SNOW AND FLOODS AND FIRES, OH MY! - A CASE FOR REGIONAL TRANSPORTATION RESILIENCE

presented to

COMPASS Educational Series Participants

presented by

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Cambridge Systematics

May 29, 2024

Cambridge Systematics

Policy + Strategy

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- 200+ staff in 12 nationwide offices
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Resilience and Sustainability

Presentation Overview

- Risk and Resilience – Basics
- Assessing Risk and Resilience
  - » Assets and Hazards
  - » Examples
- Integrating into Regional Planning
- Recap and Q&A

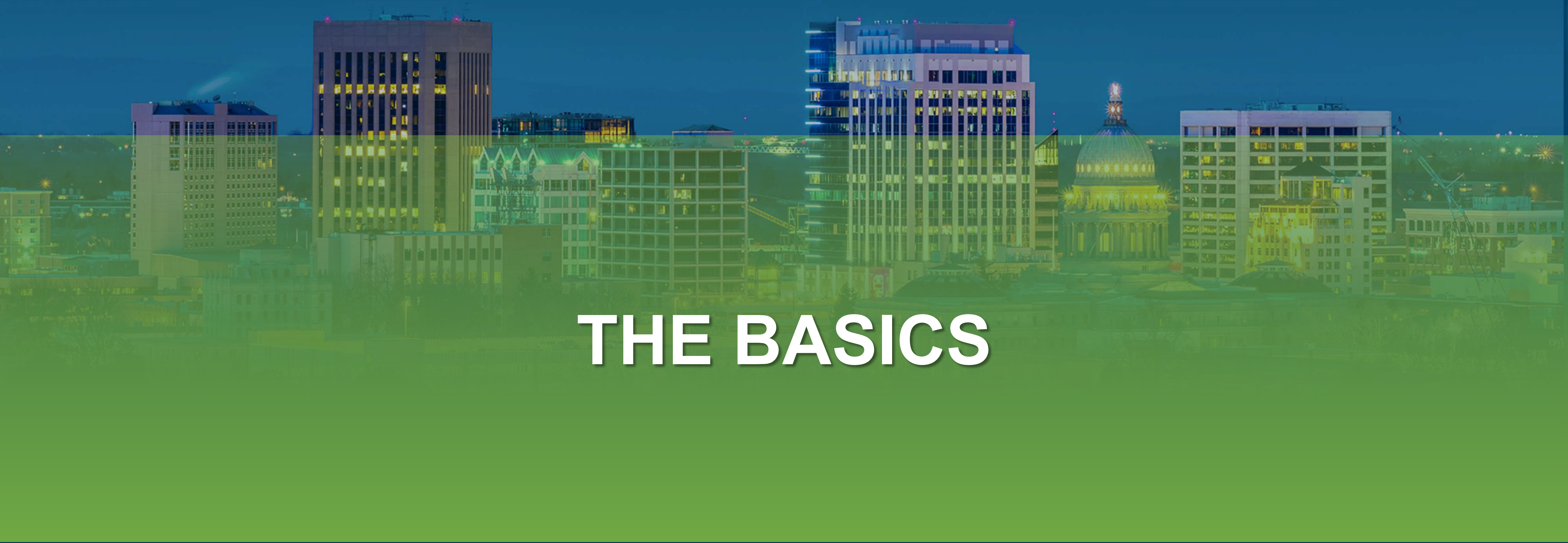
Discussion Objectives

Orientation to Transportation Resilience

Understanding of Hazards and Potential Impacts

Sharing Lived Experiences and Needs

Integrating into Regional Planning



THE BASICS

Mentimeter

1. What is a word or phrase that defines what resilience means to you?

10 responses

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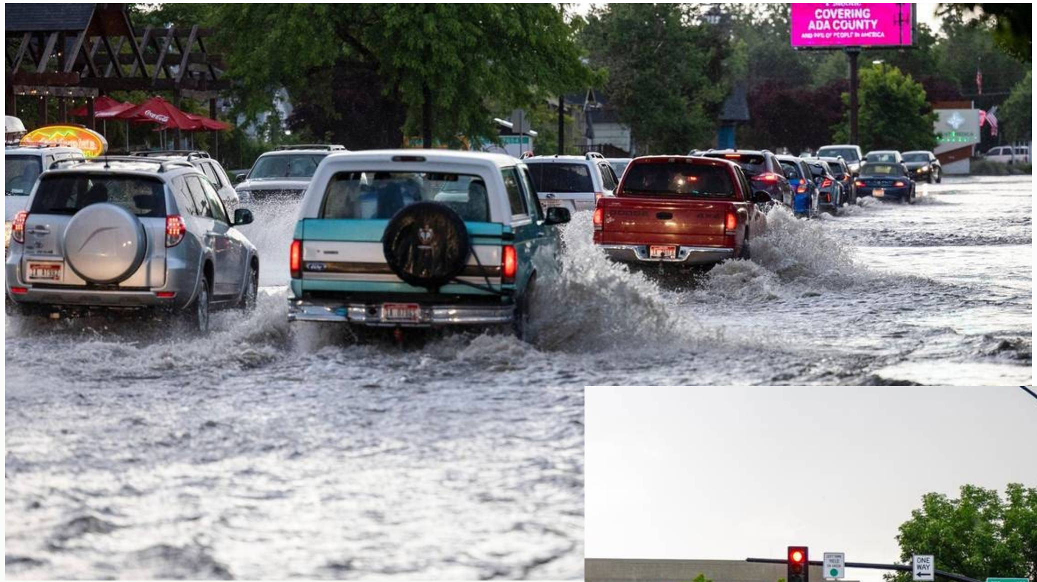
Impacts Across the US

Interstate 45 inundated during Hurricane Harvey, August 2017.

Interstate 80 in Vacaville, Calif., Aug. 19, 2020. Source: AP Photo, Courthouse News.

Rain, warm temperatures and snowmelt-induced flooding across the Midwest Flooding, 2019 (Nebraska)

Regional Transportation Impacts and Disruptions



Downtown Boise Flooding – Flash Thunderstorm – June 2023 – Source: Idaho Statesman

