Catastrophe!

Why we should care about the possibility of rare but catastrophic transport incidents

Summary

1. The rail industry and the research project
2. What is our risk tolerance?
3. *Discussion – The Value of Life*
4. The SPACE Model
5. How safe do we need to be?
6. *Discussion – Grossly Disproportionate*
7. Wrap-up

Background – The New Zealand rail industry

98
operators

Huge range of size and capability of rail operators doing a range of activities

31mil
passenger journeys

Wellington & Auckland metro

Cablecars & Trams

Tourist & long distance service

Heritage

16mil
tonnes of freight

Critical infrastructure for NZ to move goods

4200
km network

3100 signals, 1600 bridges, 70km of tunnels, 3000 level crossings

6000
workers

Maintenance crews, train staff, corporate support, volunteers

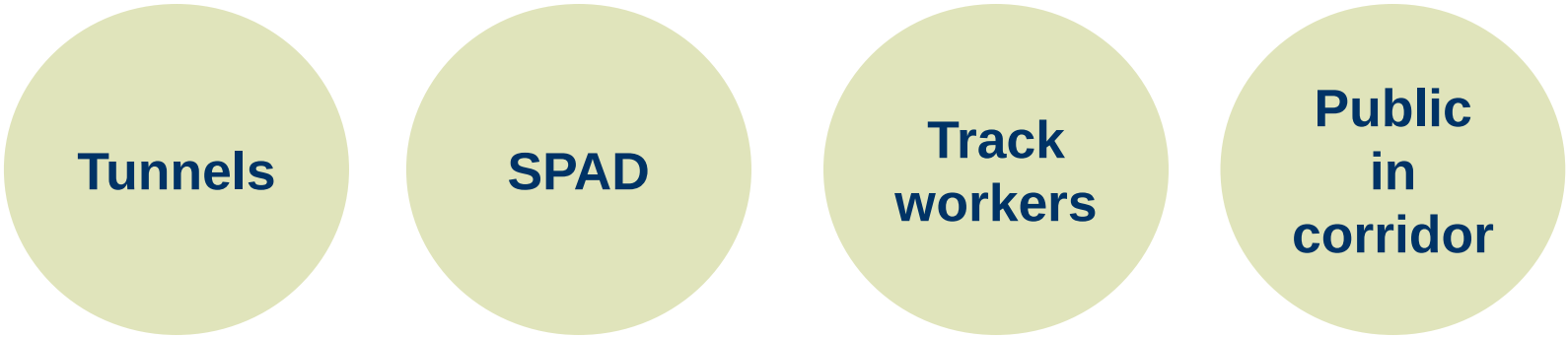

4628
4628
KiwiRail
4628
KiwiRail


CITY
LOOP
178


MAERSK
4.63

Background – The Rail Safety Regulator

- The Rail Safety Regulator is part of the Transport Agency
- We **oversee** the safety of all rail operators in NZ
  - Rail operators remain **accountable** for safety & managing risk
- Licensing, auditing, education, investigation & compliance



Background – Why the focus on risk?

- Risk management is a key activity in the rail sector
  - Trains are big and hard. People aren't.
  - Potential for multi-fatality accidents

- Rail companies must manage their own risks
  - "*Those creating the hazard are responsible for managing it*"

- Risk management is evolving in New Zealand
  - Increasingly complicated activities
  - "*Everyone comes home healthy and safe*"

Background – The research project

Framework for review and prioritisation of rail safety risks

- Agency-funded research project to build risk capability across the sector
  - What is done well, what isn't?
  - What risks should we focus on?
- Who was involved?
  - Carried out by Navigatus Consulting
  - Sector involvement – rail companies, TAIC, Worksafe, union
- How was it done?
  - Literature reviews
  - Observations of practices
  - Surveys of industry participants
  - Analysis of national & overseas data

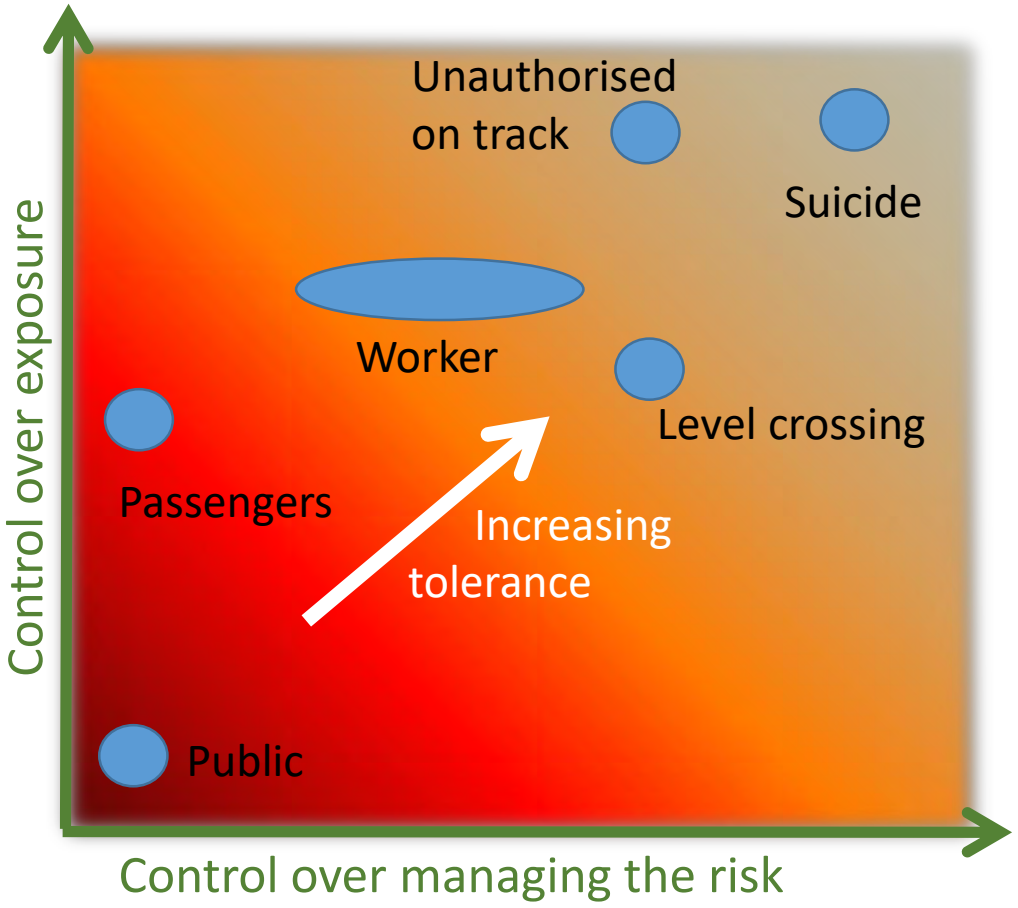
- These are the findings of a research project – not the opinion or responsibility of the NZ Transport Agency.

