

Deltares

Quantifying the cascading impacts of disrupted infrastructure



Kathryn Roscoe (together with many others)

November 3, 2021

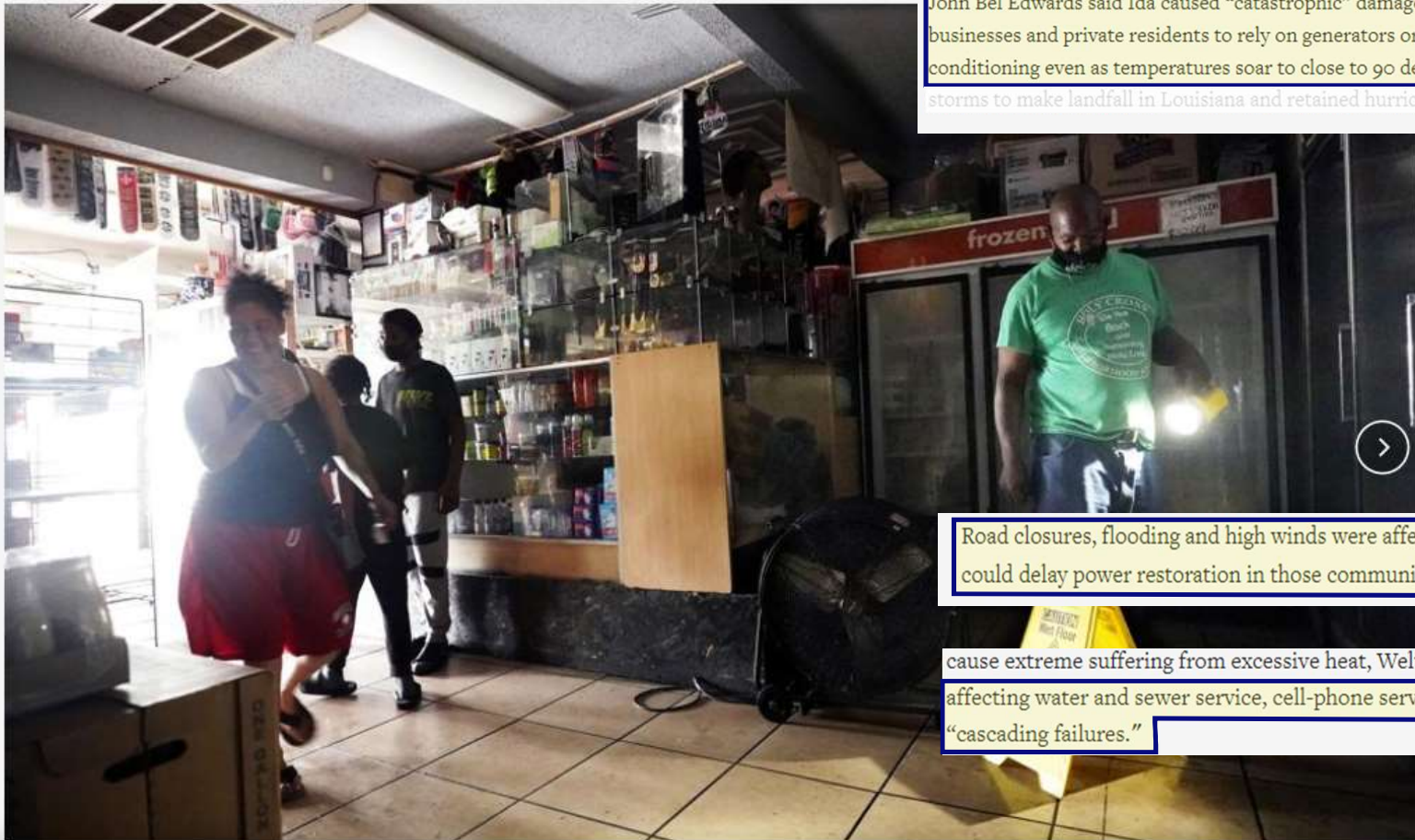
 **enabling delta life**

What are cascading impacts?



