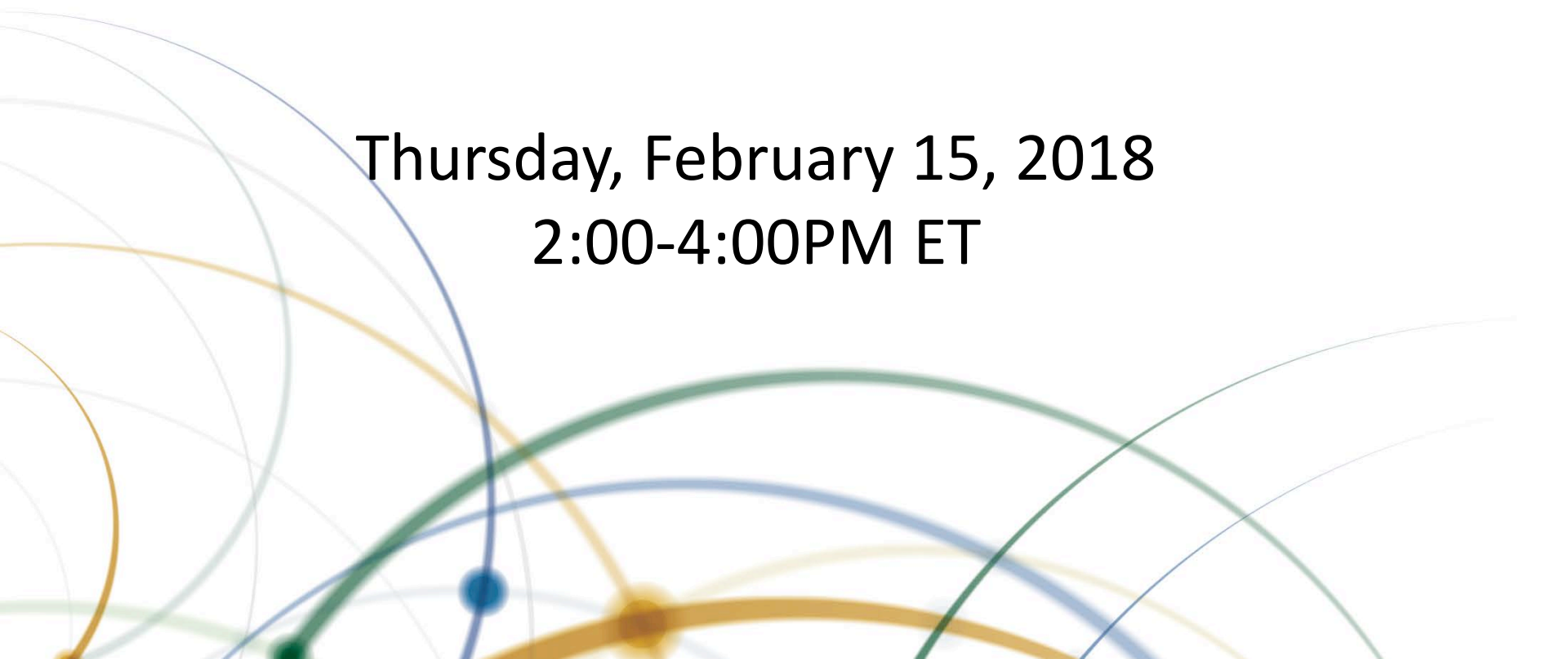


TRANSPORTATION RESEARCH BOARD

# Leveraging Transportation Mode Expertise for Community Resilience

Thursday, February 15, 2018  
2:00-4:00PM ET



***The Transportation Research Board has met the standards and requirements of the Registered Continuing Education Providers Program. Credit earned on completion of this program will be reported to RCEP. A certificate of completion will be issued to participants that have registered and attended the entire session. As such, it does not include content that may be deemed or construed to be an approval or endorsement by RCEP.***



**REGISTERED CONTINUING EDUCATION PROGRAM**



# Purpose

Discuss the state-of-the-practice in resilience planning across multiple modes of transportation.

## Learning Objectives

At the end of this webinar, you will be able to:

- Understand how to extend and apply a mode's resiliency-oriented research
- Describe the perspective of transportation providers and users under a resiliency context
- Understand how to integrate the needs of users and the larger community into resiliency planning



# Overview of Resilience

## One concept, many definitions

Presidential Policy Directive 21: “the ability to prepare for and adapt to changing conditions and to withstand and recover rapidly from disruptions...”

## TRB’s leadership

- Research
  - Updated summary of research available at: <http://www.trb.org/Main/Blurbs/166648.aspx>
- Communication, Outreach, & Engagement
  - Dedicated staffing
  - Partnerships:
    - Modal, Topical, etc
    - Example: National Institute of Standards & Technology (NIST) Community Resilience Program
  - Annual Meeting Sessions, Committee activities, Webinars:
    - Sample webinars: August 2017, February 2018
    - Upcoming webinar, Spring 2018: *Resiliency in Practice: Strategies for Knowledge, Information, and Data*
  - 2018 Summit: October 8-10, 2018, Denver CO





# Community Resilience

Places community at the center, identifies sectoral dependencies

Employs alternative or multiple frameworks

- Nature Conservancy, 100 Resilient Cities, NIST Community Resilience Planning Guide, etc
- Elements of community resilience planning - NIST
  - List socio-economic institutions
    - Note dependencies – internal and external – related to
      - Time - recovery phases
      - Space - area of impact
      - Source - impact is elsewhere but felt in community
  - List built environment areas, including transportation
  - Determine recovery goals



# NIST Community Resilience Planning Guide: A Six Step Approach



# Community Resilience & Transportation



In practice:

- Specify the business case(s)
- Address assets in or connected to community
- Leverage existing tools

Disturbance <sup>1</sup>	
Hazard Type	Any
Hazard Level	Routine, Design, Extreme
Affected Area	Localized, Community, Regional
Disruption Level	Usual, Moderate, Severe

Restoration Levels <sup>43</sup>	
30%	Function Restored
60%	Function Restored
90%	Function Restored
X	Anticipated Performance

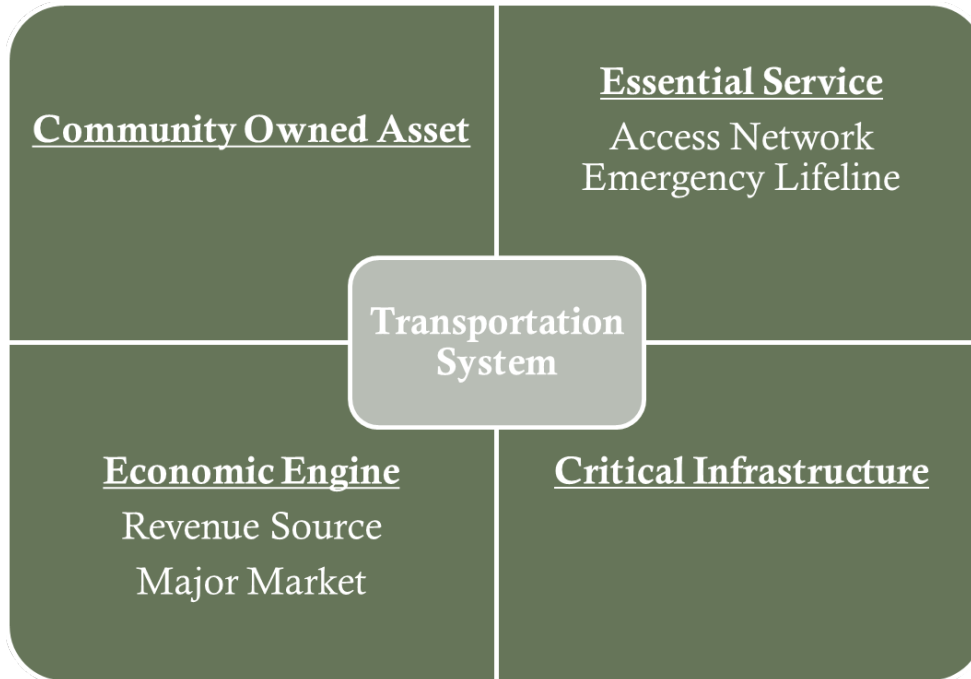
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# Leveraging Transportation Mode Expertise for Community Resiliency: A Highway Perspective

**Dave Fletcher, GPC, Inc. (Presenting)**  
**Dave Ekern, DS Ekern Consulting**




# A Highway Perspective



- Improve accessibility, mobility, and connectivity, across all modes, for all users
- Minimize service disruptions
- Preserve asset value
- Protect critical infrastructure components
- Stimulate the economy
- Maintain interconnectedness with other critical infrastructures

# Hazards to Highways & Bridges

- 
- **Heavy Rainfall & Runoff**
  - **Flooding & Storm Surges**
  - **Heavy Snow & Ice Storms**
  - High Winds & Tornadoes
  - Hurricanes & Cyclones
  - **Extreme Heat & Heat Waves**
  - Extreme Cold
  - Drought
  - Wildfires
  - Lightning
  - Rockfalls & Landslides
  - Avalanches & Mudslides
  - Earthquakes & Tsunamis
  - Sinkholes
  - Volcanoes & Lava Flows
  - Space weather & Solar Storms
  - **Sea Level Rise & High Tides**
  - Groundwater



# Extreme Weather & Highways

## Potential Impacts

- Roadway/Tunnel flooding
- Damage/destruction of bridges
- Pavement/Rail buckling
- Subway flooding
- Slope failures



## Consequences

- Supply chain disruption
- Homes, businesses, medical care, fire and police cut off
- Passenger delays
- Higher costs for all users
- Accelerated asset depreciation
- Loss of revenue
- Loss of public confidence

# AASHTO Resilience Resources

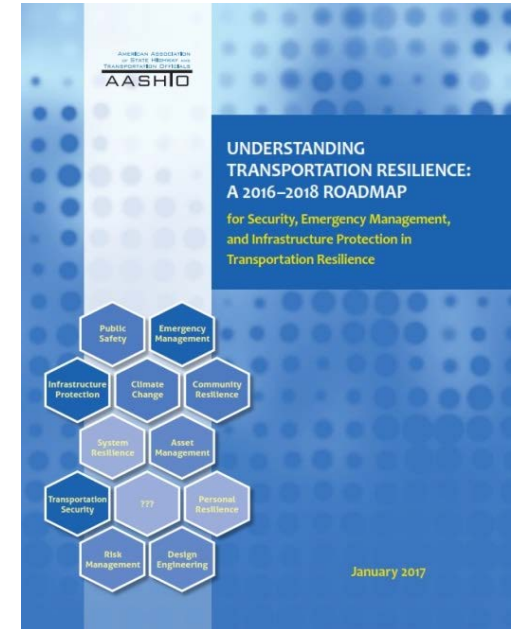
*Understanding Transportation Resilience:  
A 2016-2018 Roadmap (2017)*

*Managing Catastrophic Transportation Emergencies:  
A Guide for Transportation Executives (2015)*

*Fundamental Capabilities of Effective All-Hazards  
Infrastructure Protection Resilience, and Emergency  
Management for State DOTs (2015)*

*Security 101: A Physical Primer for Transportation  
Agencies (2009) (Update in progress)*

*A Guide to Emergency Response Planning at State  
Transportation Agencies (2010) (Update in Progress)*





# Resilience Research Framework

	OPERATIONS & EMERGENCY MANAGEMENT	DESIGN ENGINEERING	COMMUNITY PLANNING & SOCIETAL CHANGE
FUNCTIONS	The assignments, tasks, and positions in a state DOT that are critical to the performance of continued transportation activities		
ASSETS	The infrastructure, equipment, resources, tools, vehicles, hardware, and facilities owned and operated by a state DOT		
NETWORKS	The relationships maintained by a state DOT with the private sector and other branches of government that ensure continuity of transportation activities		
SYSTEMS	The critical technology and applications, including data, used to operate the DOT and the infrastructure and enable reliable network communication		
PEOPLE	The necessary personnel needed by a state DOT to ensure resilient transportation activities		

# What is resilience?

The ability to prepare and plan for, absorb, recover from, or more successfully adapt to adverse events.

