Using the open-source Resilience and Disaster Recovery (RDR) Tool Suite to prioritize projects under many uncertain hazard scenarios

Modeling Mobility Conference

September 15, 2025

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Transportation networks are under constant threat from hazard-related disruptions.

Resilience investments can reduce the impact of hazard disruptions on trips taken and travel time.

Which infrastructure investments provide the greatest impact reduction under a range of potential hazard conditions?

National Park Service, USA, Public domain, via Wikimedia Commons

The RDR Tool Suite can help users explore scenarios to answer these questions.

Why a Resilience Investment Analysis Tool?

RDR Supports:

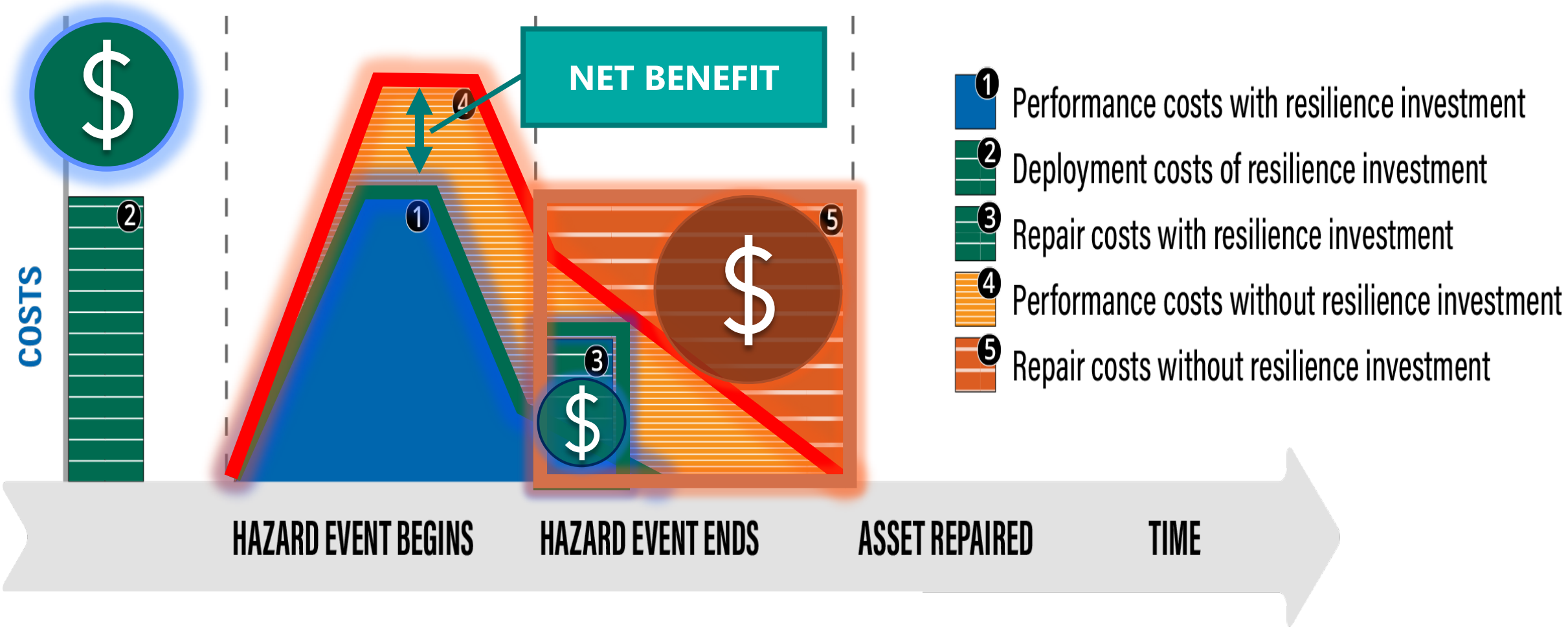
- Benefit-cost analysis for cost-effective investments.
- Investment in safe, high-integrity transportation infrastructure.
- Expedites disaster recovery planning.
- State and Metropolitan/Transportation Planning Organizations project prioritization.
- Alignment with **Achieving Efficiency Through State and Local Preparedness EO**, March 19, 2025.

