How do we ensure the assessment of infrastructure resilience is proportionate to the risk?

Matthew Holmes [a], Anna Provost [b], Derek Clucas [b], Sean Wilkinson [a]
a. Civil Engineering & Geosciences, Newcastle University, Newcastle-upon-Tyne, NE1 7RU
b. United Utilities Plc., Lingley Mere Business Park, Warrington, WA5 3LP

International Symposium for Next Generation Infrastructure
Wollongong, Australia

1st October 2013

EPSRC Engineering and Physical Sciences Research Council
stream The Industrial Doctorate Centre for the Water Sector
Newcastle University
United Utilities helping life flow smoothly
SEVERN TRENT WATER
YorkshireWater

Industrial Doctorate - Acknowledgements

stream
The Industrial Doctorate Centre for the Water Sector

EPSRC
Engineering and Physical Sciences Research Council

Newcastle University
Dr. Sean Wilkinson
Prof. Richard Dawson

YorkshireWater
David Owen
Dr. Matt Hill

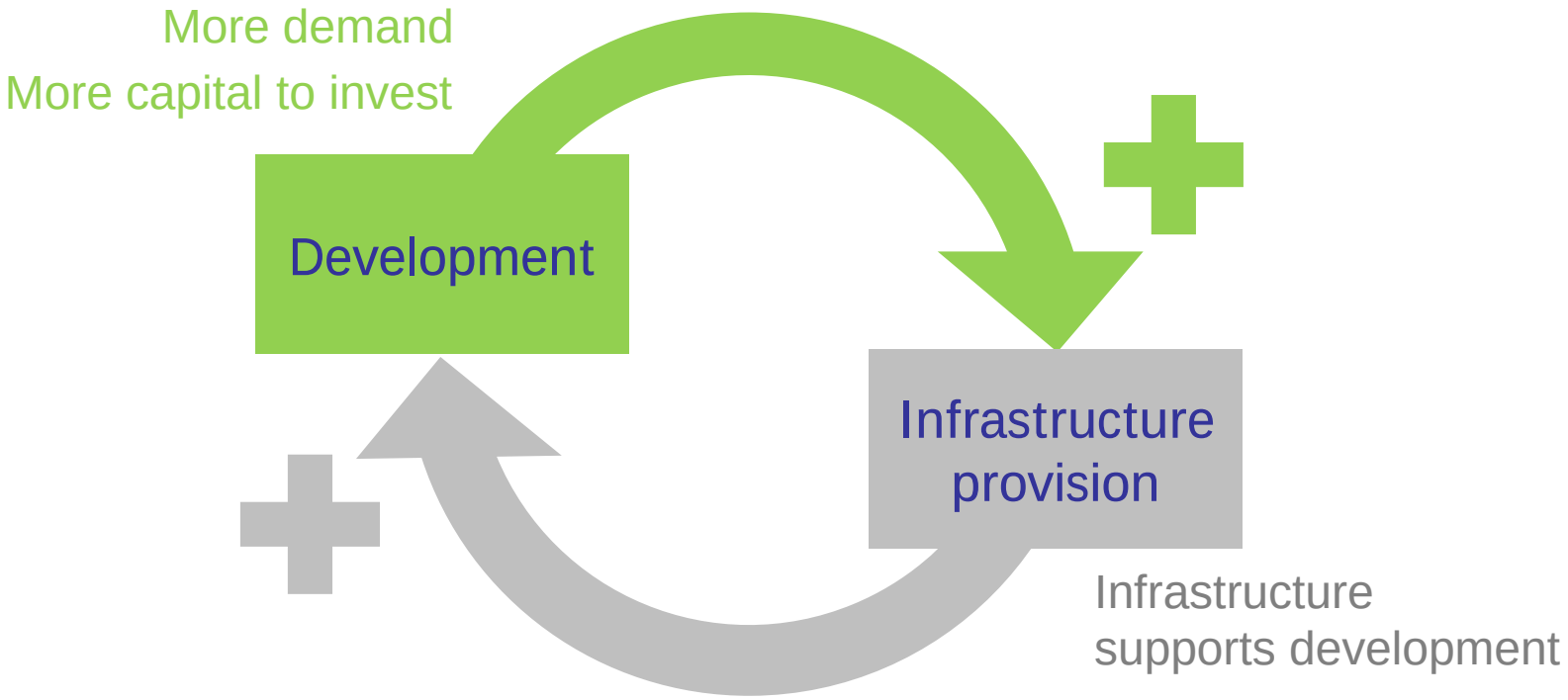
United Utilities
helping life flow smoothly
Anna Provost
Derek Clucas

