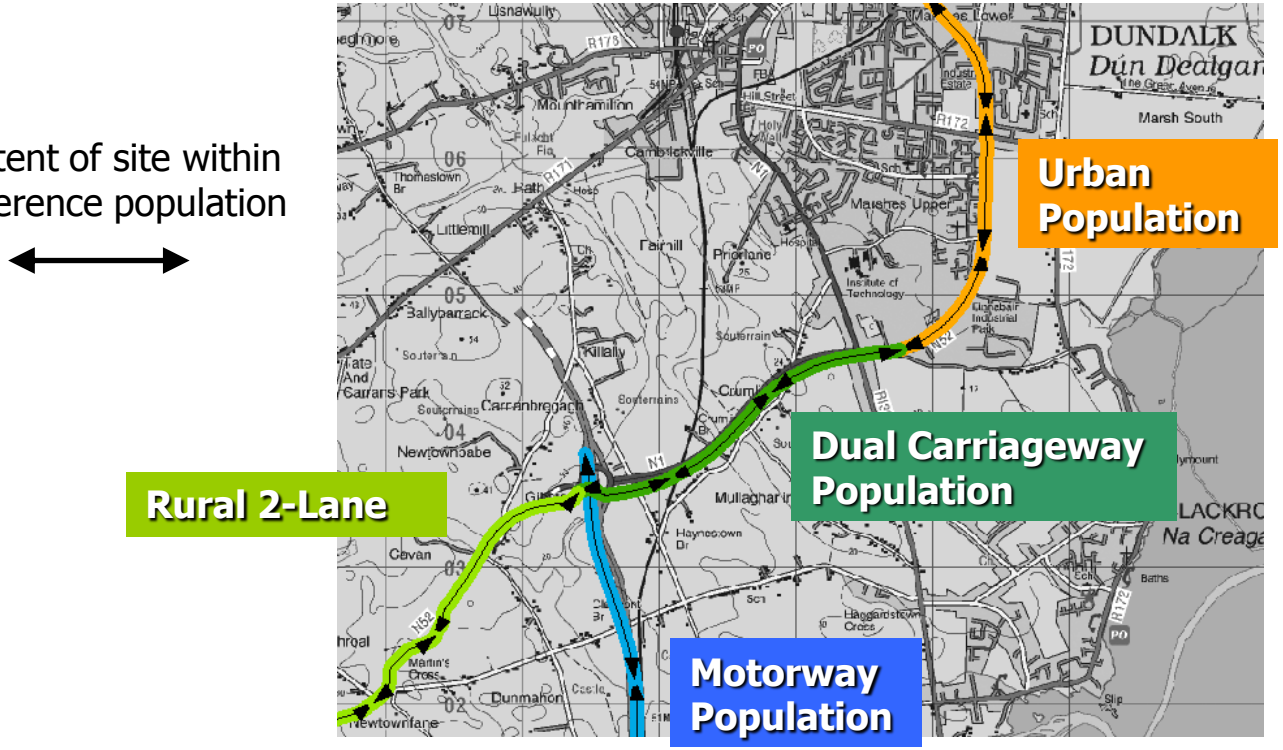
Population 2 = Dual Carriageway Sites

Population 3 = Urban Sites

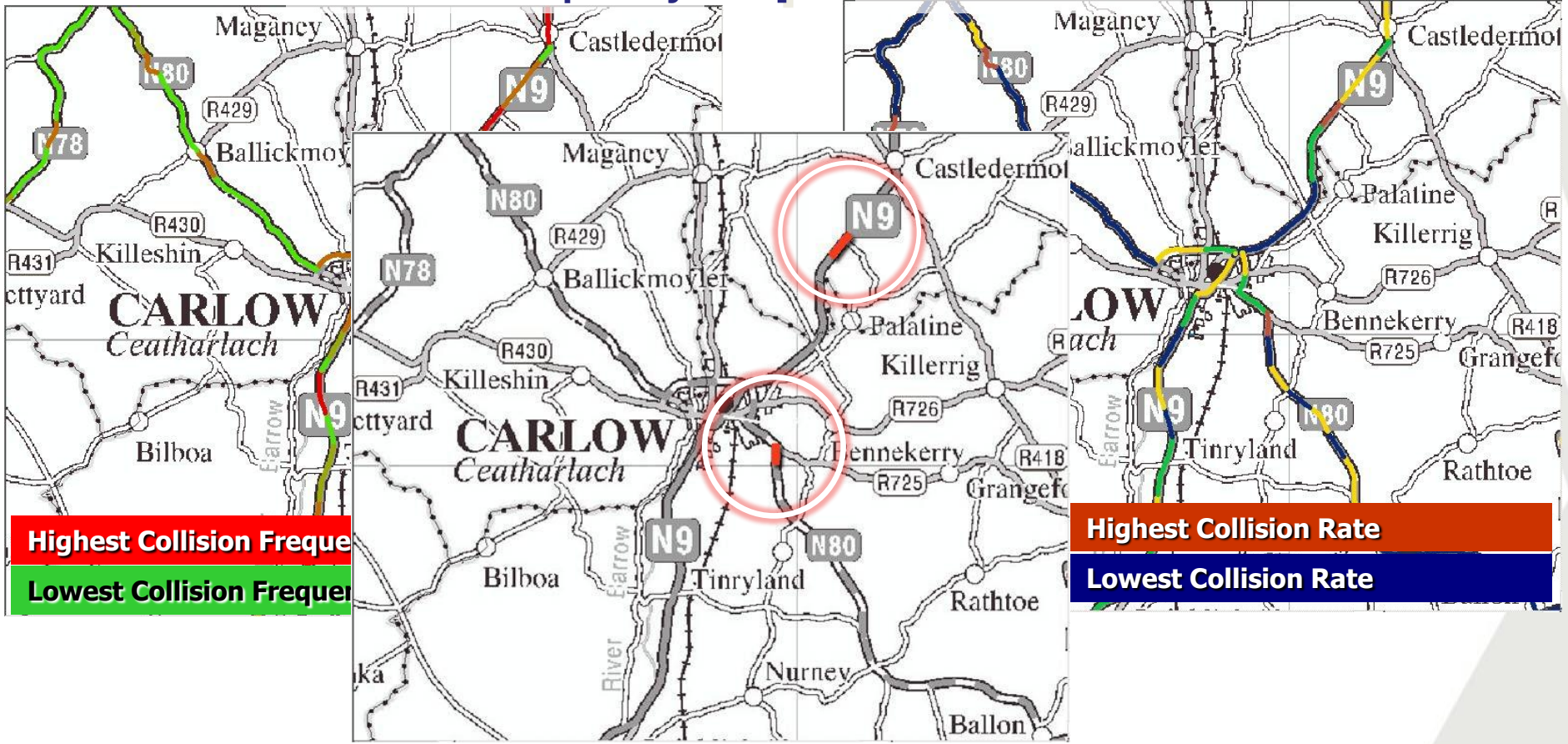
Population 4 = Rural 2-Lane Sites

HD15: Reference Populations showing sites (1km sections) within

Extent of site within reference population



Collision Frequency + Collision Rate

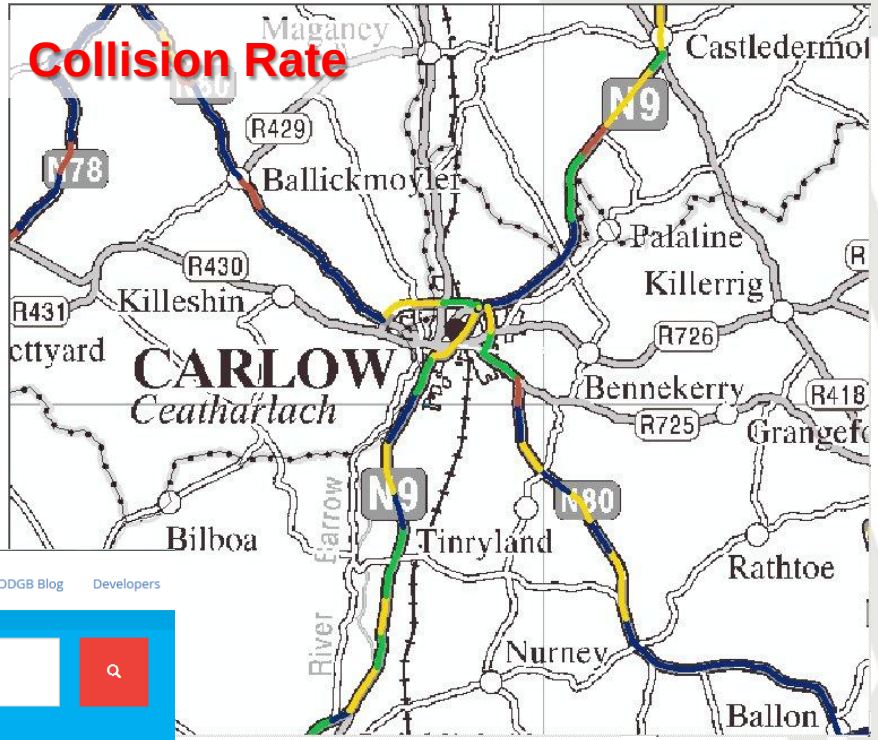


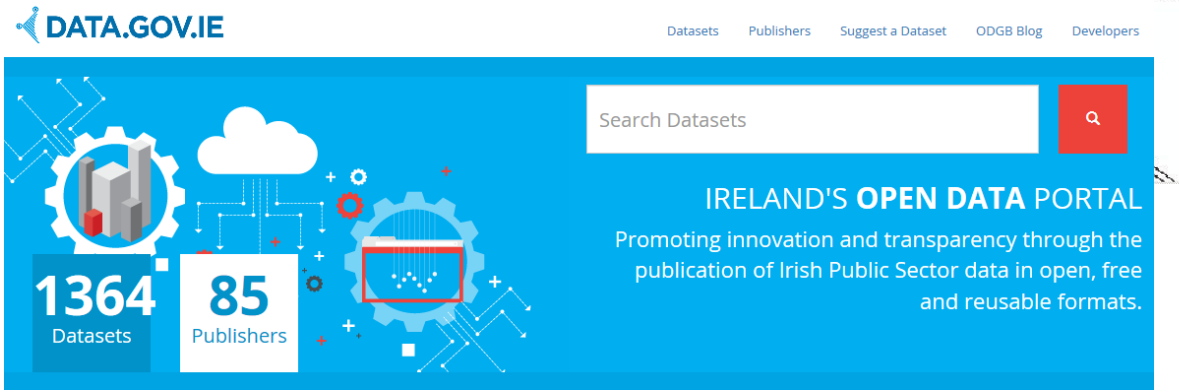
= Priority locations requiring detailed review

TII have made collision and collision rate data available via DATA.GOV.IE

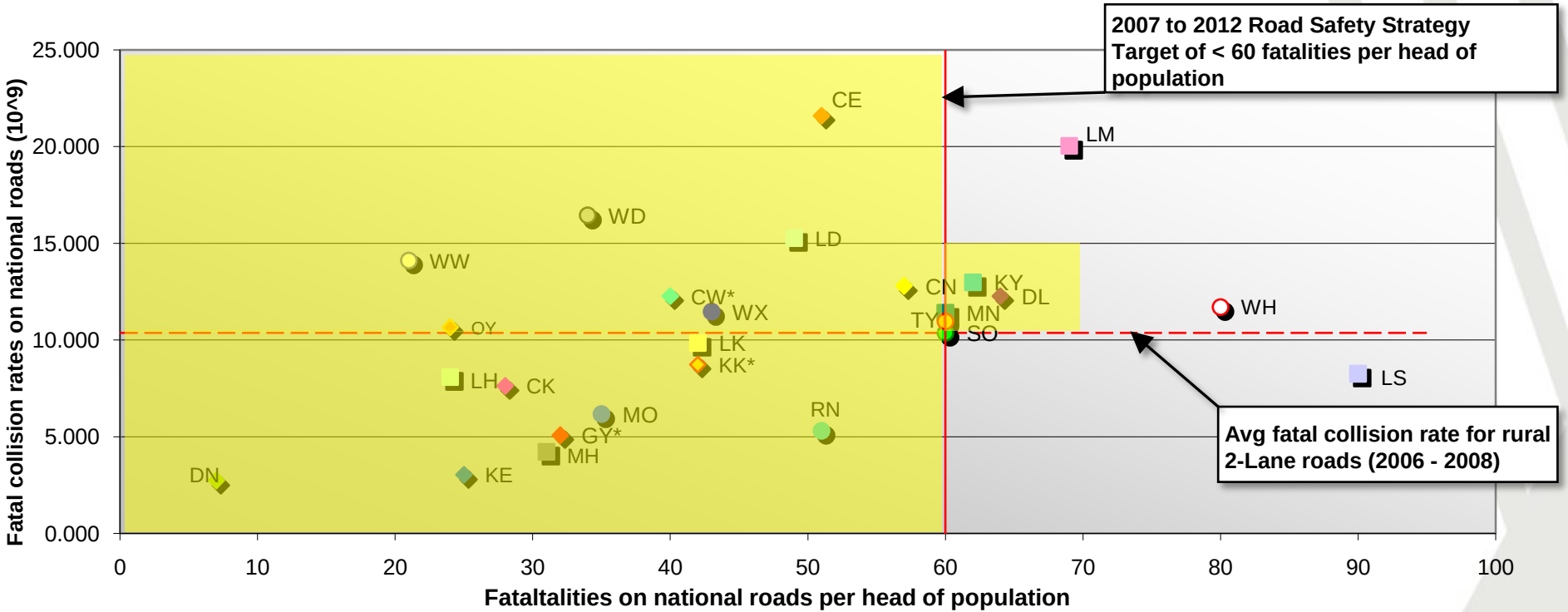
The Open Data is about making data held by public bodies available and easily accessible online for reuse and redistribution.

All data linked to the Open Data portal is published “as is”





Alternative representation of collision rate data



RISM Directive – Road Safety Inspections & HD17

- RISM Directive requires countries to carry out periodic road safety inspections (RSI) of existing roads

- HD17 establishes the frequency that these inspections must occur, the rules around the membership of the inspection team and guidance around a desktop study prior to any site visit as well as putting the final report together.


Overview map with tagged hazards
N58MO_002.0
Hazard- Ponding...
UBIPIX
2015/03/31
08:46:49
01:57 / 19:05
10:46
10:48
10:50
10:52
10:54
10:56
10:58
11:00
11:02
1X playback
POV Location: 53.906501,-9.135506
Distance from Start: 1.5558 kilometers
Loaded Tags:
Road Safety Inspections