Interstate 84 Disruptions in March 2024 between Boise and Mountain Home

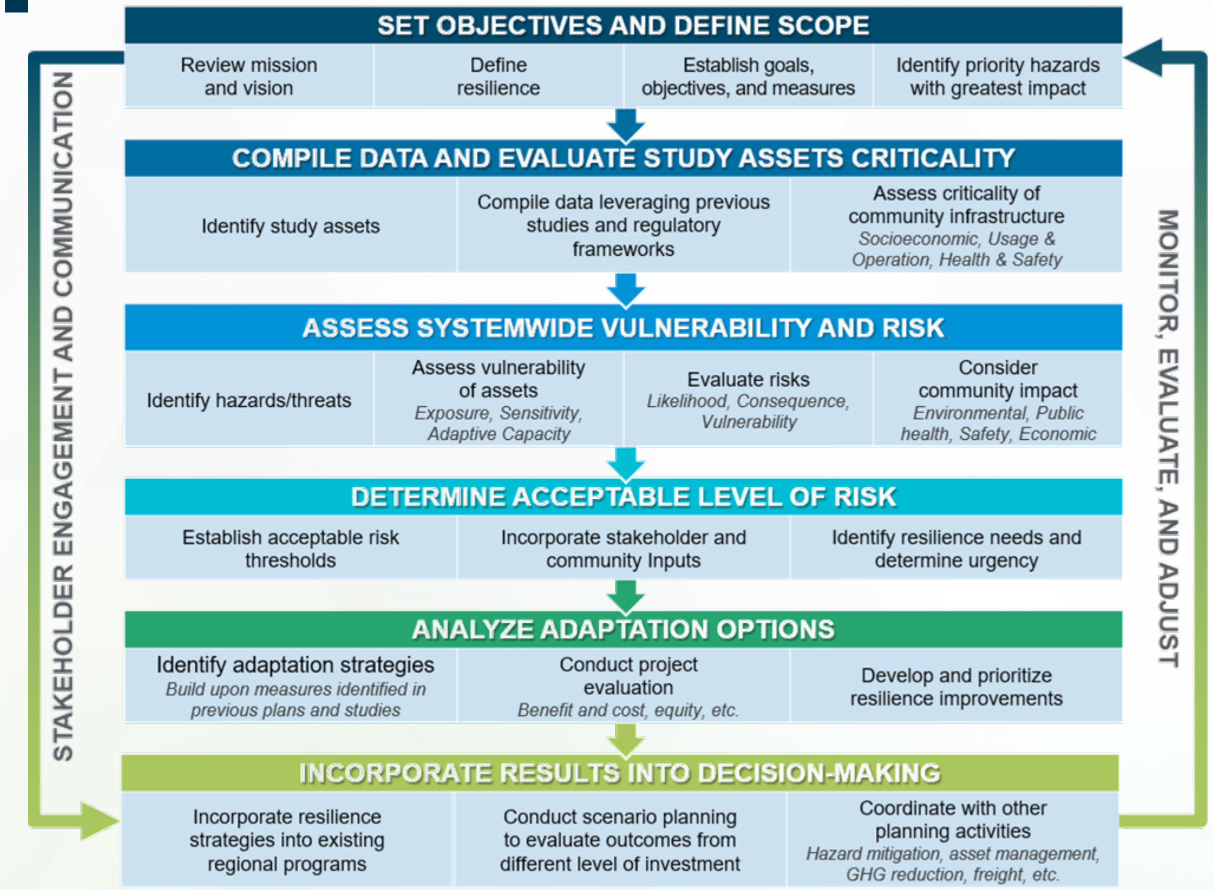
Understanding and Defining Resilience

- ***Resilience or resiliency is the <u>ability to</u> anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions (FHWA Order 5520)***

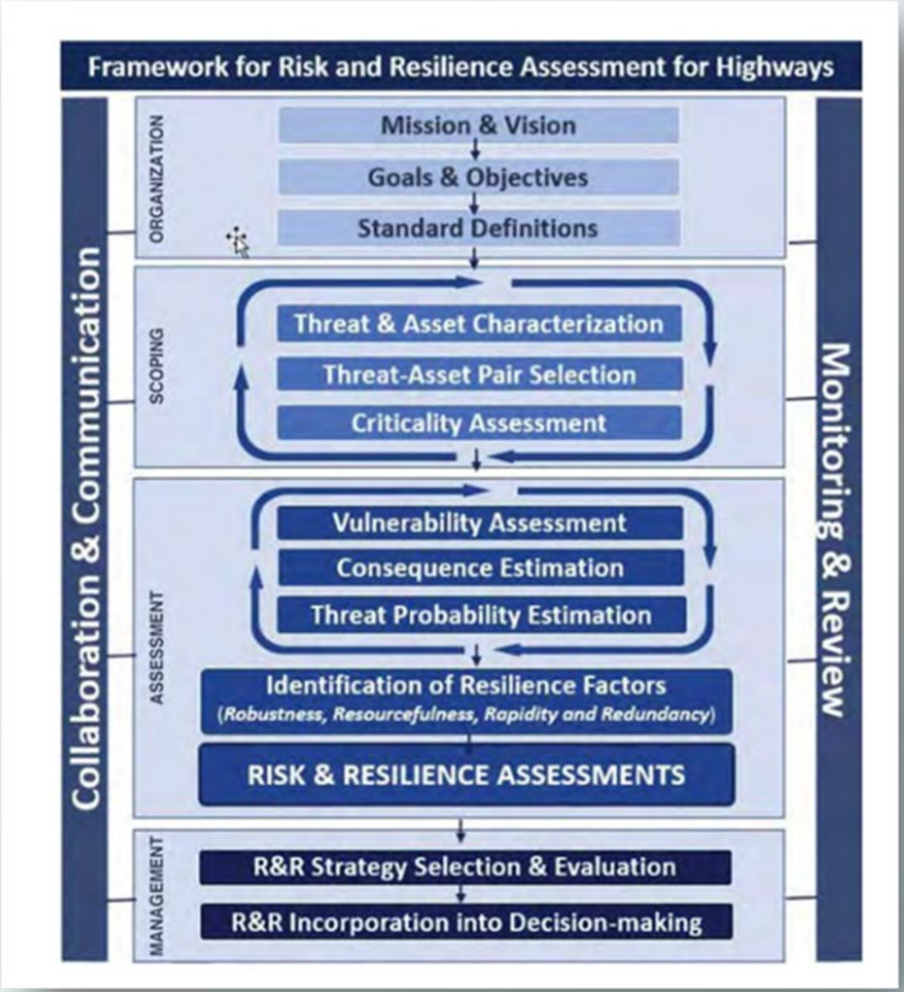
- ***Risk: The positive or negative effects of uncertainty or variability upon agency objectives. (23 CFR 515.5)***