What is our risk tolerance?

- Risk management is not risk elimination
- You can't be absolutely "safe" – risk is a consequence of activity

Our tolerance – exposure

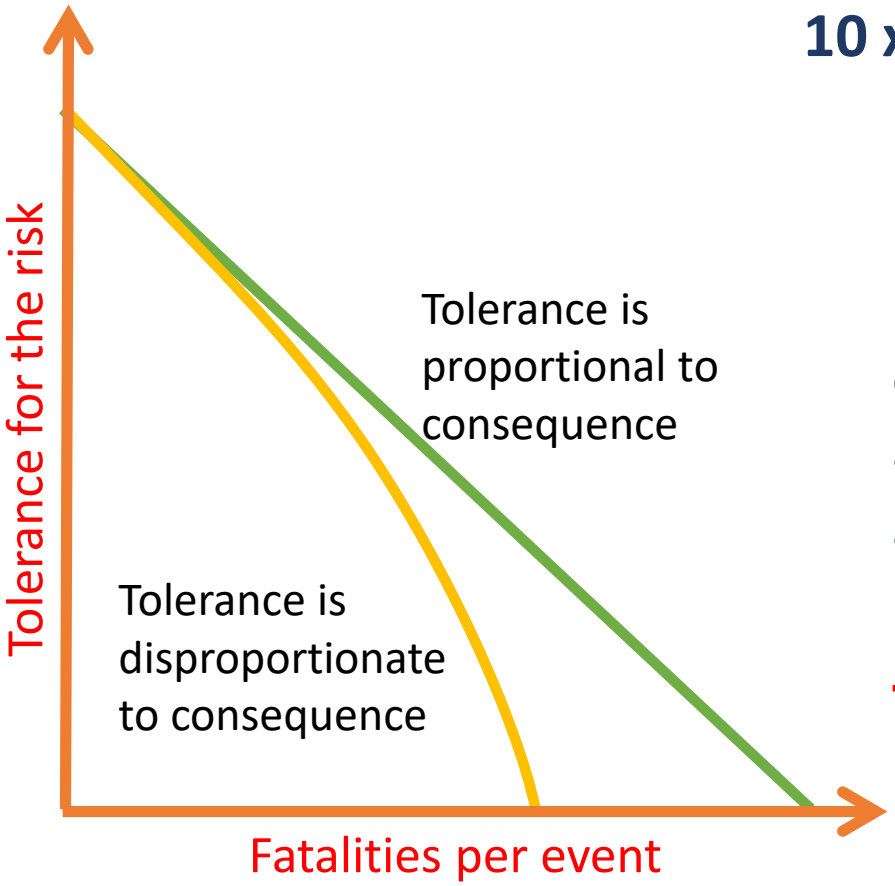
Who is exposed to the risk?



Tolerance ∝ control the person has over it

Our tolerance – scale

Do we fear bigger accidents?



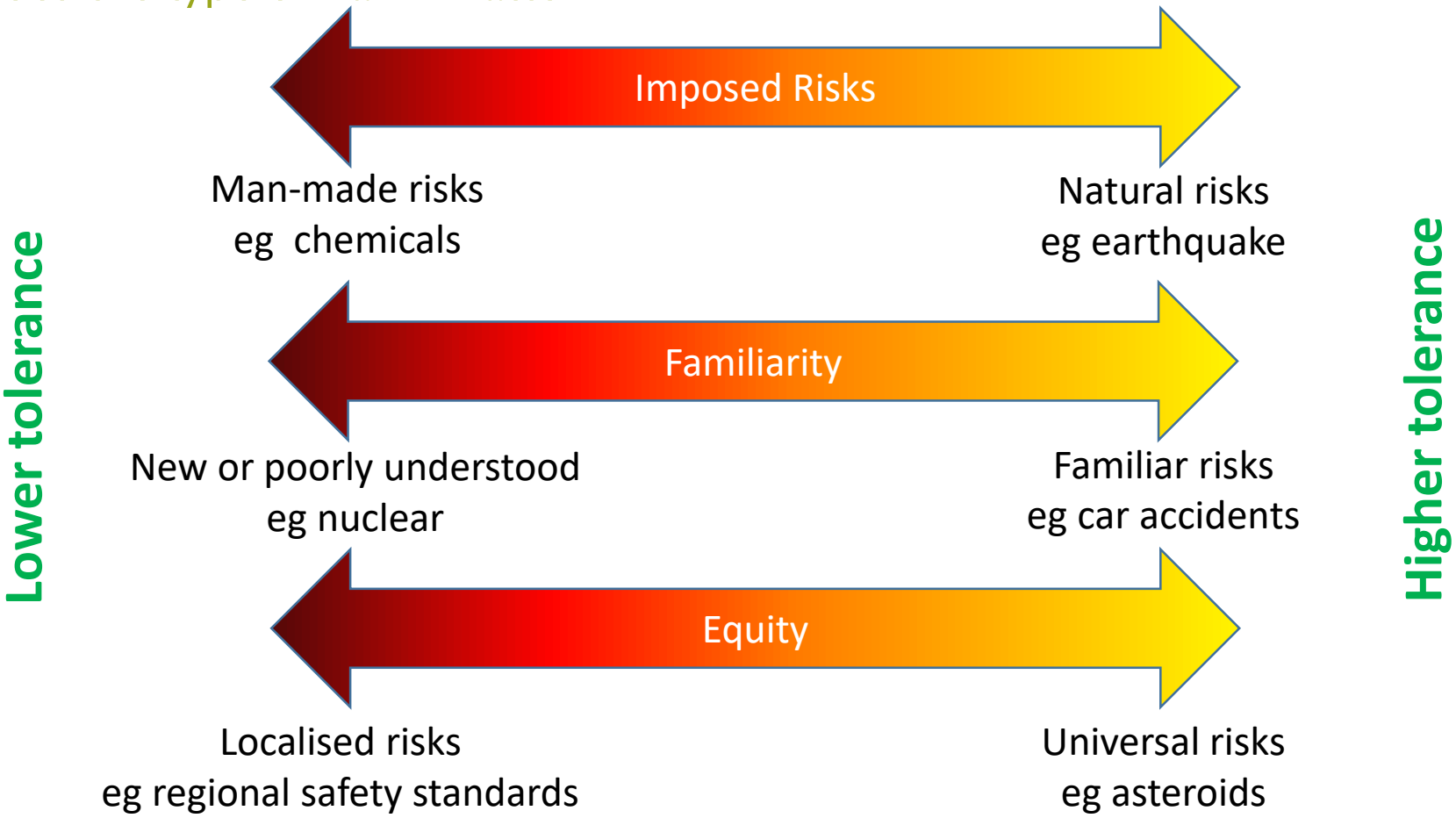
Considered:

- Public outrage in large disasters
- Countries that adjust risk standard for catastrophic accidents

Tolerance ∝ Consequence

Our tolerance – societal concerns

Does the type of harm matter?