EXPLAINER: Hit by Ida, New Orleans faces weeks without power

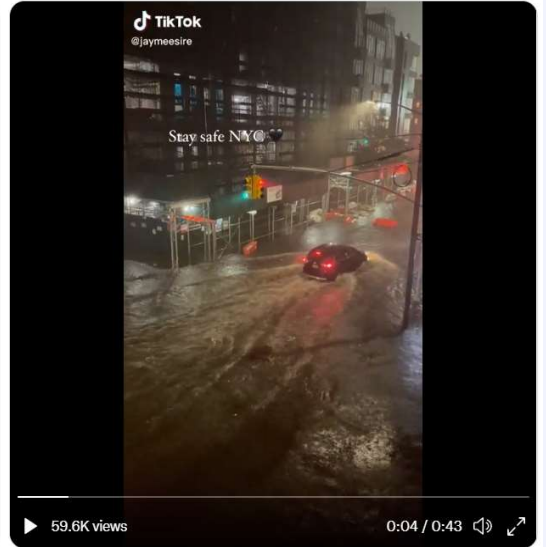
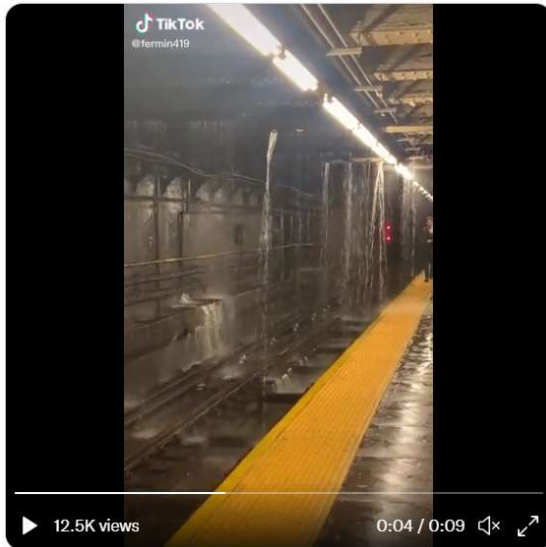
By MATTHEW DALY August 31, 2021



The hurricane blew ashore on the 16th anniversary of Katrina, the 2005 storm that breached New Orleans' levees, devastated the city and was blamed for 1,800 deaths. The office of Louisiana Gov. John Bel Edwards said Ida caused "catastrophic" damage to the power grid, forcing hospitals, businesses and private residents to rely on generators or go without refrigeration or air conditioning even as temperatures soar to close to 90 degrees. Ida was one of the strongest storms to make landfall in Louisiana and retained hurricane status nearly to Mississippi.

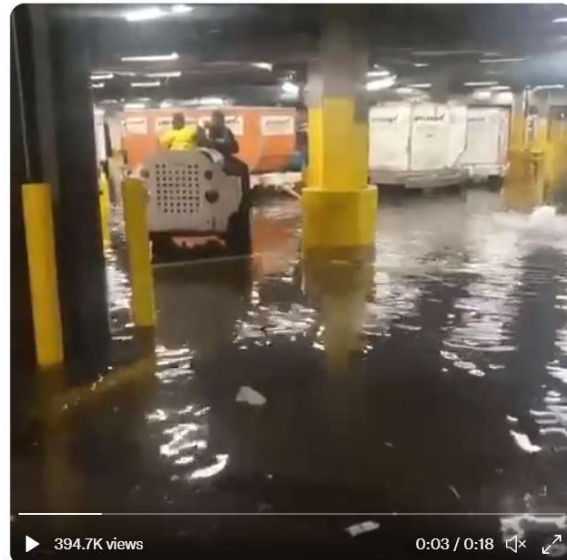
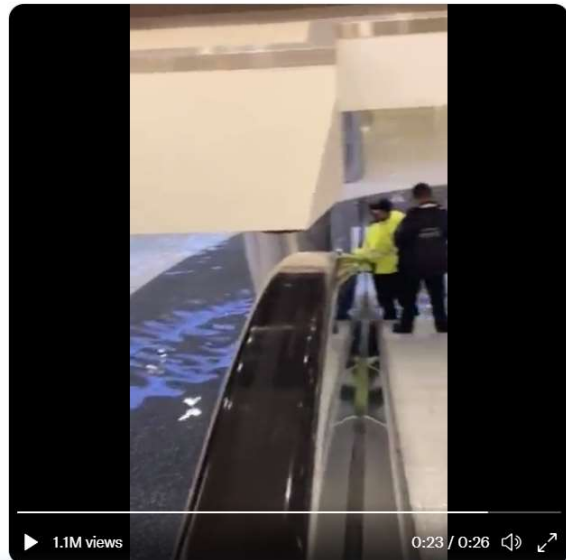
Road closures, flooding and high winds were affecting crews' ability to reach some areas and could delay power restoration in those communities, Entergy said.