ASSESSING RISK AND RESILIENCE

Frameworks for Assessment

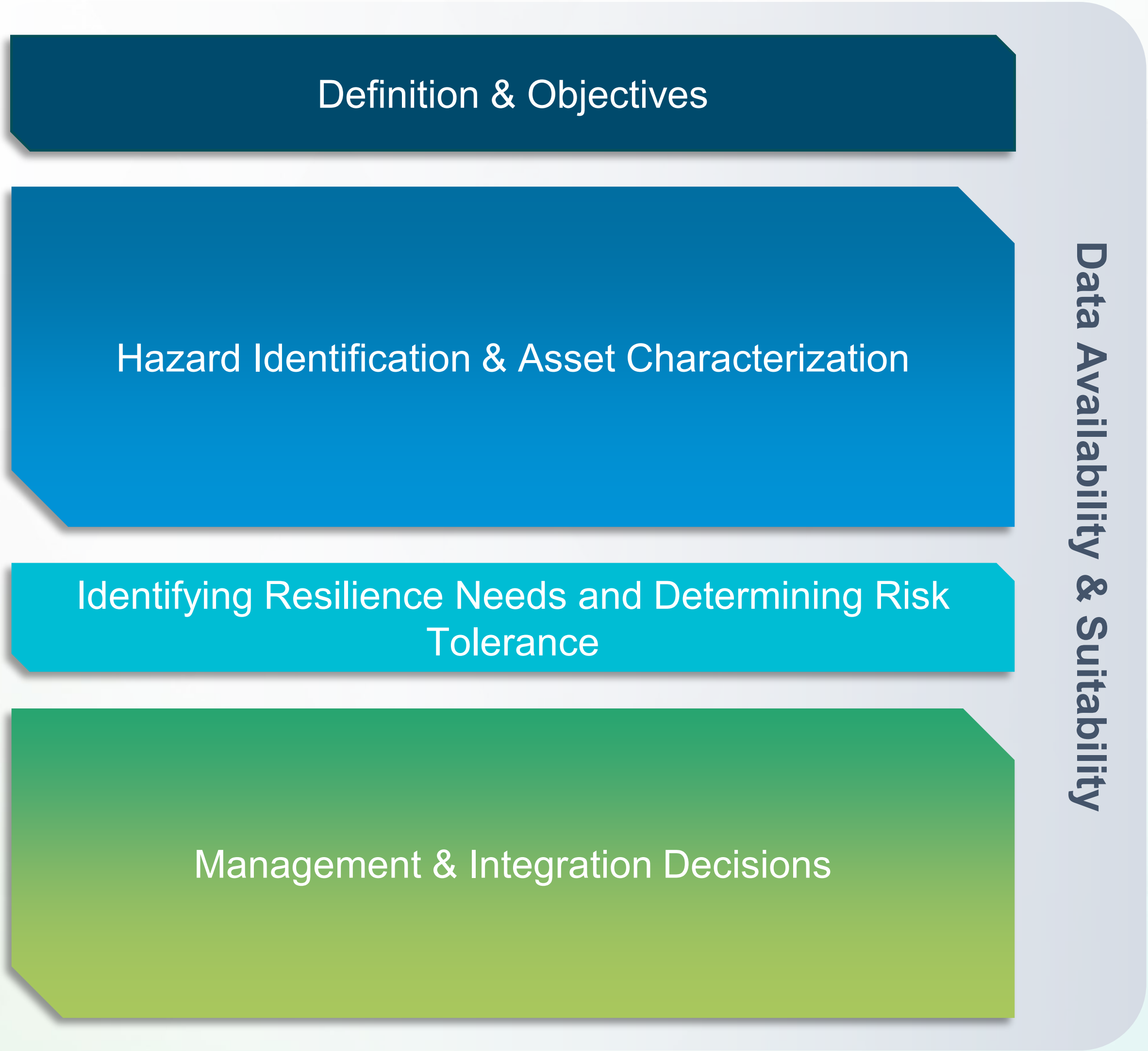


Source: Cambridge Systematics – Framework for Development of Resilience Improvement Plans



Source: NCHRP Report 1014: Developing a Highway Framework to Conduct an All-Hazards Risk and Resilience Analysis

Assessing Vulnerabilities, Risk, and Resilience



Source: Cambridge Systematics – Framework for Development of Resilience Improvement Plans

2. Why is “planning for resilience” important to the residents of treasure valley?

14 responses

Good planning

Predictability

We have floods and fires

Saves money on long run

We are growing

To ensure that we have safe and accessible options in case of emergencies.

Continued commerce

I'm an emergency you

Equity

$$$

The growth in the area is faster than how the community can respond.

Financial responsibility

It keeps goods and services flowing.

Life continues. Work arounds needed.

ASSETS AND HAZARDS

Assets – Tiering Approach

TIER 1

- **Disruption will cause a regional Impact.**
- **Roads, Bridges and Bus Routes**
- **Exposure, Sensitivity, Adaptive Capacity**

TIER 2

- Disruption impact is localized or minimal
- Railroad Lines, County Trails, Other Transportation Facilities, Dams and Levees, Culverts, Stormwater Infrastructure
- Exposure Only

Essential Facilities

- Integrated into criticality score of Tier 1 assets
- Schools, Shelters, Hospitals, Fire Stations, Police Offices, Emergency Response Center, Substations, Other Transportation Facilities.

Source: Critical Transportation Infrastructure Vulnerability Assessment, Ulster County, NY, Cambridge Systematics