By the authority vested in me as President by the Constitution and the laws of the United States of America, it is hereby ordered:

Section 1. Purpose. Commonsense approaches and investments by State and local governments across American infrastructure will enhance national security and create a more resilient Nation. Federal policy must rightly recognize that preparedness is most effectively owned and managed at the State, local, and even individual levels, supported by a competent, accessible, and efficient Federal Government. Citizens are the immediate beneficiaries of sound local decisions and investments designed to address risks, including cyber attacks, wildfires, hurricanes, and space weather. When States are empowered to make smart infrastructure choices, taxpayers benefit.

This order empowers State, local, and individual preparedness and injects common sense into infrastructure prioritization and strategic investments through risk-informed decisions that make our infrastructure, communities, and economy resilient to global and dynamic threats and hazards.

Estimating Return on Investment



Net benefit = difference between areas with and without resilience investment

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Why a Resilience Investment Analysis Tool?

CHALLENGES

Future hazard conditions are highly uncertain.

A range of resilience investment options can mitigate effects.

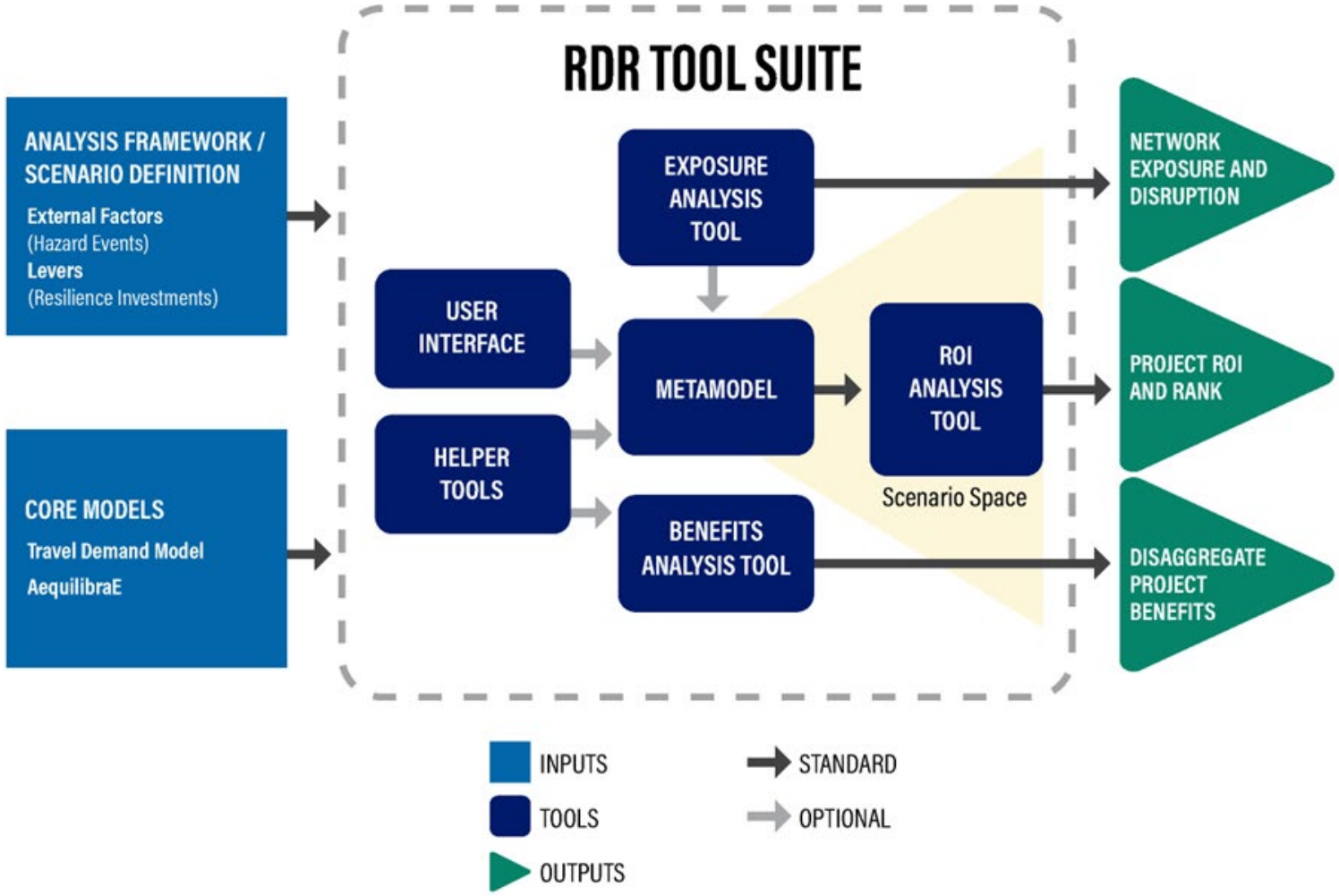
Leads to thousands of scenarios to test.

