

SUSTAINABILITY AND RESILIENCE IN TRANSPORTATION

February 25, 2020



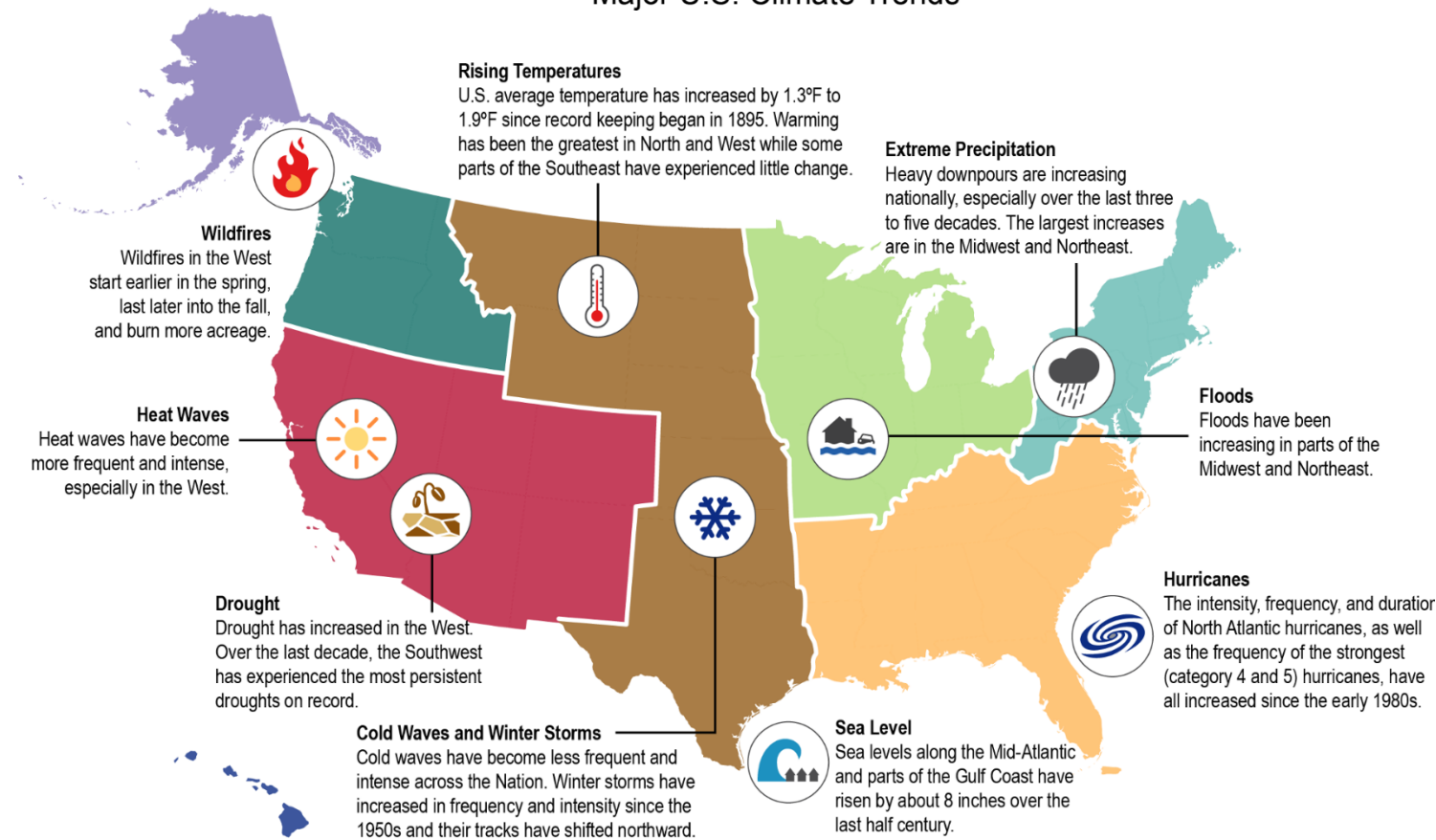
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Why Sustainability and Resilience?