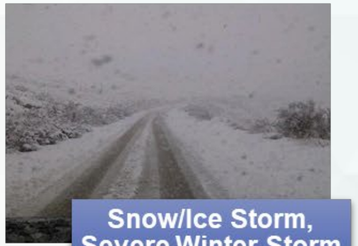
Example Hazards


Drought

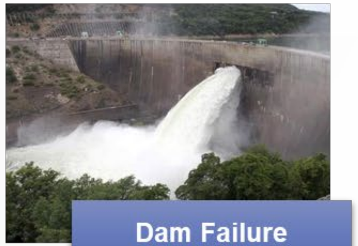

Earthquake


Extreme Temperature


Flood, Hail, Severe Thunderstorm


Snow/Ice Storm, Severe Winter Storm


Wind, Tornado

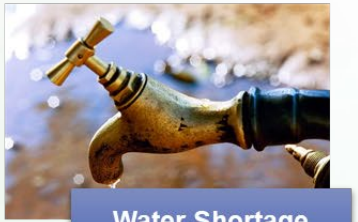

Dam Failure

Hazardous Material Incident


Population Flux


Outbreaks, Epidemics, Pandemics


Civil Disturbance, Terrorism, Shootings


Water Shortage


Food Shortage


Policies, Politics, and Misinformation


Air Quality

Source: Indianapolis MPO Resiliency Snapshot, Cambridge Systematics

Hazards – Treasure Valley – Current and Future

Table 2-3. Hazards of Concern Assessed by Local Jurisdiction

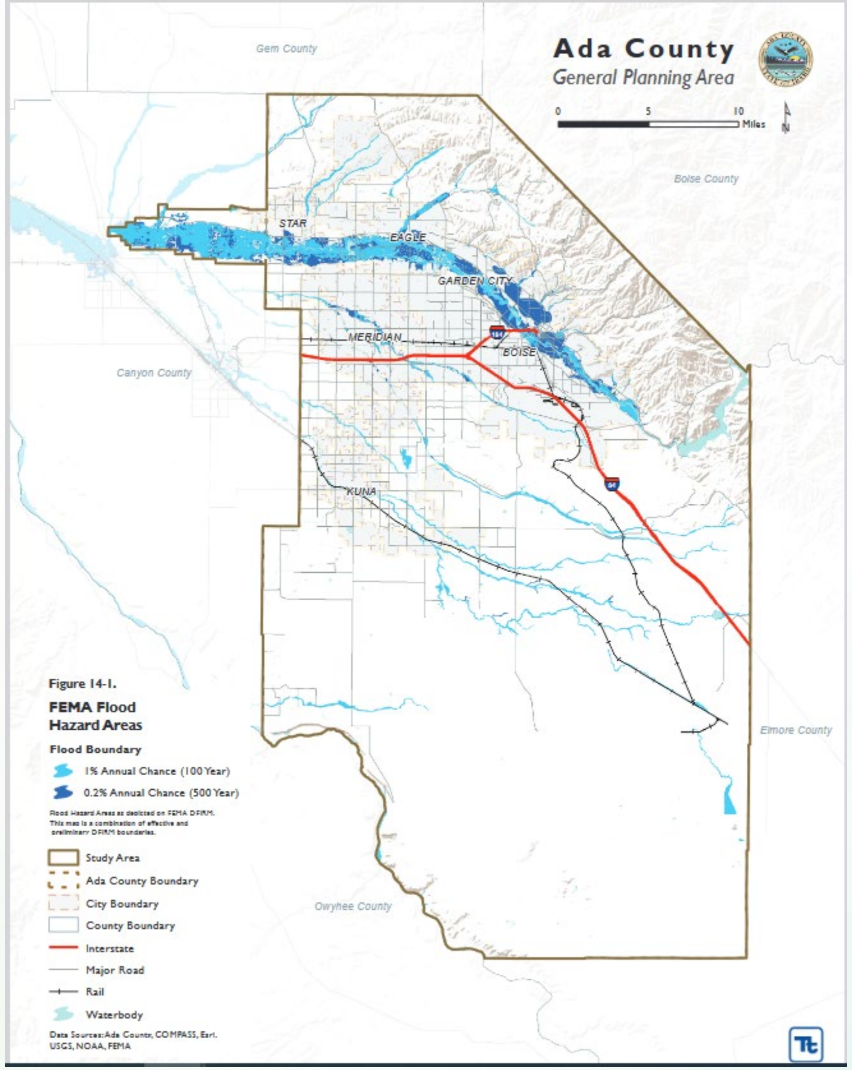
Jurisdiction	Avalanche	Drought	Earthquake / Seismic	Flood (includes dam failure)	Landslide	Severe Storms (includes wind, tornado)	Volcano	Wildfire
Ada County	–	√	√	√	√	H	√	√
Adams County	–	–	√	√	√	H	–	H
Bannock County	√	–	√	√	√	H	–	H
Bear Lake County	√	–	√	√	√	H	–	√
Benewah County	–	–	√	H	√	H	–	H
Bingham County	√	H	√	H	√	H	–	H
Blaine County	√	H	√	H	√	√	–	H
Boise County	√	–	√	H	H	√	–	√
Bonner County	√	–	√	√	√	H	–	H
Bonneville County	√	√	√	H	√	H	–	H
Boundary County	√	√	H	H	√	H	–	H
Butte County	–	–	H	–	–	–	–	–
Camas County	√	H	H	H	√	H	–	H
Canyon County	–	√	H	√	√	H	–	√

√ = hazard assessed
H = assessed as high hazard
– = no assessed hazard
Source: IOEM 2023

Source: Idaho Statewide Hazard Mitigation Plan

Hazards – Local (Ada County)

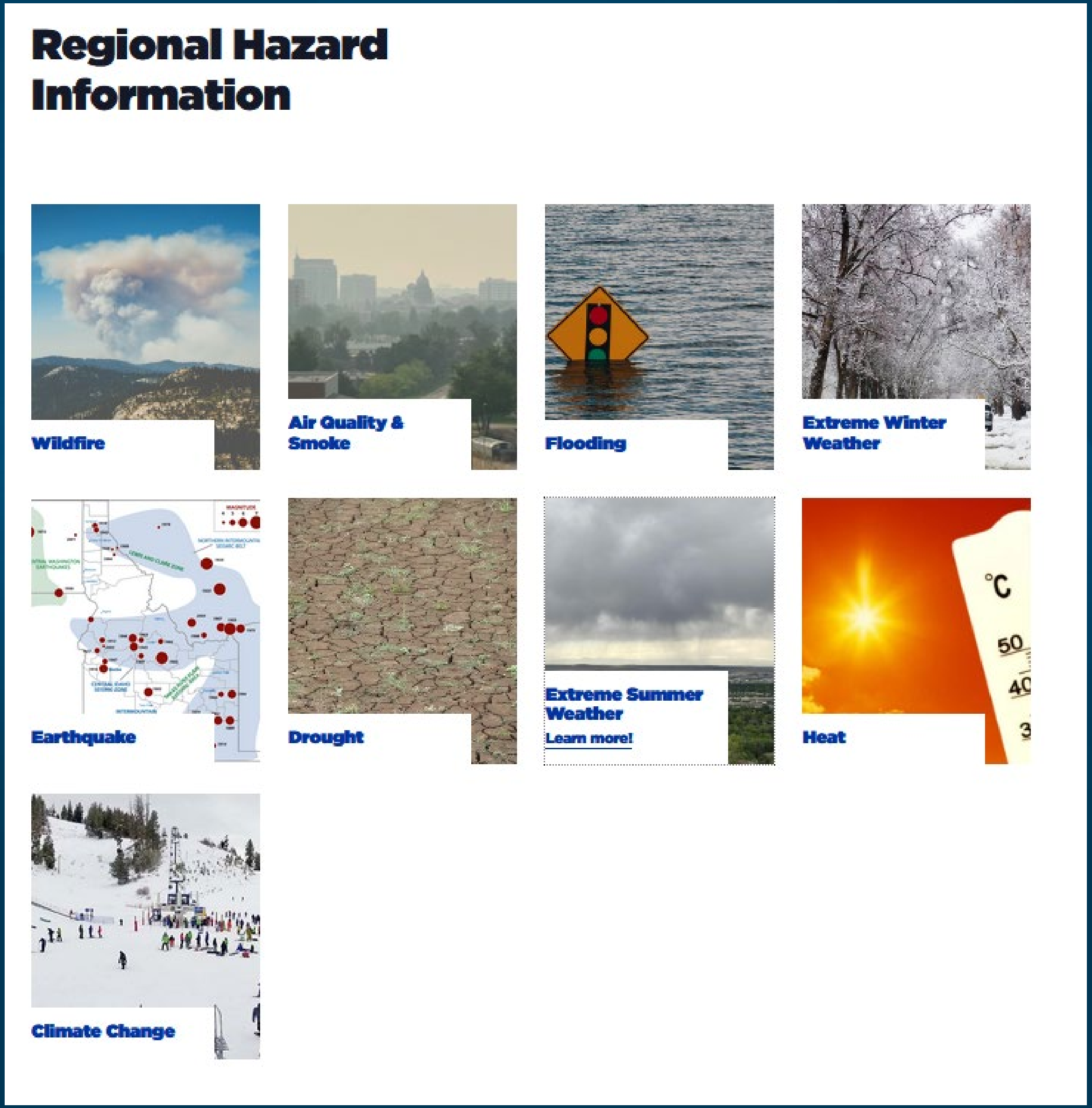
- Hazards
  - Dam/canal failure
  - Drought
  - Extreme weather
  - Flood
  - Landslide
  - Volcano (ash fall)
  - Wildfire.