Dashboard camera captures video, later uploaded and tagged to identify and rate hazards

HD17 preliminary risk results – a sample of routes

Risk Rating		Likelihood of Occurrence		
		Likely	Possible	Unlikely
Severity of Outcome	Severe	High	High	Medium
	Medium	High	Medium	Low
	Minor	Medium	Low	Low

N77 RSI Results – selected for further examination. An unexceptional candidate

Route	Count H hazards	Count M hazards	Count L hazards	Length KM	Hazard density H	Hazard density M	Hazard density L
N02	26	1417	783	132.86	0.20	10.67	5.89
N04	140	54	48	197.96	0.71	0.41	0.36
N10	3	13	22	17.02	0.18	0.10	0.17
N11	15	102	103	129.38	0.12	0.77	0.78
N21	14	44	38	84.34	0.17	0.33	0.29
N27	2	16	18	6.26	0.32	0.12	0.14
N29	2	31	28	3.53	0.57	0.23	0.21
N30	47	150	377	33.17	1.42	1.13	2.84
N52	60	214	1032	177.33	0.34	1.61	7.77
N58	12	89	9	11.26	1.07	0.67	0.07
N59	122	678	1462	298.83	0.41	5.10	11.00
N65	41	44	103	52.56	0.78	0.33	0.78
N67	71	208	265	129.16	0.55	1.57	1.99
N70	26	1004	77	141.64	0.18	7.56	0.58
N71	259	266	168	188.01	1.38	2.00	1.26
N73	86	33	28	34.24	2.51	0.25	0.21
N75	25	30	14	7.55	3.31	0.23	0.11
N77*	**15**	**51**	**83**	**48.66**	**0.31**	**0.38**	**0.62**
N80	8	40	274	114.47	0.07	0.30	2.06
N83	97	165	164	45.19	2.15	1.24	1.23
N84	70	125	206	74.06	0.95	0.94	1.55
N86	36	134	38	50.19	0.72	1.01	0.29

HD17 preliminary risk results – N77

Risk Rating		Likelihood of Occurrence		
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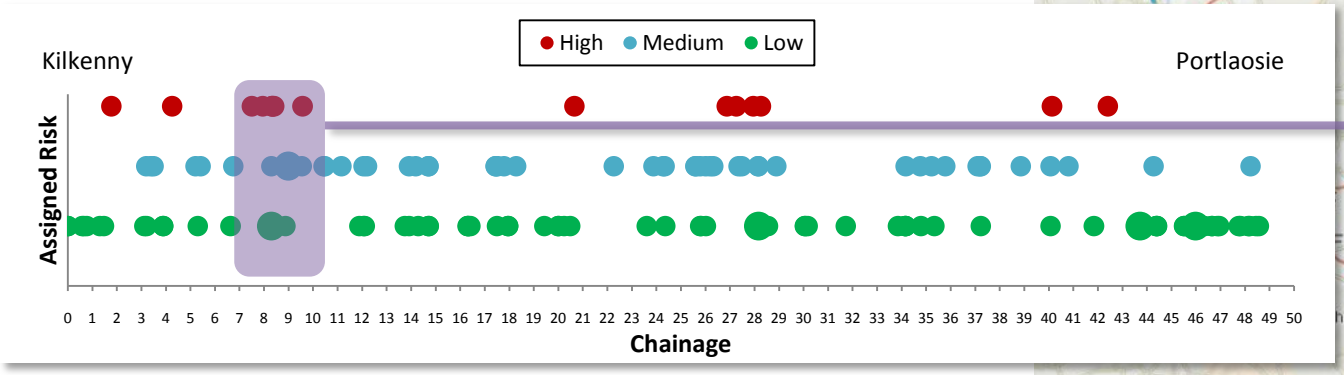