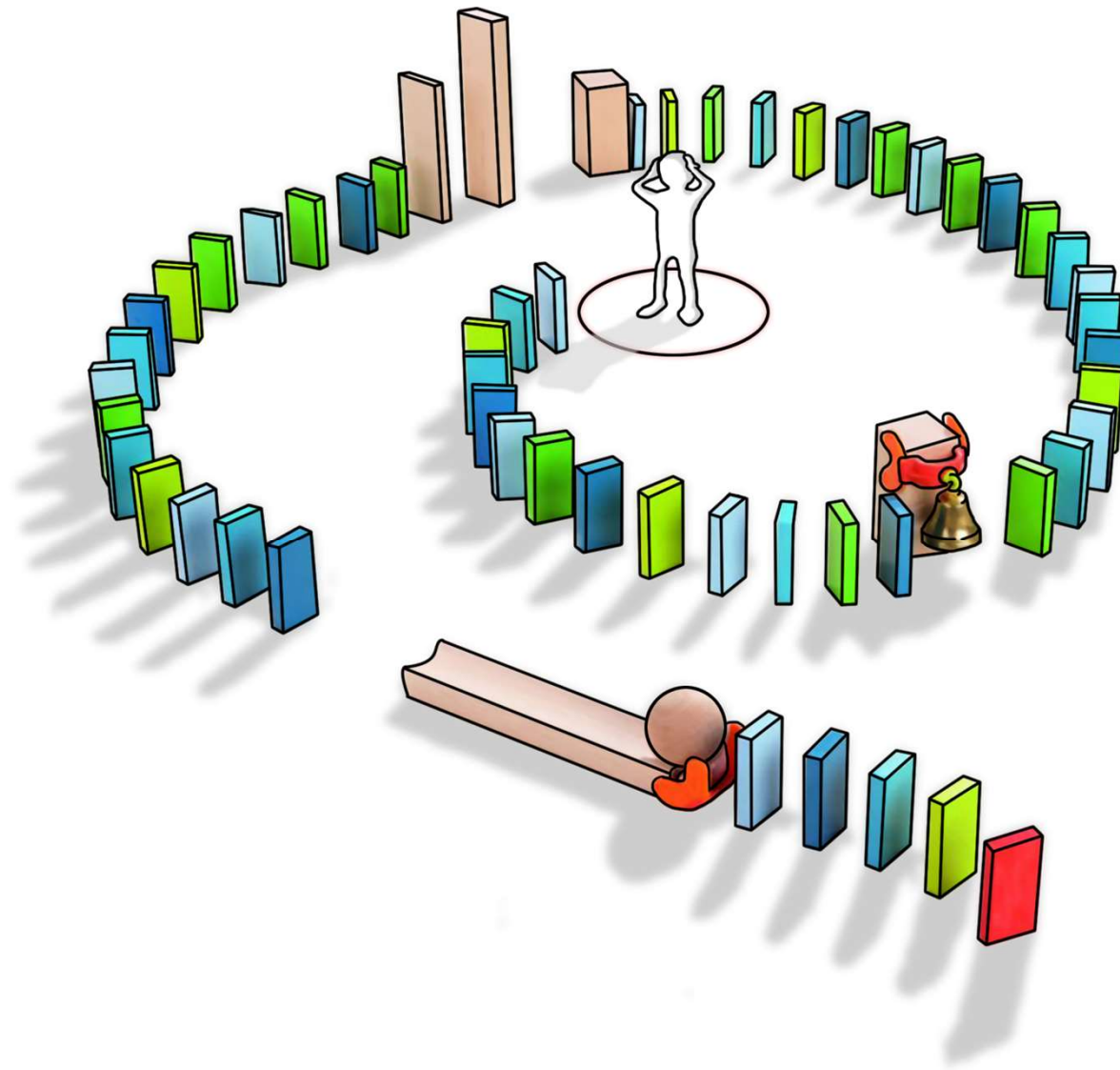
cause extreme suffering from excessive heat, Welton and others said. The storm also was affecting water and sewer service, cell-phone service and even 911 service in what Welton called "cascading failures."