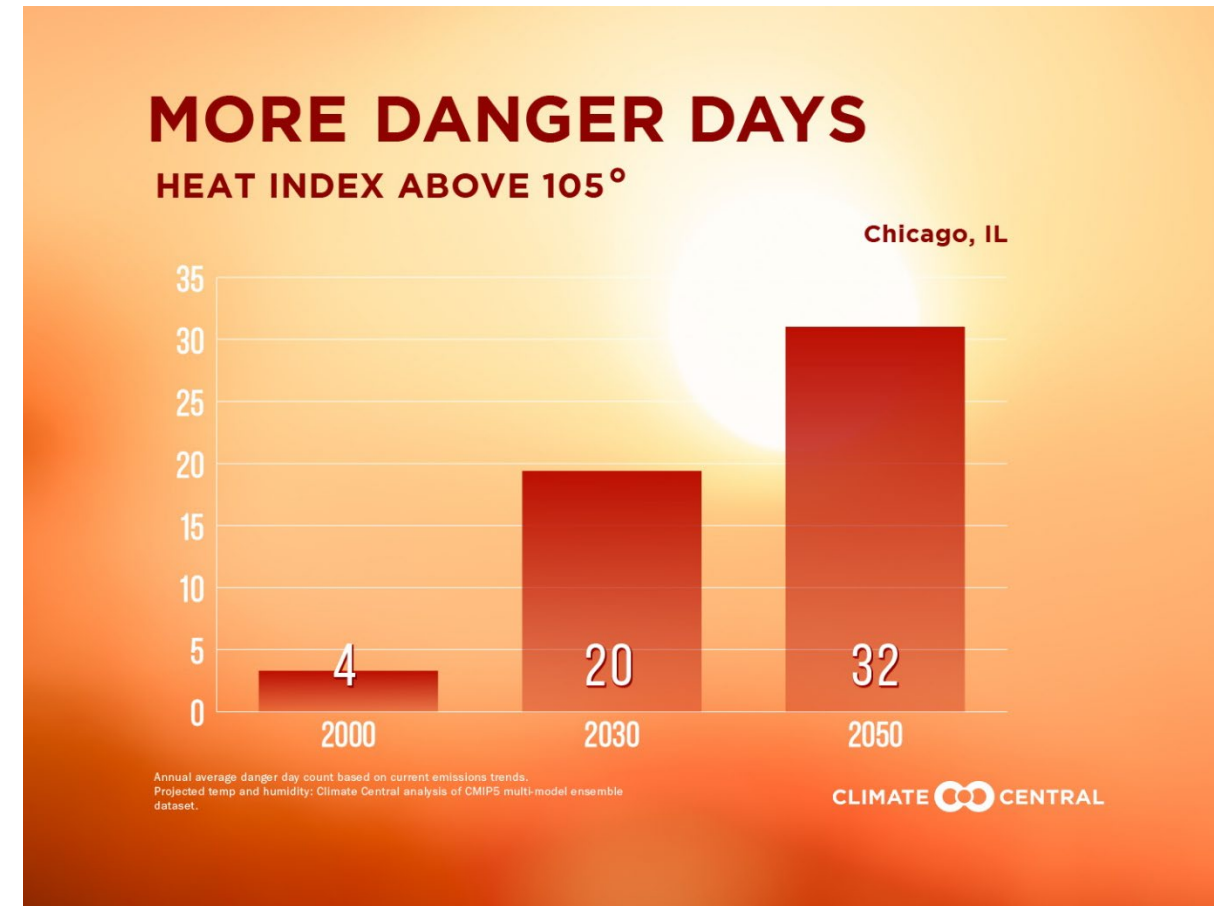
- » Extreme weather, temperature, sea levels on the rise
- » U.S. Exposure to Climate Change Risk
 - Up to 10% of GDP (National Bureau of Economic Research)
 - \$26 billion in property losses (EPA)
 - 910 million lost labor hours/year (EPA)

Major U.S. Climate Trends



Why Sustainability and Resilience?