Time to chat

The Value of a Statistical Life

Break into groups of 5-6 and discuss for 10 minutes:

- Who uses VSL?
- How do you use it?
- How do you account for risk aversion in your use?

Value of Life Saved – Valuation Methods

Used to be the standard method

Lost Earnings

Human Capital Method

Australian method

Societal Benefits

Medical Costs

Lost Earnings

Hybrid

NZ method

2017 Value $4.21 million

Context dependent

Conceptually

Risk Aversion

Pain and Suffering

Societal Benefit

Lost Earnings

Willingness to Pay

Derived from a road safety context

Value of Life Saved

Examples:

Edwards vs National Coal Board (1949)

- Compensation of £984 (1949)
  £32k (2016) $70k (NZD 2016)

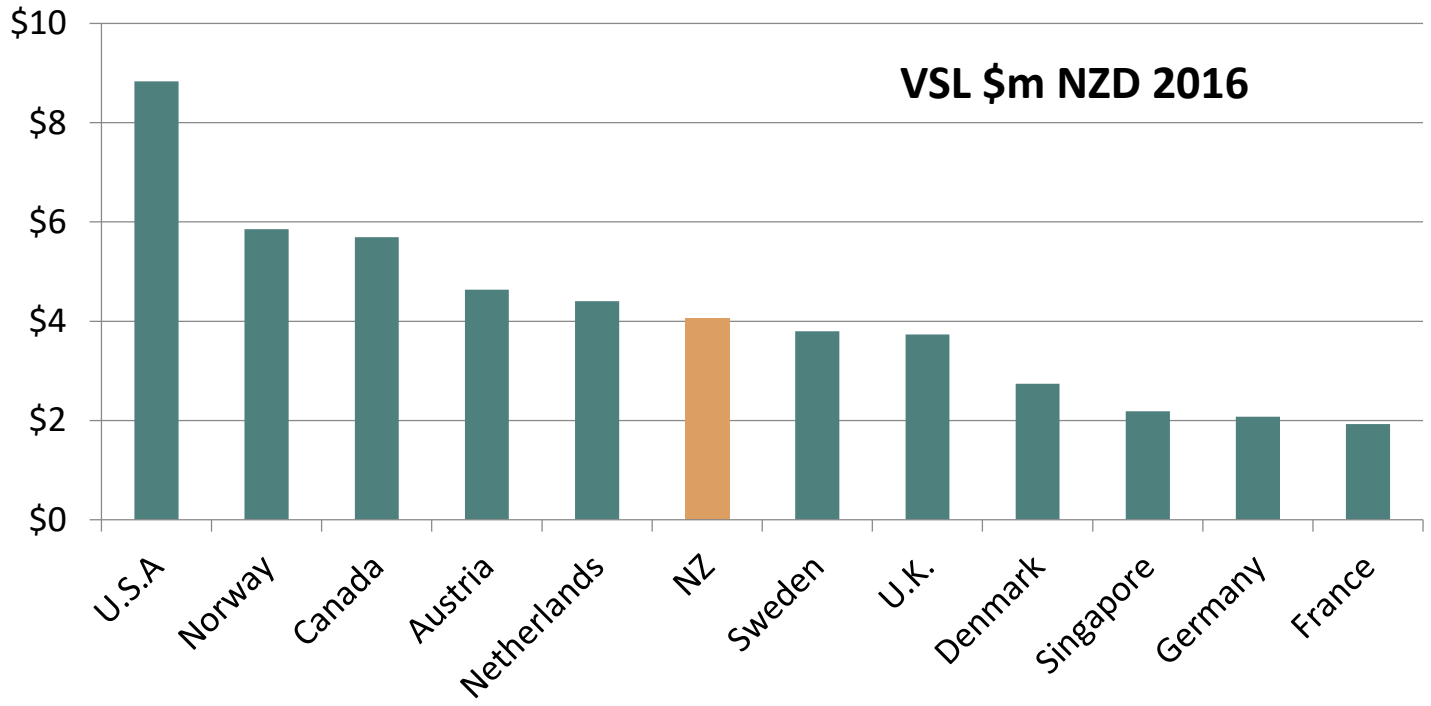
UK Court Compensation (1952–2002)

- Average compensation of £157k $330k (NZD)
- All were less than £200k $420k (NZD)
- HSE VSL at the time was £1m (≈ 2002)
- VSL was 5 times the compensation amount

Value of Life Saved

The current VSL is derived from a 1991 study by Miller and Guria asking approx. 600 people what they would be willing to pay for various improvements in road safety.

- This implicitly includes a degree of risk aversion



SPACE Model

Estimating fatality risks in New Zealand rail

Kevin Oldham, Navigatus

Contents

- Recent incidents
- The challenge
- Model overview
- Method
- Results
- Conclusions and discussion

Recent Incidents

Photo: TAIC


Photo: G S Winslow

The Challenge

The problem of frequency:

- small rail industry
- relatively low incident counts
- very few higher consequence events.

Record keeping historically patchy.

- 5 years of recent improved record.

Source: NZ Ministry of Transport

The Challenge

- Under these circumstances how can we develop a best estimate of the safety risks across both common and rare event types?

Source: NZ Ministry of Transport

SPACE Risk Model

- This required a hybrid approach, drawing on New Zealand and international data, resulting in the SPACE model.