SEVERN TRENT WATER
Mark Jones

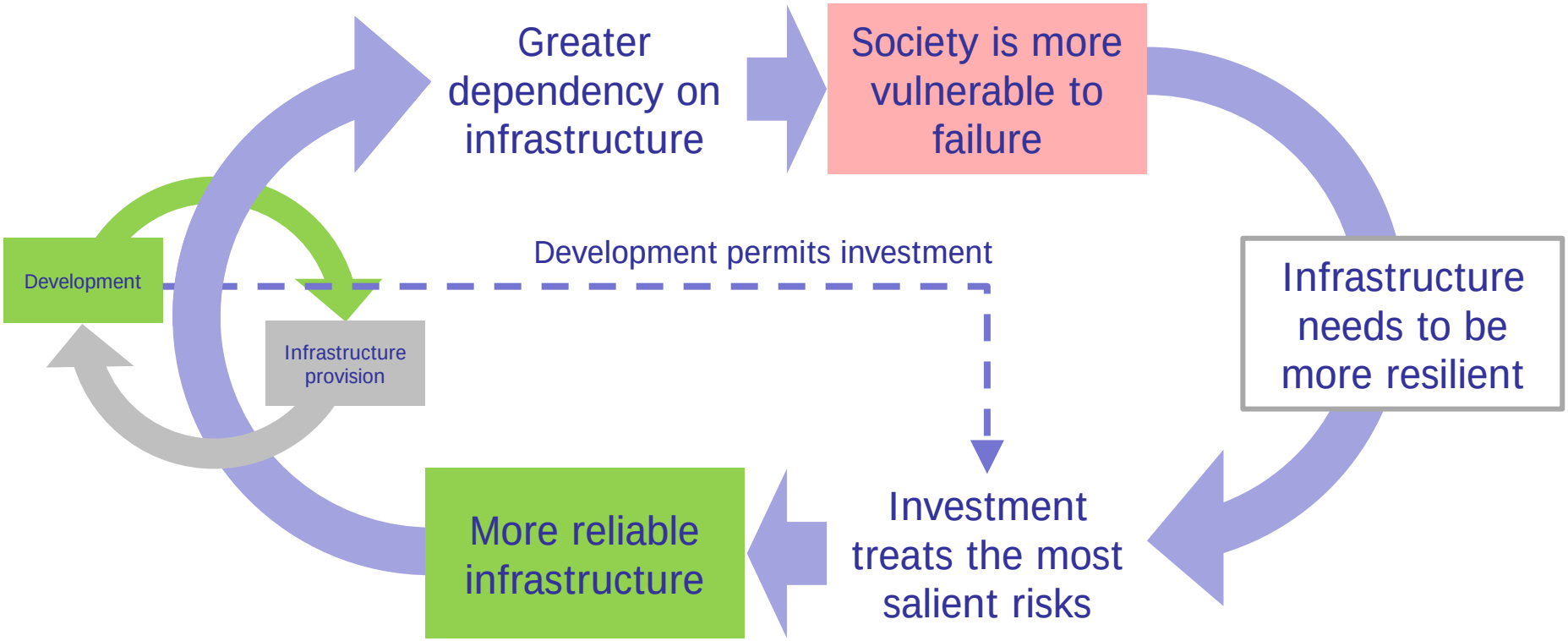
The challenge facing infrastructure risk managers

EPSRC Engineering and Physical Sciences Research Council
stream The Industrial Doctorate Centre for the Water Sector
Newcastle University
United Utilities helping life flow smoothly
SEVERN TRENT WATER
YorkshireWater

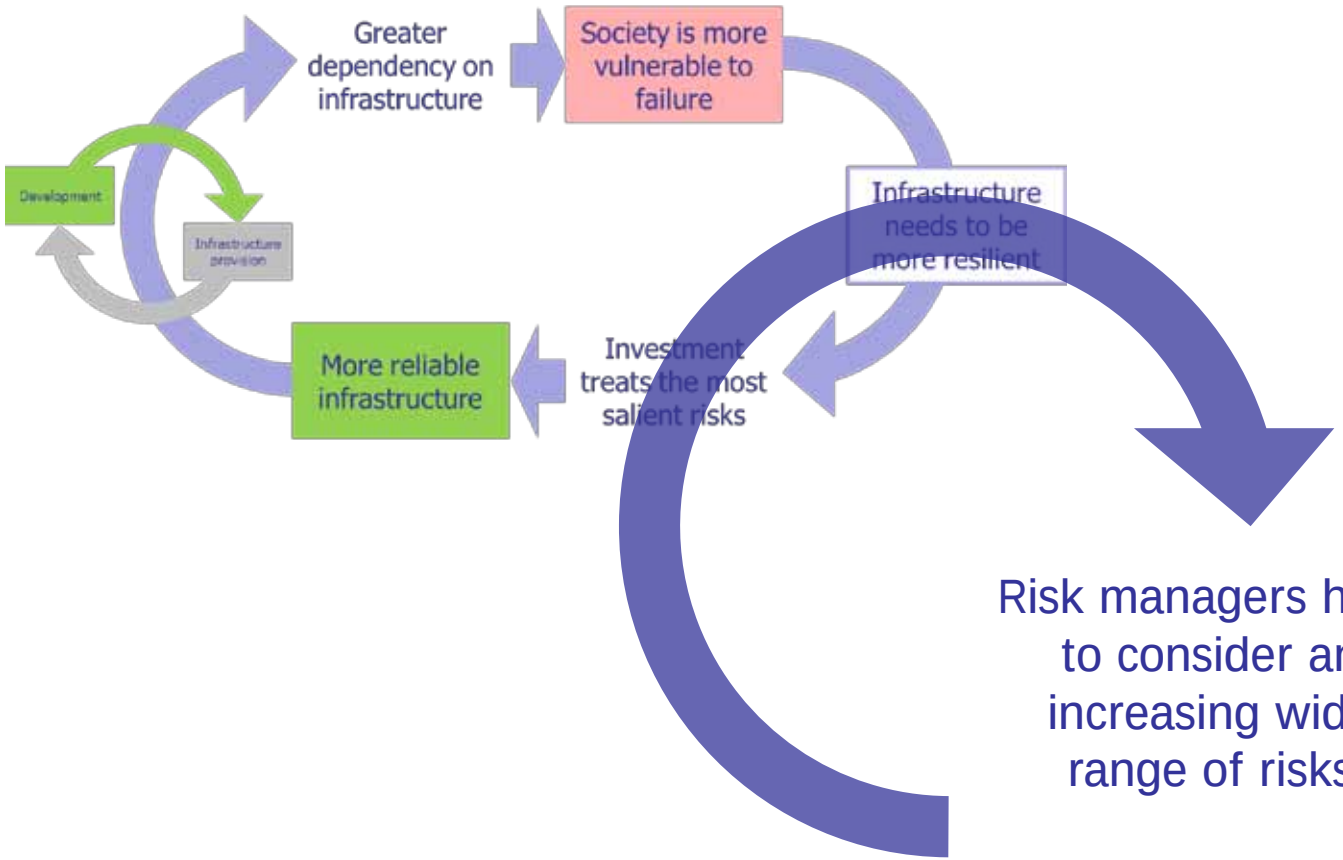
The Risk Manager's Challenge:
Development & Infrastructure