- » Climate Change in Illinois
 - Stagnant air worsens urban air quality
 - Increased urban heat island effect
 - 10x increase in dangerous heat days
 - 40% increase in drought severity index
 - 380,000 people at elevated risk of inland flooding
 - 10% increase in frequency of heavy downpours



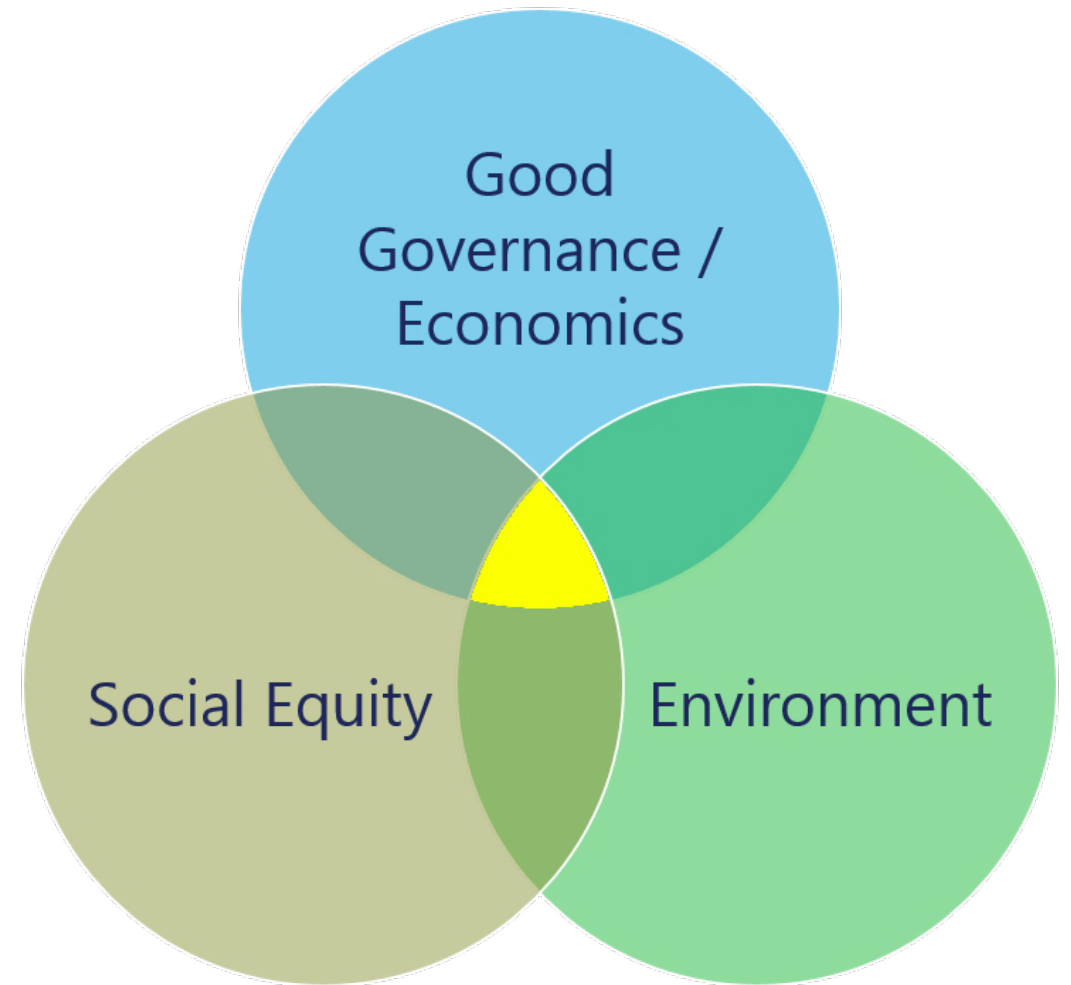
Why Sustainability and Resilience?