  Safety

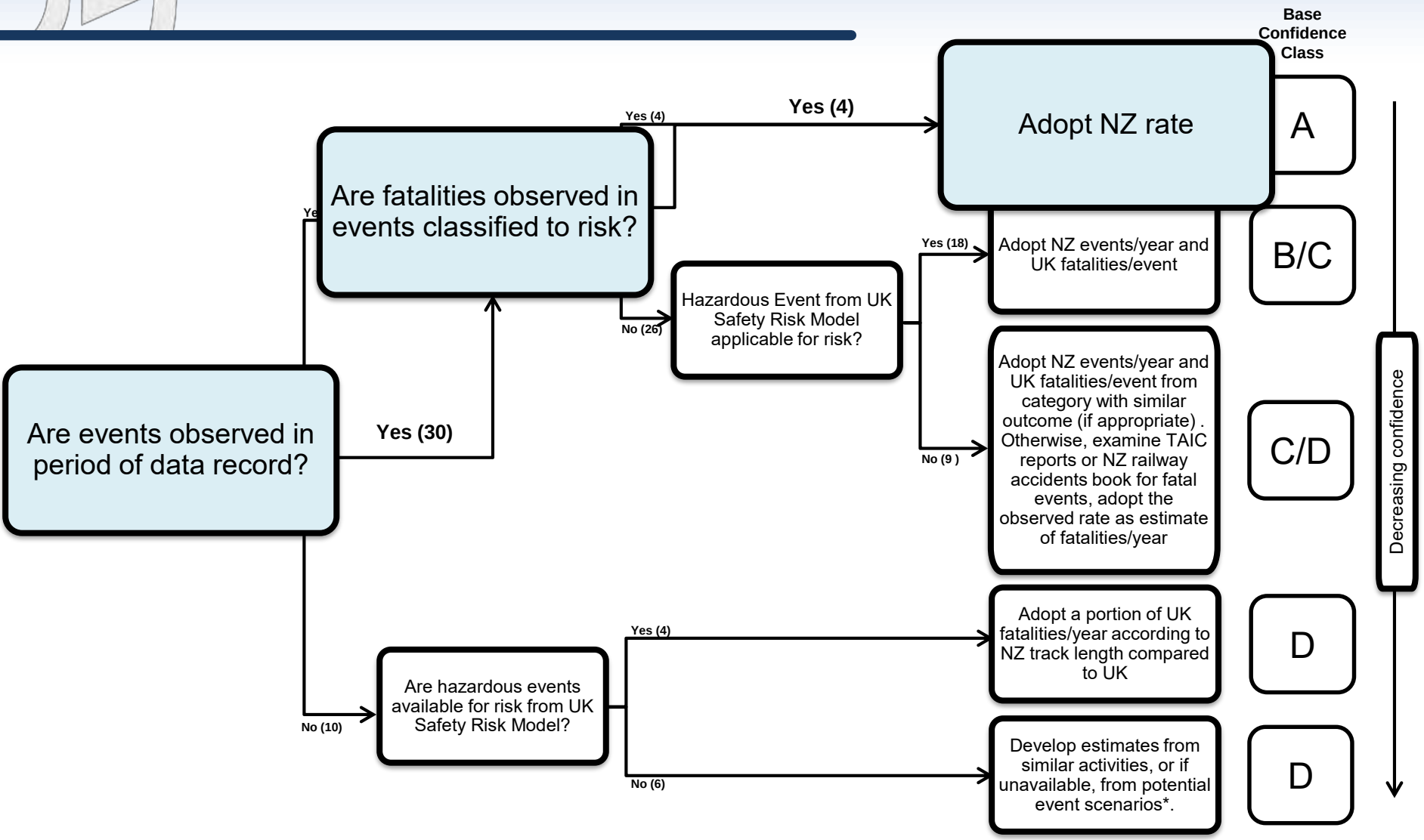
  Performance

  And

  Casualty

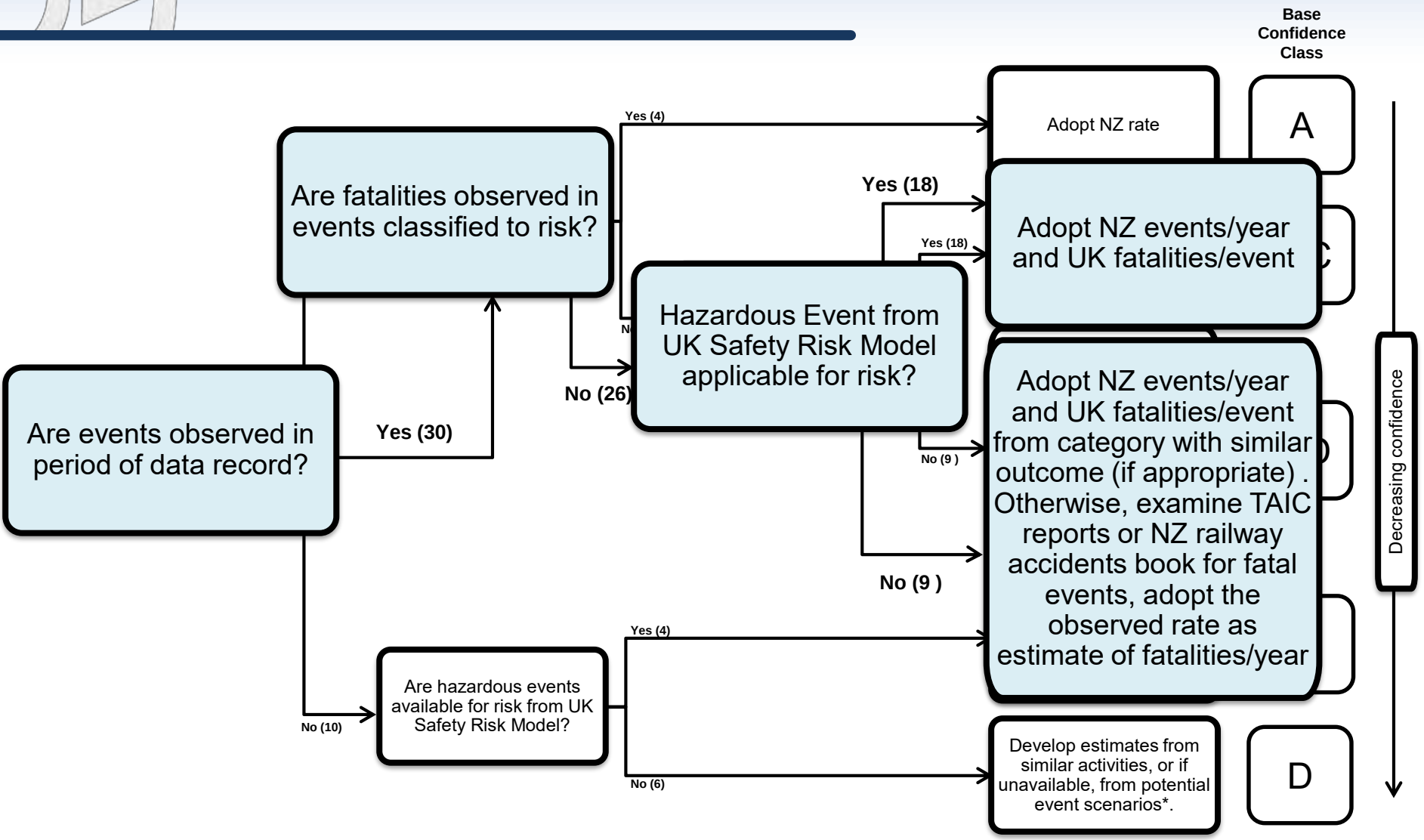
  Estimates

SPACE Methodology



* Average expected fatalities not estimated for passenger tunnel fire risk. This is a priority risk due to the maximum credible number of fatalities