The Risk Manager's Challenge:
Vulnerability & Resilience

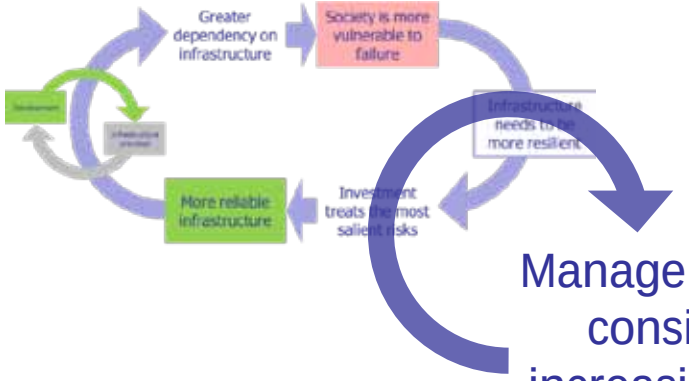


The Risk Manager's Challenge:
Risk Identification



Risk managers have to consider an increasing wide range of risks

The Risk Manager's Challenge:
Risk Selection



Managers have to consider an increasingly wide range of risks

They cannot assess every risk in detail

Their selection process must be robust and accountable


Photo: Kyodo/Reuters

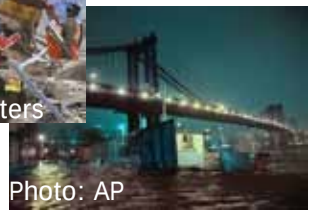


Photo: AP


Photo: Daily Telegraph

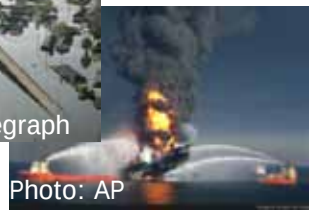


Photo: AP

Alternative approaches to selecting risks

1. Likelihood vs. Consequence

2. Subjective appraisal of uncertainty

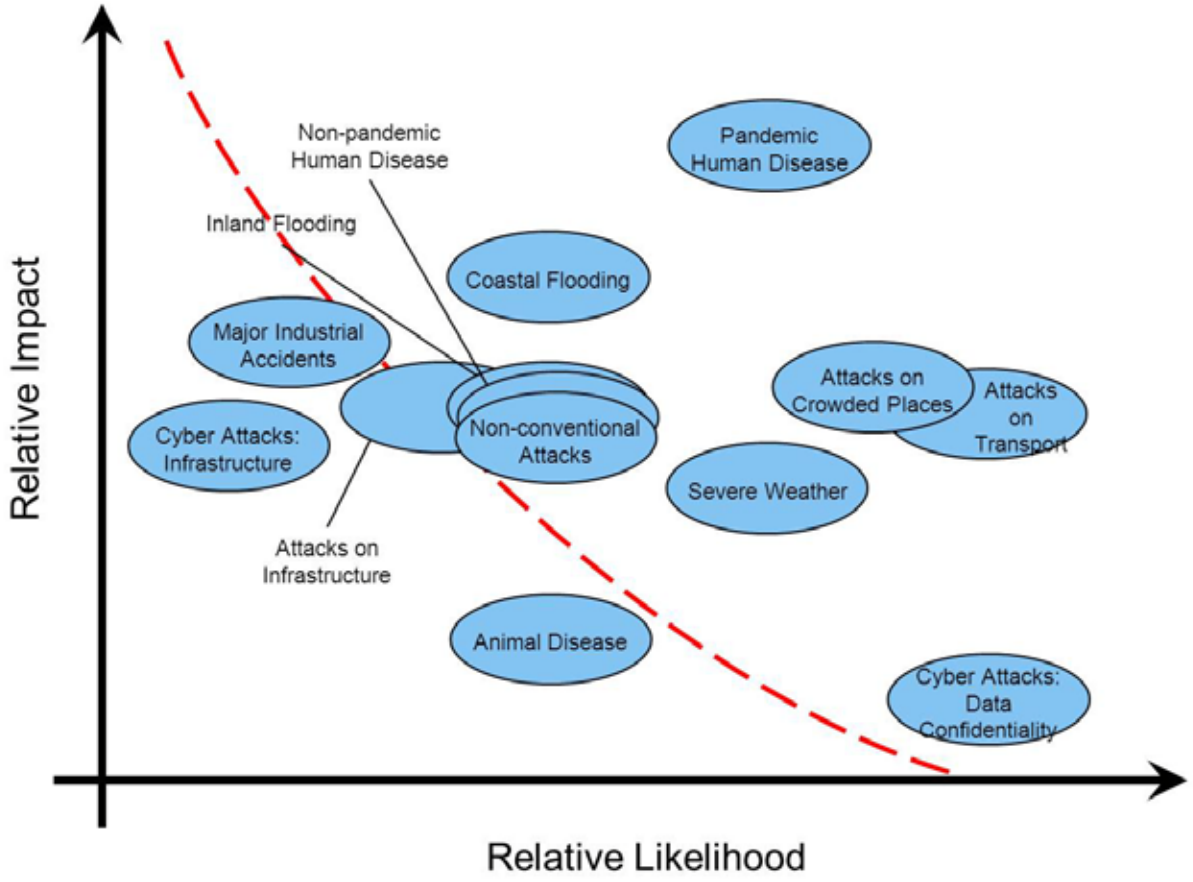
3. Formalised appraisal of uncertainty

EPSRC Engineering and Physical Sciences Research Council
stream The Industrial Doctorate Centre for the Water Sector
Newcastle University
United Utilities helping life flow smoothly
SEVERN TRENT WATER
YorkshireWater