AASHTO



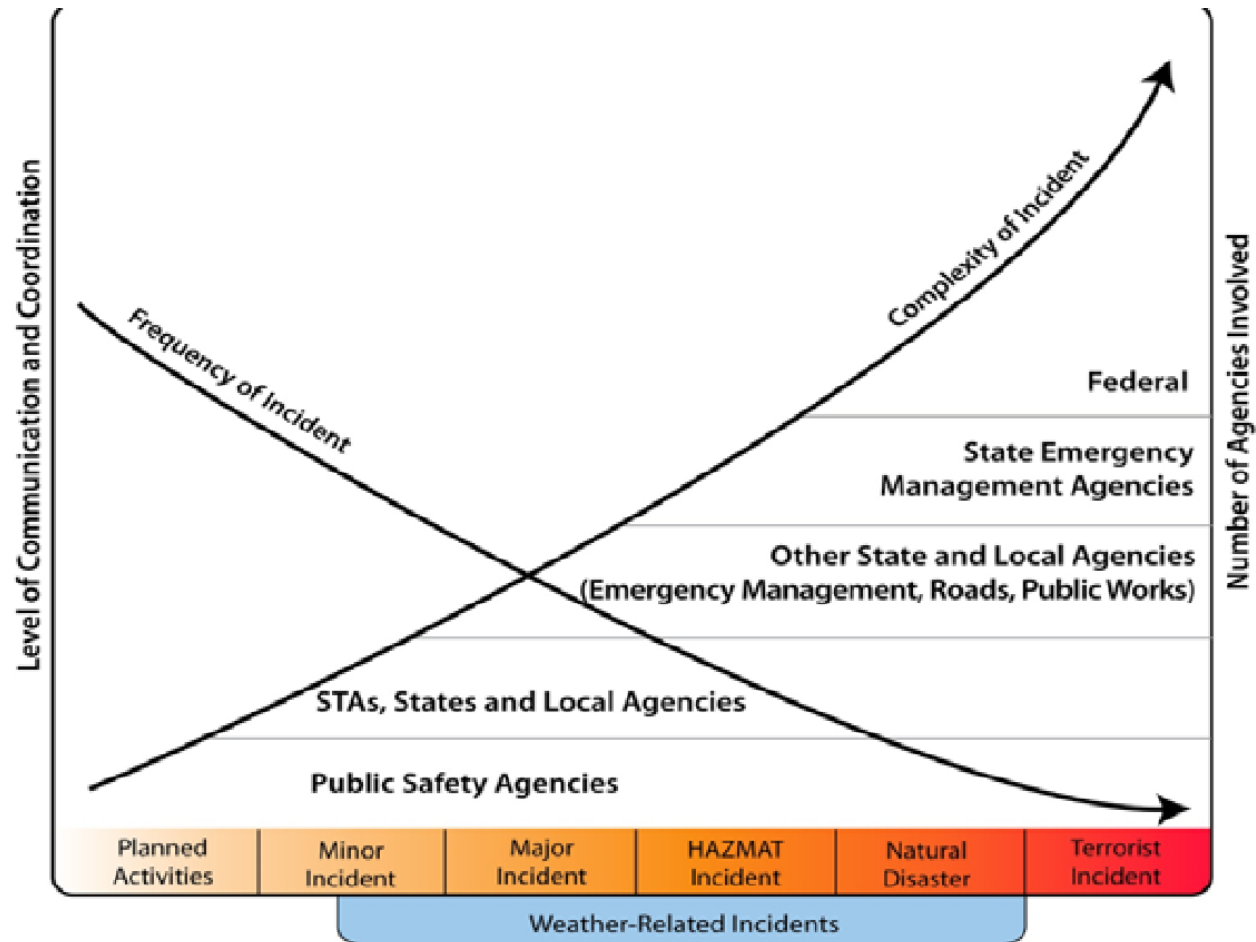
# Resilience has many faces,



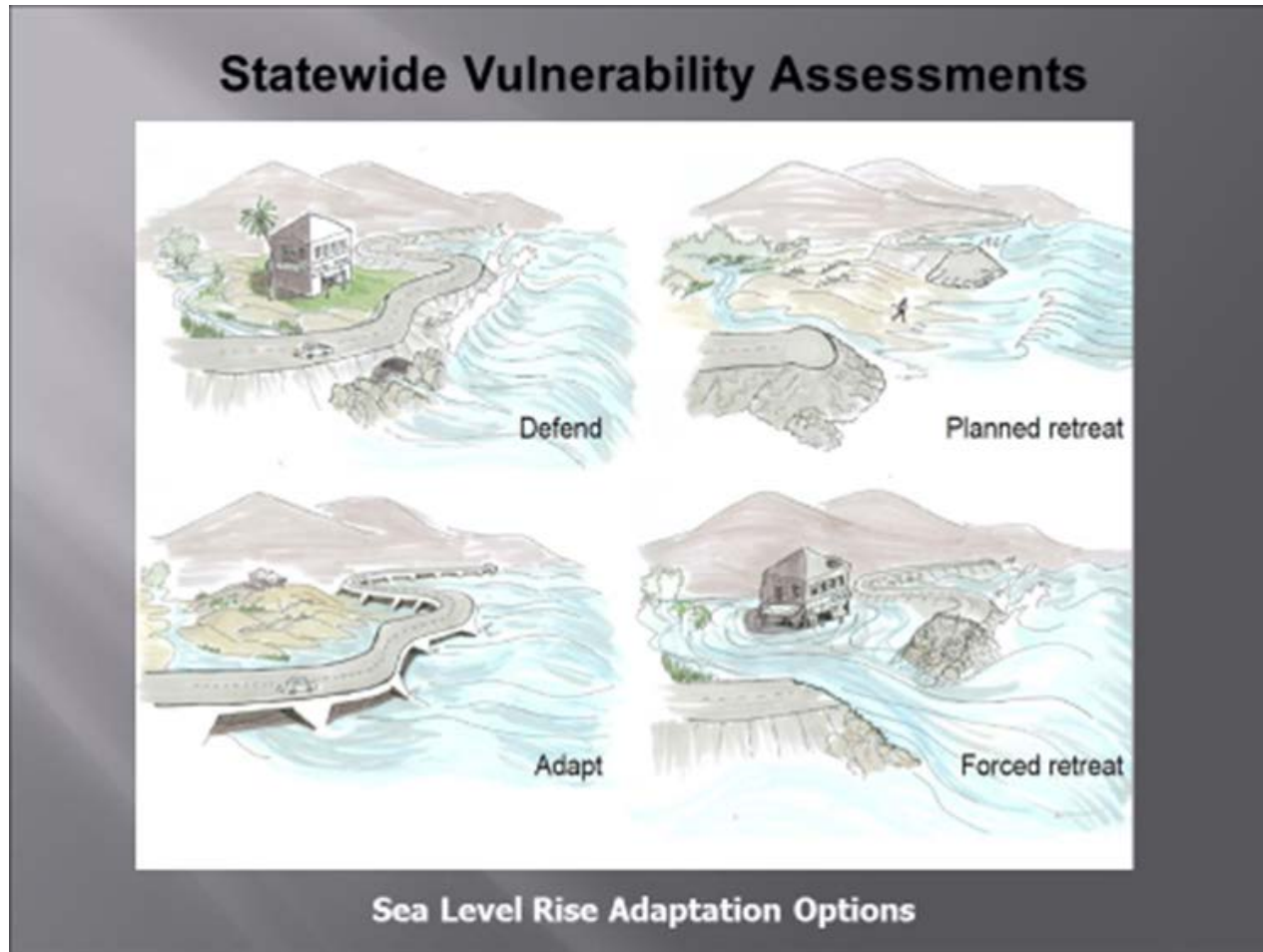
... many dimensions,

Dimension	Operations/Emergency Management	Design Engineering	Community Planning & Societal Change
<b>Mission</b>	Prepare, Respond, Recover	Resist, Adapt	Plan, Resist, Adapt, Relocate
<b>Duration</b>	Hours - Months	Years - Decades	Decades or longer
<b>Potential Disruptions</b>	Extreme weather events Natural disasters Terrorist incidents	New loading & durability requirements	Climate change impacts Sea level rise Mass migrations
<b>Impact</b>	Local - Regional	Local	Superregional - Global
<b>Governance</b>	Varies but Public Safety Agencies (PSA) generally provide Incident Command	Varies but State DOTs generally provide Project Management	All levels of government
<b>Transportation Agency Role</b>	Support evacuation and emergency access activities	Engineering and construction services	Funding Planning Policies and Standards

. . . many scales,



. . .and many choices



Source: Caltrans

# Transportation Asset Management

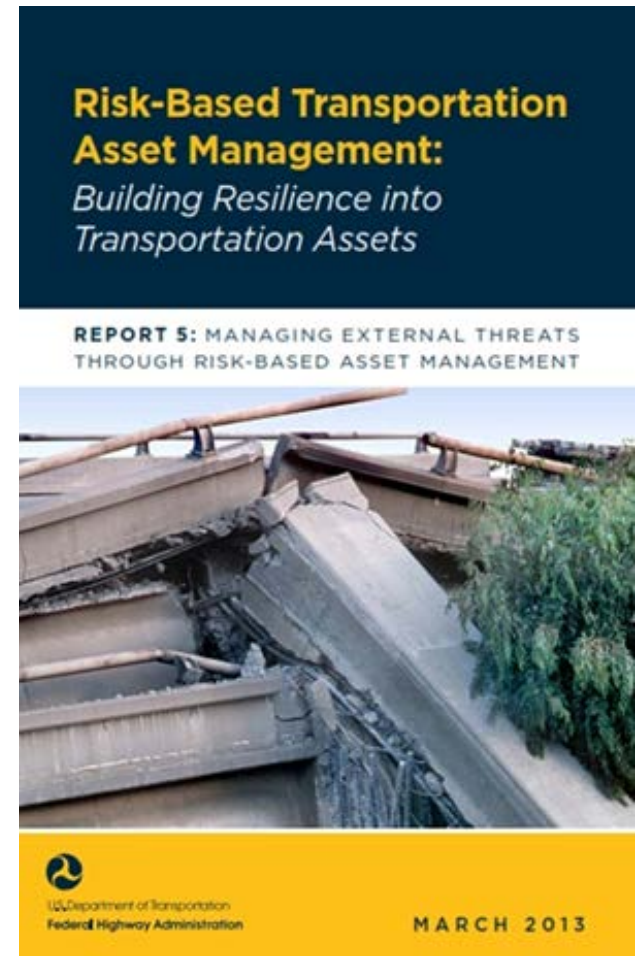
"Transportation Asset Management is a strategic and systematic process of operating, maintaining, upgrading and expanding physical assets effectively throughout their lifecycle. TAM is a business model, a decision support system, and a management approach that can be used across an agency to address five core questions:

1. What is the current state of physical assets?
2. What are the required levels of service and performance delivery?
3. Which assets are critical to sustained performance?
4. What are the best investment strategies for operations, maintenance, replacements, and improvement?
5. What is the best long-term funding strategy?



# “Resilient Asset Management”

- Accurate inventories of assets and their condition
- Sound maintenance practices within an asset management regime “hardens” assets.
- The hierarchal prioritization of critical assets conducted in a risk-based asset management program provides priorities for asset repair after events.
- Asset management staffs become competent at asset management scenario planning, which is critical when developing a post-event recovery plan.
- Sound asset inventories and good unit-cost data assist with estimating recovery costs.
- Complete and accurate allows the faster development of contract plans immediately after a event.
- Risk-management capability provides not only critical before-event prioritization but also is useful in post-event recovery allocation of resources.





# Operationalizing Resilience

## DOT Asset Management

1. Establish asset management roles.
2. Set agency goals and objectives.
3. Define the scope of TAM.
4. Integrate TAM into the organizational culture & business processes
5. Establish performance management standards.
6. Develop a TAM plan
7. Strengthen processes, IT, & data

## NIST Community Resilience

1. Form a collaborative Community Planning Team
2. Understand the situation
3. Determine goals & objectives
4. Plan Development
5. Plan preparation, review & approval
6. Plan Implementation and maintenance

# Ten Essential Points

1. Resilience requires concentrated, sustained effort
2. Resilience has short-term, intermediate and long-range horizons
3. No state is immune
4. Heat waves, severe storms, and sea level rise pose the greatest threats, resulting in
5. Reduced asset performance, disruption of service, and increased costs to users and DOTs

# Ten Essential Points

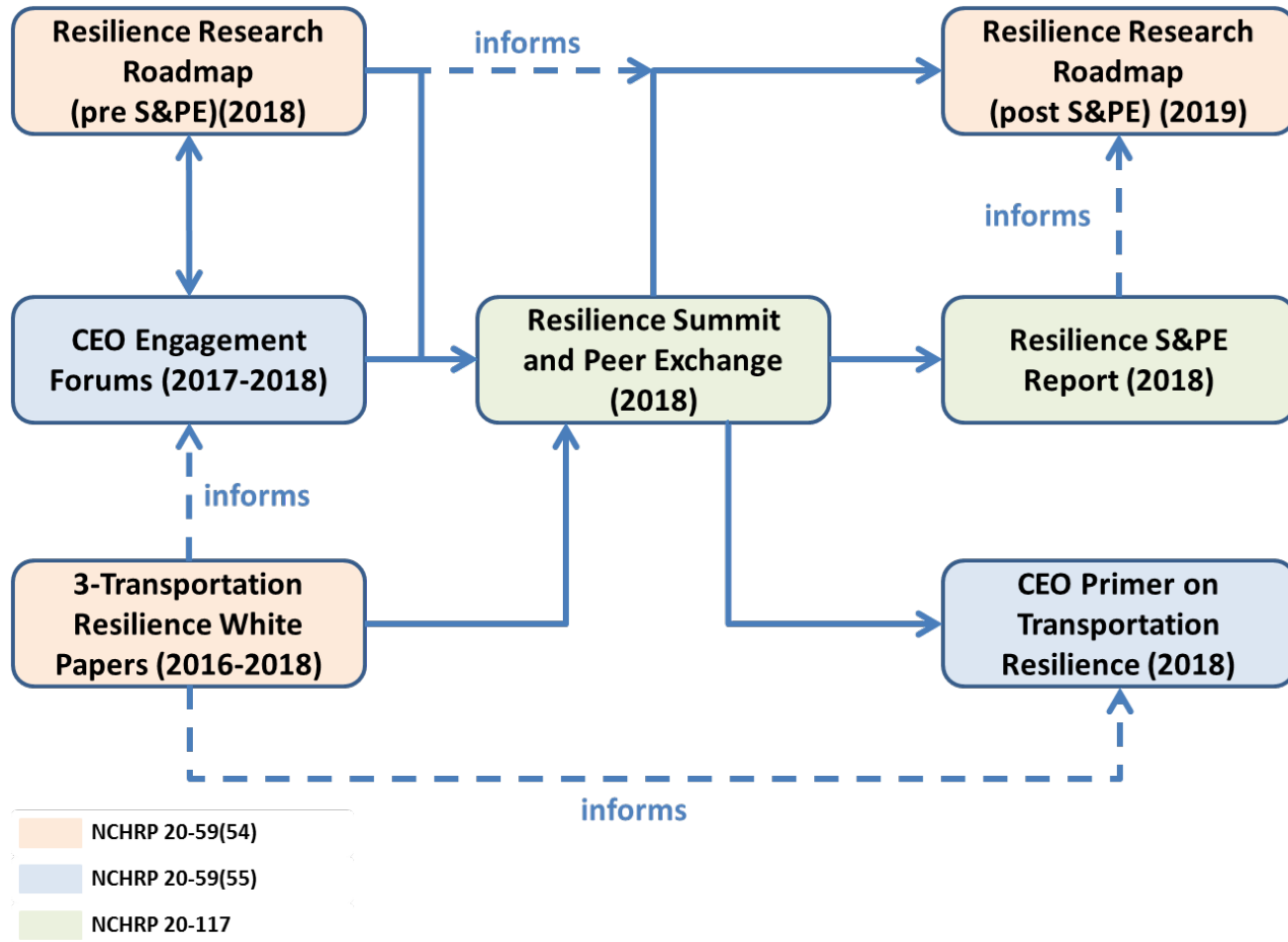
6. Failures erode public trust, affect local economies, and generate political blowback
7. Old disaster management approaches are increasingly ineffective
8. One-size solutions don't work
9. Political, institutional, scientific, and technical barriers challenge leadership
10. DOTs cannot go it alone

