

Adaptation research issues: Buildings and infrastructure

LUC

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Summary

The recently-published Climate Change Risk Assessment 2017 Evidence Report – Summary for Scotland (CCRA), and the independent assessment of Scotland's Climate Change Adaptation Programme (SCCAP), point to a range of key uncertainties and risk.

Building on direct engagement with key sectoral stakeholders, this paper sets out potential areas where research might support the process of developing the second SCCAP.

Research priorities

Priorities are grouped by broad theme, responding to the research priorities in the Independent Assessment

Infrastructure interdependencies

It is widely recognised that Scotland's infrastructure and built environment is intimately and inextricably interlinked. However, the nature, extent and vulnerability of these interdependencies – and the potential to create **cascading failures** – are not well understood.

Systems modelling and management of risk

Climate change effects have the potential to act as a significant risk multiplier across infrastructure networks, with knock-on effects on people, the economy and the environment. A helpful first step might be to characterise the extent to which this issue is considered by infrastructure providers/operators and policymakers.

Modelling to understanding the susceptibility of infrastructure to the effects of climate change has focused on nationally important, strategic infrastructure. However, the majority of Scotland's road network is managed by local authorities – some of which is likely to be at significant risk of flooding.

Research priorities

- Carry out a comparative analysis of existing approaches to climate risk and (inter)dependency identification and management applied across Scotland's built environment and infrastructure sectors to gauge compatibility, conflicts, barriers and opportunities for delivering adaptation.

- Using a case study approach, and working closely with existing research projects based around the impacts of ‘Storm Frank’ in December 2015¹, model the susceptibility of local road and rail infrastructure to flooding and coastal erosion to:
 - understand the extent of local authority and rail network exposure to risk; and
 - the existing adaptation responses.
- Scope a study on the likely impact of the ‘rural multiplier effect’ on climate change impacts, interdependencies and the costs of recovery.

Flooding and coastal erosion risk management

Modelling flood risk and flood effects

The availability of high quality probability-based flood risk modelling at the national scale is a significant benefit. The 2014 iteration of the SEPA flood risk maps help to promote adaptation by building in allowances for the effects of climate change.

Increasing severity of extreme rainfall and flood events have significant potential to damage infrastructure as a consequence of increased flows and increased erosive power. There is considerable uncertainty with regard to likely spatial distribution of risk and effects. This research identified would benefit from being based on UKCP18 data, particularly in regard to regional level data, and would as such not be possible to deliver on a timescale relevant to the SCCAP process.

Research priorities

- Scope data requirement on higher probability, lower magnitude flood and erosion events to assist stakeholders in planning for relatively frequent – but potentially disruptive – events.
- Scoping study to assess the available data on frequency and spatial distribution/clustering of flooding arising from recent severe weather events, and their implications for approaches to flood defence and community resilience.
- Using case study catchments with available data (e.g. Tarland project in Aberdeenshire), deliver a scoping study to understand the potential effects of predicted climate change on the flow rates and erosive potential of rivers, and the potential effects on in-channel and proximal infrastructure².
- Taking a case study approach in a known high risk area, assess the exposure of bridges on local road networks to risks associated with high flows (e.g. scour and debris collision), to understand the nature and scale of potential impacts – and effects on wider resilience.

Development in flood risk areas

National planning policy (SPP) with regard to development in flood risk areas is robust and, broadly, effective. However, at the local level recent research³ has identified challenges in both development planning and development management processes. Research focused on existing processes has potential to support the ongoing programme of reform to the Scottish planning system.

¹ Significant impacts in Aberdeenshire, Scottish Borders and Dumfries and Galloway

² This would include, for example: bridge cutwaters, abutments, wing-walls; engineered flood defences; access infrastructure; sewer outfalls etc.

³ LUC (2016) *Assessing the consideration of flood risk by Scottish local planning authorities*, ClimateXChange: Edinburgh

Research priorities

- Concept paper to explore the use of ‘development in the floodplain’ and ‘development at risk of flooding’, identifying key risks and uncertainties for policymakers, providing clarity for stakeholders and with potential to agree shared definitions.
- Scoping study to explore existing processes for development management data collection methodologies and management practices in local authorities, and how these might be practically improved to support the ability of this data to be collated to support a national indicator on ‘development at risk of flooding’.

Risks to culturally valued structures and the wider historic environment

Heritage assets are a fixed, finite resource. Large numbers of designated (and many more non-designated) assets are potentially at risk of significant damage as a consequence of flooding and coastal erosion. On Scotland’s local road network, and the rail and canal network, many river crossing points are in themselves highly significant heritage assets as well as critical pieces of infrastructure⁴. Adaptation of heritage assets needs to be carefully planned to conserve their cultural significance, and a strategic approach is required to understand the level of threat to this component of our historic environment.