Existing travel demand models are too slow to analyze many scenarios and cannot combine performance benefits across hazard conditions.

Why a Resilience Investment Analysis Tool?

Solution

A robust tool suite to help transportation practitioners evaluate resilience return on investment (ROI) for long-range planning across a range of uncertain scenarios.



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The RDR Tool Suite

RDR Overview:

- Screening level network performance analysis tool.
- Hazard agnostic.
- Passenger and freight focused.
- Leverages agency data and modeling.

RDR Features:

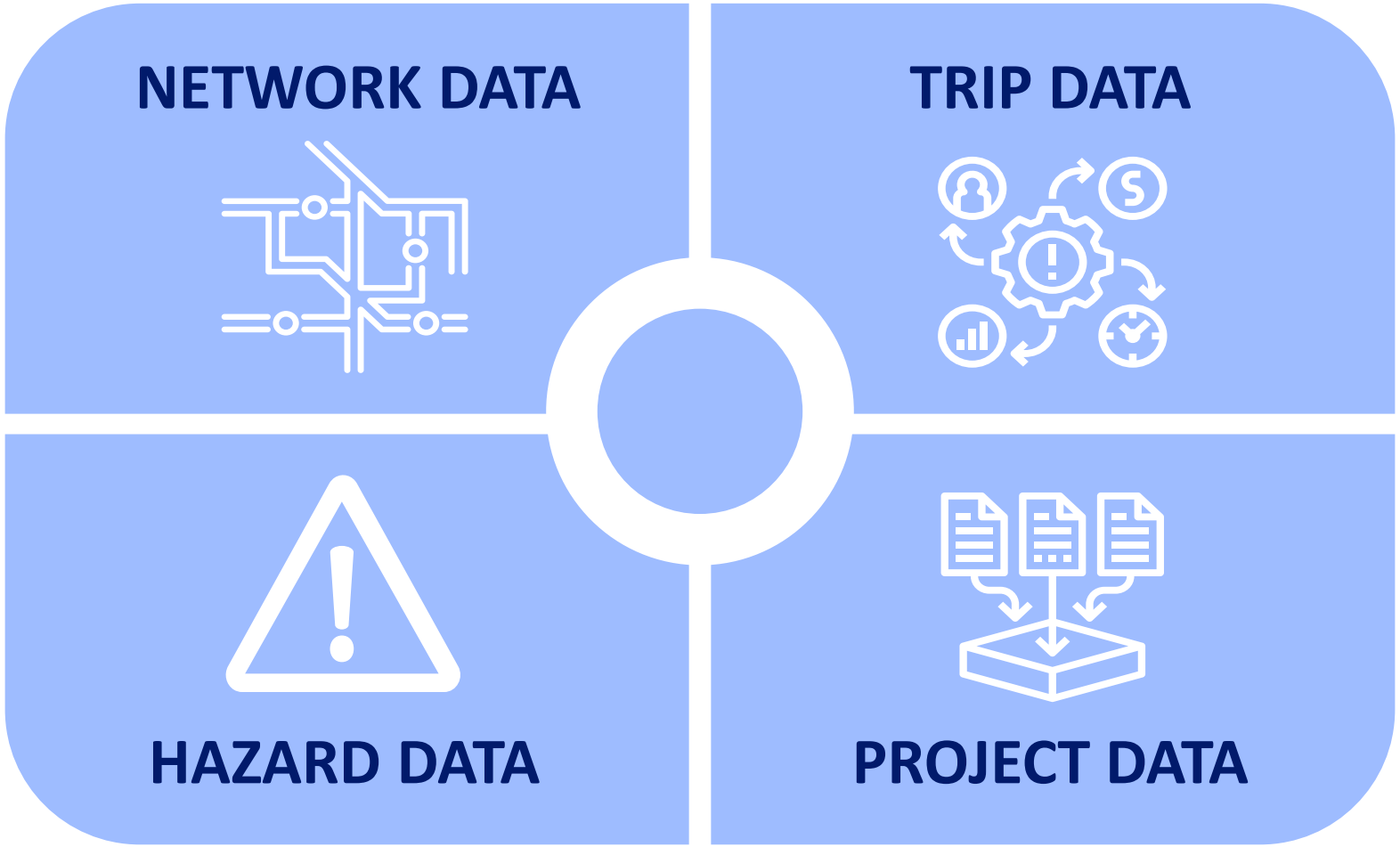
- Prioritizes resilience projects by ROI across range of future conditions.
- Robust Decision-Making based metamodel.
- Accommodates road and transit networks.
- Software: Python, R, optional Geographic Information System (GIS) components.
- Aligned with US DOT BCA guidance (May 2025)