Source: Ada County Hazard Mitigation Plan

Hazards – Regional and Local Resources

- Hazard and Climate Resilience Institute (HCRI) – Boise State University
  - Overview
  - How to prepare
  - Local Resources
  - How is this hazard impacted by a changing climate?



Source: Boise State University

CAMBRIDGE SYSTEMATICS

ASSET CHARACTERIZATION

Asset Characterization – Criticality - Example

Usage and Operational Importance

- Evacuation Routes / Lifelines (2)
- Functional Class (2)
- AADT (2)
- Freight Network (2)
- Northeast Corridor (1)
- Broadband Network (1)

Socioeconomic Importance

- Equity Areas (4)
- Population Density (3)
- Employment Density (3)

Health and Safety Importance

- Access to Dam (1)
- Access to Fire or Police Stations (1)
- Access to Hospitals (1)
- Access to Schools (1)
- Access to Emergency Shelters (1)
- Access to Power plants (1)
- Access to Transit Centers (1)
- Access to Airport (1)
- Access to Seaports (1)
- Access to Maintenance Facilities(1)
- Access to Military Installations(1)

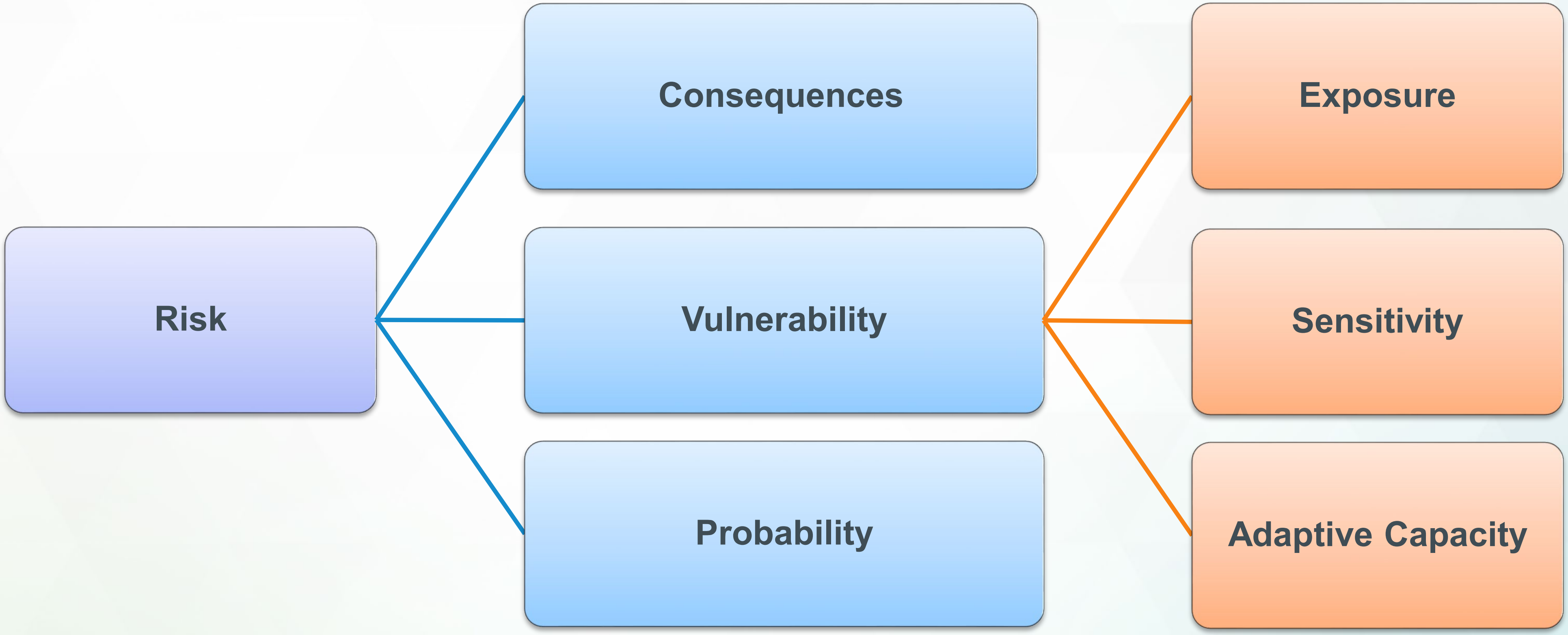
Criticality Scoring Approach – Example

Factor	Max Score	Scoring Method	Score	Description
Functional Class	4	Local	1	Roadway functional classification (UCTC) combining urban and rural roadway classes.
		Major Collector	2	
		Minor Arterial	3	
		Principal Arterial	4	
Access to Essential Facilities	3	0 facilities in a ½-mile distance	0	Number of Essential Facilities within a ½-mile distance from the road (*distance calculated is not network-distance, but crow-fly distance*)
		1 to 2 facilities in a ½-mile distance	1	
		3 to 5 facilities in a ½-mile distance	2	
		>5 facilities in a ½-mile distance	3	
Evacuation/Detour Route	1	1 if Yes, 0 otherwise	0-1	Whether the roadway is an evacuation route
Transit Corridor	1	1 if Yes, 0 otherwise	0-1	Whether the roadway is a transit corridor
Population Density	3	<=100;	1	Population density normalized by network density to avoid any disproportionate impact to rural areas/assets
		101 – 200;	2	
		> 201;	3	
Equity Areas	3	0 - 10%	1	Based on the proportion of population with 3+ risk factors (Census Community Resilience Estimates (CRE) Data)
		11% - 20%	2	
		21 % - 35%	3	
Maximum Total Score	**15**			

Source: Critical Transportation Infrastructure Vulnerability Assessment, Ulster County, NY, Cambridge Systematics