Likelihood vs. Consequence

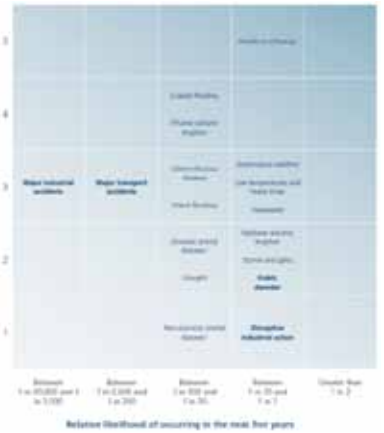
EPSRC Engineering and Physical Sciences Research Council
stream The Industrial Doctorate Centre for the Water Sector
Newcastle University
United Utilities helping life flow smoothly
SEVERN TRENT WATER
YorkshireWater

Approaches to selecting risks:
Likelihood versus Consequence

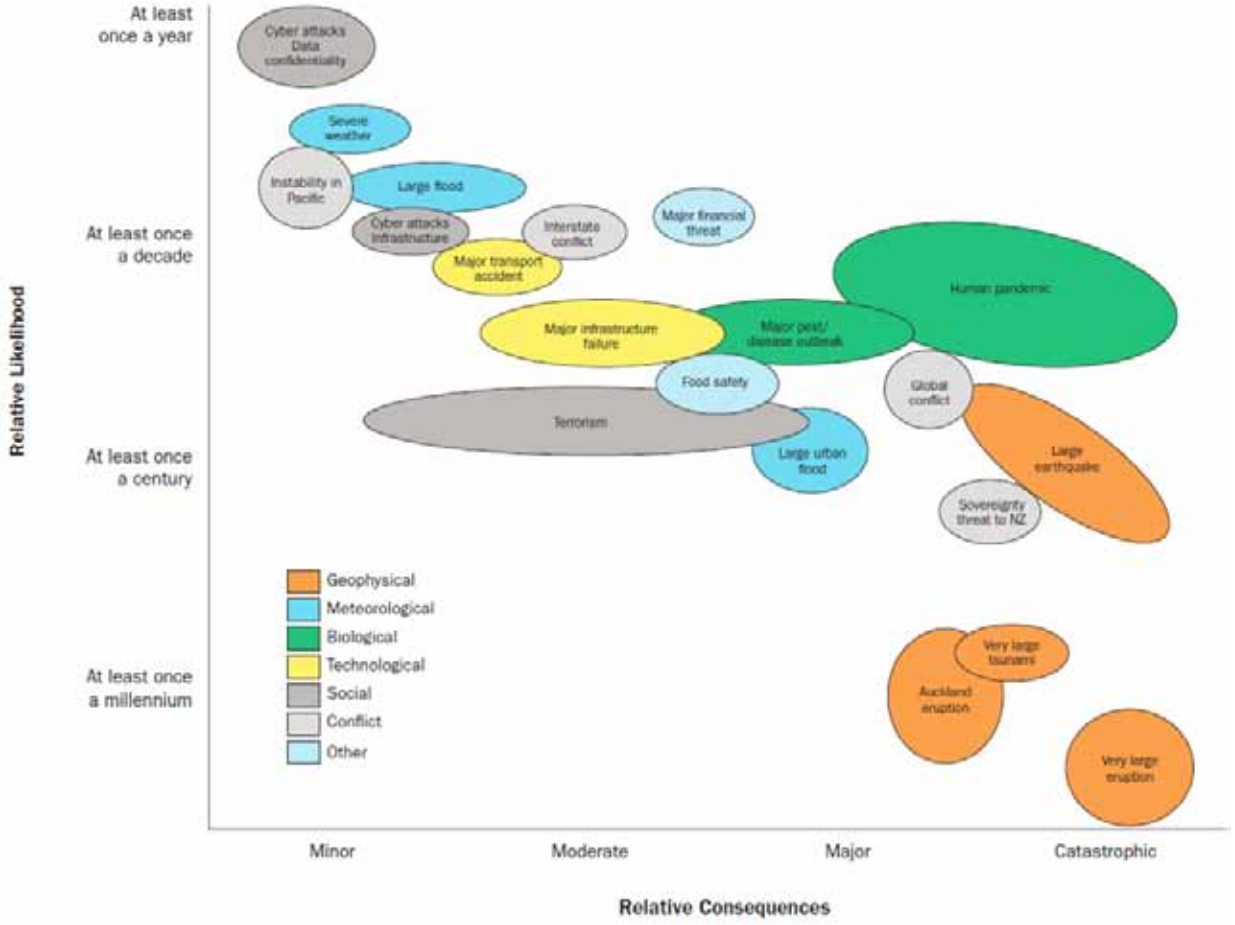


High consequence risks facing the United Kingdom
(after UK Cabinet Office 2010, red line added)

Risks of natural hazards and major accidents
(UK Cabinet Office 2012)