RDR Available at:

volpeusdot.github.io/RDR-Public

Created by the Volpe Center in support of the Office of the Secretary of US DOT (OST) and the Federal Highway Administration (FHWA).
Current activities supporting OST-R.

RDR Data Requirements



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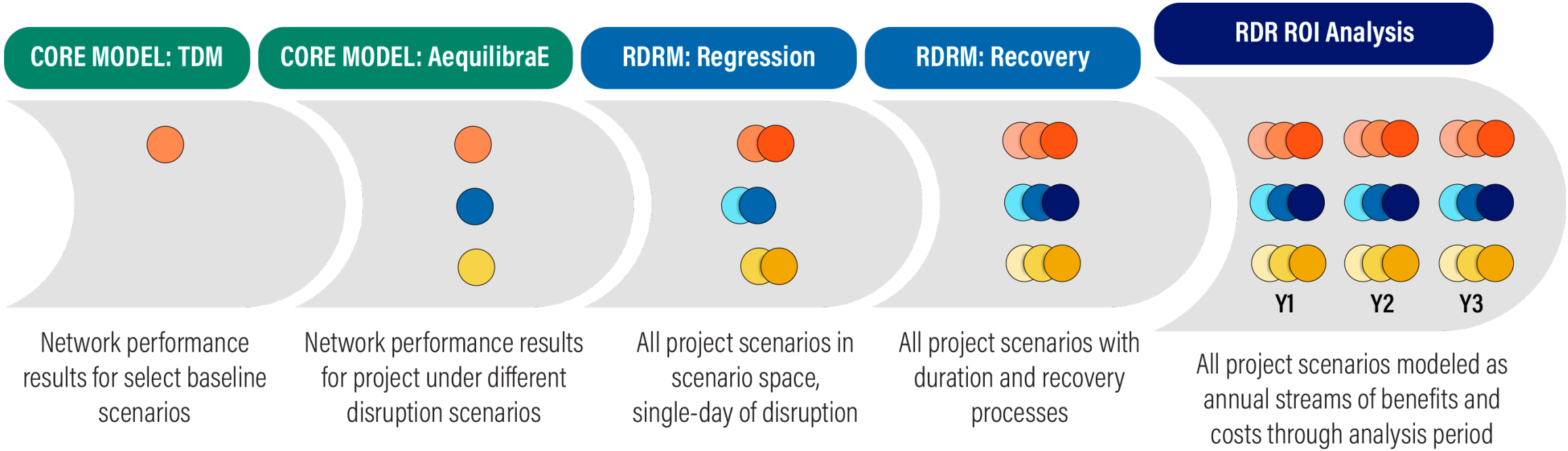
RDR Metamodel and ROI Analysis Tool – Scenario Development

Analysis defined by external factors (uncertainties) and levers (resilience investments)

- Population and land use
- Disruptive events
- Uncertainties in recovery
- Transport supply
- Resilience investments
- Recovery process