Newark airport

Flooding baggage area at newark airport





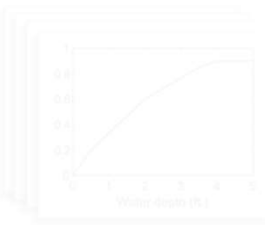
Deltares

Quantifying cascading impacts





Damage Functions



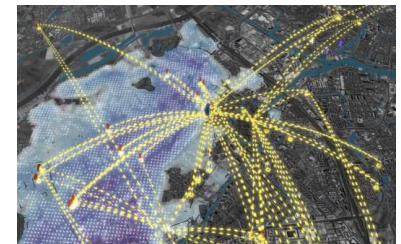
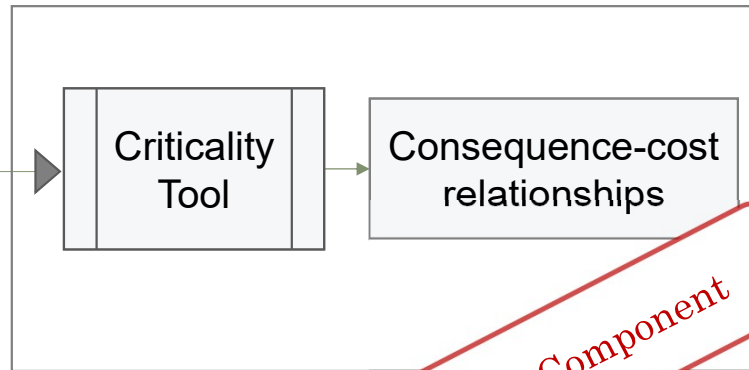
Flood hazard maps