Approaches to selecting risks:
L vs. C, with uncertainty



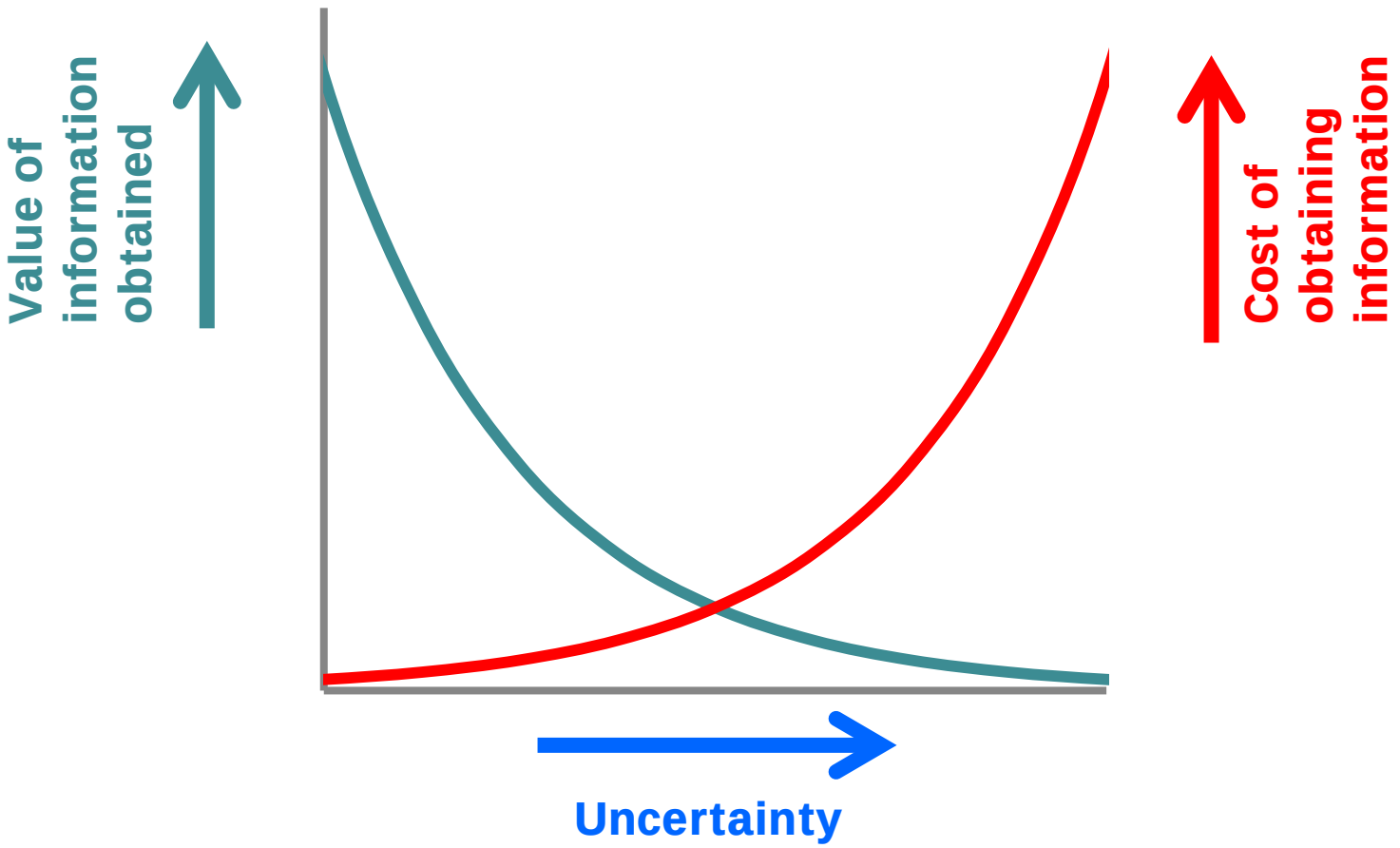
Indicative National Risks

N.B. Axes reversed compared to the UK version (IPENZ 2012)