ASSESSING RISK AND RESILIENCE

Assessing Risk

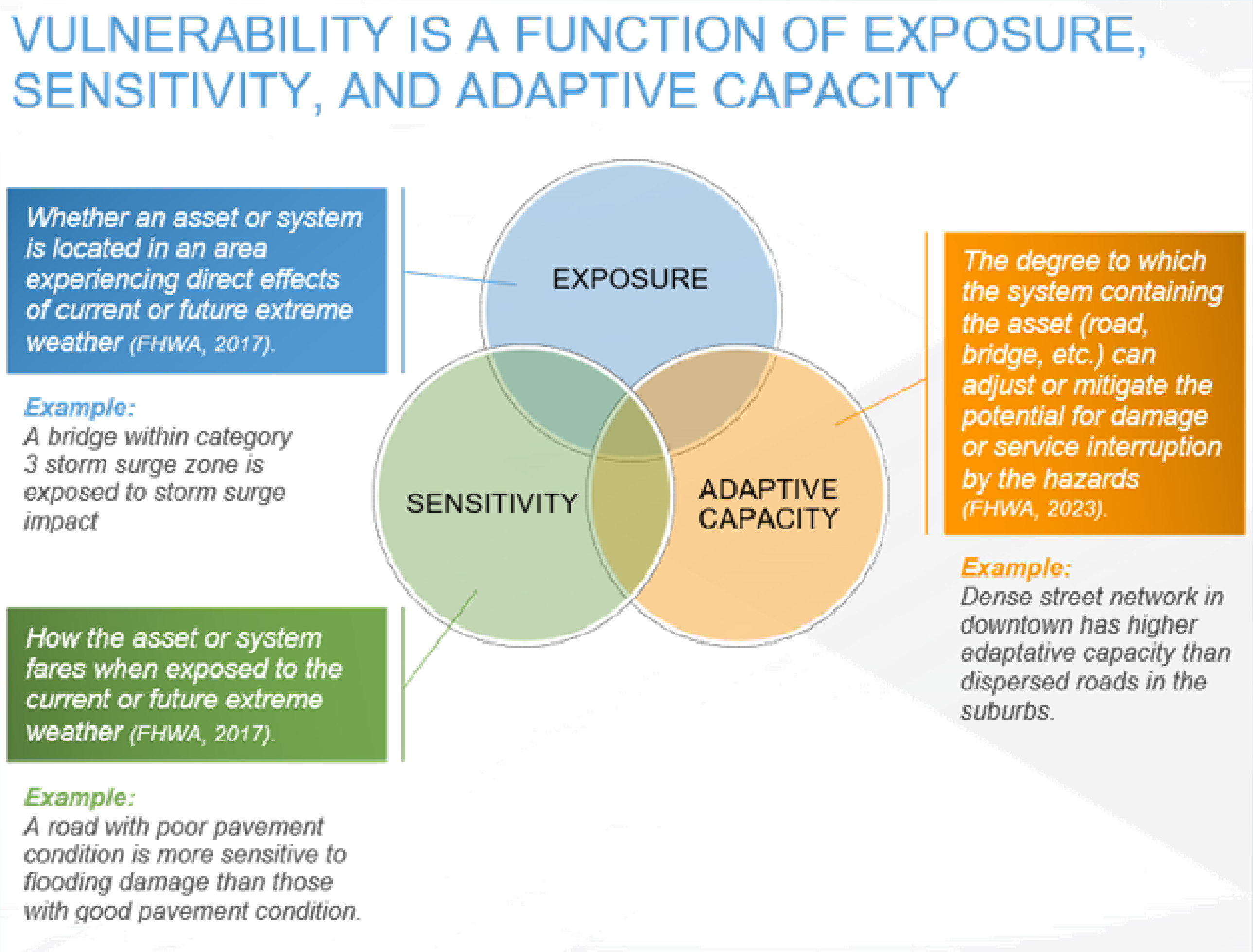


- A risk -based assessment should consider both the **probability or likelihood** that transportation assets will experience potential impacts due to disruptions, and the **consequences** of those impacts.

Vulnerability

What is vulnerability
- Relative susceptibility
- Specific to hazards and assets pairs

Why consider vulnerability?
- Help identify resilience needs



Elements of Vulnerability – Sample Indicators

Exposure	Sensitivity	Adaptive Capacity
Roads: Inundation Depth	Roads: Pavement Condition	Roads: Network Density
Bridges: Inundation Depth	Bridges: BB Rating	Bridges: Network Density
Stormwater Pipes: Inundation of pipes and outfalls	Stormwater Pipes: Last Cleaning Dates	Stormwater Pipes: Pipe Diameter + Position (up/downstream)
Stormwater Treatment Units: Inundation of STU	STU: Inspection Scores	STU: Ratio of Catchment Size to STU Volume
Sidewalks and Shared use Paths: Inundation Depth	Sidewalks and Shared use Paths: Condition	Sidewalks and Shared use Paths: Network Density

Assessing Risk

Vulnerability

- Exposure
- Sensitivity
- Adaptive Capacity

Likelihood

- Probability of Events

Consequence

- Owner Cost to Repair or Replace Assets
- User Cost of Time & Vehicle Operation & Reliability due to delay/detour

Prioritization

Risk		Low	Moderate	High
	High	High Risk Low Criticality	High Risk Moderate Criticality	High Risk High Criticality
	Moderate	Moderate Risk Low Criticality	Moderate Risk Moderate Criticality	Moderate Risk High Criticality
	Low	Low Risk Low Criticality	Low Risk Moderate Criticality	Low Risk High Criticality

Criticality

The 4Rs of Resilience

Robustness

the ability to withstand disaster forces without significant degradation or loss of performance.

Redundancy

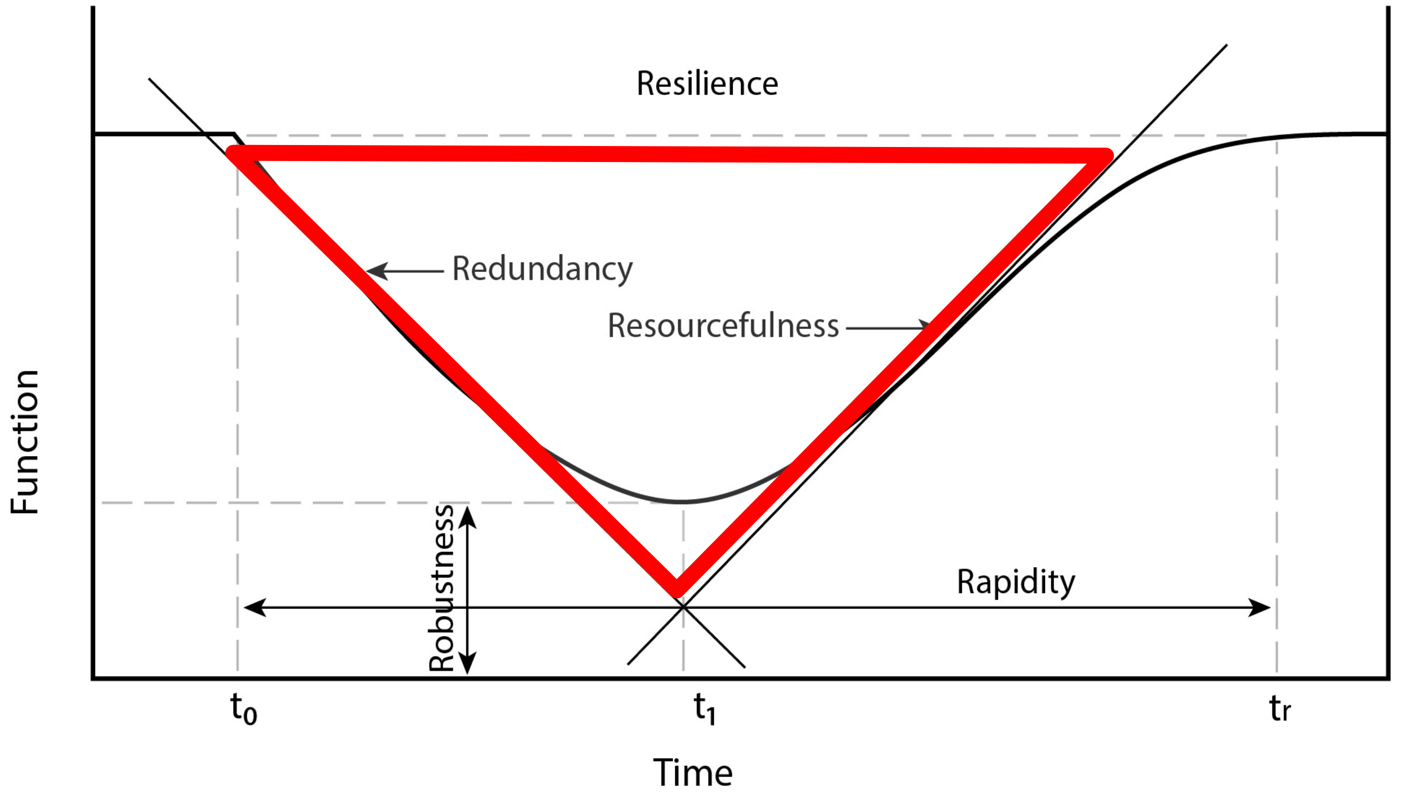
the extent to which the systems can satisfy functional requirements if significant degradation or loss of functionality occurs.