# AASHTO 2016-2018 Resilience Research Program

20-59(54)	20-59(55)	20-117
<ul style="list-style-type: none"><li>• 3 Discussion Papers</li><li>• 2020-2025 Resilience Research Roadmap</li></ul>	<ul style="list-style-type: none"><li>• CEO Interviews</li><li>• CEO Forums</li><li>• CEO Primer on Resilience</li></ul>	<ul style="list-style-type: none"><li>• Summit &amp; Peer Exchange</li><li>• Resilience Guide</li><li>• Resilience Toolkit</li></ul>

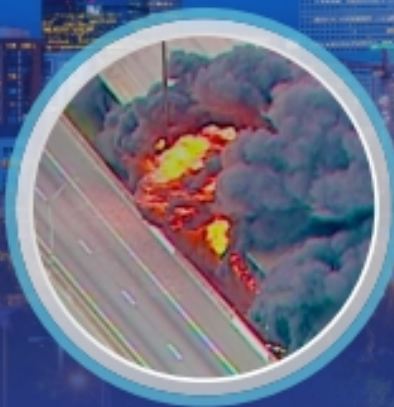
NCHRP Synthesis 20-05/Topic 48-13 Resilience in Transportation Planning, Engineering, Management, Policy, and Administration

# AASHTO 2016-2018 Resilience Research Program



2018 TRANSPORTATION  
RESILIENCE INNOVATIONS SUMMIT AND EXCHANGE

**RISE**



**SAVE THE DATE**

**OCTOBER 8-10, 2018 | DENVER • COLORADO**

**SHERATON DENVER DOWNTOWN HOTEL**

# Thank You

***Dave Fletcher, Co-Principal Investigator  
NCHRP 20-59(14)C, NCHRP 20-59(54)  
[fletcher18us@gmail.com](mailto:fletcher18us@gmail.com)***

***<https://transportationops.org/publications/understanding-transportation-resilience-2016-2018-roadmap>***

***The best time to plant a tree was 20 years ago;  
the second best time is now.***

***Traditional Proverb***



# Supply Chain Disruption and Business Continuity Practices: A Framework for Proactive Resiliency Planning & Operations

TRB Webinar – Leveraging Transportation Mode Expertise for Community Resiliency



Anne Strauss-Wieder  
Director, Freight Planning  
North Jersey Transportation Planning Authority



# What are Supply Chains?

How goods move from where they are produced to where they are consumed.

*Business continuity refers to the capacity to continue to delivery products or services after a disruptive event.*

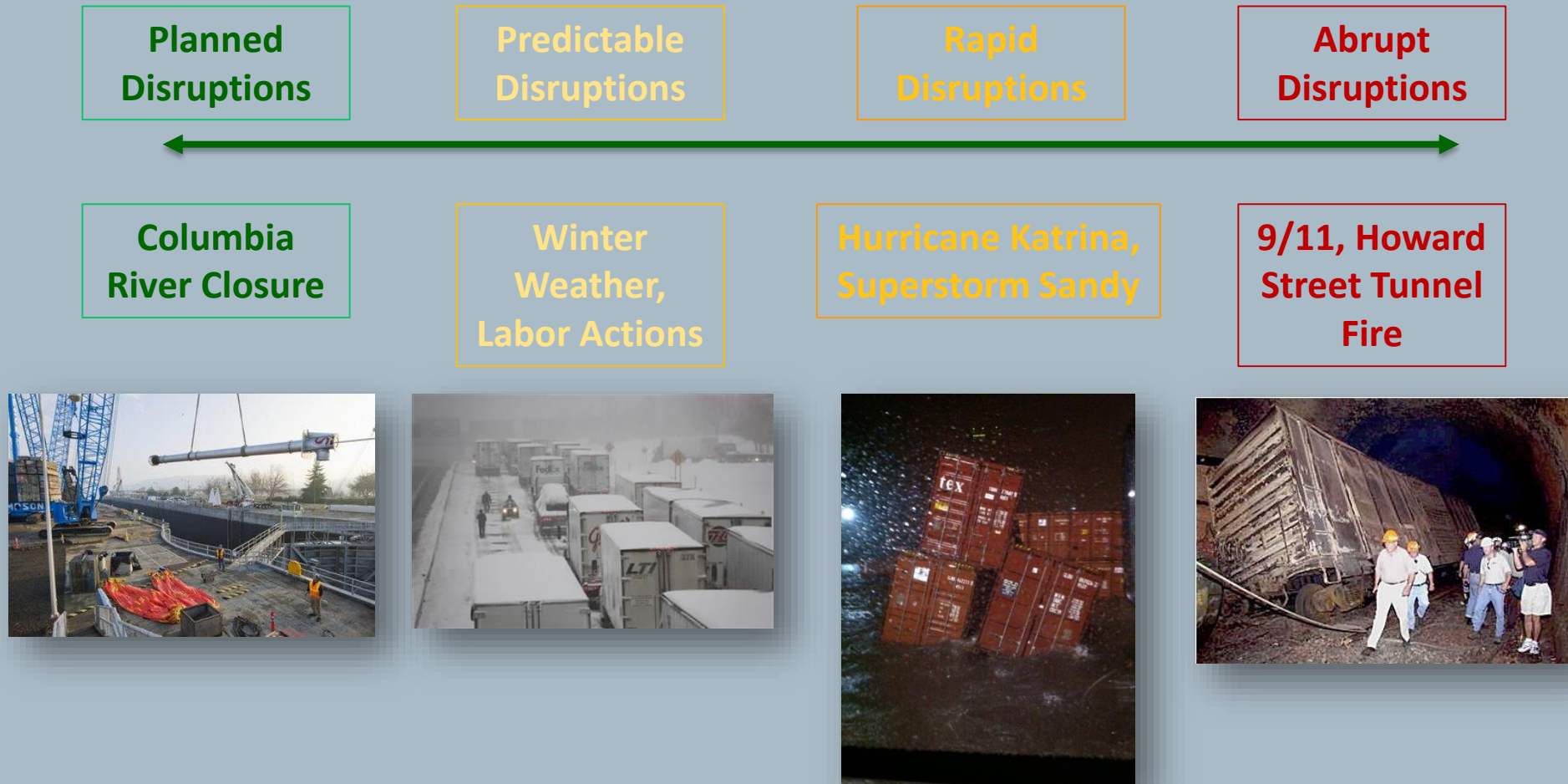


# Three Sets of Activities for Freight Movement

Activities	Definitions and Examples
Physical Flows	<ul style="list-style-type: none"><li>• Any physical activity directly needed for freight movement</li><li>• Vessels, terminals, railroads, trucks, pipelines, aircraft, warehouses and distribution centers</li></ul>
Communication & Information Flows	<ul style="list-style-type: none"><li>• Any information and transactional exchange needed for freight movement</li><li>• Bills of lading, financial flows, customer notifications, delivery appointments, warehouse management systems, inter-agency communications, etc.</li></ul>
Regulatory Considerations	<ul style="list-style-type: none"><li>• Any gov't regulations, rules, and agency activities needed for or shaping freight movement</li><li>• USCG, CBP, truck driver credentials, Jones Act</li></ul>

*Categories from: Methodologies to Estimate the Economic Impacts of Disruptions to the Goods Movement System, NCHRP 732 (2012)*

# The Disruption Spectrum



# Defining a Disruption through Characteristics

Characteristics	Example: Superstorm Sandy
Geographical Scope Affected	<ul style="list-style-type: none"><li>• Extensive – the entire East Coast</li><li>• At landfall – the New York-New Jersey Region</li></ul>
Freight Facilities Affected	<ul style="list-style-type: none"><li>• All</li><li>• Ports closed along the East Coast in the storm's path</li><li>• Railroads, trucking lines, airports and air cargo, pipelines (power outages, flooding, damage)</li></ul>
Commodities and Shipments Affected	<ul style="list-style-type: none"><li>• Occurred during peak delivery week</li><li>• Multiple commodities and shipments affected</li></ul>
Recovery Time from Disruption	<ul style="list-style-type: none"><li>• Port of New York-New Jersey closed for nearly a week</li><li>• Physical repairs to facilities still occurring</li></ul>

*Categories from: Methodologies to Estimate the Economic Impacts of Disruptions to the Goods Movement System, NCHRP 732 (2012)*



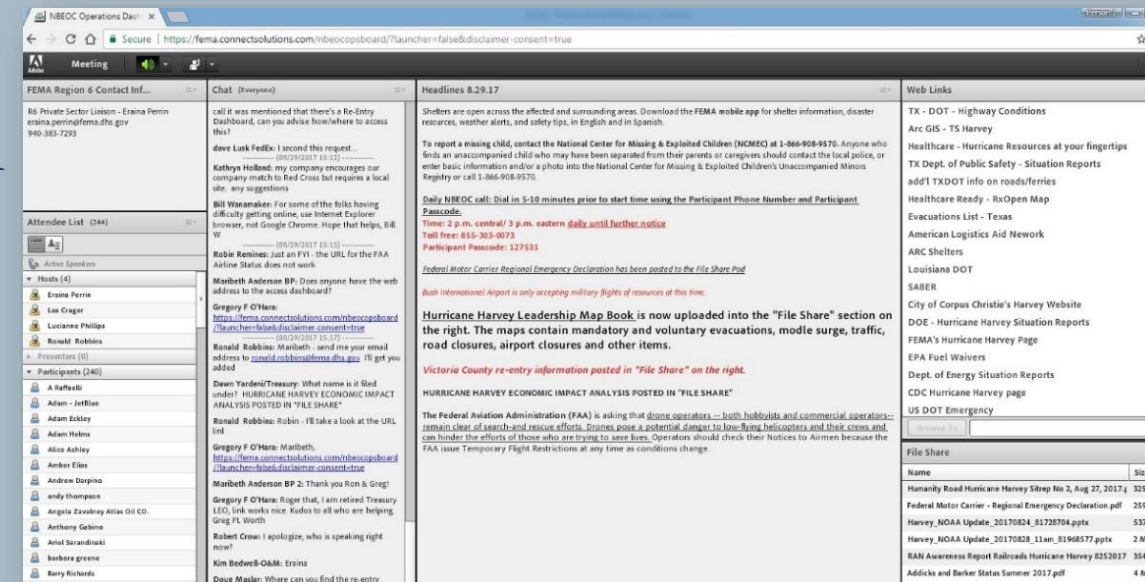
# Lessons Learned: Physical Flows

- Identified that electrical power is crucial to expediting recovery.
  - Today's ports and supply chains rely on it.
  - Utilities also must respond to extensive damage and higher priorities.
- Learned from previous events how to prepare for and respond to disruptions but still encounter the unexpected.
- Recognized that keeping the goods flowing is essential for recovery and for business continuity even outside of the affected location.
- Saw that “modal flexing” and “regional flexing” are essential to handling diverted cargo.
- Determined that ports are less prepared for surges in vessels and container movements.
- Considered how to balance resiliency and maintenance costs during rebuilding.



# Lessons Learned: Communications and Information Flows

- Build multiple communication channels ahead of time.
  - E-alerts, websites, transactional information, warehouse management systems, worker-related systems.
  - Cannot operate information systems without power.
  - Establish pre-set conference calls and WebEx forums
- Need established groups for preparation, recovery and response.
  - Build working relationships and responsibilities before a disruption occurs.
- Use existing contracts can assist in modal flexing and equipment replacement.



# The Importance of Business Continuity

- 30 percent of all companies that experience a catastrophic loss fail within the first two years after the event.
- Another 29 percent shut down after this time.
- Severe and potentially permanent economic losses for communities.



PHOTO: WARREN ANTOLA, FLICKR

TR News 311 September-October 2017, p. 14.



# The Impacts on Daily Lives and Businesses: Irma and Florida Oranges

- **Damage:** Over \$760 million.
- **Employment:** 45,000 people in Florida plant, pick, fertilize and process the fruit.
- **Market Share:** Provides more than 60 percent of US orange juice.
- **Potential Long Term Loss:** Major brands replacing Florida crops with overseas crops.