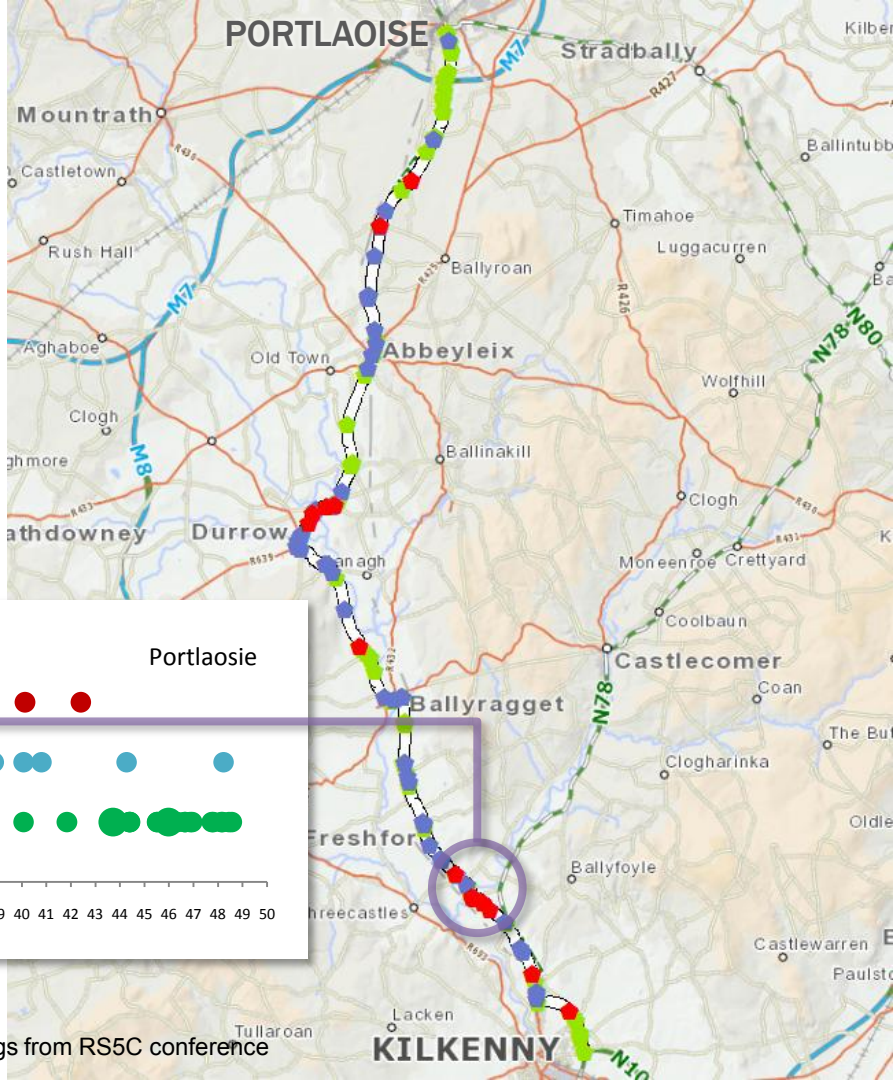

HD17 preliminary risk results – N77

Risk Rating		Likelihood of Occurrence		
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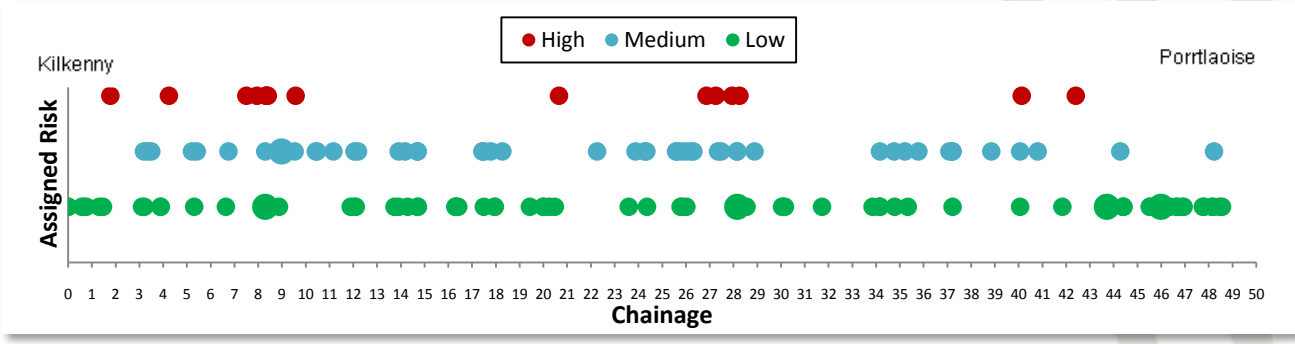

Hazard	Risk			Total
	High	Medium	Low	
Signing Lining	12	21	61	94
Surface	1	5	8	14
Roadside Hazard		4	9	13
Sight Distance		9		9
Road Layout	2	5	1	8
VRU		3	1	4
Drainage		1	2	3
Lighting		1		1
Linear		1		1
Not Selected			1	1
Safety Barrier		1		1
Total	15 (10%)	51 (34%)	83 (56%)	149 (100%)

Hazard	Nature of Hazard		Total
	Design	Maintenance	
Signing Lining	11	83	94
Surface		14	14
Roadside Hazard	10	3	13
Sight Distance	4	5	9
Road Layout	7	1	8
VRU	4		4
Drainage		3	3
Lighting		1	1
Linear	1		1
Not Selected		1	1
Safety Barrier		1	1
Total	37 (25%)	112 (75%)	149 (100%)

HAZARD	ELEMENT		Total
	Mainline	Sideroads	
Signing Lining	59	35	94
Surface	5	9	14
Roadside Hazard	12	1	13
Sight Distance	1	8	9
RoadLayout	5	3	8
VRU	4		4
Drainage	2	1	3
Lighting	1		1
Linear	1		1
Not Selected		1	1
Safety Barrier	1		1
Total	91 (61%)	58 (39%)	149 (100%)

Alternative network analysis

- Horizontal road geometry
- Contributory factors to road collisions
- Recent analysis of single vehicle collisions (2014)

Horizontal road geometry

- *“Drivers experience concentration difficulties on lower demand roads rather than high demand roads. In addition the transition from high to low demand and vice versa are areas where collisions can occur. This can be attributed to drivers failing to cope with the changing driving demands*.”

Smith et al (2006)

Fatigue crashes: the extent to which terrain change has an influence of the fatigued driver

- *“Approximately 60% of all collisions to occur in horizontal curves are single vehicle run-off-road type collisions”*

Lamm et al. (1999)