SPACE Methodology



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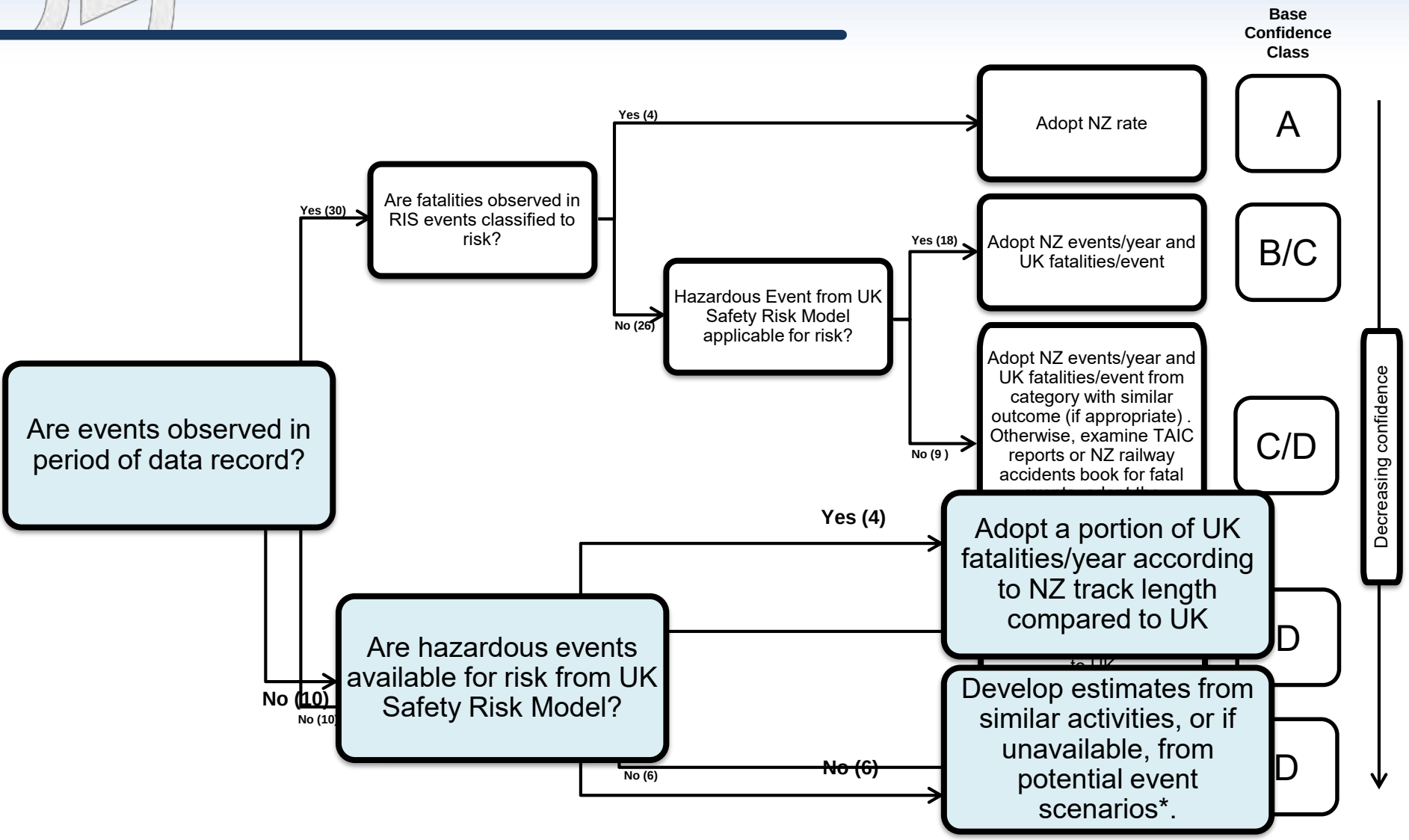
Tangiwai Disaster 1953

Source: Archives New Zealand

SPACE Methodology



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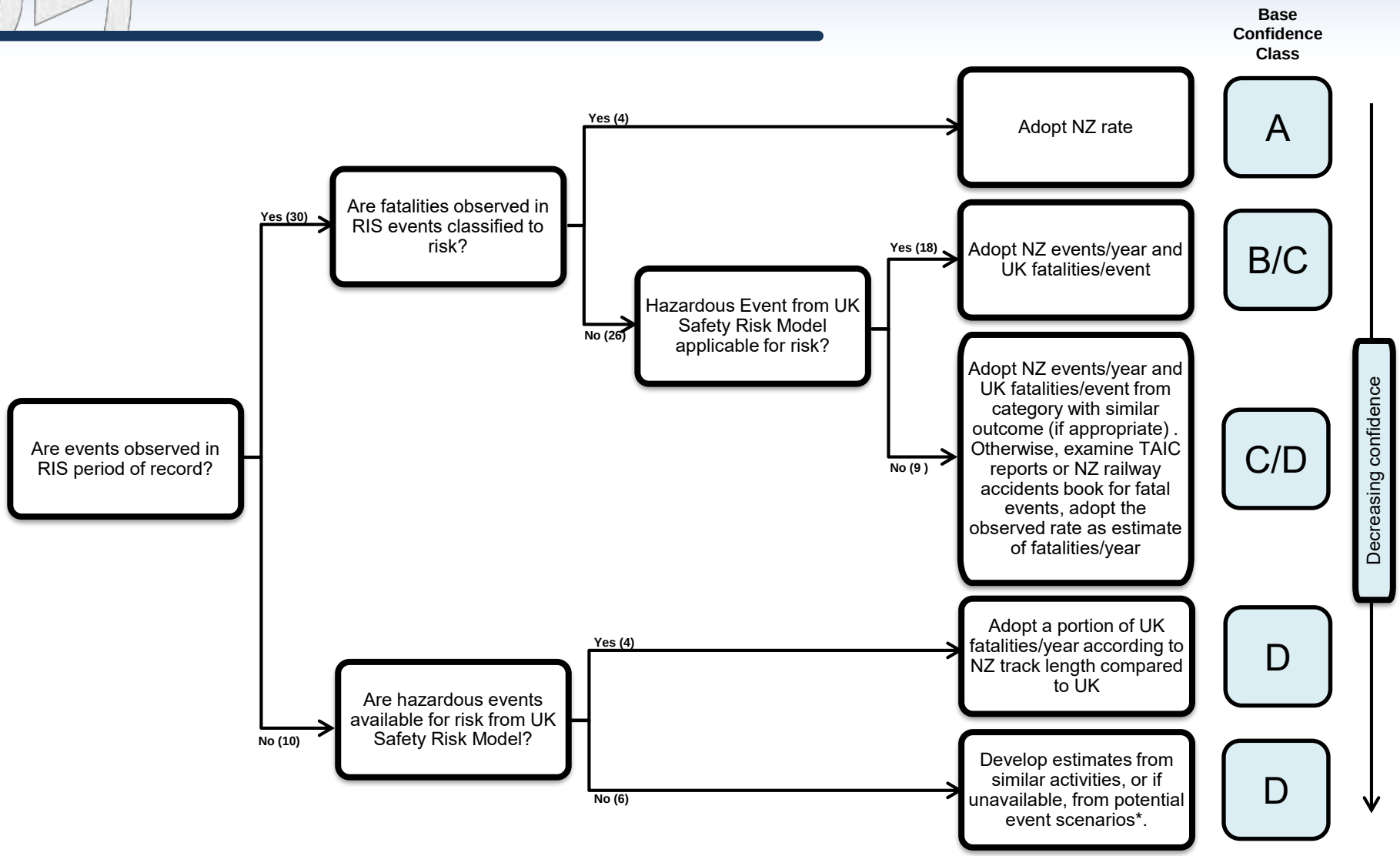
SPACE Methodology