<http://nhpr.org/post/nearly-25-percent-homes-destroyed-florida-keys-after-hurricane-irma#stream/0>

Sources: <http://www.ocala.com/opinion/20171210/ellis-hunt-florida-agriculture-desperate-for-post-irma-aid> and <http://www.gainesville.com/news/20171213/citrus-industry-in-trouble-without-federal-aid>



# The Impacts on Daily Lives and Businesses

“The medical products industry has a significant presence in Puerto Rico, and the disruption to this industry has had ramifications for patients both on the island and throughout the U.S. The FDA has been working closely with federal and Puerto Rican authorities to help stabilize the medical products manufacturing sector. We’re taking steps to mitigate or avert product shortages but we’ve still seen shortages of certain medically important products, some of which are sourced primarily or only in Puerto Rico.”



*Statement by FDA Commissioner Scott Gottlieb, M.D., on efforts to address impact of IV fluid shortages following hurricane destruction and resolve manufacturing shortfalls, November 17, 2017*

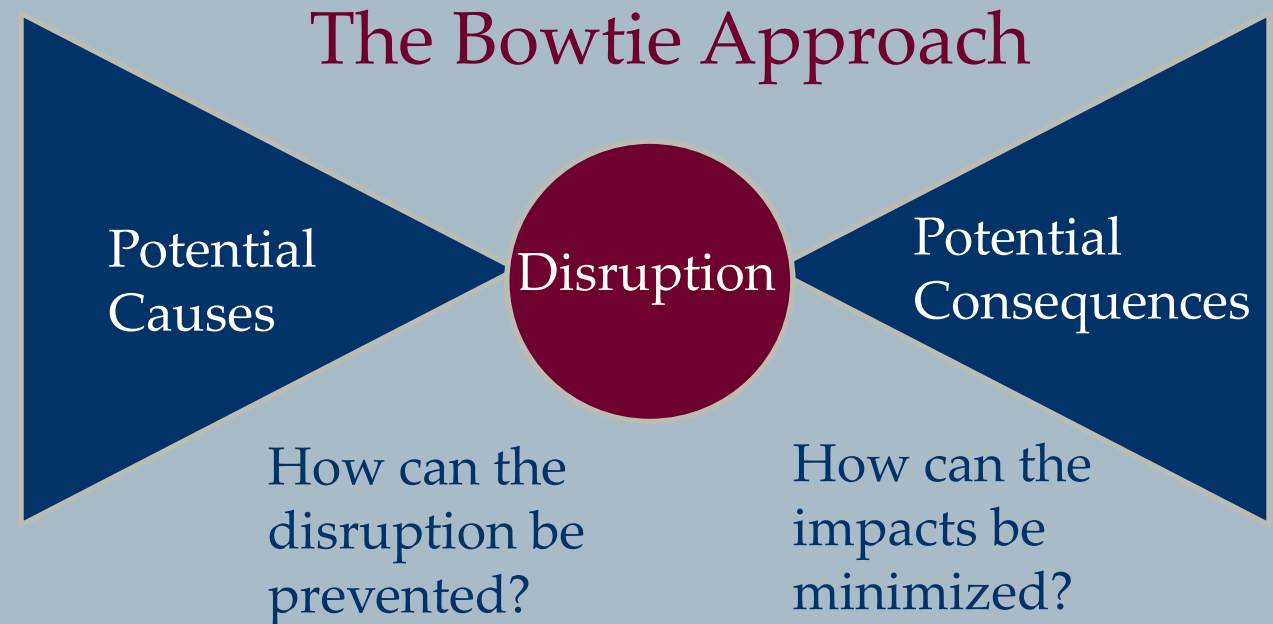
# Supply Chain Risk Categories

- Natural Disasters
- Manmade Disruptions
- Supplier Risks
- Cybersecurity and Information System Failures
- Transportation Failures
- Quality Failures



# Understanding the Causes

- Analyze using the “Bowtie Approach.”
- Develop a “Risk Register.”
  - Describe disruption
  - Identify likelihood
  - Estimate potential severity
  - Identify possible consequences
  - Consider mitigation measures



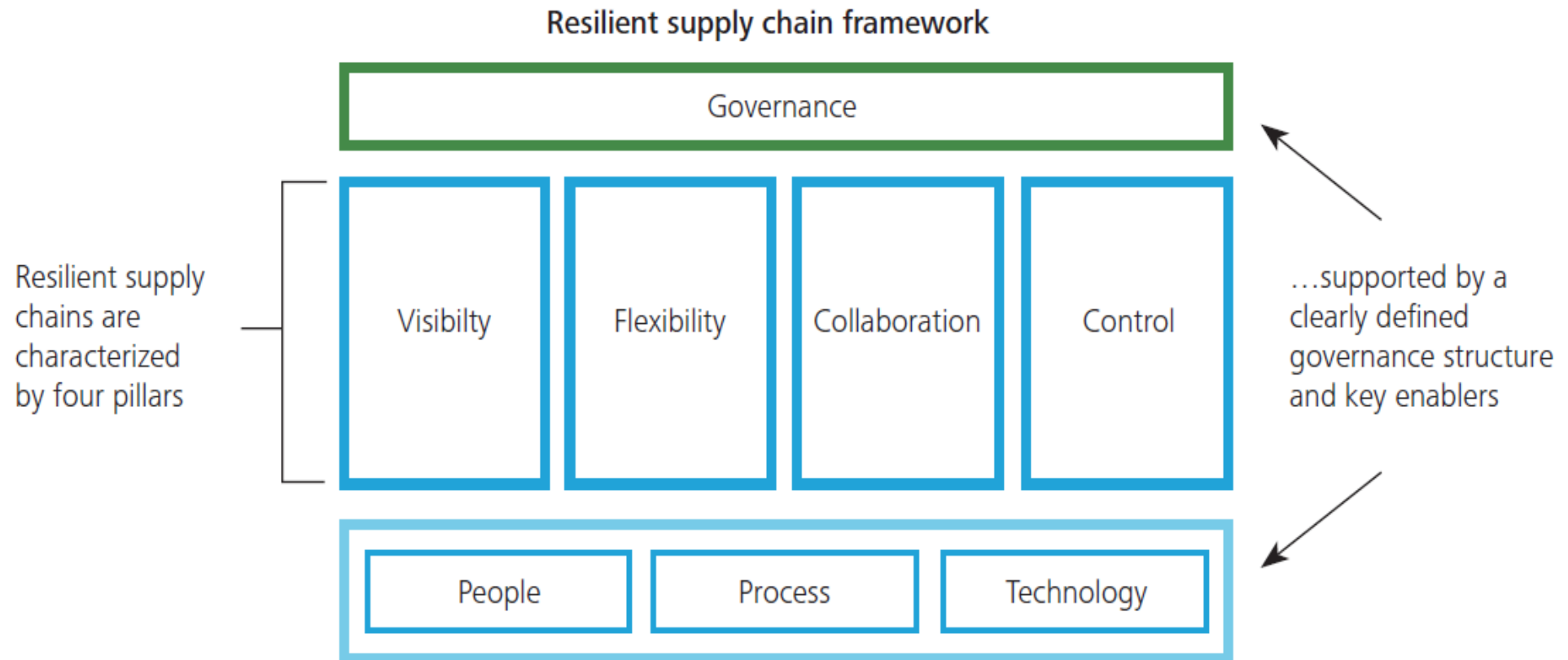
# Unanticipated Impacts But Long Term Positives

- Fukushima required a significant energy conservation effort.
- Coca-Cola had nearly 1 million electric vending machines.
- Result: Build a better vending machine that can also assist during a disruption.





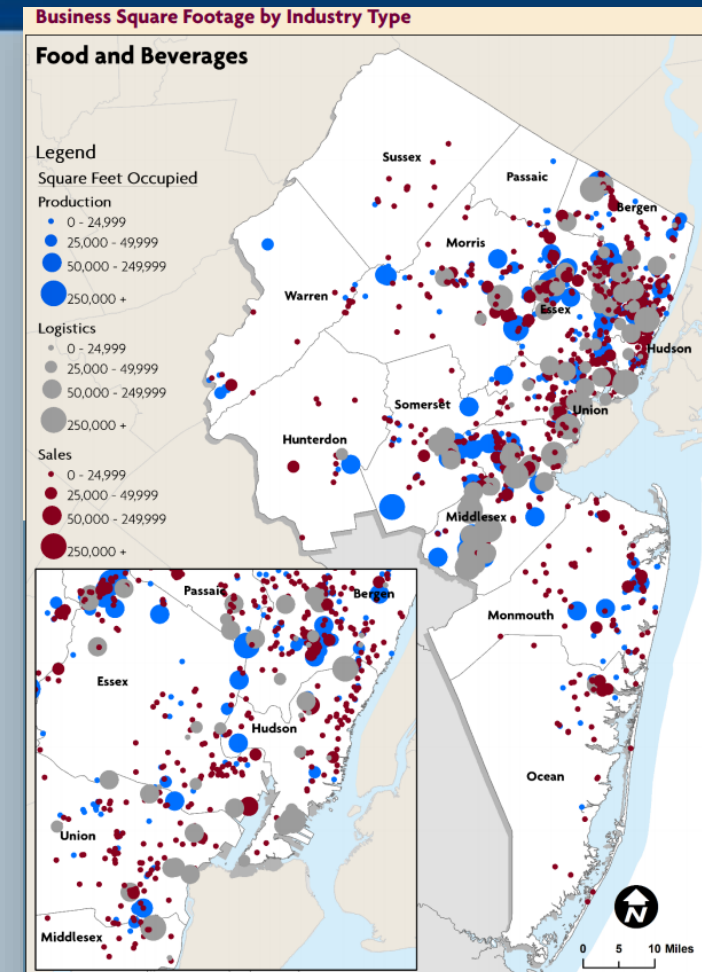
# Building Resilience





# Examples of Visibility, Flexibility, Collaboration and Control

- Visibility: Track and monitor critical supply chains
  - Example: NJTPA's Key Commodity Profiles
- Flexibility: Shift facilities, modes and routes
  - Example: CSX using Norfolk Southern rail lines for time sensitive movements after the 2001 Howard Street Tunnel fire.
- Collaboration: Work effectively with partners
  - Examples: Marine Transportation System Recovery Units, NY/NJ Council on Port Performance
- Control: Monitor and quickly respond
  - Example: Company responses following Fukushima – Merck and Intel



# The Business Continuity Takeaways

- Consider how to sustain area businesses as part of overall resiliency strategies.
- Identify potential risks, consequences and mitigations.
- Can't know all the potential risks but can create approaches to manage.
- Use visibility, flexibility, collaboration and control.
- Know that long term outcomes can be positive.



# Thank You

**Anne Strauss-Wieder**

Director, Freight Planning

North Jersey Transportation Planning Authority

(973) 639-8404

[Strauss-Wieder@njtpa.org](mailto:Strauss-Wieder@njtpa.org)



# **Resilience Planning in Public Transit**

**Jon A. Carnegie, AICP/PP  
Executive Director**

**Alan M. Voorhees Transportation Center  
Rutgers, The State University of New Jersey**

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**TRB Webinar:**

**Leveraging Transportation Mode Expertise  
for Community Resiliency**

**Thursday, February 15, 2018 | 2:00 PM - 4:00 PM EST**



# Transit Cooperative Research Program

## TCRP A-41: Improving the Resilience of Transit Systems Threatened by Natural Disasters





# Primary Work Products

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- » Guide for Improving Resilience in Transit Agencies
- » Final Research Report on Improving the Resilience of Transit Systems Threatened by Natural Disasters
  - Includes project approach, literature synthesis, case study summaries, report on mid-project workshop, review of APTA interaction
- » 17 Transit Resilience Case Studies :
  - 15 large, mid-size and small U.S. agencies
  - 2 International examples
- » Transit Resilience Website with a Database of Downloadable Information at [resilienttransit.org](http://resilienttransit.org)
  - Full case study write-ups, profiles of the tools described in the Guide, literature summaries, and a range of other useful resources



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# **Current State of the Practice**

# Defining Resilience

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*...the ability to **prepare and plan** for, **absorb, respond, recover** from, and more successfully **adapt** to adverse events.*

*~ The National Academies of Sciences,  
Engineering, and Medicine*

# What definition is right for you?

*“The ability to provide core functions in the face of threats, and recover quickly from major shocks or changing conditions”*

~ LACMTA

*Being able to “...bounce back from shocks during natural disasters or weather-related events.”*

~ Kansas City Transit Authority

*“Being better prepared to withstand and recover from an extreme weather event or threat.”*

~ NJ TRANSIT

One definition need not fit all. It is up to you to figure out what resilience means for your agency.