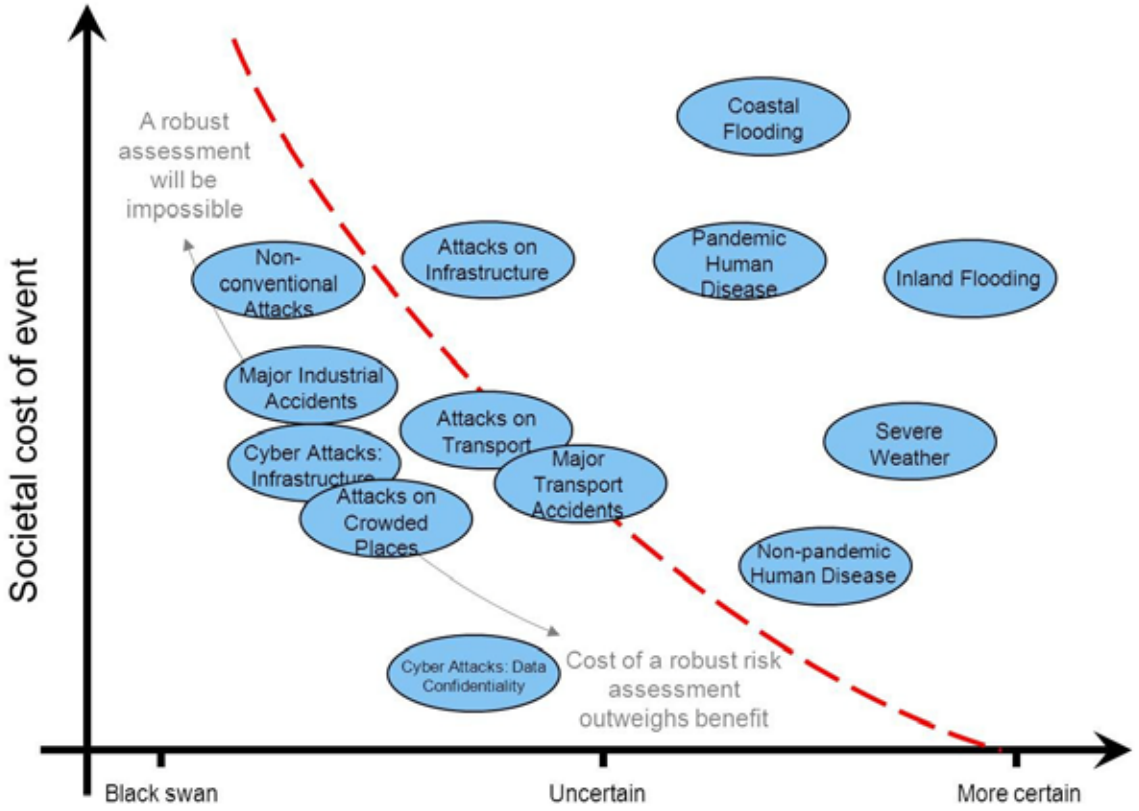
Subjective Appraisal of Uncertainty

EPSRC Engineering and Physical Sciences Research Council
stream The Industrial Doctorate Centre for the Water Sector
Newcastle University
United Utilities helping life flow smoothly
SEVERN TRENT WATER
YorkshireWater

The problem with highly uncertain appraisals



Approaches to selecting risks:
Subjective Appraisal of Uncertainty



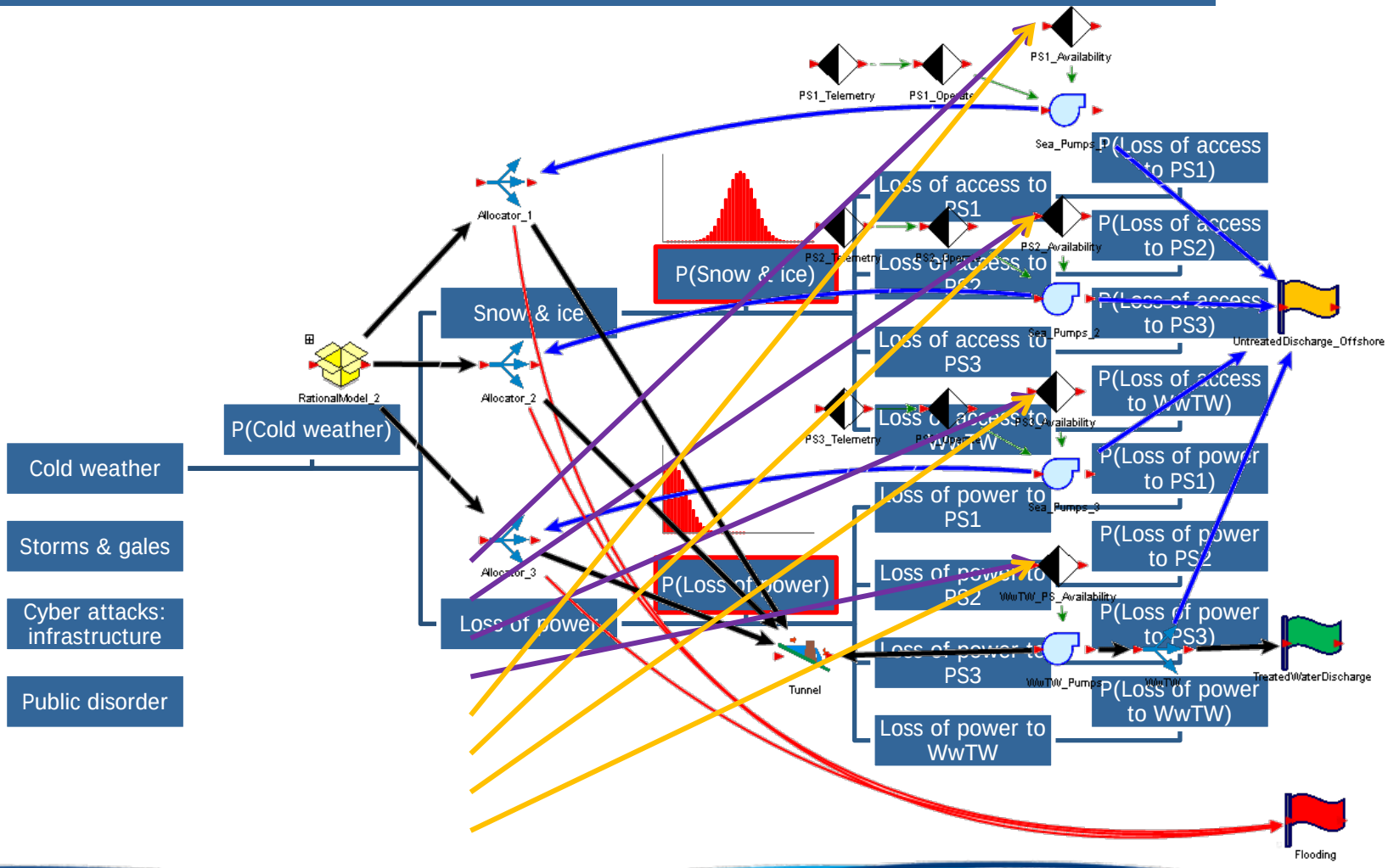
Risk selection based upon the uncertainty of the probability assessment

(adapted from the UK Cabinet Office diagram in slide 9)

