



Natural Environment Research Council's (NERC) Environmental Risks to Infrastructure Innovation Programme survey

Output from workshop held on June 24, CIRIA offices, London

SUMMARY

A workshop was held on 24 June 2014 which included representatives from a number of asset owners and their supply chain. A list of participating organisations is shown in Appendix 1.

The workshop considered four broad topic areas as indicated in Box 1 below. These had been selected on the basis of a pre-meeting questionnaire seeking views from participants. Recognising that the four selected topics were not mutually exclusive and that there would inevitably be a degree of crossover, each was handled and discussed separately.

Topic 1 - FREQUENCY AND INTENSITY OF WEATHER EXTREMES Topic 2 – MULTI-HAZARD COMBINATIONS Topic 3 - FLOODING, STORMS AND PRECIPITATION Topic 4 - OTHER TOPICS
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The discussion for each topic was framed around two questions:

- What are the key decisions or questions you have as operators/owners/advisors relating to this topic
- What type of information do you need from the research base to support these decisions?

The Aim of these sessions were to identify and agree a number of “subjects” that could be discussed in more detail at a subsequent meeting with representatives from the academic and wider research communities to be held on 8 July.

The discussion took the form of group working resulting in a range of individual comments and points being captured. These were clustered and presented at a subsequent plenary discussion during which “subjects” were identified and captured on flipcharts. The flipcharts, together with associated points from the group working session are transcribed in Appendix 2.

As anticipated, there is a degree of synergy in the resulting “subjects” from each of the four topics. Following the meeting, “subjects” from across the four topics were drawn together to form five potential “key discussion areas” for Meeting 2 (See Section 1). The “subjects” in Appendix 2 have been re-grouped under these five areas in Appendix 3 for cross-reference purposes only.

KEY DISCUSSION AREAS ARISING FROM REVIEW OF WORKSHOP 1 OUTPUTS

Appendix 2 shows the “subjects” discussed under each of the four topics introduced at the workshop. As anticipated, there are synergies between these “subject” areas” and these have been drawn out together as five cross-cutting Key Areas in the table below. These five key areas will form the input to the second Workshop to be held on July 8.

<p>KEY AREA 1</p> <p>Understanding variability and chronology in extreme events</p> <p><i>For further details see Appendix 2 key topic items: 1B, 4C</i></p>	<p>This discussion recognised that a range of hazard scenarios needed to be considered</p> <ol style="list-style-type: none"> 1. Extreme events (especially low probability high consequence events) 2. Environmental conditions were changing over time (trends) and often varied considerably over shorter periods (e.g. daily). These had the potential to affect infrastructure ranging from sensitive instrumentation to larger structures. 3. Changes in operational practices re resistance/recovery depending on magnitude of impact
<p>KEY AREA 2</p> <p>Hazard combinations and impacts</p> <p><i>For further details see Appendix 2 key topic items: 1C, 2C</i></p>	<ol style="list-style-type: none"> 1. Combinations of events occurring together or in succession (e.g. heavy rainfall following a long dry spell) <p>Inter-dependencies were also considered e.g. the effects on land stability on prolonged dry periods</p>
<p>KEY AREA 3</p> <p>Incorporating uncertainty in design, operational and investment decisions</p> <p><i>For further details see Appendix 2 key topic items: 1D, 2B</i></p>	<p>This discussion considered how uncertainties in statistical data (e.g. time series / joint probabilities) can be incorporated into design, operational and investment decisions.</p> <p>It recognised that different investment and business models might need to be developed. The approach to combinations of events as identified in Key Area 2 was also discussed, as were “trigger” points that might lead to a change in approach (e.g. from measures to increase resistance to an approach that ensures that there can be quick recovery).</p>
<p>KEY AREA 4</p> <p>Supply chain resilience</p> <p><i>For further details see Appendix 2 key topic items: 2D, 4A</i></p>	<p>This discussion considered the resilience of an asset owner’s supply chain to environmental hazards, combinations and successions thereof, both in a national and international context</p> <p>What techniques, data and tools were available to ensure that contingency arrangements were adequate?</p>
<p>KEY AREA 5</p> <p>Flooding, storms and precipitation</p> <p><i>For further details see Appendix 2 key topic items: 3A, 3B, 3C, 3D</i></p>	<p>The suggestions discussed under the flooding topic recognised that there was already a significant body of research underway and/or completed. It was considered that a key action for this area would be to signpost / summarise these different programmes and projects which were being undertaken across the research councils and elsewhere.</p> <p>Other topics included</p> <ul style="list-style-type: none"> • The use of groundwater modelling data, particularly the potential for applying it to “local scale” problems • Secondary consequences of hazards e.g. the effect on ground stability on prolonged dry periods • Ecosystem services and blue/green infrastructure approaches to flood hazard mitigation. <p>Note: topics related to extreme rainfall etc. would be covered in Key Area 1</p>

A sixth area was discussed in the workshop. However, in consultation with NERC, it was suggested that this should not be considered as a “stand-alone” topic, but rather specific needs for data identified within the other 5 identified Key areas.