Network maps

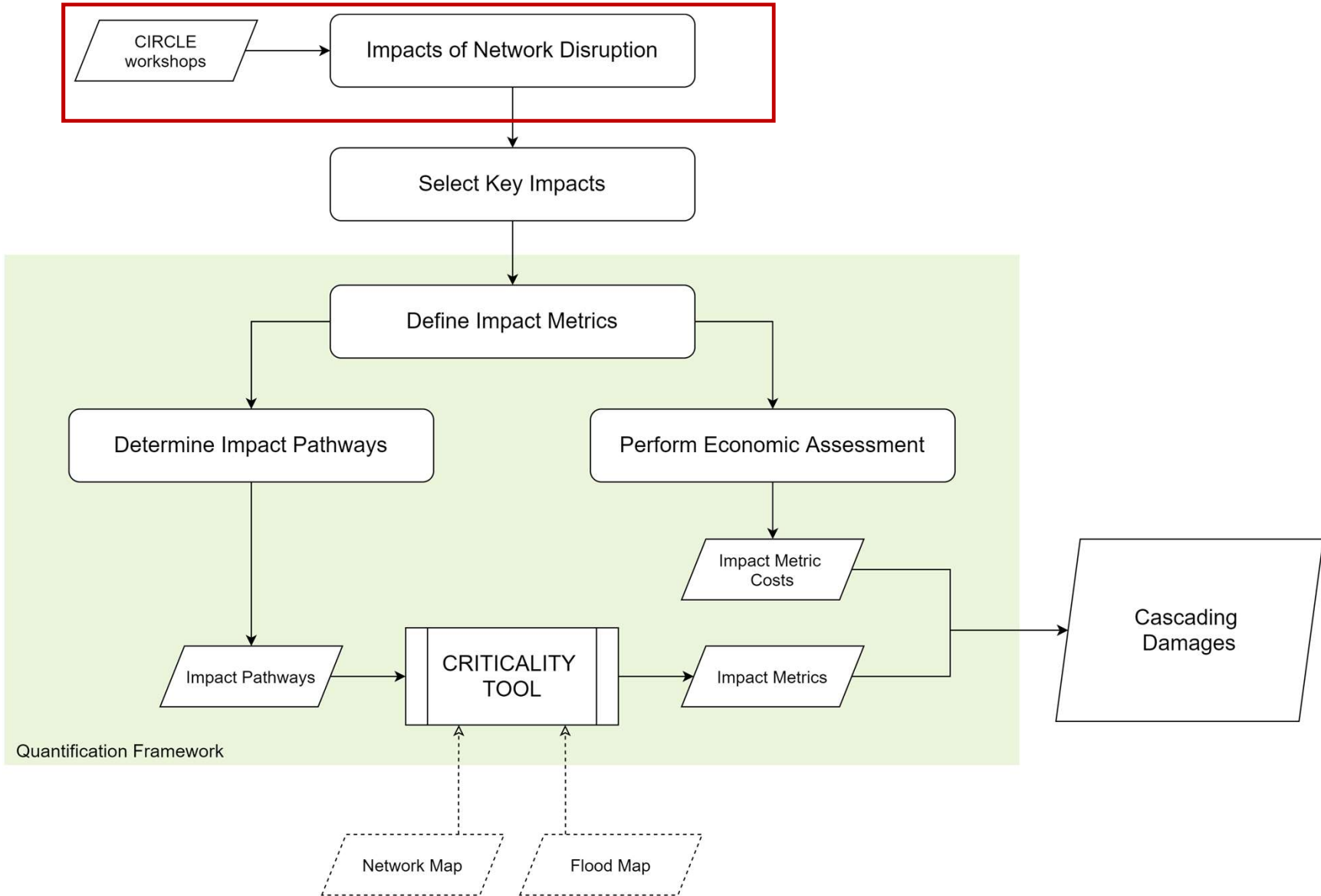


Direct Impacts



Cascading Impacts

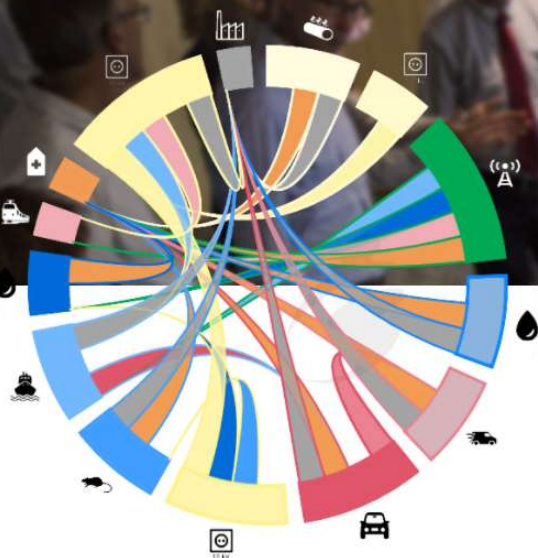
Methodology Overview





Circle - Critical Infrastructure

Understand connections. Stimulate partnerships. Prepare for the future.



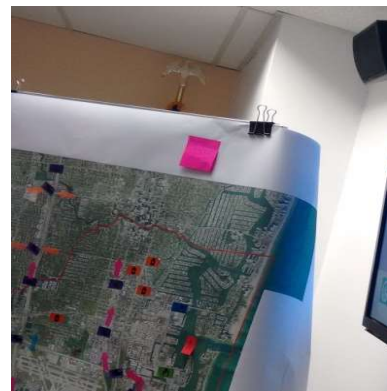
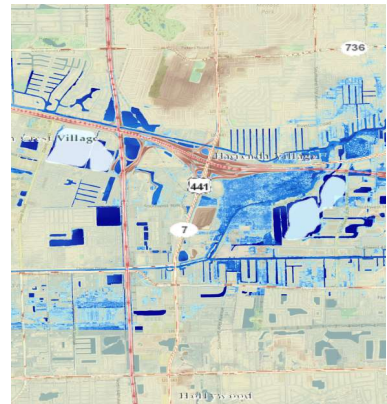
Circle (Critical Infrastructures: Relations and Consequences for Life and Environment) is a tool to support the analysis of domino effects of critical infrastructures. To get insight in which critical infrastructure is affected in case of failure of other critical infrastructure(s). Whether or not triggered by extreme events such as flooding.

In Circle you describe the dependencies between Critical Infrastructures. Circle facilitates the discussion between the stakeholders dependent on each other, builds trust and stimulates future partnerships.