Formal Appraisal of Uncertainty

EPSRC Engineering and Physical Sciences Research Council
stream The Industrial Doctorate Centre for the Water Sector
Newcastle University
United Utilities helping life flow smoothly
SEVERN TRENT WATER
YorkshireWater

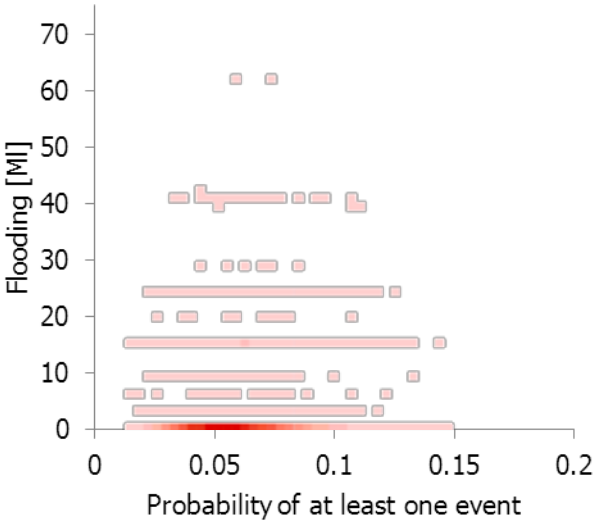
Approaches to selecting risks:
Formalised Appraisal of Uncertainty