# Many Paths to Resilience

---

**Past Disaster  
Experience**

**Asset  
Management  
and State of  
Good Repair**

**Sustainability  
and  
Environmental  
Programs**

**Leadership  
and  
Organizational  
Culture**

Representative examples from Case Studies show more than one way to resilience



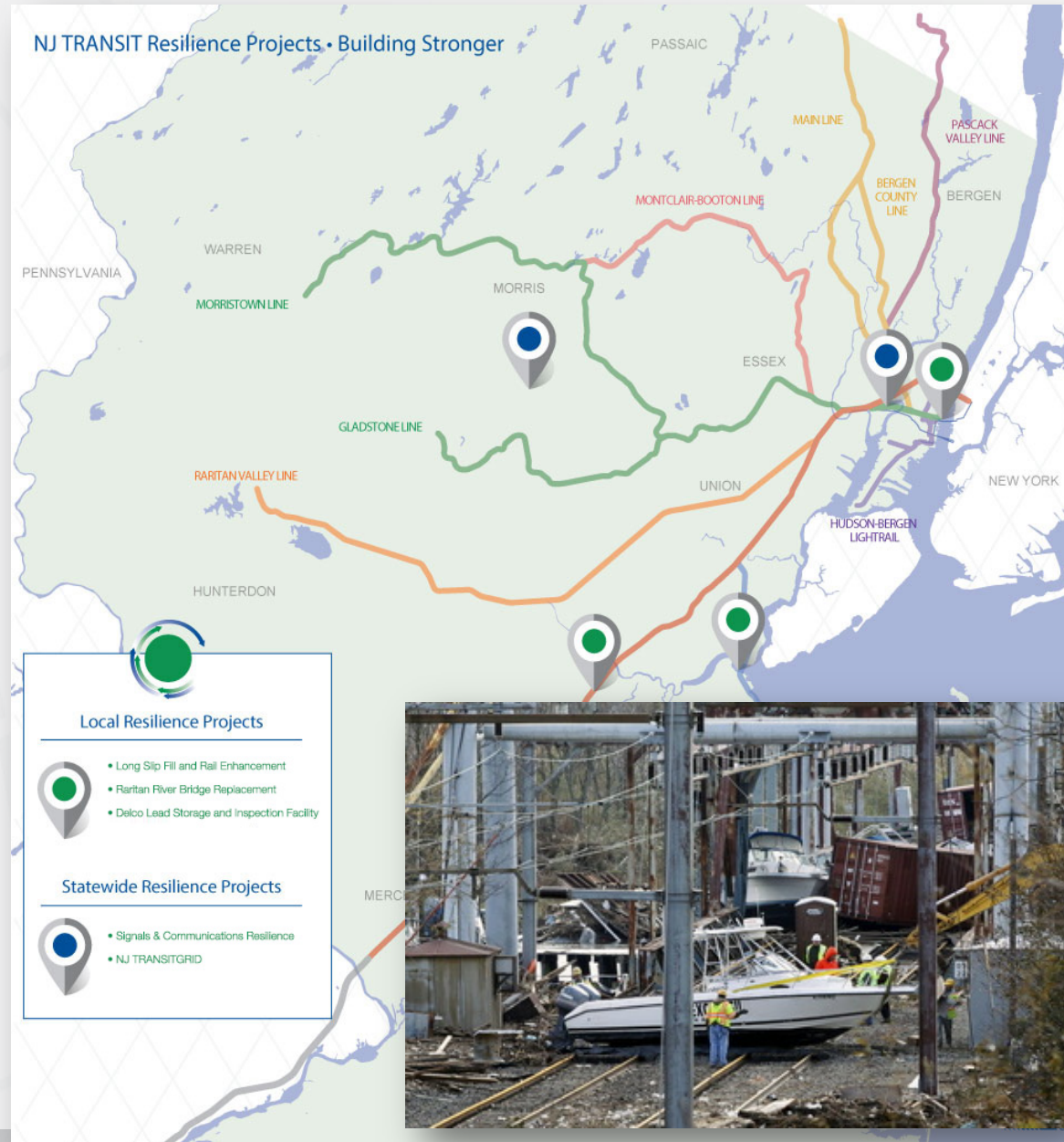
# Past Disaster Experience:

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- » **Massachusetts Bay Transportation Agency (MBTA):** Boston MA 2015 winter snow storms—changes in operations protocols, equipment upgrades
- » **Nashville Metropolitan Transit Authority (MTA):** 2010 flooding and partial fleet destruction—operations changes and MOUs
- » **New Orleans Regional Transit Authority (NORTA):** 2005 Hurricane Katrina and fleet destruction—operational changes and MOUs
- » **San Francisco Municipal Transit Agency (Muni) and Bay Area Rapid Transit (BART):** Loma Prieta Earthquake (1989), Northridge Earthquake (1994—changes in structural design standards, infrastructure, equipment retrofits, warning systems
- » **Southeastern Pennsylvania Transportation Authority (SEPTA):** repeated flooding, high heat, winter storms—multi-faceted cost-effective responses
- » **Transport for London (TfL):** Bombings, flooding, high heat and 2012 Olympics—improved preparedness

# NJ TRANSIT

- » Agency Size: Large
  - 5,000 + vehicles
  - 271 m unlinked trips
- » Location: East Coast
- » Modes: Commuter rail, light rail, bus, demand response
- » Hazards: Flooding, high winds, coastal storm surge, sea-level rise, high heat, extreme cold, winter storms
- » Resilience strategies: Capital investments + operations improvements- COOP, SOPs, training, communications, more



# Leadership and Organization Culture:

---

- » **Nashville MTA** Mayor, CEO and COO committed to expand transit service and preparedness
- » **Metropolitan Atlanta Rapid Transit Authority (MARTA)** and Muni leadership cultivate “cultures of collaboration and forward thinking,” as well as asset management systems that provide a foundation for resilience
- » **LA Metro** mid-level management leadership and successes have cultivated senior management and board-level buy-in
- » **Swedish Transportation Authority** maintenance crews alerted the authority to larger, more frequent restoration, repair and reconstruction projects, due to weather and climate effects



# Hillsborough Area Regional Transit Authority, Tampa, FL

- » Agency Size: Medium
- » Location: Gulf Coast
- » Modes: Light rail, bus, demand response
- » Hazards: Heavy precipitation and flooding, high winds, coastal storm surge, wave action, sea-level rise, high heat
- » CFO interested and empowered
- » Resilience strategies: O&M -fleet monitoring; systems planning-nimble rerouting, relocate planned BRT route - > flooding



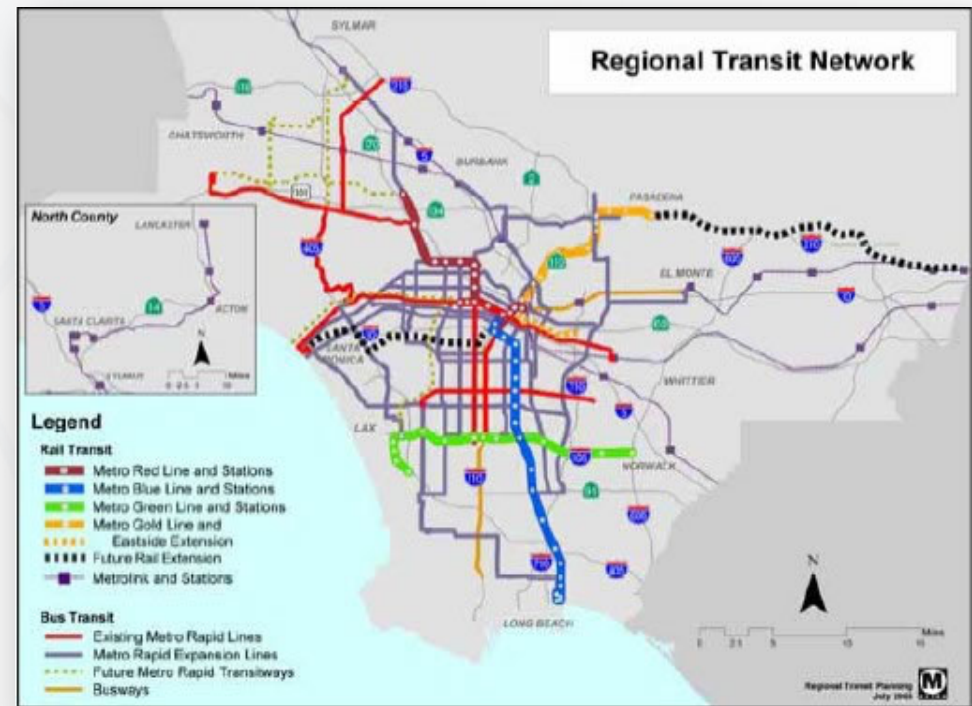
# Sustainability and Environmental Programs:

- » The **Federal Transit Administration (FTA)** promotes sustainability through Environmental Management Systems (EMS)
- » **Hillsborough Area Regional Transit (HART)**, Tampa, FL uses sustainability and EMS as organizing framework for resilience
- » **SEPTA** has an active EMS program
- » **Kansas City Area Transit Authority (KCATA)** is advancing green infrastructure and other sustainability projects as part of city-wide initiatives
- » **MARTA** has significant solar panel installations on bus facilities; the Atlanta region pursues system resilience in the context of the term “sustainability”



# LA Metro, Los Angeles, CA

- » Agency Size: Large
  - 3,300 + vehicles
  - 476 m unlinked trips
- » Location: West Coast
- » Modes: Heavy rail, light rail, bus, demand response
- » Hazards: Earthquakes, flooding, mudslides, wildfires, high wind, sea-level rise, dust storms, high heat
- » Industry leader in Environmental Management System (EMS); adds resilience data & metrics into EMS



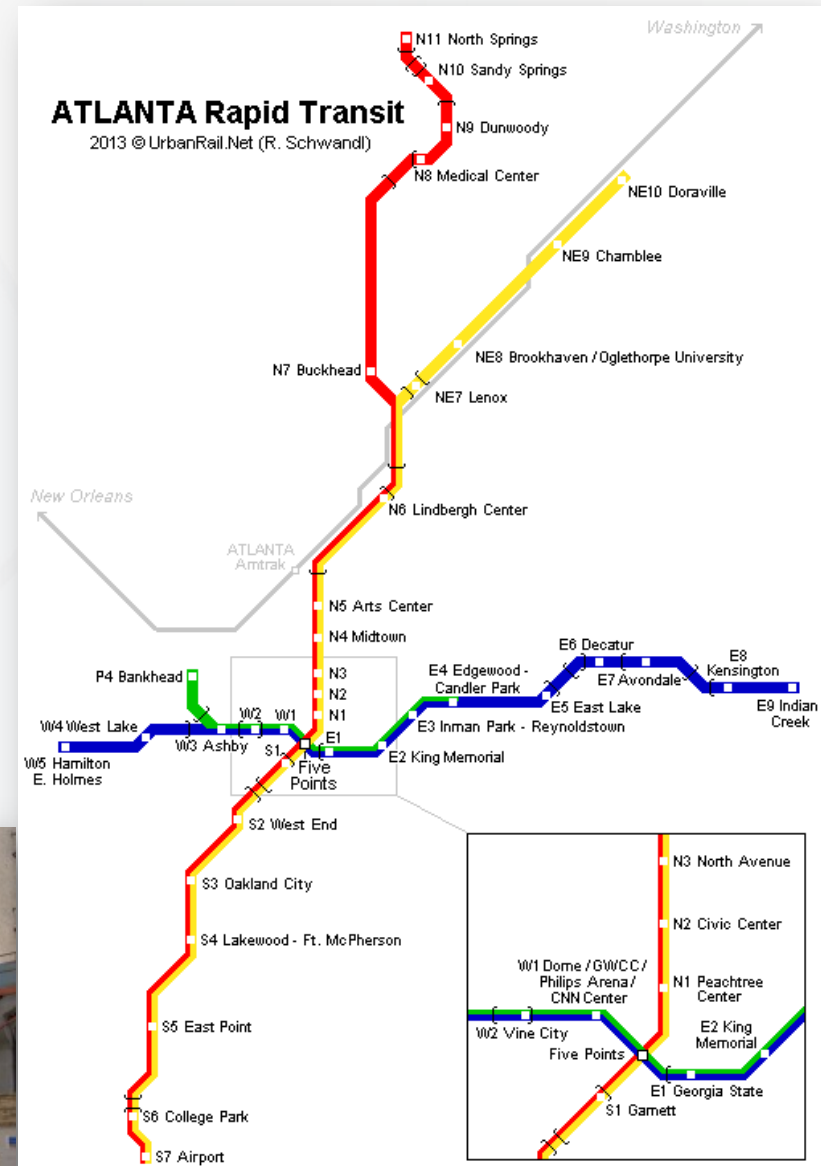
# Asset Management and State of Good Repair:

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- » **Maryland Transit Administration (MTA)** is incorporating climate/ weather risk data and assessment as part of their AMS to monitor SGR
- » **Valley Regional Transit (Idaho)** focuses on event readiness and grounds resilience efforts in concepts of sustainability, asset management and emergency preparedness.