Resourcefulness

the ability to diagnose and prioritize problems and to initiate solutions by identifying and mobilizing resources;

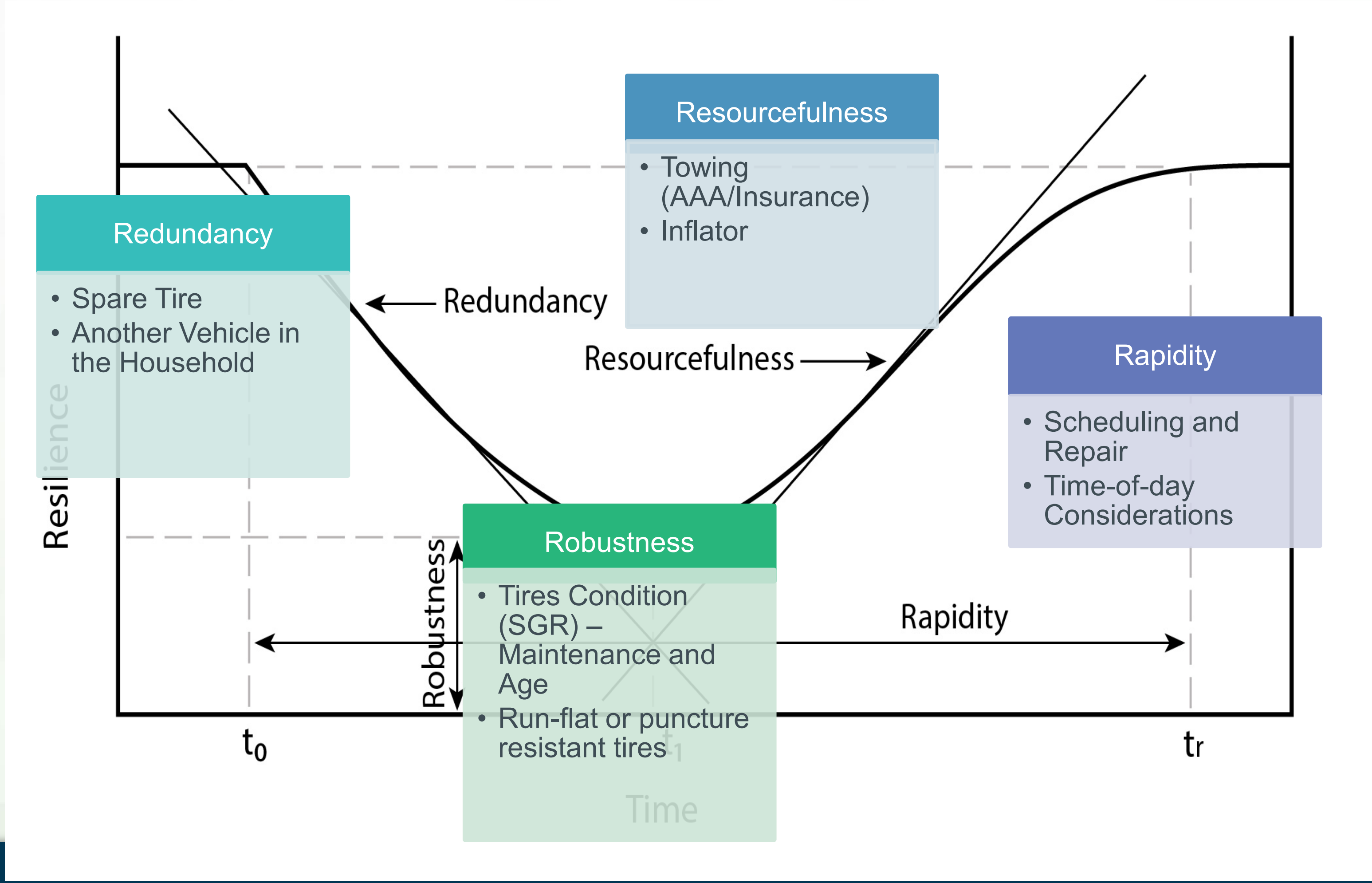
Rapidity

the capacity to restore functionality, contain losses, and avoiding disruptions.



Source: Original graphic; based on Simonovic, S. P., and Arunkumar, R. (2016), Comparison of static and dynamic resilience for a multipurpose reservoir operation, Water Resour. Res., 52, 8630–8649, doi:10.1002/2016WR019551.