<p>KEY AREA 6</p> <p>Data to support decision-making</p> <p><i>For further details see Appendix 2 key topic items: 1A, 2A, 3A, 4B</i></p>	<p>This discussion recognised the different types of data information required depending on the level of decision being taken and the severity of any associated event or risk.</p> <p>It explored the feasibility of better availability and sharing of data between different parties – whether they are different asset owners or different stakeholders associated with a particular asset owner</p> <p>The emphasis was on having sufficient data to support the required decision rather than focussing on the creation of perfect, complete datasets</p>
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APPENDIX 1
Workshop attendance

Name		Company
Kate	Avery	Network Rail
Pietro	Bernadara	EDF Energy
Ruth	Boumphrey	Lloyds Register Foundation
Alison	Brown	Shell
Greg	Chant-Hall	Skanska Infrastructure
Louise	Clarke	CIRIA
Sirio	DAleo	CIRIA
Geoff	Darch	Atkins
John	Dora	IOAF
Eyram	Fiadzigbey	AECOM
Fai	Fung	Environment Agency
John	Gillard	NERC
Steve	Hill	Severn Trent Water
Owen	Jenkins	CIRIA
Ben	Kidd	CIRIA
Shanti	Majithia	National Grid
Paul	Marshall	Highways Agency
Robert	O'Brien	BP
Richard	Ploszek	Infrastructure UK (HM Treasury)
Arefa	Siddiqi	HS2 Limited
Jonathan	Simm	HR Wallingford
Robyn	Thomas	NERC
Sally	Watson	Mott MacDonald

APPENDIX 2

Transcript of flipchart notes plus associated points recorded during the group working and discussion session

TOPIC 1 - FREQUENCY AND INTENSITY OF WEATHER EXTREMES		
	Decision to be supported / Question that need answering	Types of information needed to support these decisions / questions
1A	Data sharing	<ul style="list-style-type: none"> • Cross-sector data sharing / Open data source between infrastructure operators and research centres etc. • Data sets tailored to decision makers e.g. “Gold Command” during an extreme event or operators in less severe events • Focus needs to be on providing sufficient data for decision support and not on 95%+ accuracy
1B	Understanding extremes and responses	<ul style="list-style-type: none"> • Durations v intensities • Note large difference can occur over a day • Effects on sensitive equipment etc. • Tipping points (intervention points) – when does it cease to become practical to implement measures to deal with repeating occurrences and when is major upgrade necessary • Which parts of the infrastructure are <u>unlikely</u> to fail
1C	Understanding variability and chronology	<ul style="list-style-type: none"> • As well as joint probabilities, understand how a sequence of weather phenomena can impact infrastructure. Not necessarily extremes – e.g. prolonged dry spell followed by intense storms
1D	Design and assessment methodology	<ul style="list-style-type: none"> • Design philosophy for multi-event resilience i.e. a succession of events not just joint probability of simultaneous occurrence • Changes in average and extremes e.g. wind, waves, rainfall etc. and how to accommodate

TOPIC 2 – MULTI-HAZARD COMBINATIONS		
	Decision to be supported / Question that need answering	Types of information needed to support these decisions / questions
2A	Understanding impacts and interdependencies across and within sectors Identifying vulnerable and non-vulnerable assets	<ul style="list-style-type: none"> • Data to support decision-making • Access to cross disciplinary data / Shared information across data and asset owners • Understanding opportunities and constraints to shared data access • Understanding critical points across where infrastructures are interdependent – e.g. flooded road prevents access to emergency pumping equipment. • Critical infrastructure mapping
2B	Planning for future infrastructure investments and operation (understanding and changing business models)	<ul style="list-style-type: none"> • Understanding uncertainty (including climate change) and how this can be taken into account in investment and long-term operational decisions • Understanding how infrastructure impacts might change over the course of a long event – e.g. lightning strike during storm, river flooding characteristics, subsequent groundwater flooding etc.
2C	Emphasis on science <ul style="list-style-type: none"> • Multiplier effect • Joint events • Probability 	<ul style="list-style-type: none"> • Do infrastructure systems rely on the same technology e.g. Global Navigation Satellite systems • Probabilities of joint events • Low probability – high impact joint events • Information on probabilities to support asset operator decision-making • The Swiss-cheese effect i.e. system deals with a succession of “local” failures, but collapse will occur when there is a critical mass.
2D	International aspects	<ul style="list-style-type: none"> • Dependencies from outside UK e.g. energy supply etc. • How vulnerable are these to environmental risks / combinations

TOPIC 3 - FLOODING, STORMS AND PRECIPITATION		
	Decision to be supported / Question that need answering	Types of information needed to support these decisions / questions
3A	Flood risk data (including groundwater) <ul style="list-style-type: none"> Scalability and applicability of use from national to local use 	Linked to this is the associated appropriate use by infrastructure clients (including in design and operation of infrastructure)
3B	Factors affecting land stability e.g. drought and secondary effects	Secondary effects on infrastructure, potentially building on existing EPSRC research but utilising BGS datasets and expertise
3C	Opportunity to manage water cycle differently e.g. ecosystem services (robustness of infrastructure)	Innovative opportunities associated with environmental risks to infrastructure, for example adoption of 'ecosystem services' and blue/green infrastructure approaches, linked to the future resilience/robustness of infrastructure
3D	Synergies with existing research <ul style="list-style-type: none"> Synthesising what's been done or underway 	Including LWEC Flood Research Strategy, EA/Defra Flood and Coastal Erosion Risk Management (FCERM) Research & Development Programme, to review opportunities for adding value via collaboration with NERC funded centres/research

TOPIC 4 - OTHER TOPICS		
	Decision to be supported / Question that need answering	Types of information needed to support these decisions / questions
4A	Supply chain resilience and diversity	How vulnerable supply chain to climate hazards <ul style="list-style-type: none"> Risk register How many spares to carry Alternative Interconnections
4B	Data and tools available to change a decision (right language for different audience)	Quantification of future risk Validation (uncertainty) Info shared between asset owners / supply chains / stakeholders and public
4C	When is it resilience and when recovery? (resilience: preparation + resistance + recovery + adaptation)	How do we characterise them? How do we identify and understand them? How do we manage them? In some situations recognising that first practical intervention will be recovery