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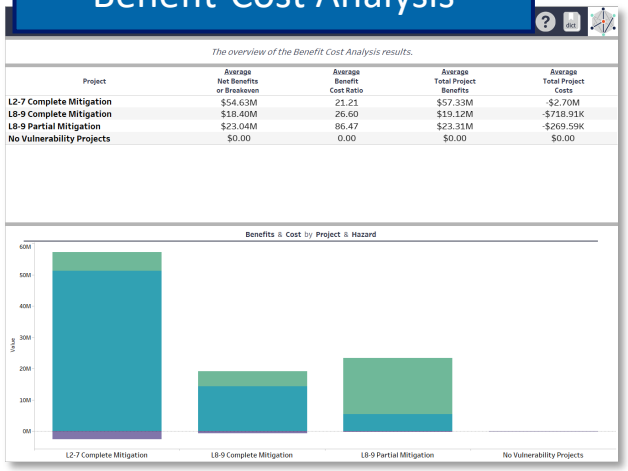
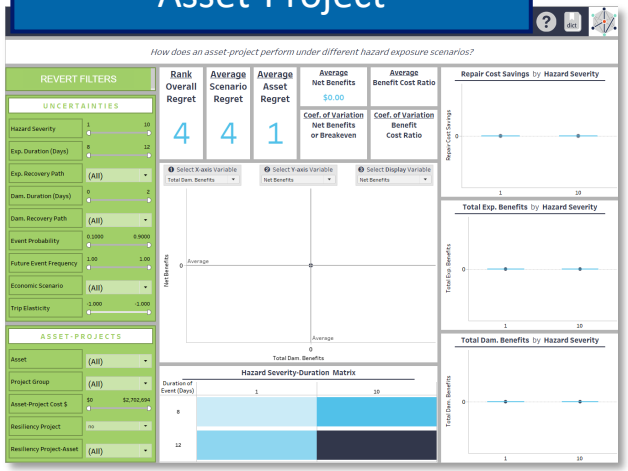
RDR ROI Analysis Tool – Tableau Dashboards