Research priorities

- Scoping study to refine CXC BB6 ‘Cultural heritage in flood risk area’ / SCCAP indicators BE4 / FL15 focused on critical infrastructure and implications for community resilience during an extreme weather event

Surface water and sewer flooding

With projected increases in peak rainfall volumes and intensity, managing surface water is likely to be a key challenge for infrastructure and the built environment. Sustainable Drainage Systems (SuDS) have been a statutory requirement for several years, and an assessment of policy effectiveness, considering location, design, maintenance and resilience would be timely. In addition, roofing, rainwater goods, streetscapes and stormwater drainage should act as a unified system.

Challenges also exist in sewer flooding, particularly for older ‘combined sewers’. Carrying capacity, flow rates, maintenance requirements and the effects of updated climate/weather projections need to be better understood – along with the relationship with above-ground water management infrastructure (e.g. SuDS).

Research priorities

- Using a case study approach, focusing on an area with known vulnerabilities, evaluate the impact of current practice of streetscape change on water management and flow pathways. (Leith Walk in Edinburgh is a potential example)
- Evidence assessment of existing knowledge on the engineering and systemic issues associated with sewer flooding.
- Scoping research, using a case study approach focused on two or three local authorities, to understand how information on SuDS installations is retained and used to secure and fund appropriate management, monitoring, maintenance and protection of devices.

⁴ for example: [General Wade’s Bridge, Aberfeldy](#) (1733), Category A-Listed designed by William Adam; [The Mound bridge and tidal barrier, Loch Fleet](#) (1815-18), Category A-Listed, built by Thomas Telford

Resilience of buildings to extreme wind and rain

In addition to flood risk, there are potential impacts from severe weather events, through intense rainfall and high winds, higher humidity and extreme temperatures for Scotland's buildings and infrastructure. Understanding the relationship between the identified nationwide deficiency in building maintenance⁵ and vulnerability to climate change effects is important.

Research priorities

- Scoping review to explore potential application of adaptation standards currently being developed by ISO and CEN into Scottish building regulations
- Scoping review to assess the value of, and potential to include, targeted climate change adaptation / adaptability metrics in the Scottish House Condition Survey / Scottish Housing Quality Standard.

Resilience of infrastructure services

Roads and the rail network

While work has been undertaken at the strategic level, information on the exposure of the local road network is variable, particularly for slope instability.

Research priority

- Scoping study to understand the level of exposure of Scotland's road networks to slope instability, to inform understanding of the risk factors, potential impacts and development of appropriate indicators.

Energy networks

Summer drought is already having an effect on the efficacy of run-of-river hydroelectric schemes, and policy responses are partly covered by the draft National Water Scarcity Plan.

Research priorities

- Taking a case study approach focused on, for example the Tummel, Affric-Beaully, or Sloy-Awe scheme catchments, assess the impact of changes to water availability under emerging climate change scenarios, and the risk to generating capacity.

We have also identified a need for scoping research into the projected effects of climate change on overhead electricity and telecommunications lines through increased tree growth vigour and growing season length, and interaction with projected patterns of extreme weather and levels of exposure. This research could inform the development of a national indicator. However, such research would benefit from being based on UKCP18 data, particularly in regard to regional level data.

⁵ The Scottish House Condition Survey (SHCS) provides a useful insight into the critical issue of property maintenance. The 2015 survey indicated that 73% of all dwellings had some degree of disrepair (52% to critical elements; 33% 'urgent'; and 8% extensive disrepair).

Annex: Stakeholder details

Contributed to project

Interviewee	Organisation	Subject Area Expertise
Anna Beswick	Adaptation Scotland	Cross-cutting expertise on adaptation issues / uptake
Peter O'Broin	Airport Operators' Association	Airport operations
Stephen Garvin	BRE	Climate resilience of existing buildings
Richard Taylor	Civil Aviation Authority	Airport regulation
Silke Isbrand	CoSLA	Local authorities
Derek McGlashan	Forth Ports	Port operations
Mairi Davies, Roger Curtis	Historic Environment Scotland	Climate change impacts on heritage assets
Roger Street	Infrastructure Operators' Forum / UKCIP	Climate impacts on infrastructure
David Stewart	Scottish Federation of Housing Associations	Housing associations and environmental management
Gavin Peart	Scottish Government, Building Standards	Building standards
-	Scottish Power Energy Networks	Electricity distribution
Mark Williams, Miranda Jacques-Turner	Scottish Water	Water networks, sewerage
Katherine Lakeman, Alan Speedie, Marion Shoote, Neil Deasley, Fiona McClay	SEPA	Flood risk, flood risk modelling
Graham Edmond, Steven Thomson	Transport Scotland	Transport networks and transport policy

Unable to contribute to project

Organisation	
AGS Airports	Ofcom
BT	Openreach
GIP (Edinburgh Airport)	Scottish and Southern Energy Networks
Network Rail	Scottish Government, Planning and Architecture Division
SGN	