Users are governmental organizations and agencies, network operators, emergency response organisations as well as large industries. You can use Circle yourself or ask Deltares to support you through circle@deltares.nl.

[Discover more](#)

<https://circle.deltares.org/>



Flood Resilience of Critical Infrastructure: Approach and Method Applied to Fort Lauderdale, Florida

Karin M. de Bruijn ^{1,*}, Carolina Maran ², Mike Zygnerski ², Jennifer Jurado ², Andreas Buzzei ¹, Claire Jouken ³ and Jayantha Obeyesekere ^{4,*}

- ¹ Deltares, 2600 MH Delt, The Netherlands; Andreas.Buzzei@deltares.nl
- ² Environmental Planning and Community Resilience Division, Environmental Protection and Growth Management Department, Broward County, Fort Lauderdale, FL 33301, USA; CMaran@broward.org (C.M.); MZygnerski@broward.org (M.Z.); Jjurado@broward.org (J.J.)
- ³ Deltares USA Inc., Silver Spring, MD 20910, USA; claire.jouken@deltares-usa.us
- ⁴ Sea Level Solutions Center, Florida International University, Miami, FL 33199, USA
- * Correspondence: karin.debruijn

Received: 17 January 2019; Accepted:

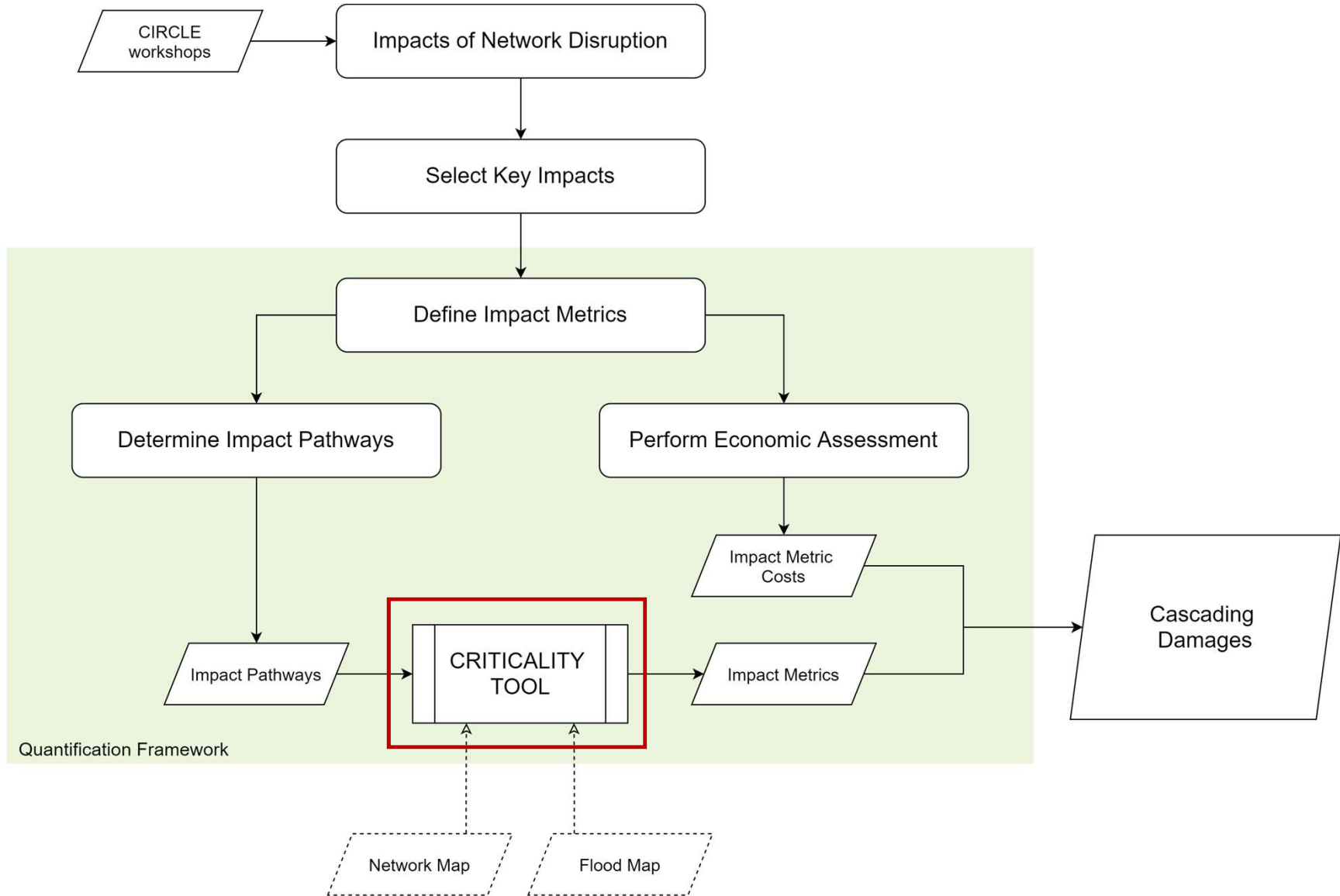
Abstract: In order to increase the resilience of critical infrastructure, it is also crucial to make critical society. Cities are complex systems of critical infrastructure networks. Information about these networks is not sufficient to increase flood resilience. A comprehensive approach is needed. This paper presents a critical infrastructure resilience impact from these actors. It also discusses potential disruption due to flooding of critical infrastructure and measures to increase resilience.