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Sample of Raw results

Type	Operations	Average Expected Fatalities (10-3 pa)	Max Credible Fatalities from Single Event	Confidence Class
Collision (level crossing)				
Pedestrian	All	1200	1	A
Bus	All	75	30	C
Heavy Vehicle	Mainline	343	15	A
	Heritage	76	15	D

Risk Weighting

Method 1: treating every circumstance equally.

Method 2 : weight assessment in an effort to reflect broad societal values on risk acceptance.

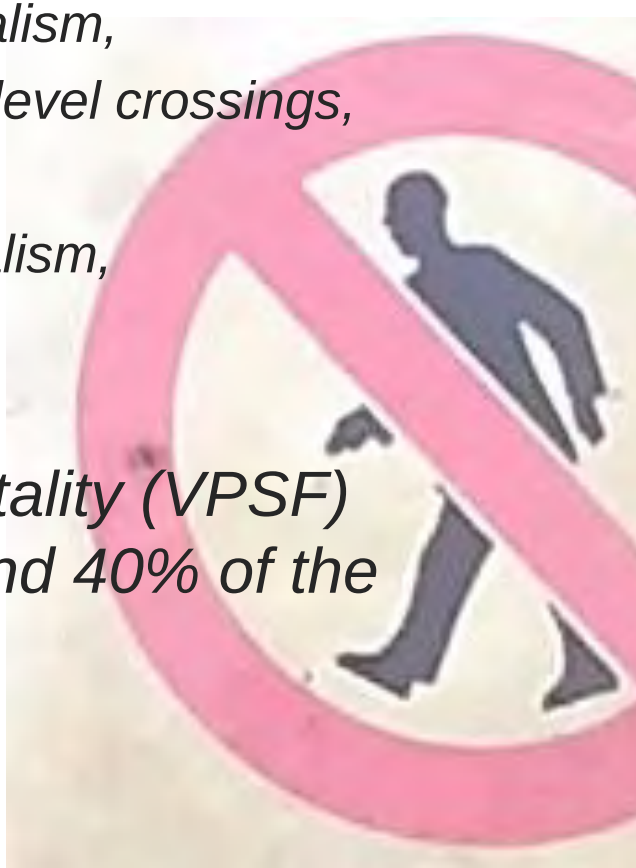
Example: Influence of Volition

- Reseach by Covey et al (2008) found that:

  Public would reduce willingness to spend on preventing a statistical falatity if victims are behaving iresponsibly: e.g.

  - *adult trespassers engaged in acts of vandalism,*
  - *adult car drivers behaving irresponsibly at level crossings,*
  - *adult drunks falling from platforms*
  - *child trespassers engaged in acts of vandalism,*
  - *suicides.*

The Value of Preventing a Statistical Fatality (VPSF) ratios relative to the baseline case around 40% of the baseline figure.



Weighting: Party (Volition)

1 Unauthorised Member of Public (UMOP)
2 Level Crossing User
3 Railway Worker
4 Passenger
5 Member of Public (Bystander)

Weighting: Control

1 Unauthorised Access
2 Level Crossings
3 Natural Events
4 Technical risks

Result: Weighted Rankings

Rank	Top risks ordered by Average Expected Fatalities / Year	Top risks in party weighted order	Top risks in party and outcome control weighted order
1	Collision with unauthorised member of public	Collision with unauthorised member of public	Tsunami
2	Level crossing collision with light vehicle	Tsunami	Collision with unauthorised member of public
3	Level crossing collision with pedestrian	Level crossing collision with light vehicle	Level crossing collision with light vehicle
4	Tsunami	Level crossing collision with pedestrian	Level crossing collision with pedestrian
5	Mainline passenger level crossing collision with heavy vehicle	Passenger train collision with civil works failure	Passenger train collision with civil works failure
6	Passenger train collision with civil works failure	Mainline passenger derailment	Mainline passenger derailment
7	Collision with Infrastructure Maintenance Worker	Tourist and heritage derailment	Tourist and heritage derailment
8	Shunting incident	Mainline passenger level crossing collision with heavy vehicle	Collision with infrastructure maintenance worker
9	Mainline passenger derailment	Collision with infrastructure maintenance worker	Shunting incident
10	Tourist and heritage derailment	Shunting incident	Fire at station
11	UMOP electric shock	Fire at station	Freight derailment
12	Fire at station	Freight derailment	Mainline passenger level crossing collision with heavy vehicle
13	Freight derailment	Level crossing collision with bus	Collision between trains involving at least one passenger train
14	Tourist and heritage level crossing collision with heavy vehicle	Collision between trains involving at least one passenger train	Level crossing collision with bus

Priority Risks

Interesting Outcome

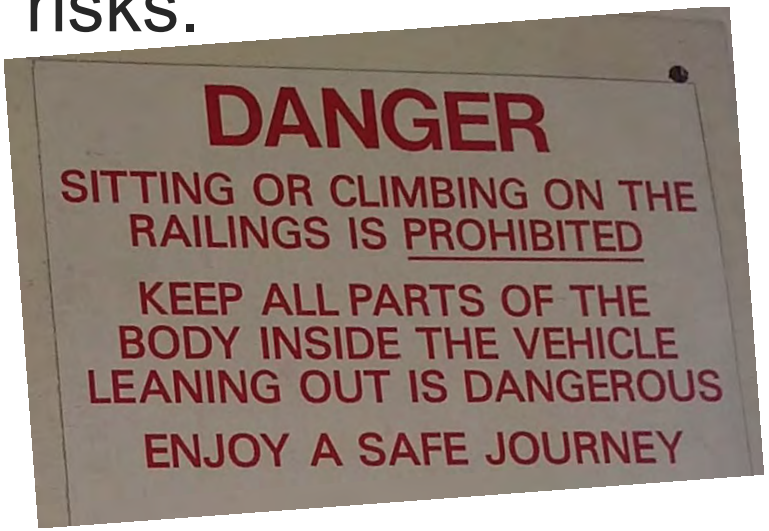
- Tsunami risk was the highest ranked risk.
- Emerging understanding of tsunami risk in New Zealand and internationally.
- The biggest ever railway disaster arose in Sri Lanka during the Boxing Day tsunami of 2004.
- This wouldn’t have been assessed under conventional historical incident analysis, as no rail fatalities have been observed due to tsunamis in New Zealand history.