Flat Tire Analogy



Mentimeter

4. List some known areas/facilities that are impacted by these stressors from your lived/recent experiences.

16 responses

Sidewalks

Foothills = fires

I-84

Greenbelt flooding

Greenbelt

Greenbelt

Bridges crossing the

Snow on

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CAMBRIDGE SYSTEMATICS

Mentimeter

1. What core/basic needs would be impacted due to the disruptions we discussed? (Examples: access to groceries, medical appointments)

11 responses

Emergency responders	Military functions	Evacuations	Access to schools, access to
		Fire agency	

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INTEGRATION INTO PLANNING OR AGENCY BUSINESS PROCESSES

Incorporation into Regional Planning

Scenario Planning and Performance-based Investing

Project Screening and Prioritization

Project Design and Development

Regional Project Prioritization – Resilience

Project Name	Estimated Project Cost (2018 Dollars)	Annual Average Daily Traffic	Safety	EPDO	EPDO per 100,000,000 vehicles (Risk)	Cost per EPDO (Cost/Benefit)	Risk Group	Cost/Benefit Group	Project Impact Group	Top 200 Crash Location (Total EPDO)	HSIP Cluster (Total EPDO)	HSIP Bicycle Cluster (Bike-involved EPDO)	HSIP Pedestrian Cluster (Ped-involved EPDO)
			SAFETY SCORING										
Route 60 Improvements (Medford, Arlington) est	$40,000,000	20,400	high	3360	16637	$11,905	1	1	2		2		5
Improvements to Sweetser Circle (Routes 16/99) (Everett) est	$22,000,000	45,000	high	641	1439	$34,321	1	1	2				
Widening on Route 1 (Malden, Revere, Saugus)	$172,500,000	115,000	high	2063	1812	$83,616	1	2	1				
Southeast Expressway Modification (Southampton) (Boston)	$143,750,000	225,000	high	4662	2093	$30,834	1	1	1				1

Project Name	System Preservation and Modernization	Cost per Index Point (000s)	Percent Resilience Related	Structurally Deficient Bridges	Weighted IRI	Total Project Roadway-miles	Total Project Lane-miles	Weighted Deficiency Index
	SYSTEM PRESERVATION SCORING							
Route 60 Improvements (Medford, Arlington) est	high	$12	0.3		252	8.2	16.3	3374
Improvements to Sweetser Circle (Routes 16/99) (Everett) est	high	$18	0	1	274	1.7	5.4	1237
Widening on Route 1 (Malden, Revere, Saugus)	medium	$34	0.3		191	8.7	34.8	5081
Southeast Expressway Modification (Southampton) (Boston)	medium	$59	0		121	4.5	31.8	2417

Project Name	Capacity Management and Mobility (Autos)	MPO-Identified Express Highway Bottleneck Location	MPO-Identified Arterial Bottleneck Location	Capacity Management and Mobility (Buses)	Regional and Local Bus Trips (Daily)	Total Regional Bus Trips (Daily)	Total Local Bus Trips (Daily)	Number of Regional Bus Routes Served	Number of Local Bus Routes Served	Capacity Management and Mobility (Peds/Bikes)	Nonmotorized Total	Pedestrian Improvements	Bicycle Improvements	Improves Transit Access
	CAPACITY MANAGEMENT SCORING													
Route 60 Improvements (Medford, Arlington) est	medium		moderate	high	508		508		8	high	4	2	1	1
Improvements to Sweetser Circle (Routes 16/99) (Everett) est	medium		moderate	high	497		497		8	medium	1	1		
Widening on Route 1 (Malden, Revere, Saugus)	high	severe		high	168	168		4		medium	2	1	1	
Southeast Expressway Modification (Southampton) (Boston)	high	severe		high	464	250	214	6	4	low				

Project Name	Economic Vitality	Total points	Mostly Serves Existing Area of Concentrated Development	Partly Serves Existing Area of Concentrated Development	Facilitates New Development	Provides Vehicle Acess to Target Development Area	Provides Transit Acess to Target Development Area	Provides Bicycle Acess to Target Development Area	Provides Pedestrian Acess to Target Development Area
	ECONOMIC VITALITY SCORING								
Route 60 Improvements (Medford, Arlington) est	medium	2					1		1
Improvements to Sweetser Circle (Routes 16/99) (Everett) est	high	7	2		1	1	1	1	1
Widening on Route 1 (Malden, Revere, Saugus)	medium	4	2		1	1			
Southeast Expressway Modification (Southampton) (Boston)	medium	2	2						

Source: Boston MPO, Evaluated Major Infrastructure Projects for the Destination 2040 LRTP

RECAP

Discussion Objectives

Orientation to Transportation Resilience

Understanding of Hazards and Potential Impacts

Sharing Lived Experiences and Needs

Integrating into Regional Planning

Q&A

Thank You!

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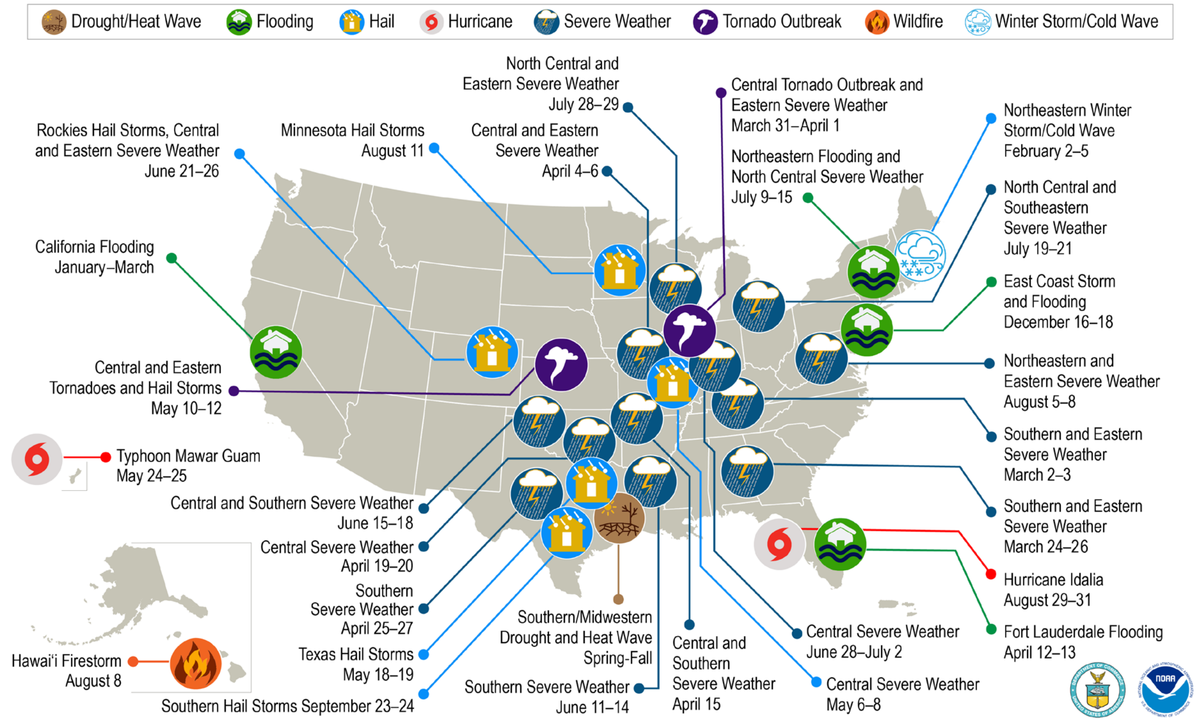
Contact Information

Major Disasters and Disruptions – US and Idaho

U.S. 2023 Billion-Dollar Weather and Climate Disasters



*This map denotes the approximate location for each of the **28 separate billion-dollar weather and climate disasters that impacted the United States in 2023.***