# MARTA – Atlanta, GA

- » Agency Size: Large
  - 130 m unlinked trips
- » Location: Southeast, not coastal
- » Modes: Heavy rail, bus, demand response
- » Hazards: Heavy precipitation and flooding, high heat, drought
- » Asset management “baked in,” resilience folds in via risk management





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# **Guidebook Framework**

# Guidebook

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- ❖ Aimed at any agency personnel, but especially middle managers who often lead resilience planning efforts
- ❖ Presents an actionable, step-wise approach to help transit agencies meet the challenges created by climate change and the impacts of extreme weather
- ❖ Designed for easy printing and binding as agency workbook
- ❖ Includes case study examples, tools, and tips to try



CASE



TOOL



TIP



# How the Guidebook can help...

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- » Consider different definitions of transit system resilience and the domains of resilience adoption
- » Explore which path(s) to resilience might be right for your transit agency
- » Learn basic steps to chart a course to resilience
- » **Understand regional and multi-sector context of interdependencies to promote regional resilience**
- » Learn about tools and resources to help your agency achieve its resilience goals
- » Understand how the APTA standards update process can integrate resilience into existing practices

# Four Basic Steps

## Get Started

- Understand your agency context
- Engage to plan and implement
- Identify opportunities and barriers

## Take Stock

- Assess vulnerabilities and risk
- Identify domains for resilience adoption
- Identify supportive processes
- Assess the current status of activities

## Move Forward

- Articulate resilience goals
- Create a shared sense of need
- Select and prioritize strategies
- Develop/implement detailed action plans

## Monitor Progress

- Choose performance measures
- Collect and track data
- Evaluate success

Adjust course as needed

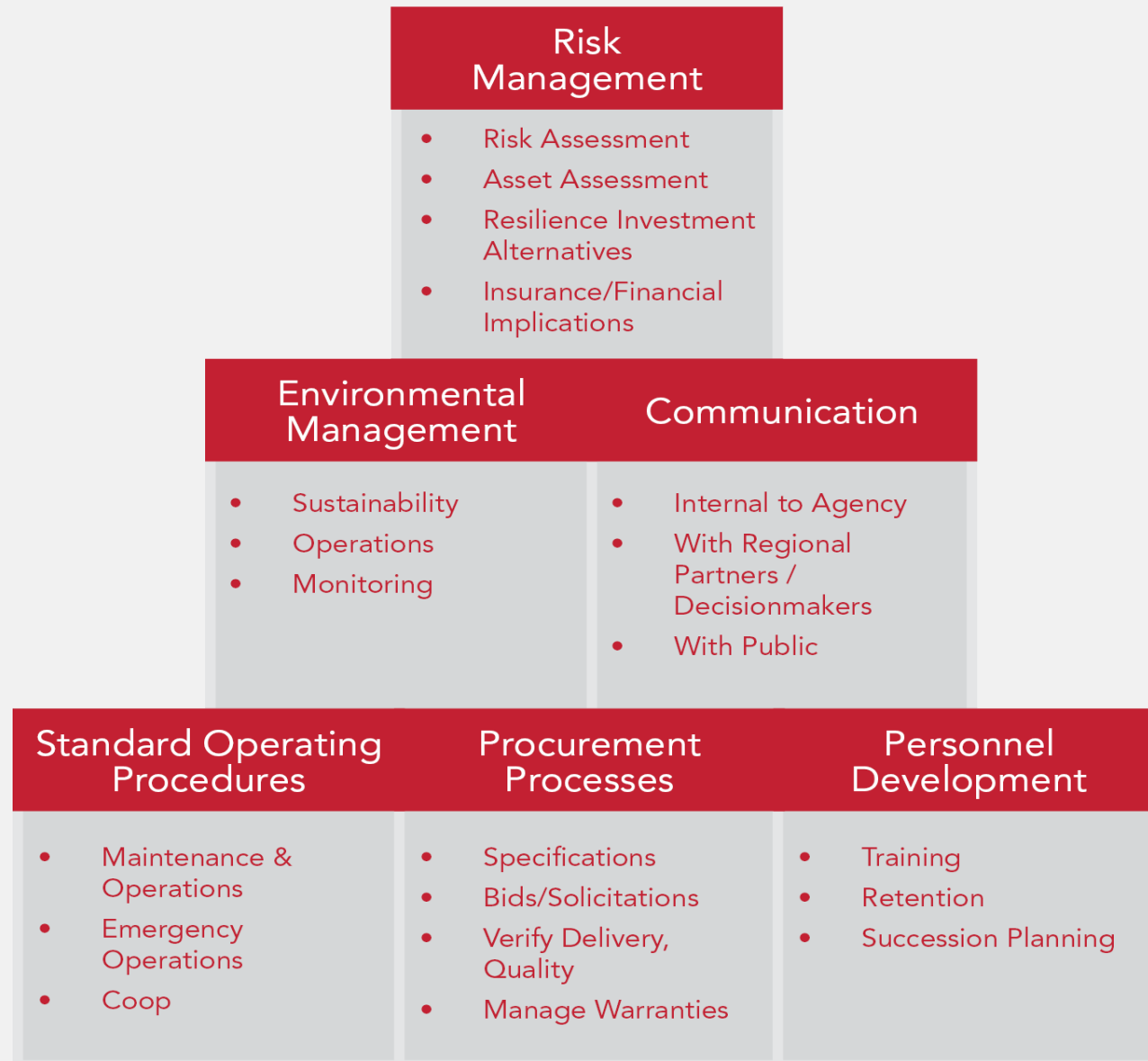


# “Domains” of Adoption

The concept of improving transit systems resilience is framed around the idea of building resilience across all “domains” of transit agency business.



# Processes To Support Resilience Adoption



# Transit Resilience Database

- » Browse the Library
- » Search by:
  - Resource type
  - Hazard type
  - Adoption domain
  - Transit mode
  - Keyword
  - Tags
- » Print summary of selected resource
- » Links to full documents or web reference

Resilient Transit Search Page

Resilient Transit Tools and Resources

Print

### Resilient Transit Tools and Resources

Showing 1-100 of 110 [add filters](#) [export](#)

100 per page

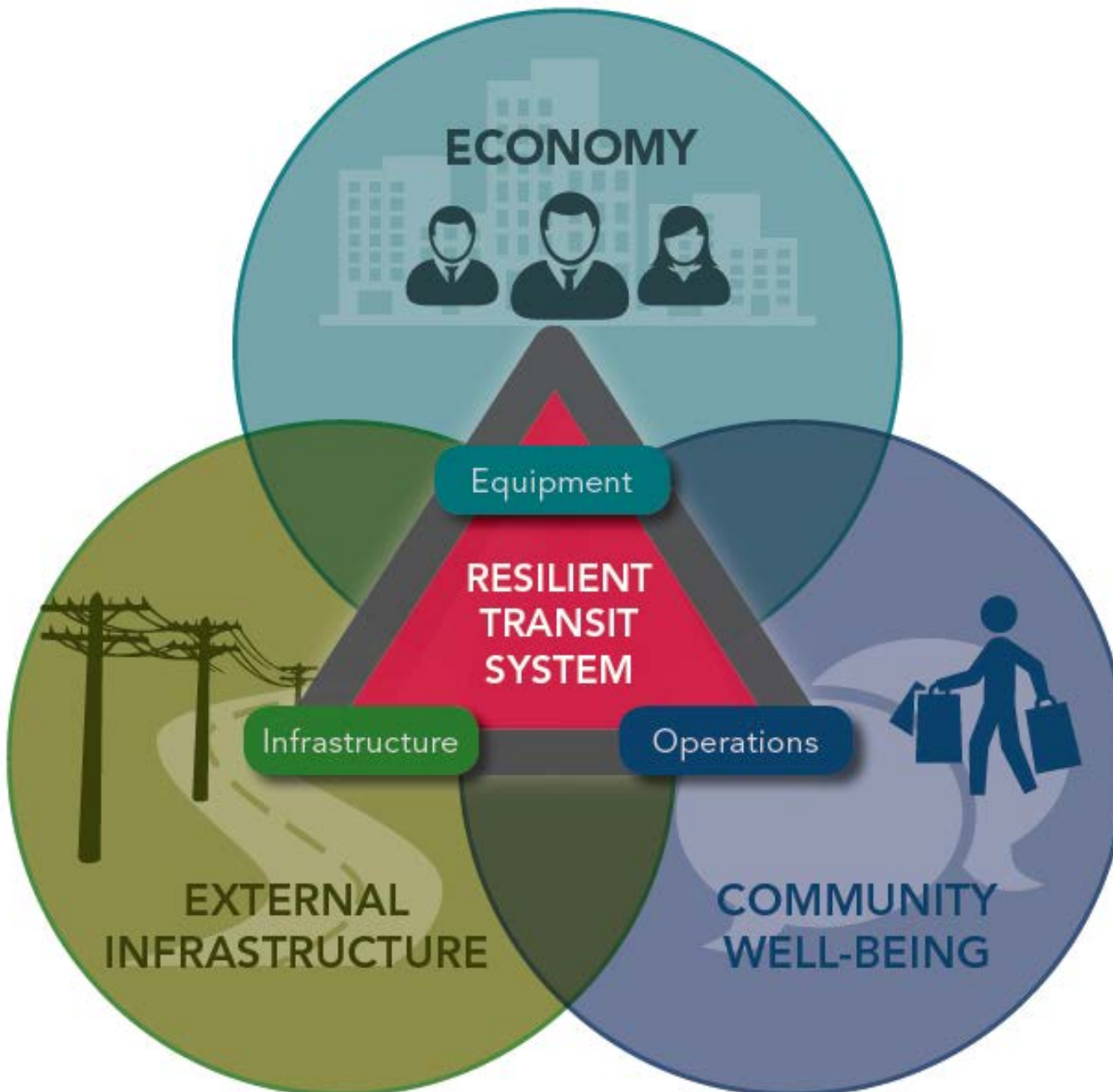
Page 1 of 2

< >

Resource/Tool Name	Type of Resource/Tool	Description	View Resource Details
Adaptation of Transport to Climate Change in Europe	Report (General)	As an initial step towards the necessary widespread mainstreaming of climate change adaptation into transport planning and decision-making, this report aims to shed light on initial adaptation practices in the transport sector across Europe while providing a perspective on the emerging challenges and opportunities. The purpose of the report is to stimulate discussion. The factual information collected is based on data available in the Climate-ADAPT (1) information platform, a literature review, case studies provided by many stakeholders, and a questionnaire on transport and adaptation addressed to EEA member countries in 2013. A total of 23 country representatives answered this questionnaire and provided information on the variety of national approaches to adaptation in transport.	<a href="#">view</a>
Adapting to Climate Change Through Asset Management Planning	Other	This presentation examines the relationship between potential climate change factors and transit assets and operations, with particular focus on how a transit agency's asset management system can be used in support of strategic adaptation investment decision making. It offers a framework for integrating climate adaptation in transit asset management.	<a href="#">view</a>
Adapting to Climate Change: Another Challenge for the Transportation Community	Article	The paper outlines a series of issues surrounding the incorporation of climate change into transportation planning processes. Accepting climate change is occurring, the paper outlines a series of impacts to various regions of the United States while outlining the uncertainty the data provides. Diving into the concerns, it identifies approaches to risk management and the need for long term planning as necessary but also maintains awareness of potential data uncertainty.	<a href="#">view</a>
Adapting to Climate Change: Practical Strategies at the Port Authority	Policy, Other	The presentation outlines the efforts the PANYNJ has been undertaking to address climate change. These efforts include policy.	<a href="#">view</a>



# Think Beyond Your Agency...



**No agency is an island.**

**Who do you depend on?**

**Who depends on you?**

# Identify Existing Regional Resilience Efforts

- » Look to Mayors, MPO, County executives, non-profit organizations, state efforts, others (may be more than one initiative)
  - Definitions of extreme weather risks, climate change scenarios
  - Vision and mission for resilience- time frames, action orientation- Capital? Operating? Addressing interdependencies?
- » No existing organization? consider forming your own (see NCHRP Report 777)



# Get Involved

---

- » Make the case for transit as an essential partner for resilience
- » Contribute time, ideas, questions, answers, and collaborative, co-benefit projects
- » Participate in planning and carrying out regional exercises
- » Participate in seeking grants, prioritizing projects
- » Develop Memoranda of Understanding (MOUs) with diverse partners

TRANSIT  
COOPERATIVE  
RESEARCH  
PROGRAM

# TCRP

Web-Only Document 70:

## Improving the Resilience of Transit Systems Threatened by Natural Disasters

### Volume 1: A Guide

Deborah Matherly  
Louis Berger  
Washington, DC

Jon A. Carnegie  
Alan M. Voorhees Transportation Center  
Rutgers, The State University of New Jersey  
New Brunswick, NJ

Jane Mobley  
Louis Berger  
Kansas City, MO

Guidebook for TCRP Project A-41  
Submitted May 2017

The National Academies of  
SCIENCES • ENGINEERING • MEDICINE

TRANSPORTATION RESEARCH BOARD

## TCRP A-41

Improving the Resilience of Transit Systems Threatened by Natural Disasters

[Home](#) [About the Research](#) [TRB and Resilience](#) [Guide](#) [Database](#) [Final Report](#)

Extreme weather events and other natural disasters threaten the operations and the capital assets of transit systems across the United States. This website was created as part of *TCRP (Transit Cooperative Research Program) A-41: Improving the Resilience of Transit Systems Threatened by Natural Disasters*—a research project funded by the Transportation Research Board.

Click on the links below to find out more about the project's three main work products:

- [Improving Transit Resilience Guide](#)
- [Improving Transit Resilience Database](#)
- [TCRP A-41 Final Report](#)



### GUIDE



Photo courtesy of Nashville MTA

### DATABASE



Photo courtesy of REUTERS/Doug Mills/Pool

### FINAL REPORT



Photo courtesy of USDOT Volpe Center



# For Further Information

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Jon Carnegie | 848.932.2840 | [carnegie@ejb.rutgers.edu](mailto:carnegie@ejb.rutgers.edu)





# **Airport Weather Advanced Readiness (AWARE) Toolkit and Connections to NIST Community Resilience Planning Guide**

## **ACRP Report 160**

Beth Rodehorst  
Senior Manager, Climate  
Change Adaptation &  
Resiliency  
ICF

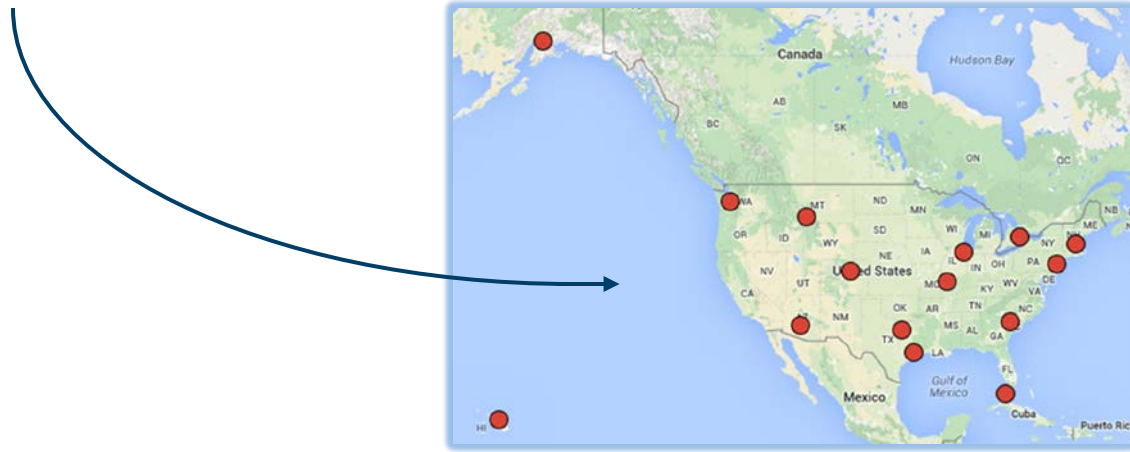
# What is the AWARE Toolkit?