Critical Infrastructure Networks of Broward County

Assessing relationships and exploring adaptation and mitigation measures in participatory stakeholder workshops



Methodology Overview



Dare to Share



Deltares



RA2CE - Resilience Assessment and Adaptation for Critical Infrastructure helps to quantify resilience of critical infrastructure networks, prioritize interventions and adaptation measures and select the most appropriate action perspective to increase resilience considering future conditions.

The platform supports governments, intergovernmental agencies, IFIs and infrastructure owners to gain insight in long-term cost-beneficial investment strategies with the goal to make their infrastructure network resilient to natural and man-made hazards. RA2CE is globally applicable and has been applied for resilient investment planning in several settings such as the Netherlands, Philippines, Myanmar, Dominican Republic and Albania.



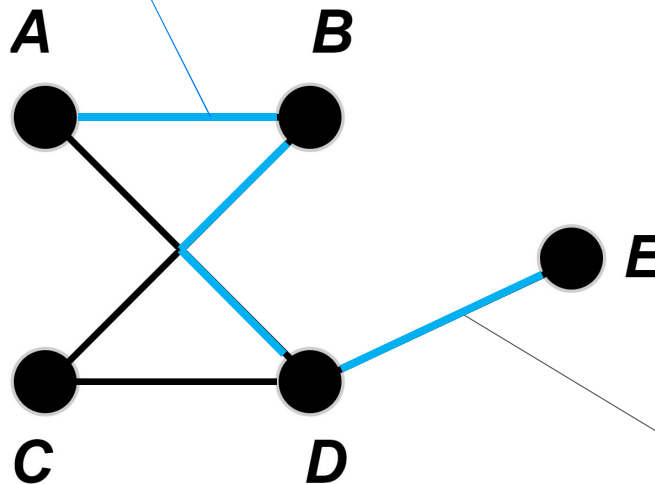
Map with locations where RA2CE has been applied.



Application of RA2CE for near real time impact assessments during floods in Myanmar