Highway design and traffic safety engineering handbook

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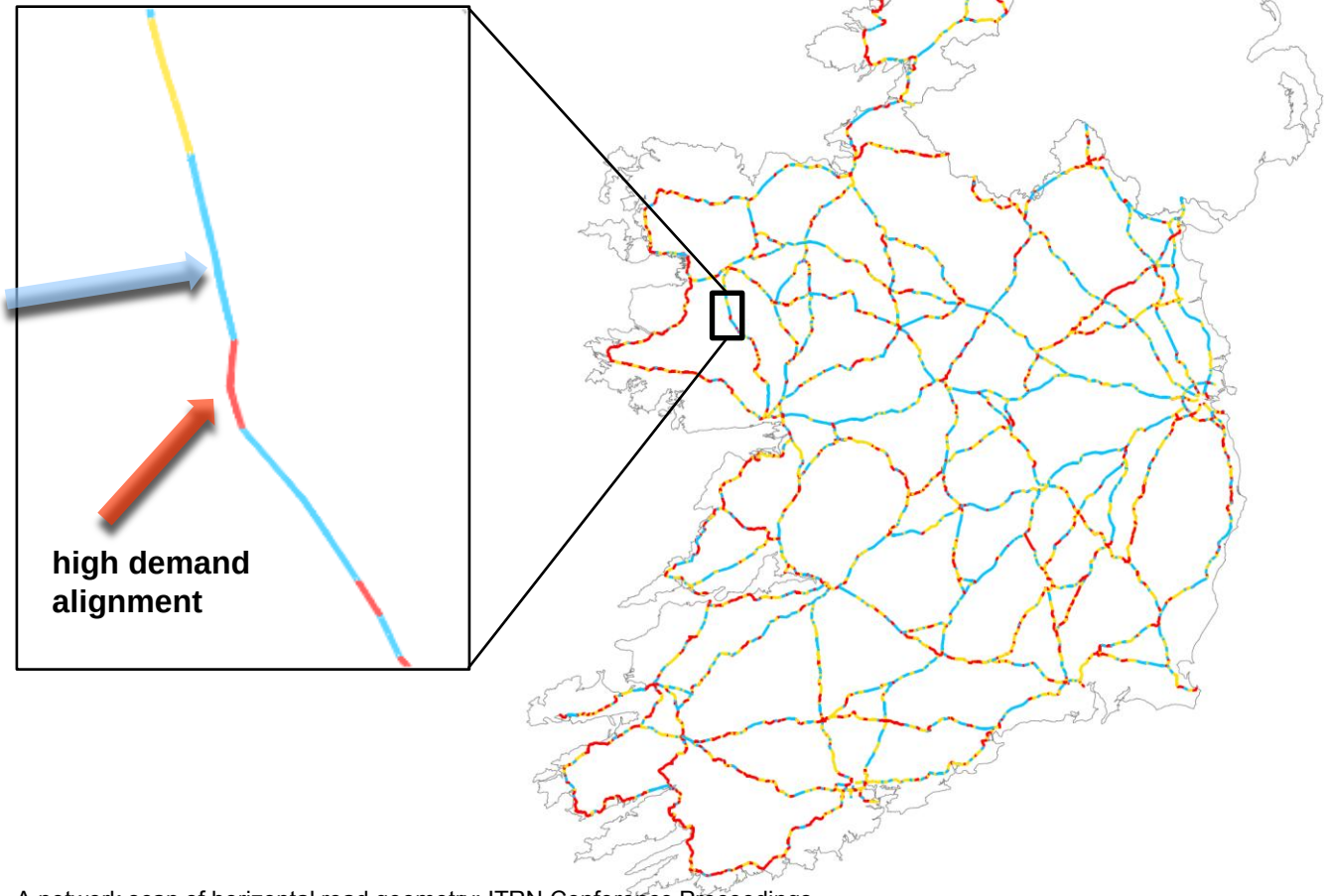
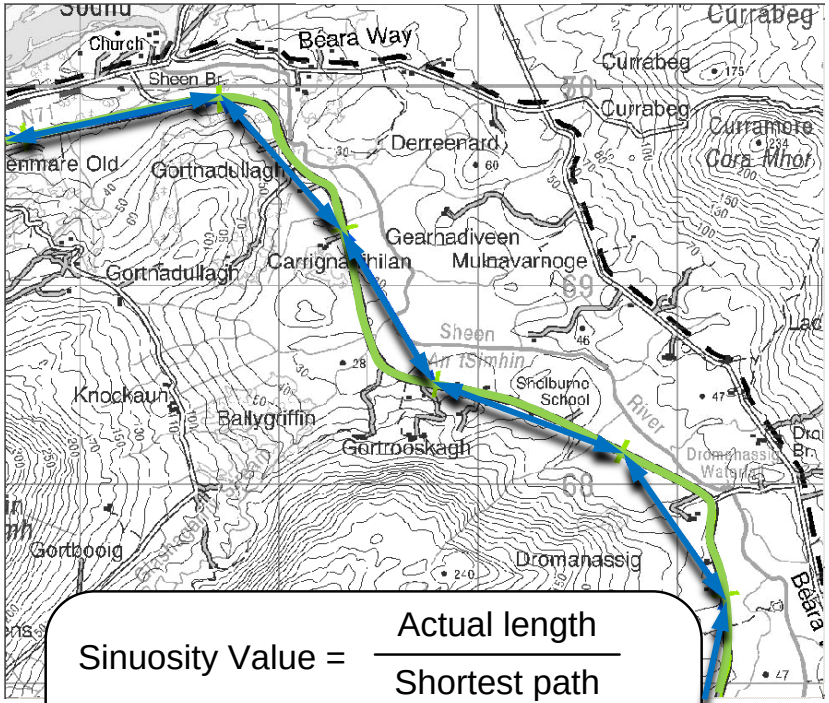
Horizontal road geometry – sinuosity analysis



O'Connor, D. 2011. A network scan of horizontal road geometry: ITRN Conference Proceedings

input data

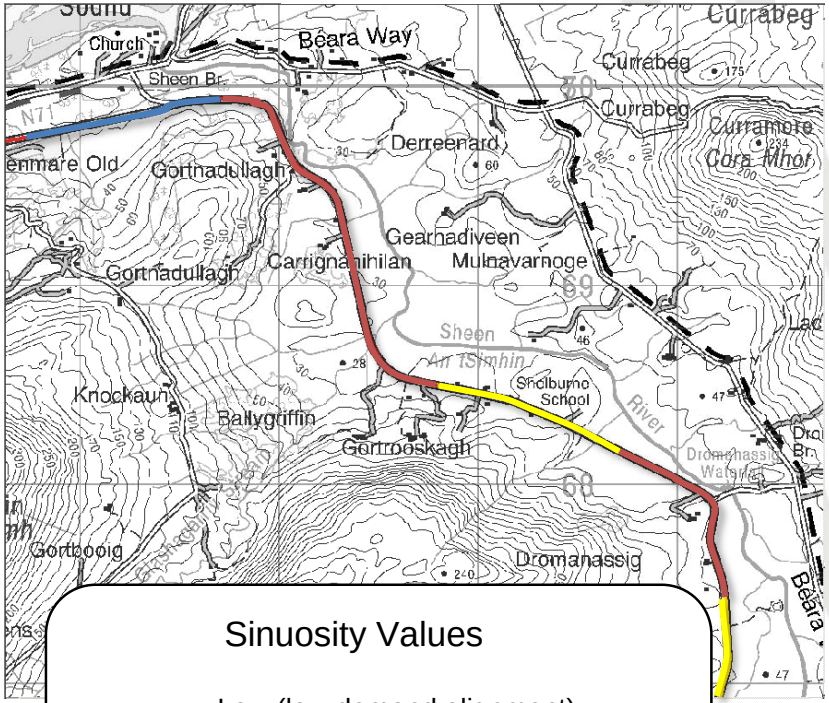


Sinuosity Value = $\frac{\text{Actual length}}{\text{Shortest path}}$

shortest path between X_1Y_1 and X_2Y_2

actual length between X_1Y_1 and X_2Y_2

results



Sinuosity Values

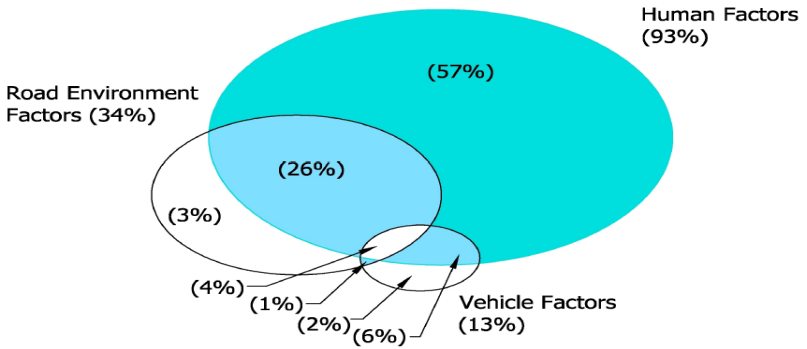
Low (low demand alignment)

Medium (medium demand alignment)

High (high demand alignment)

Treat et al. (1979). USA: Tri-level study of the cause of traffic accidents.

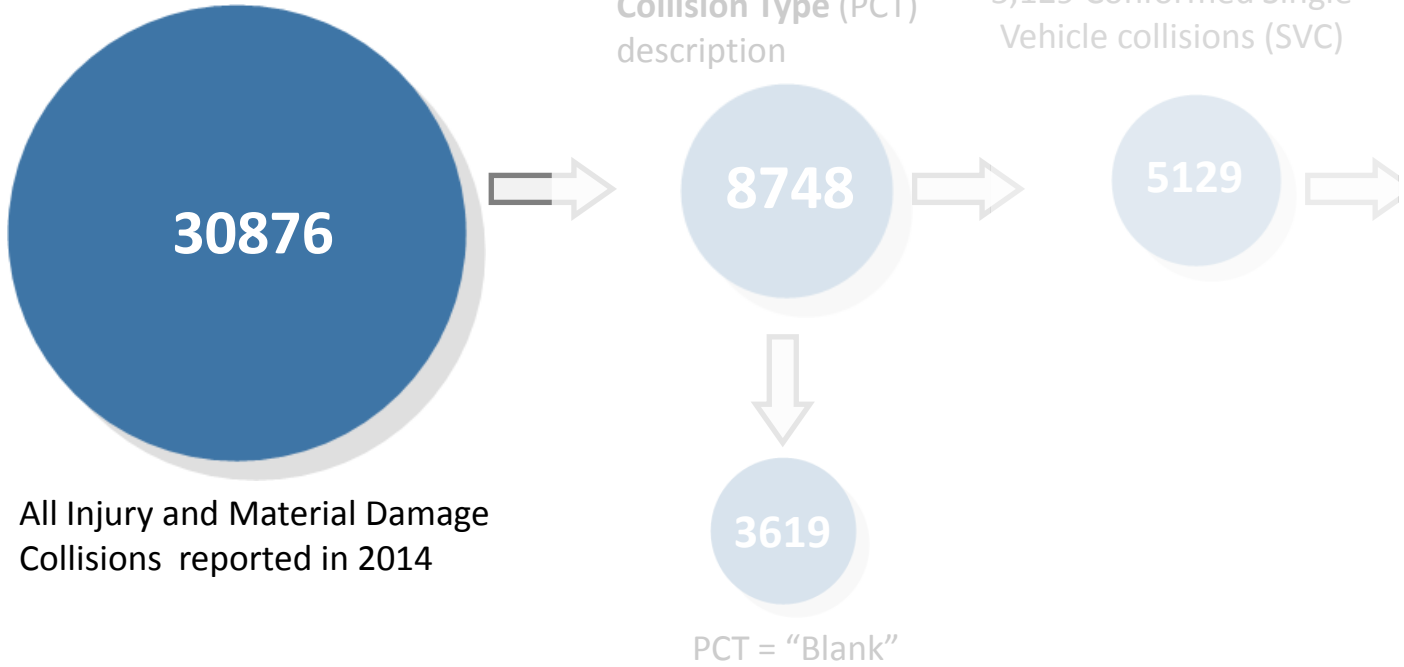
NRA / Risk Solutions research (2012)