- The AWARE Toolkit is a stakeholder-driven tool to help airports improve their readiness for significant weather events and track the physical and financial impacts of such events to aid in recovery and future planning



# Toolkit Uses

- Learn about exposure to 17 significant weather event types at each airport location
- Assess airport readiness for significant weather events across 6 distinct functional areas
- Learn how to improve readiness for significant weather events
- Access “Best Practices in Action” based on 15 airport case studies across North America



# Today's Webinar

- April 5<sup>th</sup> webinar will introduce details of toolkit
- Today, we consider how the toolkit and case studies fit within the NIST Community Resilience Planning Framework



# Using AWARE for Community Resilience Planning

- Use Exposure Module to quickly and easily identify “rare but plausible” extreme weather events
- You just need a zip code or airport code!



## Airport Weather Advanced REAdiness (AWARE) Toolkit

Exposure Module

Extreme Events Overview

Click to PDF

Back to Select Location

Next

This page provides a snapshot of extreme weather in the county that corresponds to the selected location.

In the first panel to the right, events are ordered by frequency of occurrence in the county. The second displays events that have not occurred in the county but may have occurred in adjacent counties. Events recommended for further study - which are *rare but plausible* - are listed in the box to the right.



Click on the **flood icon** to learn more about precipitation event impacts.



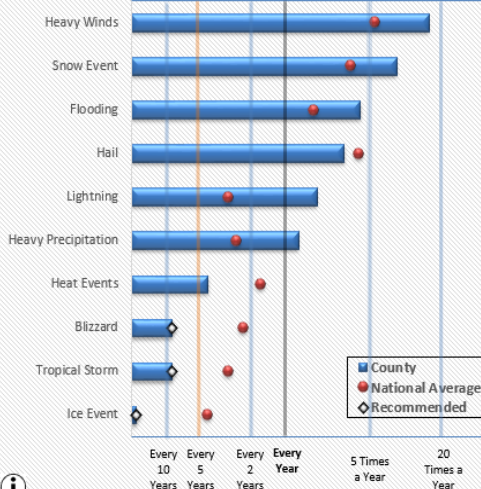
Click on the **FEMA icon** for a list of weather events that have had disaster declarations in the selected county.

Location ID

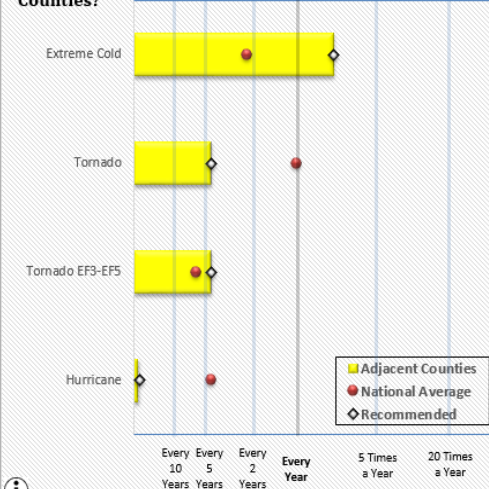
ZIP code 01982  
County Essex  
State Massachusetts  
FAA Region ANE



### How Often Have Events Happened in Your County?



### How Often Have Other Events Happened in Adjacent Counties?



To view these events in more detail, please click 'Next' to proceed to the **Detailed Analysis**. For descriptions of weather events click on "Methodology and Data Sources" below.

#### Events Recommended for Review

Blizzard  
Tropical Storm  
Ice Event  
Extreme Cold  
Tornado  
Tornado EF3-EF5  
Hurricane

Event Definitions, Methodology and Data Sources

Events not occurring in either selected county or adjacent



# Using AWARE for Community Resilience Planning

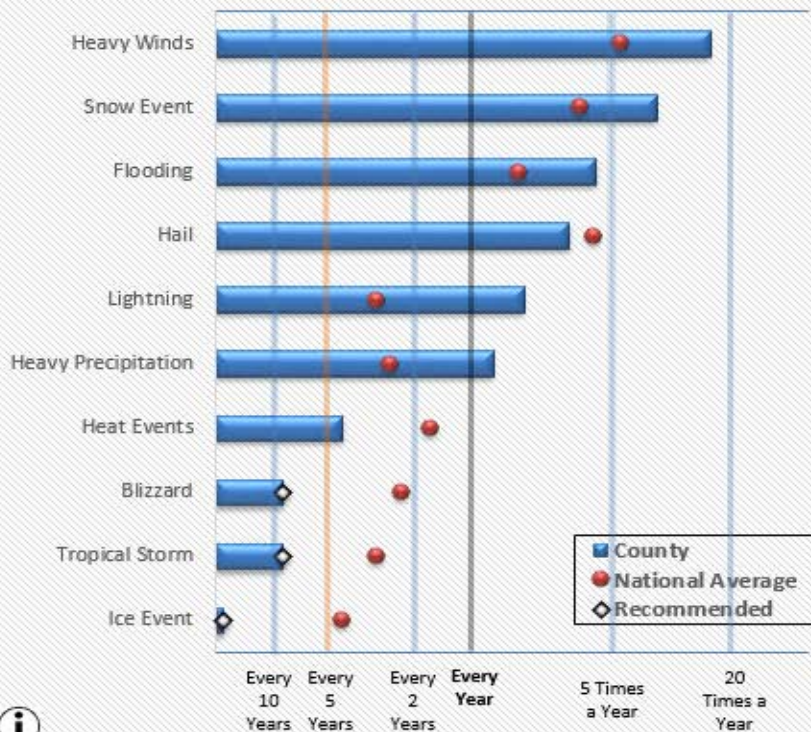
AWARE) Toolkit

Click to  
PDF

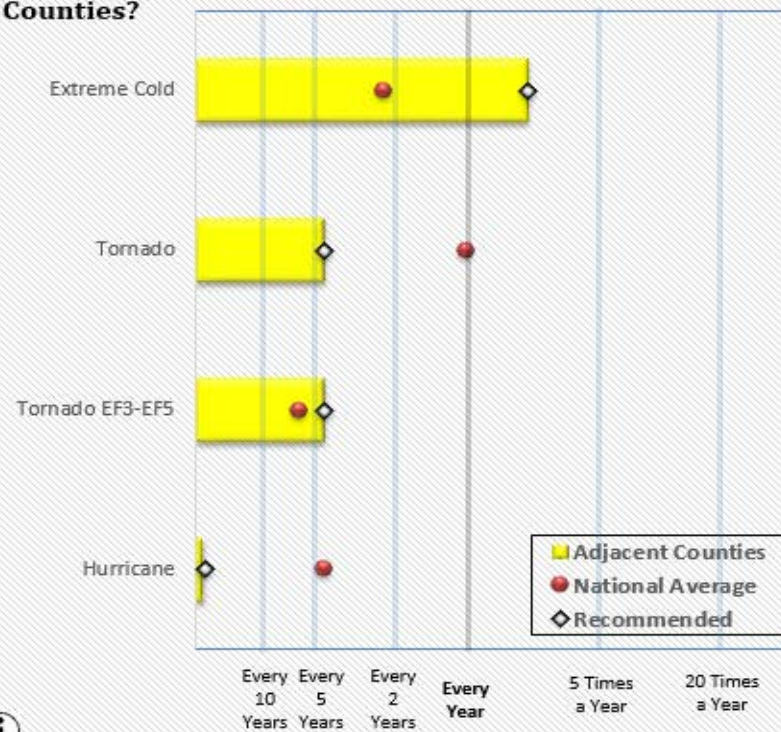
Back to Select  
Location

Next

## How Often Have Events Happened in Your County?



## How Often Have Other Events Happened in Adjacent Counties?



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# Using AWARE for Community Resilience Planning

## Readiness Self-Assessment for Airports

**AWARE Toolkit: Airfield Operations Module** PDF/Print Home Step 1 Step 2 Step 3 Step 4 End

Readiness Self-Assessment: Is your airport taking these steps?

Select event type:

Overarching

Update Event

**Instructions**

- Review the following best practices for preparing for different weather event types. Check off the items that your airport already completes.
- Press the **Next** button at the bottom of the page to move through event types sequentially, or select an event using the yellow drop down and the **Update Event** button to the left.

**Best Practices and Implementations Steps: Overarching**

Hide All Sub-Steps

Hide

Planning

- ☒ Prior to, and during, an identified weather event, communicate with airlines to understand broader weather conditions surrounding the airport
- ☐ Develop a training for departure controllers to communicate weather impacts reported from pilots effectively
- ☒ Setup a communication link between departure tower and airport management
- ☒ Develop a method to log reports from pilots and a way evaluate them in terms of current weather impacts
- ☐ Communicate priority reports on impending weather to airport staff
- ☒ Evaluate past performance and improve reporting
- ☐ Hold pre-season meetings and exercises to coordinate response
  - ☐ Identify key personnel that need to be engaged in the preplanning meeting, and set up meeting times with key personal (e.g., use Doodle, Survey Monkey, Google Sheets, or another tool for meeting times)
  - ☐ Prepare agenda that includes an outline of the existing response plan for event with corresponding responsibilities; determine based on in-meeting knowledge whether an exercise is needed

**Type Legend:**

- Communications
- Personnel
- Funding
- Procedures
- Equipment
- Infrastructure

[+ See Case Studies](#)

Show/hide best practices by stage (Planning, Mitigation, Response, Recovery)

Select event type and update checklist

Click to see case studies



# Using AWARE for Community Resilience Planning

## Best Practices Checklists

### AWARE Toolkit: Administration & Finance Module

#### Extreme Weather Preparedness Checklists

##### Instructions

- Review checklists of best practices yet-to-be implemented. Add notes in the right-most columns to customize the checklist for your airport.
- If you make any changes to the self-assessment and want to update these checklists, press the "Update Checklist" button at right.

Update Checklist

Next

Remaining Action Items	Who?	When?	Other Notes
<b>Overarching</b>			
NIMS: Review the National Incident Management System document. Click the "See Additional NIMS Resources" link above for a link to the document			
NIMS: Review ACRP Report 103: A Guidebook for Integrating NIMS for Personnel and Resources at Airports and implement recommendations as appropriate. Click the "See Additional NIMS Resources" link above for a link to the document			
NIMS: Understand well before an event occurs the triggers that will require establishing an Emergency Operations Center (EOC). Click the "See Additional NIMS Resources" link above for Organizational Chart Templates by Type of Incident			
NIMS: Structure organizational responses based on if the weather event impacts will be acute (e.g., tornado) or longer term (e.g., flood). Click "See Additional NIMS Resources" for organizational chart templates for EOC flood and tornado response			