Consistency and Reliability

- How can you have consistent and reliable results when the method varies?
  - Researcher degrees of freedom
  - Researcher choices can greatly affect the outcomes
  - Judgement
  - Fit for purpose
  - Peer review
- Best available estimate of safety risk given current state of knowledge

Discussion

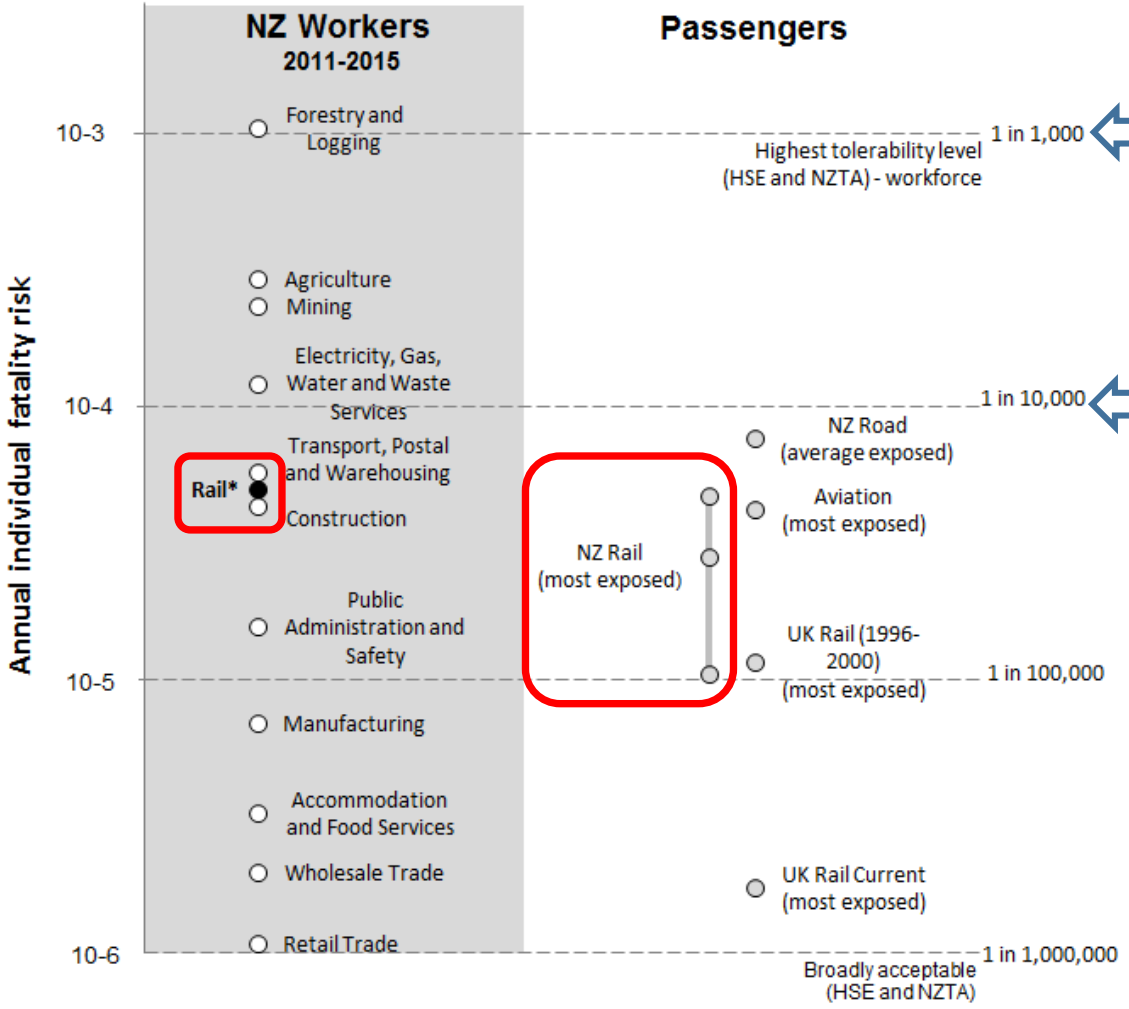
- Intent is to draw on best available data and apply most approriate risk assessment approach.
- Builds a transparent and rational overview.
- Peer review and industry working group oversight.
- Building consensus on main risks.



Findings

- Hybrid approach is useful to build a system overview where incidents occur at widely different frequencies.
- Resarcher degrees of freedom – results may not be replicable.
- Needs to be used with care and with understanding of limitations.

How safe – What is the current standard?