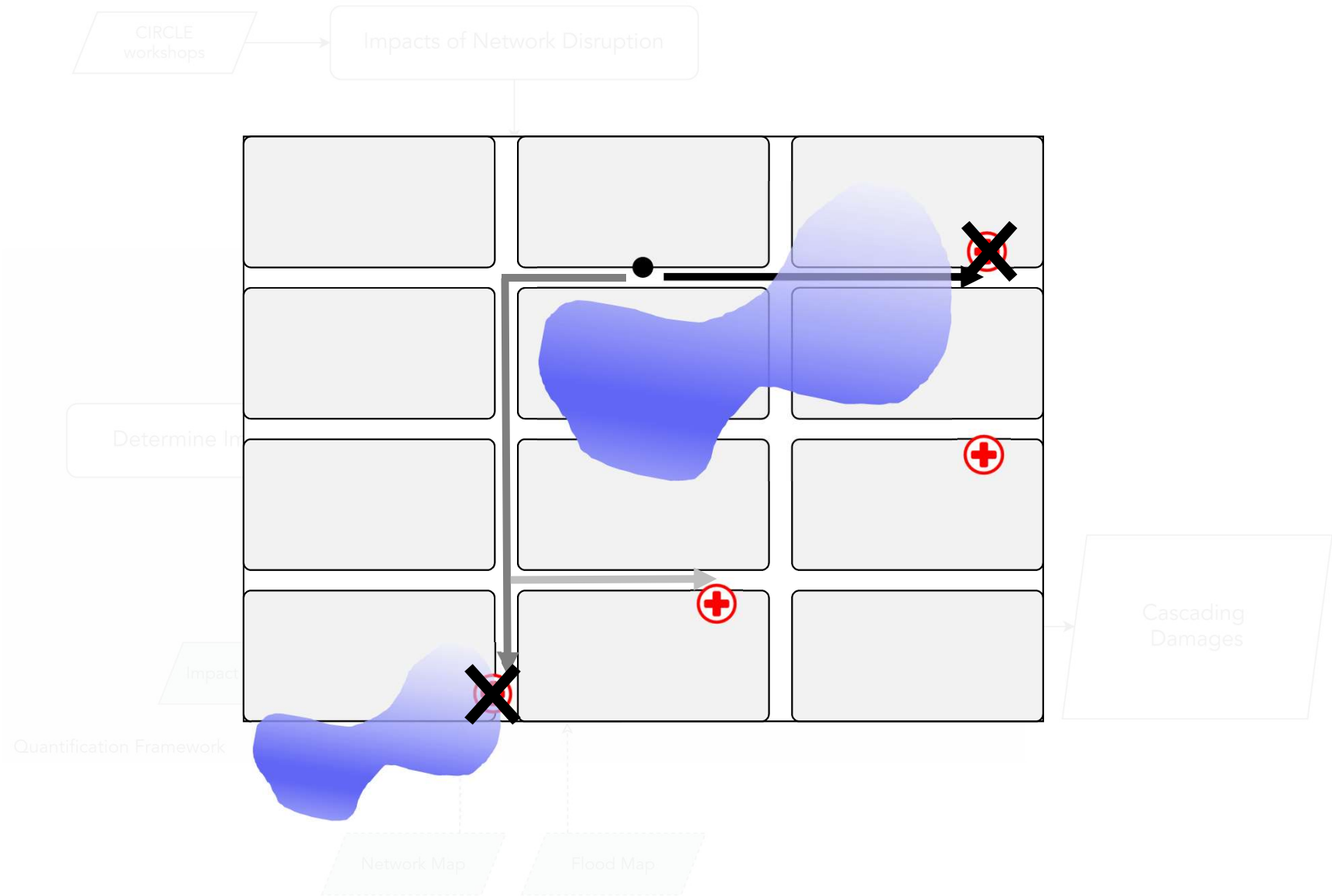
The Criticality Tool

Fasted route via Dijkstra's Shortest Path algorithm



1. Redundancy
2. Accessibility to critical locations
3. Isolation of critical locations

Edges are weighted by distance or travel time





Full Story and Demo



<https://storymaps.arcgis.com/stories/14ed7fcf649648aa98c07d868b80d99b>

Cascading impacts of flooded infrastructure

Economic quantification for evaluating cascading risks and adaptation solutions

Deltares | FIU | ICF | SFWMD | Broward County



<https://storymaps.arcgis.com/stories/14ed7fcf649648aa98c07d868b80d99b>

https://www.deltares.nl/app/uploads/2021/08/Incorporating-the-cascading-impacts-of-critical-infrastructure-damages-in-economic-flood-risk-analysis_FINAL.pdf

Incorporating the cascading impacts of critical infrastructure damages in economic flood risk analysis



FIU
FLORIDA
INTERNATIONAL
UNIVERSITY



Deltares
Deltares USA



BROWARD
COUNTY
FLORIDA

Contact

Kathryn.Roscoe@Deltares.nl

 www.deltares.nl

 [@deltares](https://twitter.com/deltares)

 [linkedin.com/company/deltares](https://www.linkedin.com/company/deltares)

 info@deltares.nl

 [@deltares](https://www.instagram.com/deltares)

 [facebook.com/deltaresNL](https://www.facebook.com/deltaresNL)