NRA / Risk Solution Report (2012). Road Collision Data Collection in Ireland and International Benchmarking

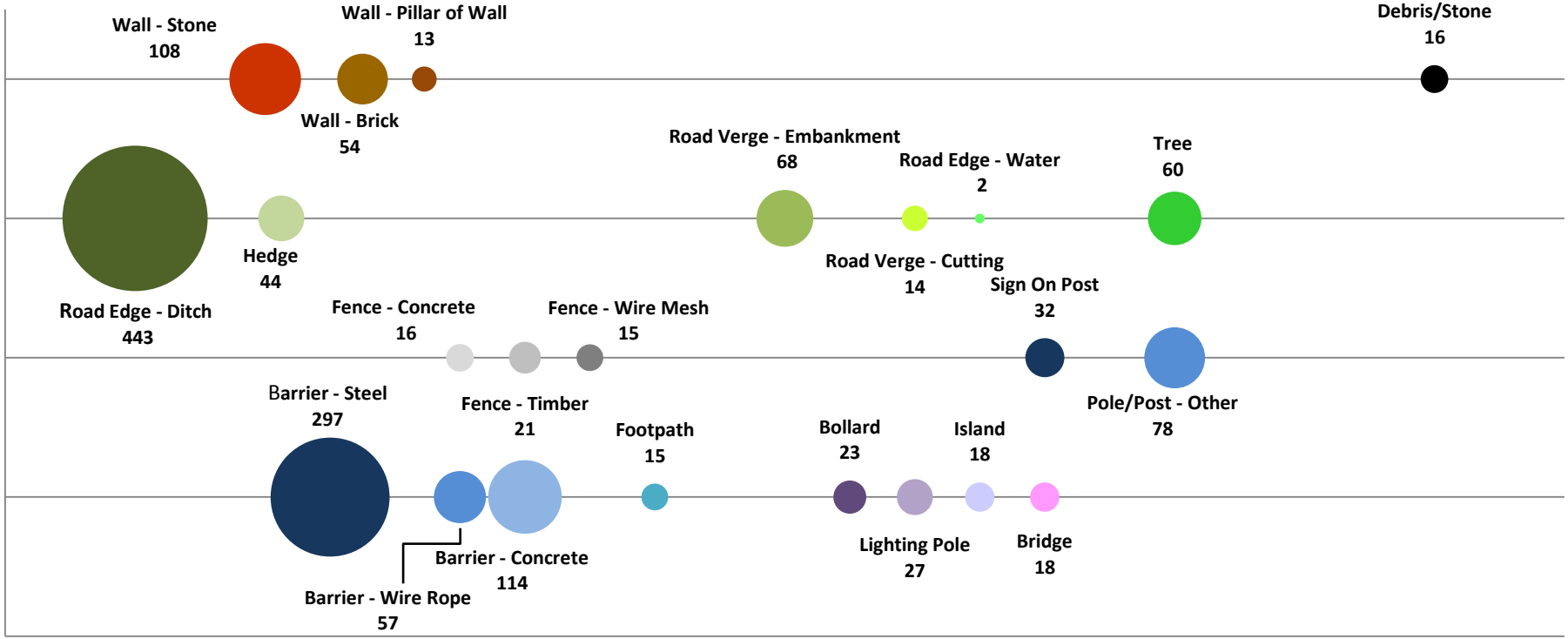
Ireland NRA National roads, 2007-2010	% of collisions	USA All roads, 1971-1975	% of collisions	UK HA single carriageway roads, 2007 to 2010	% of collisions
No contributory factor	**31.27%**	No contributory factor	**0%**	No contributory factor	**4.91%**
Driver only, Pedestrian only, or both	**63.28%**	Human only	**57.1%**	Driver only	**70.18%**
Environment only, Road only, or both	**3.24%**	Environment only	**3.3%**	Road/Environment only	**5.17%**
Vehicle only	**0.20%**	Vehicle only	**2.4%**	Vehicle only	**0.54%**
Driver & Environment or Driver & Road or all three	**1.94%**	Human & Environment	**26.4%**	Driver & Road/Environment	**14.51%**
Driver & Vehicle	**0.07%**	Human & Vehicle	**6.2%**	Driver & Vehicle	**1.52%**
Vehicle & Environment or Vehicle & Road	**0%**	Vehicle & Environment	**1.2%**	Vehicle & Road/Environment	**2.87%**
Driver/Pedestrian, Environment/Road and Vehicle	**0%**	Human, Environment & Vehicle	**2.9%**	Driver, Road/Environment & Vehicle	**0.30%**

Analysis of all reported SVCs in 2014



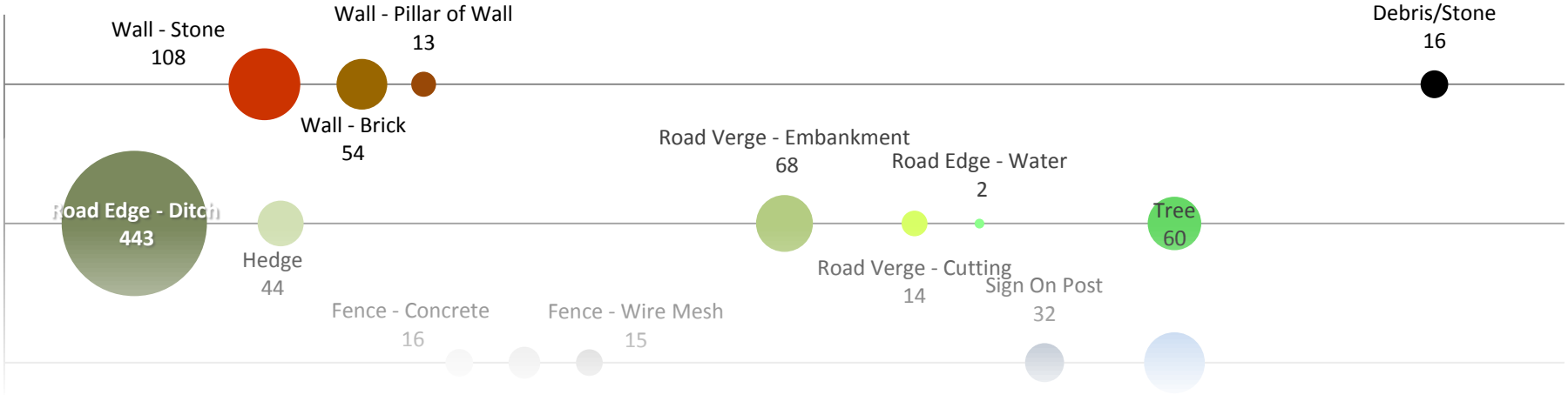
1553 – The number of SVCs reported to have occurred on National Roads in 2014

How best to interpret this chart describing Single Vehicle Collisions (SVCs)?



1553 – The number of SVCs reported to have occurred on National Roads in 2014

Collisions towards the top of the chart are with roadside features (beyond the verge) associated with older legacy type roads



