Resilience of emergency responders under extreme flooding scenarios in the City of Leicester, UK

[Poster]

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Resilience of emergency responders under extreme flooding scenarios in the City of Leicester, UK.

Green, D.1 | Yu, D.1 | Wilby, R.1 | Yang, L.2 | Pattison, I.3 | Bosher, L.3 | Ryley, T.3

Department of Geography, Loughborough University | School of Business & Economics, Loughborough University | Civil and Building Engineering Department, Loughborough University

Leicester's transport network is critical for conveying emergency vehicles. Scenario testing using floods of different magnitudes has been conducted to enhance the City's resilience to flooding.

Background

The Principal Urban Area of the City of Leicester, UK, is at risk from surface water (pluvial) flooding caused by intense precipitation events which cannot infiltrate into the sub-surface or drain via storm water systems and fluvial flooding from the River Soar and associated tributaries. Leicester is ranked 16th out of 4,215 settlements assessed in England in terms of its surface water flood risk and the Environment Agency estimate that 36,900 properties (88,560 people; 27% of Leicester's population) are at risk. 26 flood 'hotspots' have been identified across Leicester, including the main hospital, Leicester Royal Infirmary. Leicester City Council have previously considered direct impacts (i.e. areas inundated) but have not studied the indirect, cascading impacts associated with flooding (e.g. disruptions to emergency response times). Ambulance services in the UK are required to respond to 75% of high priority, category 1 incidents in 8 minutes or less. However, this response time may be unachievable under disruptions from flooding.

Project aims

1. Where are the key infrastructural pinch-point/bottleneck locations within the City of Leicester?
2. What are the networked impacts of infrastructural failure on emergency response?
3. How can the emergency management system be made more resilient?

Methodologies - Stakeholder discussions

The Civil Contingencies Act (2004) classifies public services as Category 1 and Category 2 responders. During emergencies (including flood-related incidents), Category 1 responders (Fire & Rescue, Ambulance Service, Police, Hospitals, Environment Agency, City Councils etc.) have a statutory duty to cooperate and put in place multi-agency emergency plans. Category 1 stakeholders were engaged through discussions to enable the co-production of knowledge and to create useful and usable project outputs.

Methodologies - GIS

Ordnance Survey Integrated Transport Network (ITN) and road restriction layers were inputted into ArcGIS Network Analyst to perform shortest path routing of vehicles across the City under normal, unaffected conditions and to create service zones of emergency service stations. Next, Environment Agency fluvial and surface water inundation modelling data under 1 in 20, 1 in 100, 1 in 1,000 year design storm modelled depths were inputted into Network Analyst. A threshold depth of 25cm was set, although just 15cm is advisable not to drive through normally. Areas of inundation exceeding 25cm in depth were then identified and assessed to ensure network restrictions were realistic (i.e. areas surrounding bridges and watercourses). Depths greater than 25cm which intercept the transport network act as network restrictions whereas depths less than 25cm were treated as passable for emergency vehicles. The figure above demonstrates that a 1 in 100 year pluvial flood event affects a large spatial scale and such an event may have significant impacts on emergency response times in Leicester. Emergency vehicles may be unable to reach serious incidents within the Government’s 8 minute target.

Results - Fluvial flood scenarios

Fluvial flooding from the River Soar may severely affect emergency response across the City of Leicester. Parts of Leicester are at risk of high (>100 year) fluvial flood risk which may increase the response times of key emergency responders.

Results - Pluvial flooding

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Conclusions and project outputs

Leicester is at risk from large-scale flood events but has little experience or 'flood memory' of dealing with large events. Currently, Leicester is still in the preparation phase of the emergency response cycle. Emergency services gain knowledge through communicating with forces with hands-on experience, specific water-related incident training and tabletop exercises and flood management documentation.

As an output of this project, a multi-agency flood-oriented tabletop exercise will be arranged for the key stakeholders. This will enhance emergency responder resilience and raise awareness of indirect flood impacts within the City of Leicester.