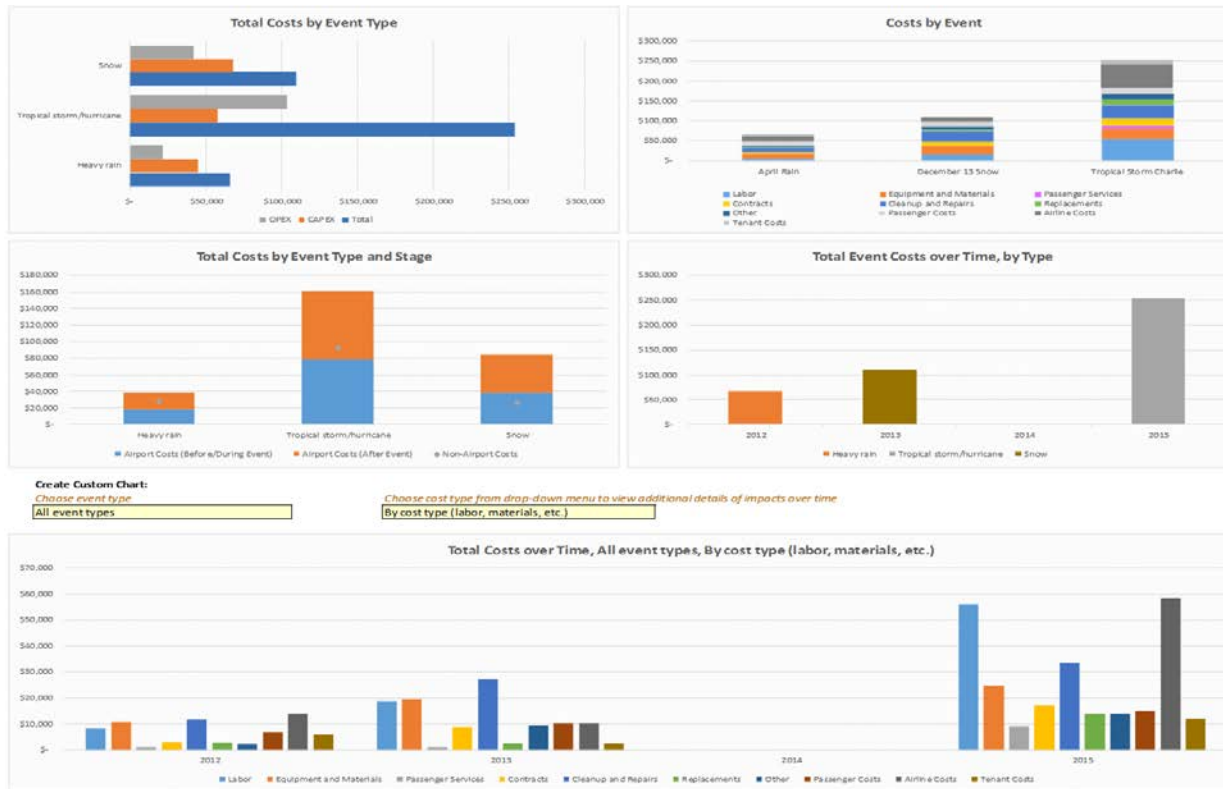
### SIX-STEP PROCESS TO PLANNING FOR COMMUNITY RESILIENCE



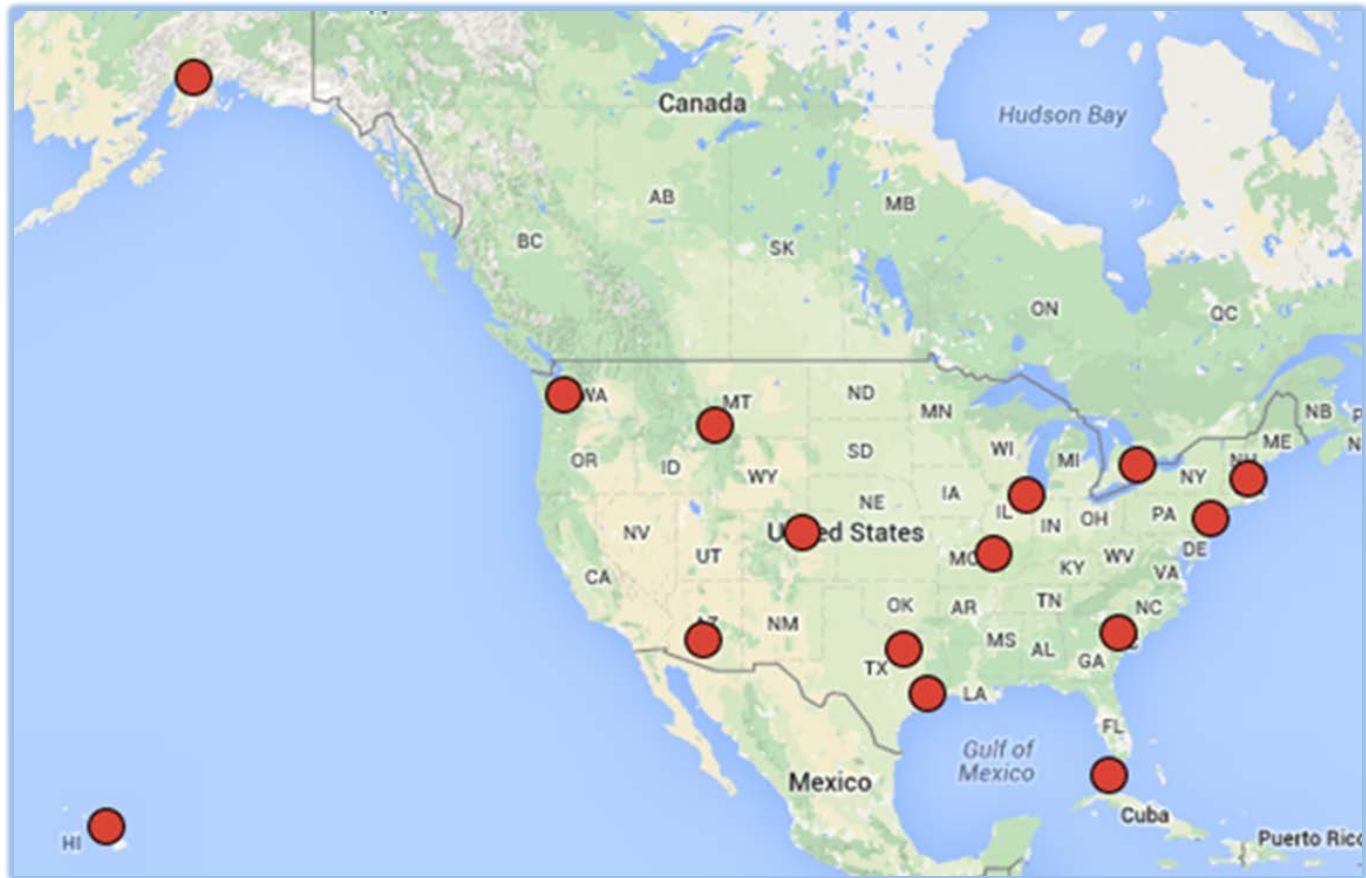


# Using AWARE for Community Resilience Planning

## Impacts Tracking



# Insights from Airport Case Studies





# AWARE Case Studies

ACRP Report 160 | ACRP x

www.trb.org/ACRP/ACRPReport160.aspx

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- AAA

ACRP > ACRP Report 160

## Toolkit and Supplemental Information to ACRP Report 160: Addressing Significant Weather Impacts on Airports



ACRP Project 02-49, "Addressing Significant Weather Impacts on Airports," resulted in products to help airports become r addition to their airport emergency plans. The chief product is the Airport Weather Advanced REAdiness (AWARE) Toolkit responses to recent significant weather events. This toolkit can help various types and sizes of airports and their stakehol

The AWARE Toolkit and related products are described in detail below.

**Disclaimers:** The opinions and conclusions expressed or implied in this material are those of the researchers who perform Materials noted with an asterisk (\*) have been edited by TRB; otherwise, materials are as supplied by the contractor.

Any digital files or software included is offered as is, without warranty or promise of support of any kind either expressed c liable for any loss or damage caused by the installation or operation of this product. TRB makes no representation or war fitness for a particular purpose, and shall not in any case be liable for any consequential or special damages.

### AWARE Toolkit Files

- ▶ **AWARE Toolkit**  
The AWARE Toolkit contains readiness modules for six different functional areas of an airport (as well as a consolidated version for small airports). These modules allow the user to (1) review best practices for preparing for different weather events, (2) assess their readiness for those events, and (3) generate customized checklists for preparing for and recovering from weather events. The Toolkit also contains the Impacts Tracking Module, a tool to help airports track costs and other impacts from weather events, such as flight delays, over time as events occur.
- ▶ **Quick Start Guide \***  
The Quick Start Guide provides a rapid introduction to the AWARE Toolkit and features screenshots and tips for users interested in beginning to use the Toolkit.
- ▶ **AWARE Toolkit User Guide \***  
The User Guide provides detailed information on how to navigate and use the AWARE Toolkit and

ACRP Report 160 web site:  
<http://www.trb.org/ACRP/ACRPReport160.aspx>

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# AWARE Case Studies

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## ▶ [AWARE Toolkit](#)

The AWARE Toolkit contains readiness modules for six different functional areas of an airport (as well as a consolidated version for small airports). These modules allow the user to (1) review best practices for preparing for different weather events, (2) assess their readiness for those events, and (3) generate customized checklists for preparing for and recovering from weather events. The Toolkit also contains the Impacts Tracking Module, a tool to help airports track costs and other impacts from weather events, such as flight delays, over time as events occur.

The AWARE Toolkit files include several Excel files integrated into one. For best results, download the [Zip file](#) and extract all files onto your computer before using. Follow instructions on the below Quick Start Guide on how to extract the Zip file and get started.

## ▶ [Quick Start Guide](#) \*

The Quick Start Guide provides a rapid introduction to the AWARE Toolkit and features screenshots and tips for users interested in beginning to use the Toolkit.

## ▶ [AWARE Toolkit User Guide](#) \*

The User Guide provides detailed information on how to navigate and use the AWARE Toolkit and information on each component of the toolkit.

## ▶ [AWARE Toolkit Overview](#) \* (PowerPoint)

The AWARE Toolkit Overview summarizes the purpose, intended uses, components, and key features of the AWARE Toolkit.

## ▶ [AWARE Toolkit Brochure](#) \*

This brochure summarizes the purpose, contents, and key features of the AWARE Toolkit.

### Supplemental Information

## ▶ [National Incident Management System \(NIMS\) Organizational Charts](#)

These NIMS organization charts illustrate NIMS response structures under different incident types.

## ▶ [Literature Review and Checklist Resources](#)

This document lists the resources used in the literature review and development of this ACRP product.

## ▶ [Airport Survey Methods and Results](#)

This document outlines the methods and findings from a survey of 70 North American airports about the types of weather events experienced by airports; what kind of damage was associated with those events; and how the airports prepared for, responded to, and recovered from those events.

## ▶ [Historical Weather Analysis Details](#)

This resource provides an overview of the methods and data used to develop weather event type definitions used in the Toolkit as well as the Exposure Information Module.

## ▶ [Airport Case Studies](#) \*

These case studies summarize the experiences of 15 airports in the United States and Canada in preparing for, responding to, and recovering from extreme weather events. The case studies explore best practices and challenges in managing extreme weather risks.

## ▶ [References](#)

This resource lists the references used in developing these ACRP products.

**\*ACRP Report 160:**

***Addressing Significant Weather Impacts on Airports: Quick Start Guide and Toolkit***



VIEW THIS PDF

Right There!

# Collaboration and Coordination

- **Dallas/Ft. Worth emphasizes communication with airlines to understand how they are adjusting service during events**
  - Affects how airport staffs its team, how much of which materials to have on hand
  - Airport can make sure food service tenants, custodial staff, etc. are prepared to service extra customers in terminals
- **DFW has PR person in emergency operations center to help communicate status to public**



# Collaboration and Coordination

- **Kahului Airport (Maui)**  
**emphasizes face-to-face meetings before events**
  - It helps immensely to *know* the individuals to collaborate with, have their direct phone numbers
- **Maui County's civil defense center has reps from airport, Coast Guard, private fueling companies, State Government, etc.**
  - Coordination occurs across many groups



# Planning for Service During Event: Not “All or Nothing”

- **DEN’s snow removal plan used to seek to keep operations totally normal**
  - Didn’t work during major blizzards, such as in 2006
  - Refocused goal of snow removal plan to maintain service for primary services; other services temporarily suspended
- **During major snow events, planes could still arrive...but then couldn’t depart because ground crew couldn’t keep up with de-icing efforts**
  - Now, coordinated effort with FAA and airlines to purposely reduce # of planes arriving, so that incoming/outcoming flights are balanced





# Airports as Community Resources During Events

- **Kahului Airport in Maui is designated community center during tsunami and hurricane threats**
  - Up to 7,000 people may shelter in terminals with normal capacity of 5,000
- **Important to think through entire process of how people arrive there, through how they are taken care of during stay**
  - Parking lots can't handle vehicle volume
    - Cars parked on streets could potentially block emergency vehicles
  - County cuts off electricity and water
    - Need portable bathrooms and supplies readily available



# Airports as Community Resources During Events

- **Key West International Airport critical for recovery after hurricanes**
  - Relief Supplies
  - Personnel
- **Airport has equipment, above sea level, on hand to quickly get operations back up**
- **Clear guidelines established for when commercial service can be restored**
  - Includes making sure functional hospital is available
  - Requires close communication with emergency managers throughout the County



# Staffing During Events and Foresight in Contracting and Planning

- During “deep freeze” in January 2014, Toronto Pearson International Airport experienced temperatures of -39° C
- Staff didn’t have coats, gloves, etc. to work safely. Many called in sick.
- **Emphasized importance of:**
  - Ensuring the right equipment is available to employees. Need to keep them safe!
  - Anticipating when absences could be an issue so service could be proactively reduced if needed—no surprises
  - Reconsidering incentives and strategies to ensure sufficient # of workers



# Staffing During Events and Foresight in Contracting and Planning

- **DFW: Major storm event in May 2011 stranded 6,200 people in terminal**
  - Insufficient custodial staff
  - Overflowing trash cans, cleaning concerns
- **Event forced DFW to consider how to more carefully set up contracts with service providers**





## Thank You!

Beth Rodehorst, ICF  
Senior Manager, Climate Change Adaptation &  
Resiliency  
[Beth.Rodehorst@icf.com](mailto:Beth.Rodehorst@icf.com)



# Today's Participants

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- Anne Strauss-Wieder, *North Jersey Transportation Planning Authority*, [Strauss-Wieder@njtpa.org](mailto:Strauss-Wieder@njtpa.org)
- Jon Carnegie, *Rutgers University*, [carnegie@ejb.rutgers.edu](mailto:carnegie@ejb.rutgers.edu)
- Beth Rodehorst, *ICF*, [Beth.Rodehorst@icf.com](mailto:Beth.Rodehorst@icf.com)

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- Become a Friend of a Committee (<http://bit.ly/TRBcommittees>)
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  - May provide a path to become a Standing Committee member
  - ***Sponsoring committee: ABR10***
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  - Create your account
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- Must register as an individual to receive credits (no group credits)
- Credits will be reported two to three business days after the webinar
- You will be able to retrieve your certificate from RCEP within one week of the webinar