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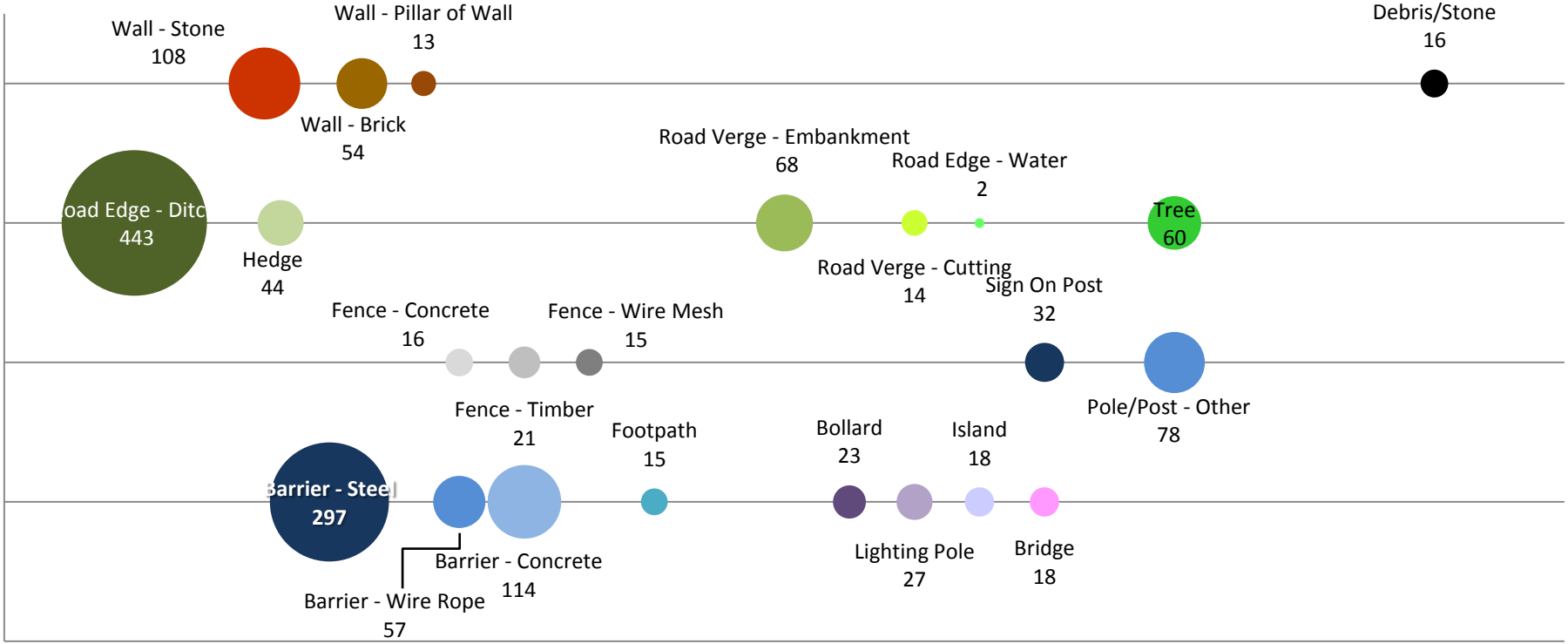
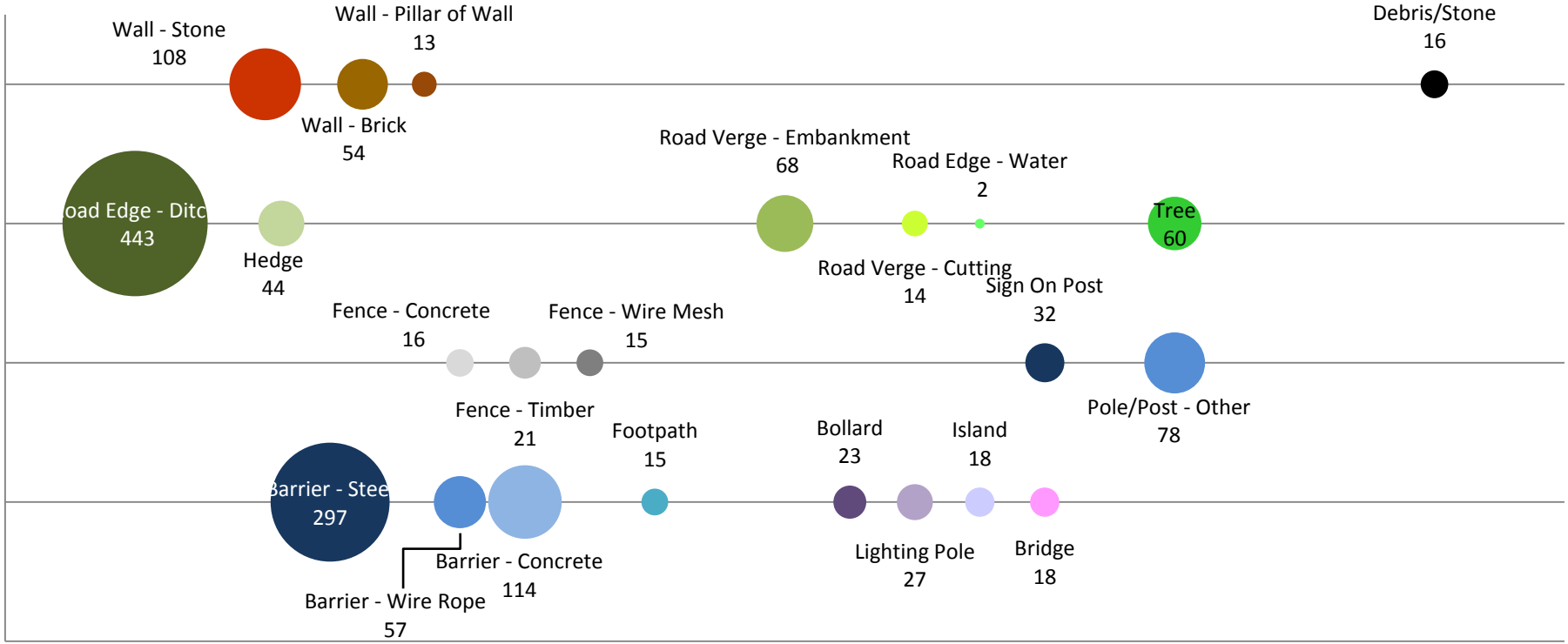


Collisions towards the bottom of the chart are within the road or close to the road edge, included as part of a road design

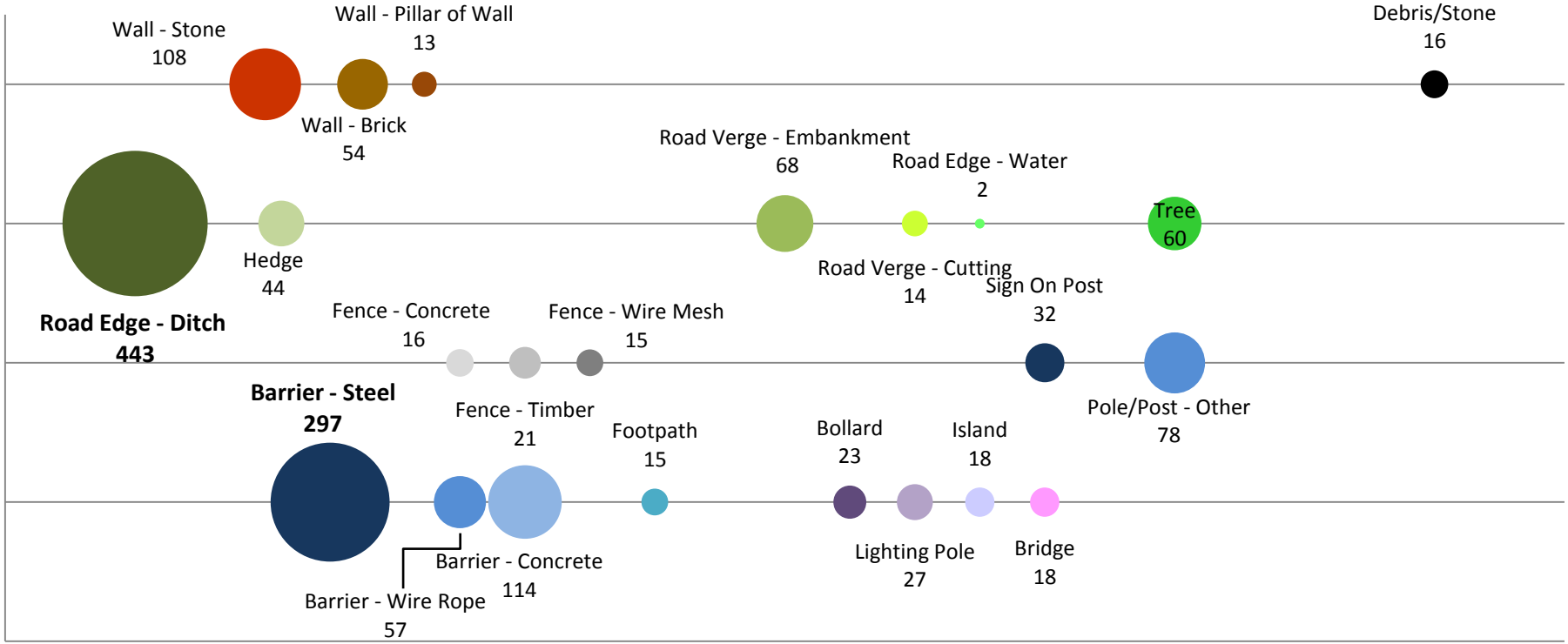
1553 – The number of SVCs reported to have occurred on National Roads in 2014