Benefit-Cost Analysis

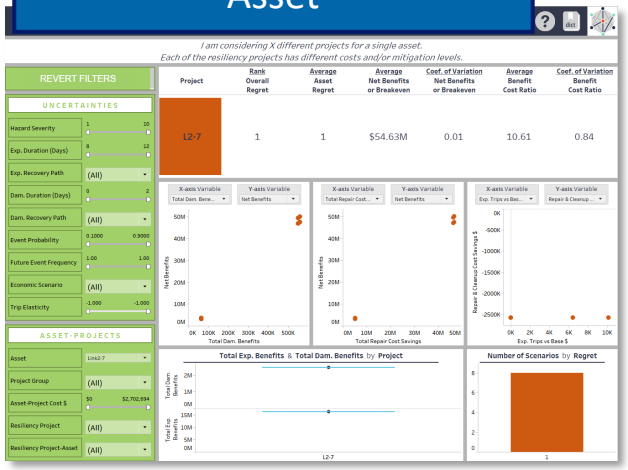


Regret

Asset-Project

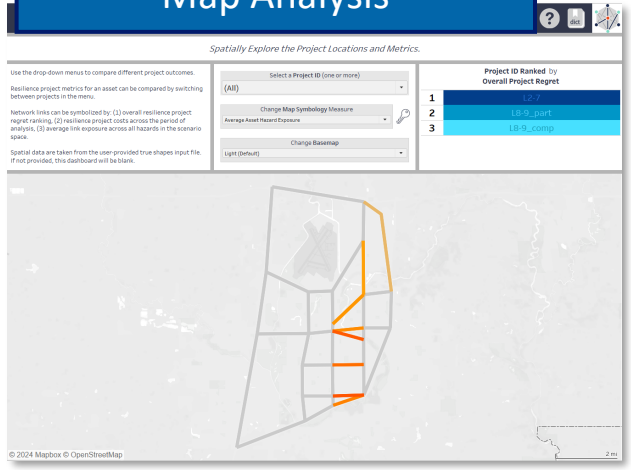


Asset



Exploratory

Map Analysis



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HAMPTON ROADS

Coastal Virginia
Mouth of the Chesapeake Bay

1.7 Million People

Strategic Location
Foreign Trade
Tourism
Military Facilities

Slide courtesy of HRTPO

HAMPTON ROADS TPO

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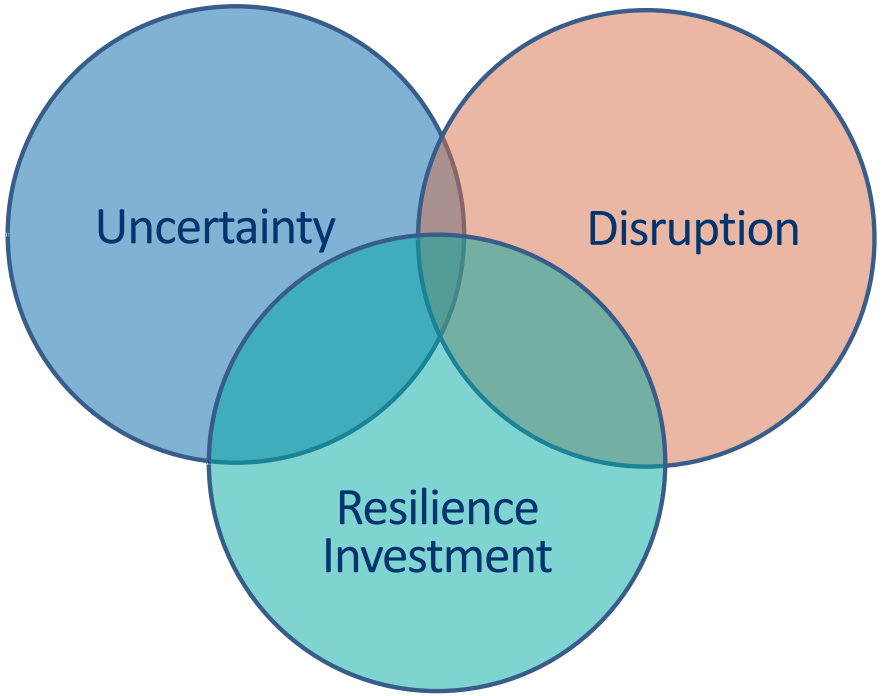
HRTPO Objectives with RDR Tool Suite

- Model multiple flooding scenarios efficiently
- Support objective, data-driven resiliency measures for use in Project Prioritization Tool
  - Identify inundation and extent (low and high frequency events)
  - Quantify congestion as a result of flooding
  - Quantify congestion avoided from mitigating flooding
  - Cost-benefit ratio of resiliency improvements

RDR Tool explores multiple scenarios to assess network-wide effects of losing some assets (highway links).



Slide courtesy of HRTPO

HAMPTON ROADS TPO

Volpe RDR Tool: HRTPO Planning Applications

Scenario Planning

- Multiple flooding scenarios

Candidate Project Identification

- Identification of high disruption assets for project consideration
- Project design/cost refinement incorporating resilience

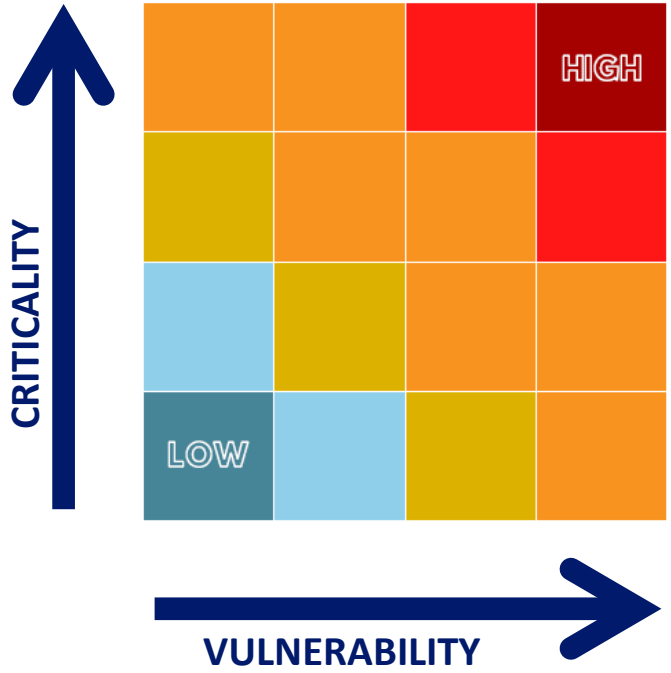
Factors for Project Prioritization

- Vulnerability/exposure across scenarios
- Disruption severity/change in network performance
- Equitable access in hazard events
- Refinement of cost effectiveness measures

Fiscal Constraint

- Help identify critical projects to constrain in LRTP

Measuring Criticality and Vulnerability



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RDR Tool Suite Users

Testing Partners:

- Hampton Roads Transportation Planning Organization and Planning District Commission
- Hillsborough, FL Transportation Planning Organization (with Florida DOT support)
- Houston-Galveston Area Council