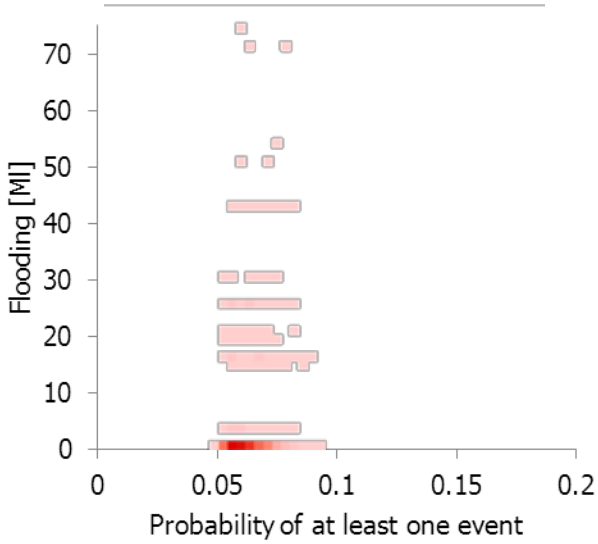


Approaches to selecting risks: **Results**

Storms & Gales

- High risk
- Large spread of results: low precision



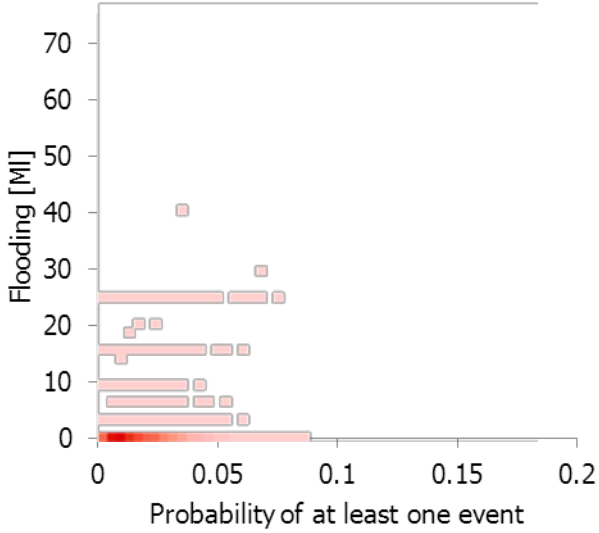


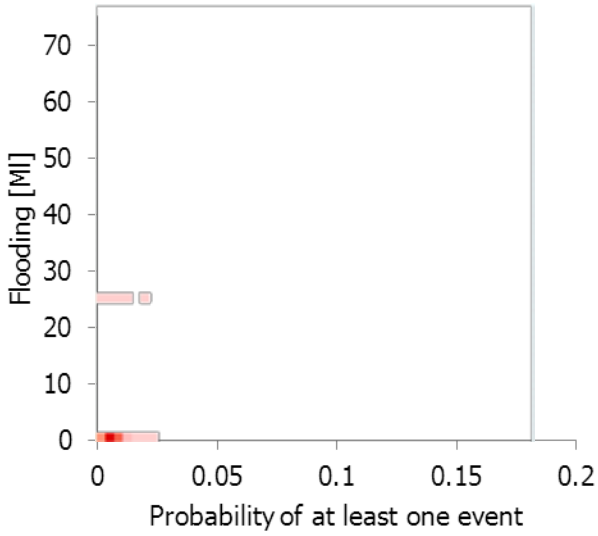
Cold Weather

- Medium – high risk
- Probability restricted to a narrow band

Cyber Attacks: Infrastructure

- Low risk
- Large uncertainty

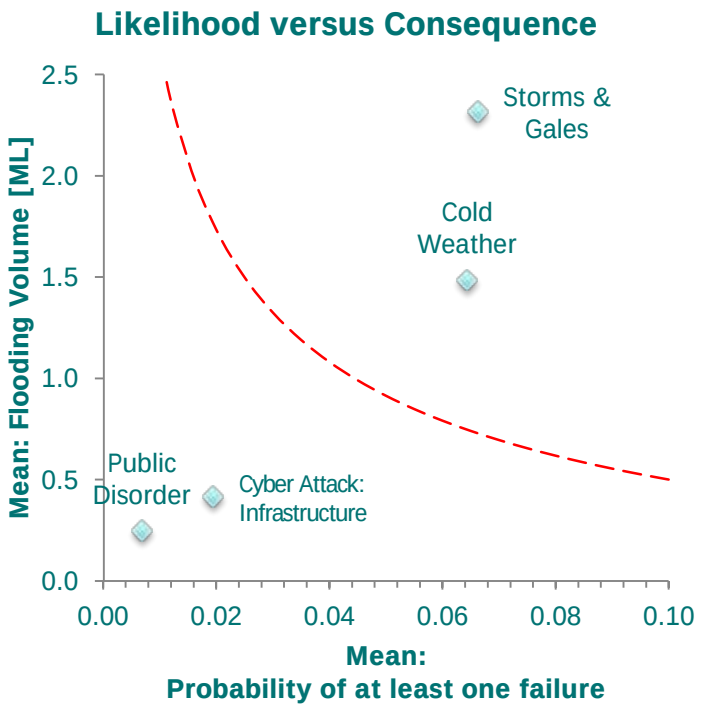


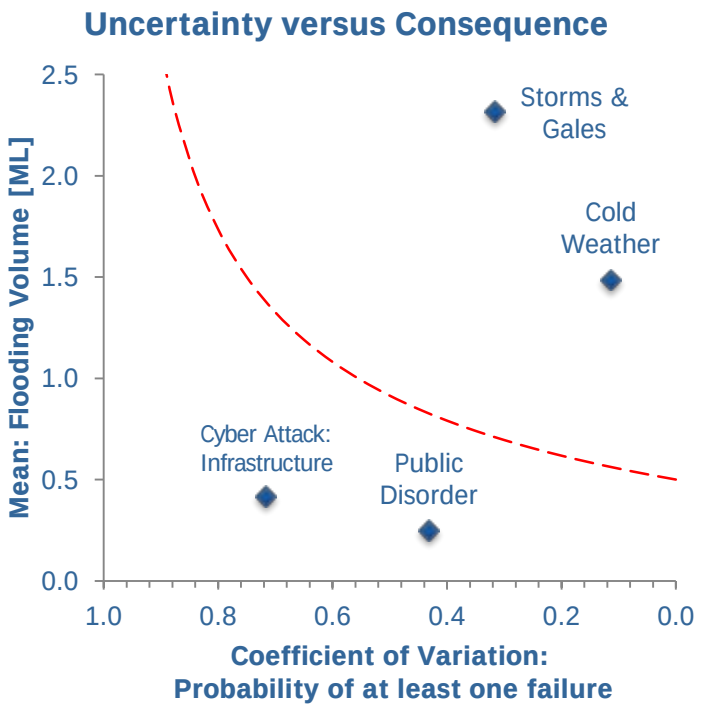


Public Disorder

- Very low risk
- Low uncertainty (only 1 failure mode)

Approaches to selecting risks:
Comparison with Likelihood vs. Consequence





- Does the new information materially affect the selection?
- Is this extra information worth the extra effort?
- How reliable is a risk manager's judgement?

Discussion & Conclusion

EPSRC Engineering and Physical Sciences Research Council
stream The Industrial Doctorate Centre for the Water Sector
Newcastle University
United Utilities helping life flow smoothly
SEVERN TRENT WATER
YorkshireWater

Discussion

1. Omitting uncertainty at the risk screening phase is not inherently flawed.

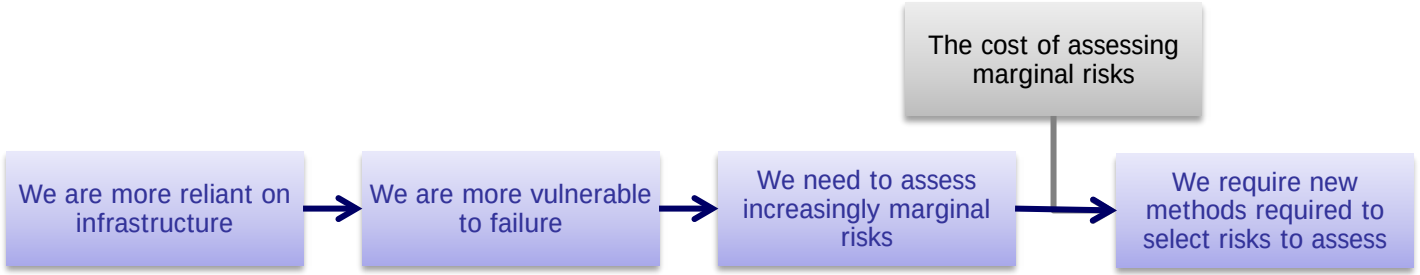
2. However, it misses an opportunity to justifiably eliminate some risks whose assessment adds little value.

3. Incorporating subjective information on the uncertainty over probability is more perceptive, but subjective and opaque.

4. Formalising this process reduces opacity, but the extra complexity and cost may exceed the value of the new information.

Conclusion

1.



2. The more formal appraisal of uncertainty is interesting but flawed because:
   a) It does not eliminate subjectivity, just moves and exposes it.
   b) The effort required to do it is self-defeating, given we are looking for new ways to screen risks.

3. Therefore, the subjective appraisal looks the most promising approach.

Thank you

Any questions?

matthew.holmes@stream-idc.net

References:

Cabinet Office (2011) Keeping the country running: natural hazards and infrastructure. London: Cabinet Office.

Cabinet Office (2013) National risk register of civil emergencies 2013 edition. London: Cabinet Office.

IPNEZ (2012) A safer New Zealand: reducing our exposure to natural hazards. Wellington: IPENZ

EPSRC Engineering and Physical Sciences Research Council

stream The Industrial Doctorate Centre for the Water Sector

Newcastle University

United Utilities helping life flow smoothly

SEVERN TRENT WATER

YorkshireWater