Collisions to the right of the chart are with isolated / discrete hazards



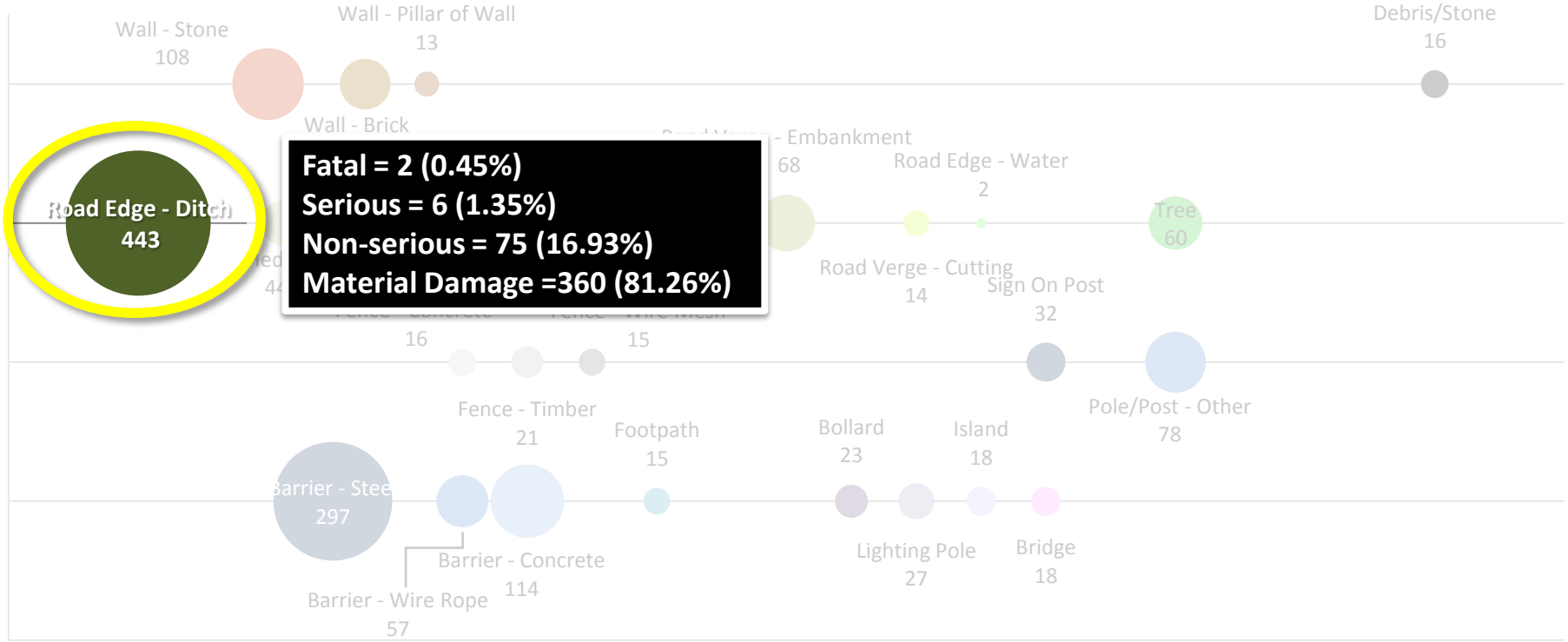
1553 – The number of SVCs reported to have occurred on National Roads in 2014

Collisions to the left of the chart involve linear/continuous type hazards



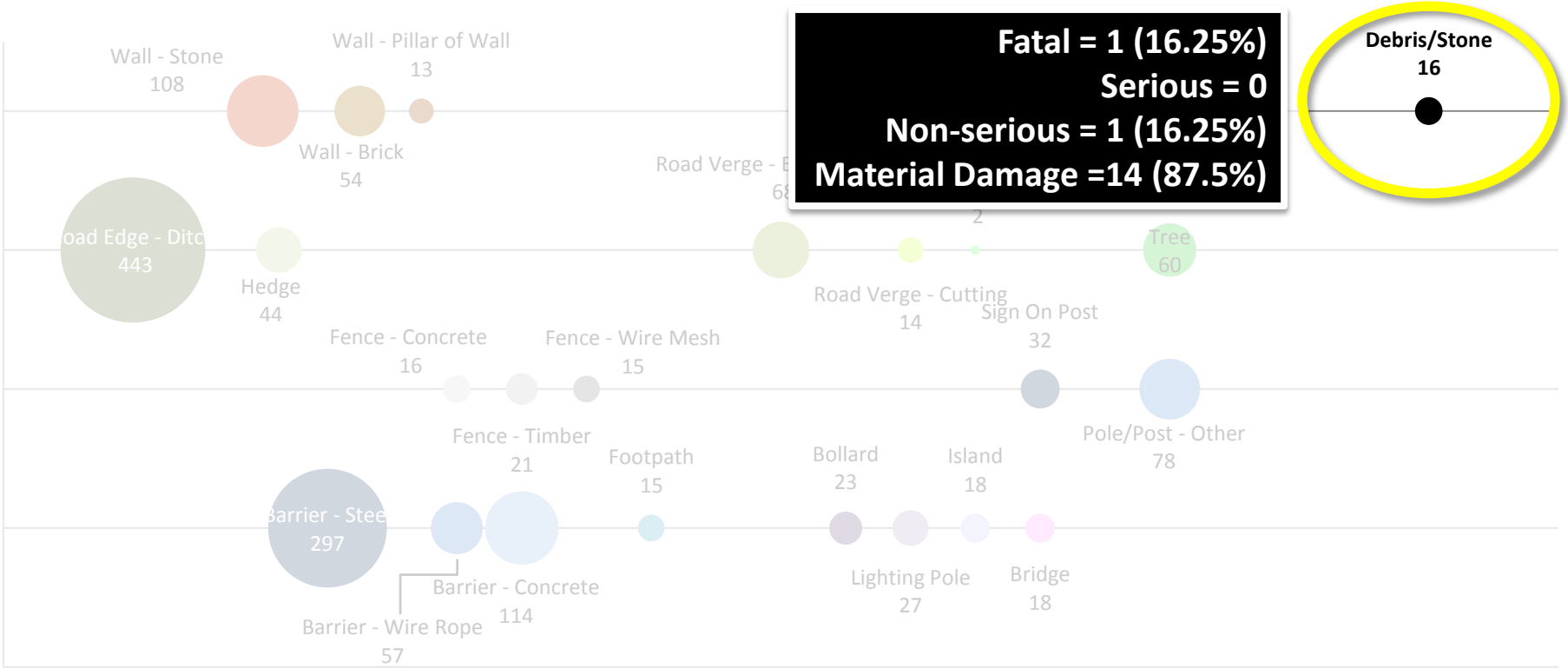
1553 – The number of SVCs reported to have occurred on National Roads in 2014

Road Edge – Ditch, is the most common type of single vehicle collision on national roads



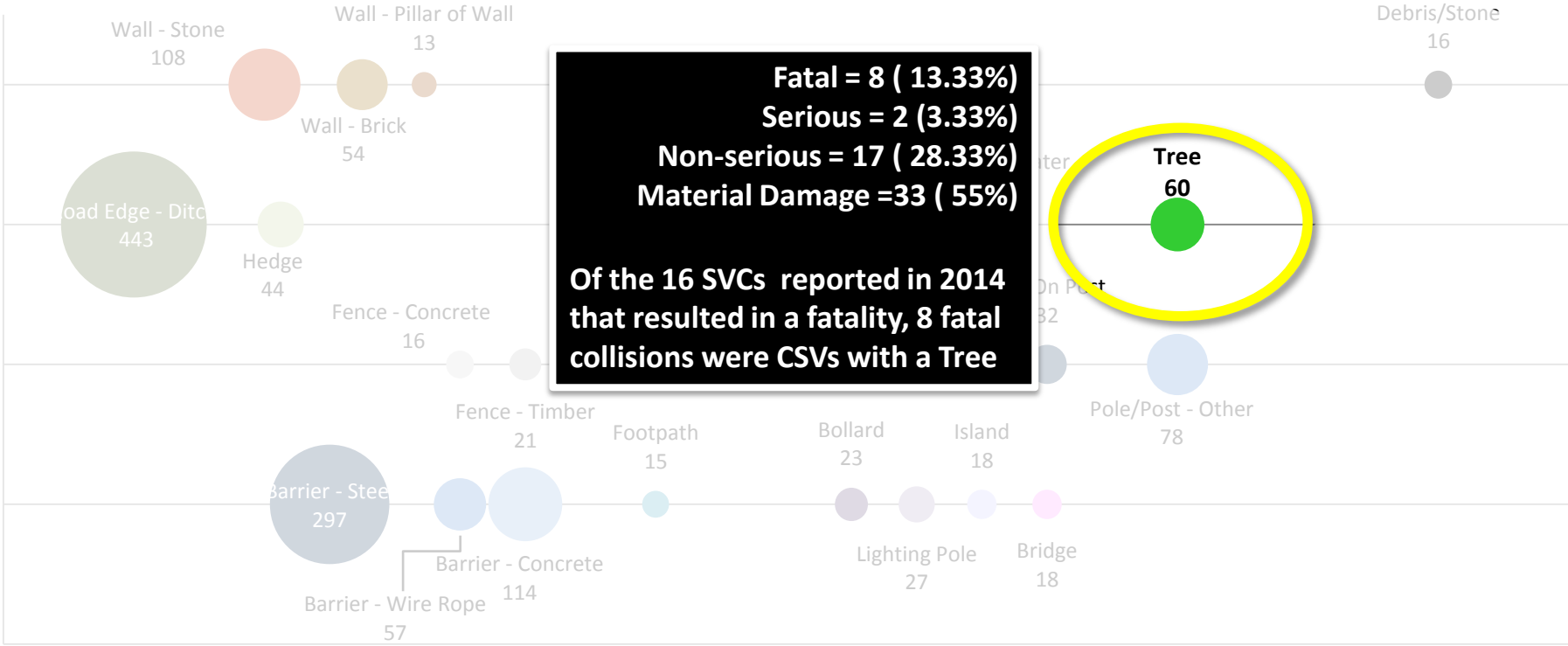
1553 – The number of SVCs reported to have occurred on National Roads in 2014