Workers: 1 in 1000

Too high

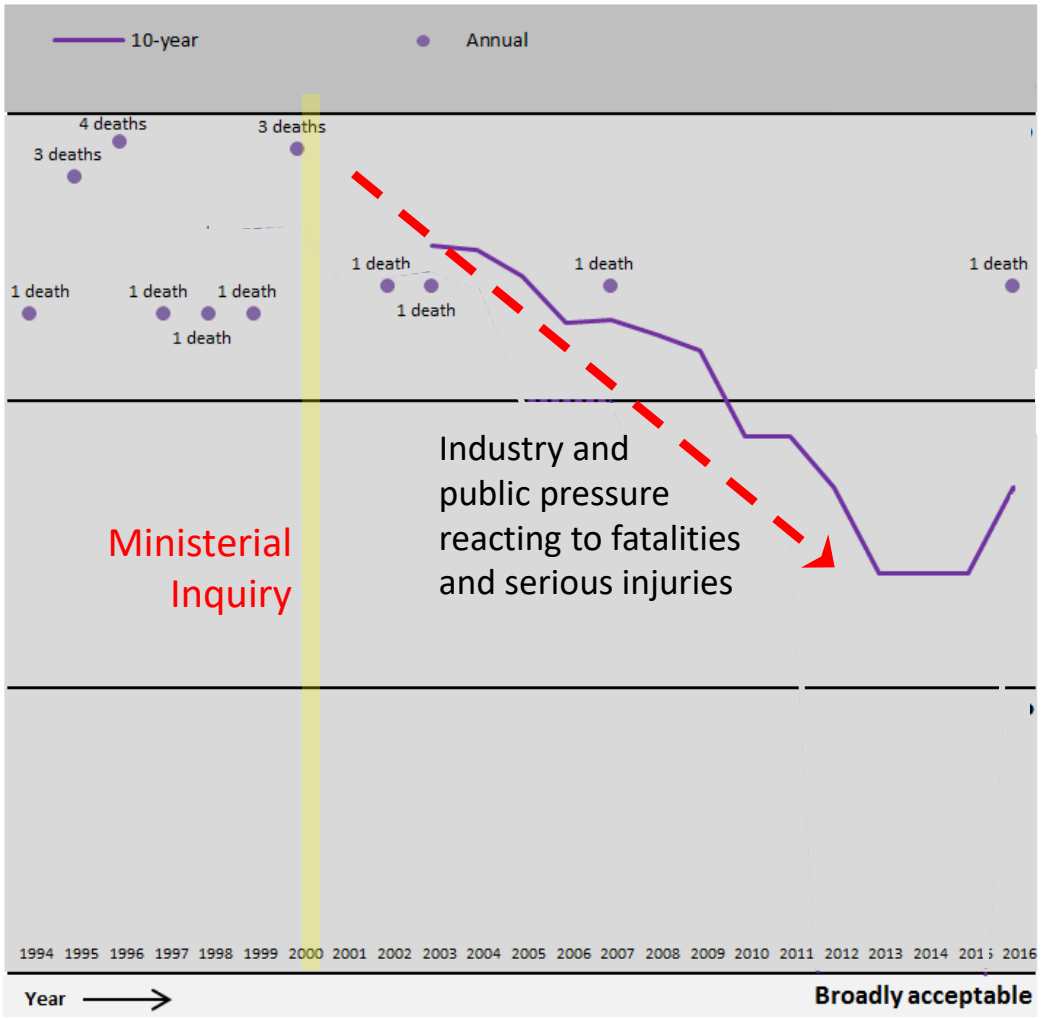
- Industries in this range must reduce

Public: 1 in 10,000

Higher than in practice

- Less public pressure to reduce?

How safe – What should it be?



1 in 1,000

1 in 10,000

1 in 100,000

1 in 1,000,000

Research recommendation:

1 in 10,000 for workers

What impact does this have for other transport modes?

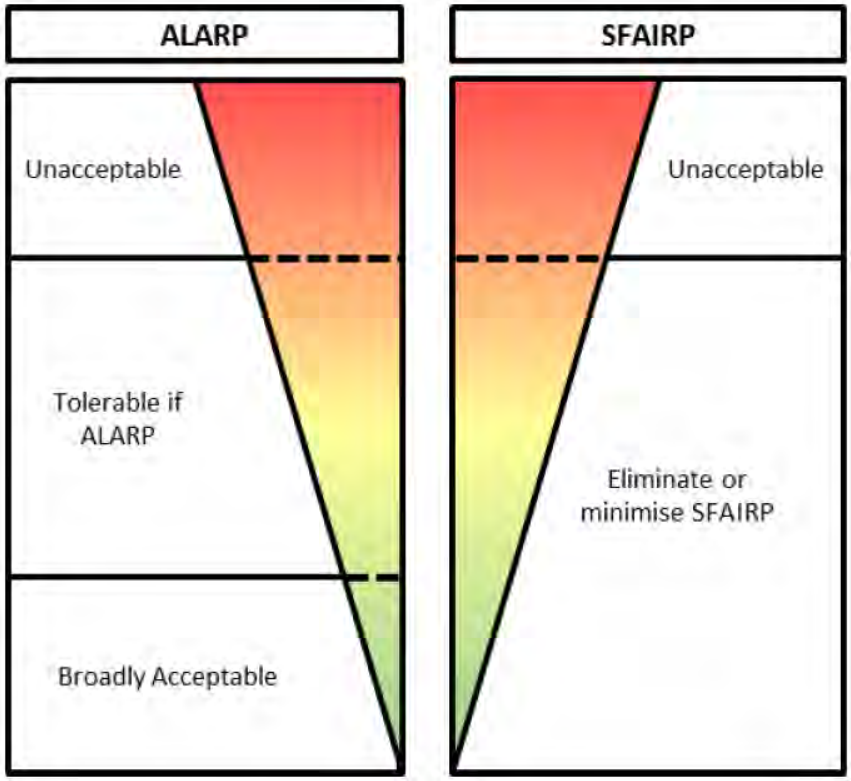
How safe – And where should we be heading?

The influence of SFAIRP

- Tolerance is the upper ceiling

SFAIRP – there is no longer an acceptable level of risk

- Continually strive to reduce risk
  - as better safety controls become available, risk will decrease
  - as catastrophic risks are better understood, improved focus

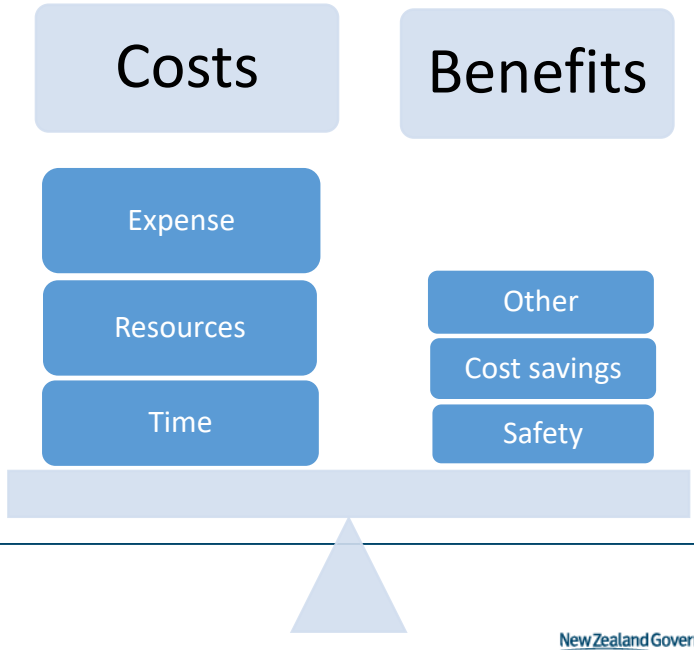


Time to chat

Q. What does “Grossly disproportionate” mean? How can it be assessed?

Break into groups of 5-6 and discuss for 10 minutes:

- Is it being applied – where?
- How disproportionate?
- Can it be used with the VSL?



Grossly disproportionate

Edwards vs National Coal Board, 1949

Reasonably practicable is a narrower term than 'physically possible' …

*…if it be shown that there is a **great disproportion** between [the quantum of risk and the sacrifice to avert it] – the risk being insignificant in relation to the sacrifice – the person upon whom the obligation is imposed discharges the onus which is upon him.*

Wrap-up – Questions and Comments?