User Types:

- State DOTs and MPOs
- Academics
- Transportation Consultants

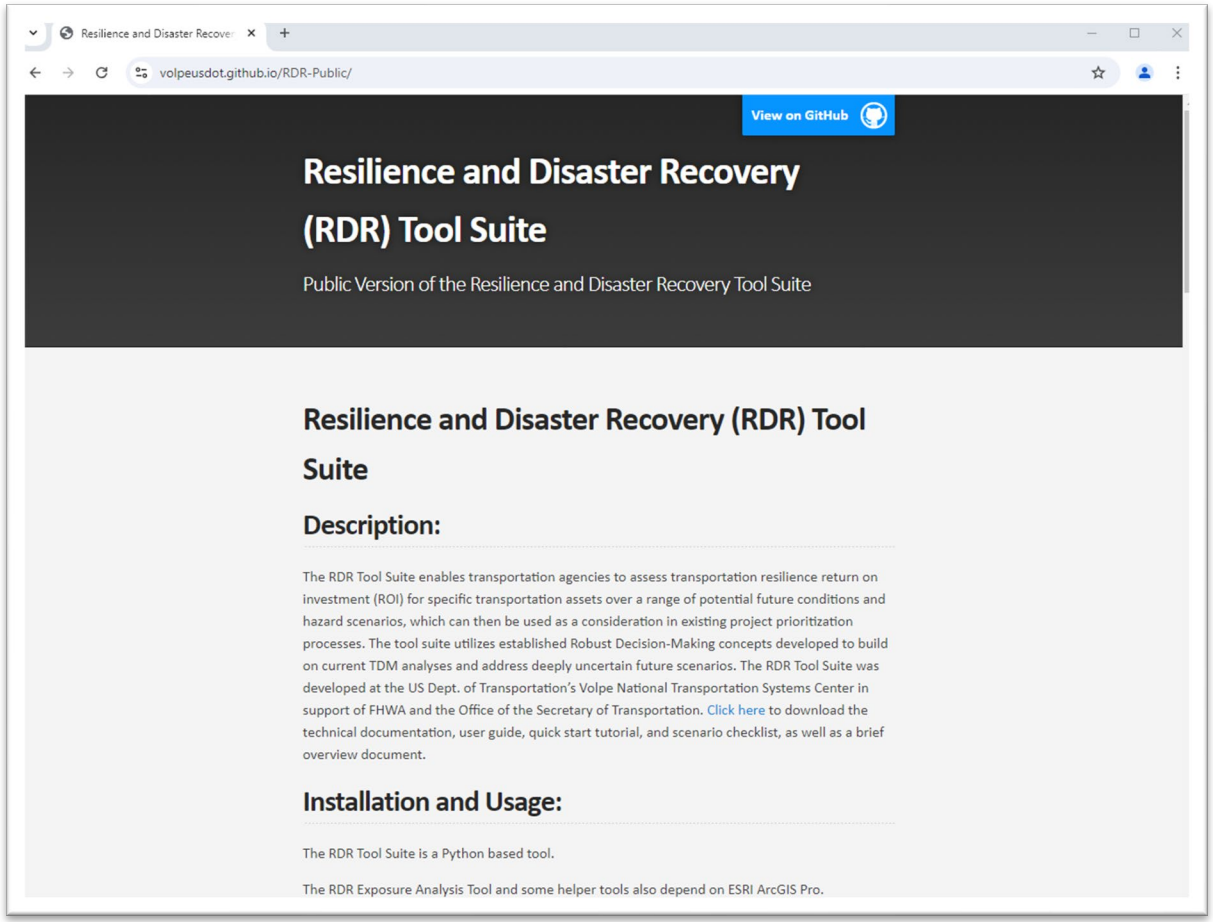
The RDR team is available for technical assistance of public users.

New versions are released biannually with new features, including user suggestions.

RDR Tool Suite Highlights

Download the latest release:
volpeusdot.github.io/RDR-Public

- RDR is a free, open-source tool available on GitHub for evaluating resilient infrastructure return on investment.
- Codebase includes full documentation and reference scenarios.
- Issues / bugs / requests can be raised on GitHub site.
- The RDR team is available for technical assistance now.
- Email RDR-Team@dot.gov!



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Thank you!

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