Some hazards are isolated, random and temporal



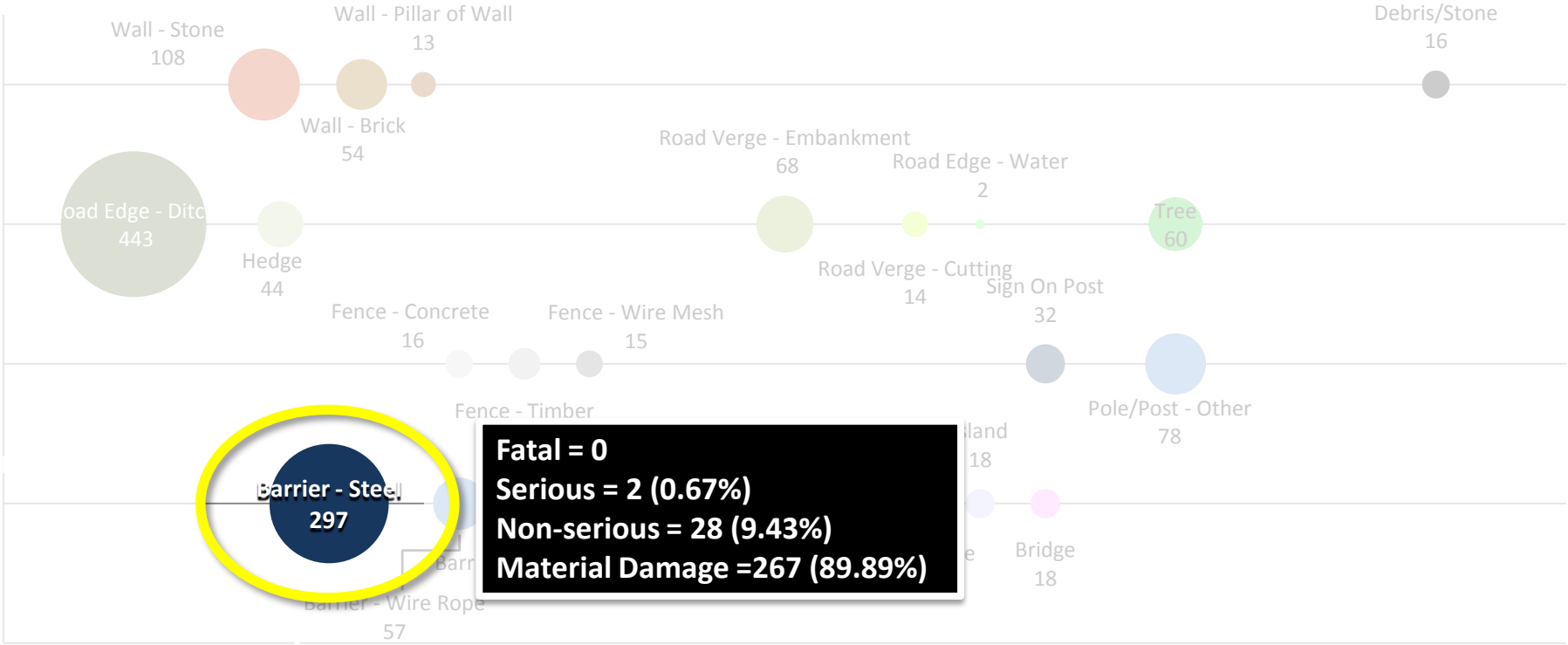
1553 – The number of SVCs reported to have occurred on National Roads in 2014

Hazards can be isolated but common features to the road verge



1553 – The number of SVCs reported to have occurred on National Roads in 2014

Steel Barriers present a hazard to the road user but majority (90%) are "material damage only" collisions



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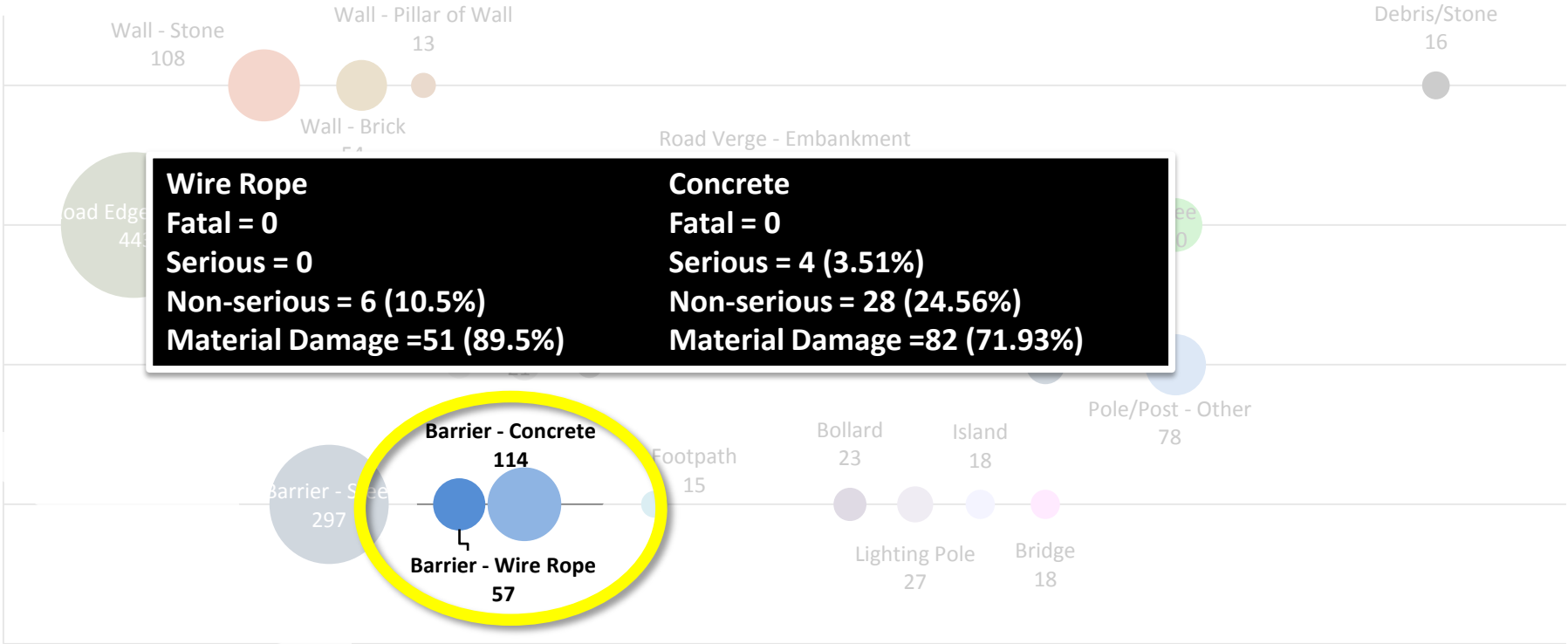

How to analyse data at a national level - summary

- Collision density results from ‘68 & ’69
- A decade of risk map results from EuroRAP programme
- HD15 network safety ranking process
  - Alternative visualisations; rates by population by county
- HD17 road safety inspections
- Assessment of horizontal road geometry
- Analysis of single vehicle collisions (2014)

Why all the change in approach to establishing risk?

- Considered use of different data and data models helps expand our understanding of the subject matter

"Progress is impossible without change and those who cannot change their minds cannot change anything"

George Bernard Shaw
Playwright and co-founder of LSE

Where will change come from to continue progress on road safety issues?

Further change / further progress

- Make more data available (data.gov.ie)
- Continue supporting safety related research
  - CEDR (SAVeRS, ASAP, BROWSeR … 2012 research call)
  - CEDR (PRACT, EUSight, ESReT … 2013 research call)
  - NUI Maynooth (development of Ubipix)
  - Dublin Institute of Technology (roadside distraction / car simulator)

Thank You

- References

An Foras Forbartha 1971. High Accident Locations: Vol. 1. The Principal Inter Urban Roads

An Foras Forbartha 1984. High Accident Locations (7): The National Routes (1977 – 1982)

Crowley, F. Curan, A. Hearne, R 1980. Road Safety in Ireland; Characteristics of the problem and the development of research

Lamm, R. Psarianos, B. Mailaender, T 1999. Highway Design and Traffic Safety Engineering Handbook

McClelland, G. O'Connor, D 2013. Ireland Report: Proceedings from the EuroRAP seminar

O'Connor, D. 2011. A Network Scan of Horizontal Road Geometry: Conference proceedings from ITRN conference

O'Connor, D. Cullen, H. Vigors, V & De Beer, A 2015. Implementing Road Safety Inspections in Ireland and Initial Results: Proceedings from RS5C conference

Risk Solutions 2012. Road Collision Data Collection in Ireland and International Benchmarking: A report for the National Roads Authority

Smith, M. 2006. Fatigue Crashes: The Extent to which Terrain Change Has an Influence on the Fatigued (drowsy) Driver: a Research Project Report Presented as Partial Fulfilment of the Requirements for the Degree of Master of Engineering in Transportation Engineering, Department of Civil Engineering, University of Canterbury, Christchurch, New Zealand

Treat, R. Tumbas, S. McDonald, S. Shinar, D. Hume, R. Mayer, R. Stansifer, N & Castellan, N 1979. Tri-Level Study of the Causes of Traffic Accidents: Final Report- Executive summary