- » **Sustainability** leaders' stocks 25% higher (Goldman Sachs)
- » \$1 spent on **Resilience** saves \$4-\$6 in future costs (National Institute of Building Sciences)
- » Associates prefer **Sustainable/Resilient** companies, are more productive and deliver higher quality work (University of Chicago)



What is Sustainability?

- » Common Definitions:
 - Meet the needs of the present w/o compromising ability of future generations (World Commission on Environment and Development)
 - Strike long-term balance between environmental quality, quality of life and economic prosperity
- » What is your definition?



What is Resilience?

- » The ability to absorb and quickly recover from events (NCHRP)
- » The ability to **prepare and plan** for, **absorb**, recover from, and **more successfully adapt** to adverse events (AASHTO, NAS)
- » *Just events? Or should we consider a wider range of time-periods?*

Increased heat

Drought

Extreme precipitation

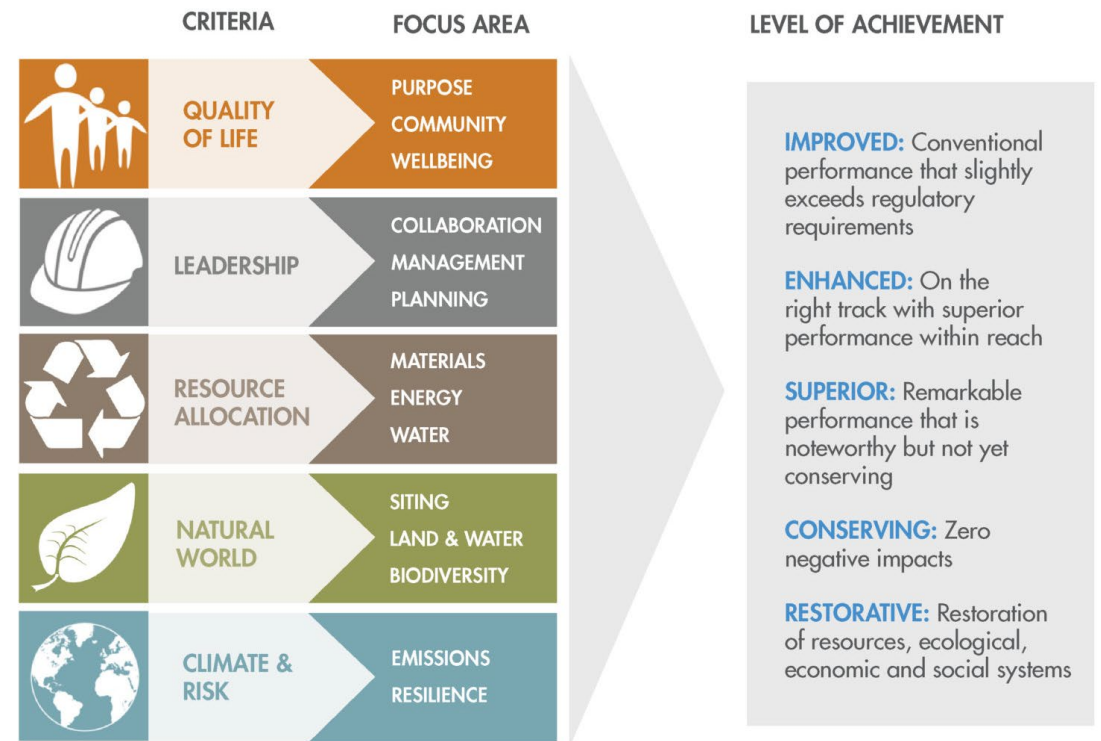
Stronger storms

Sea level rise

Other natural/
man-made
disasters

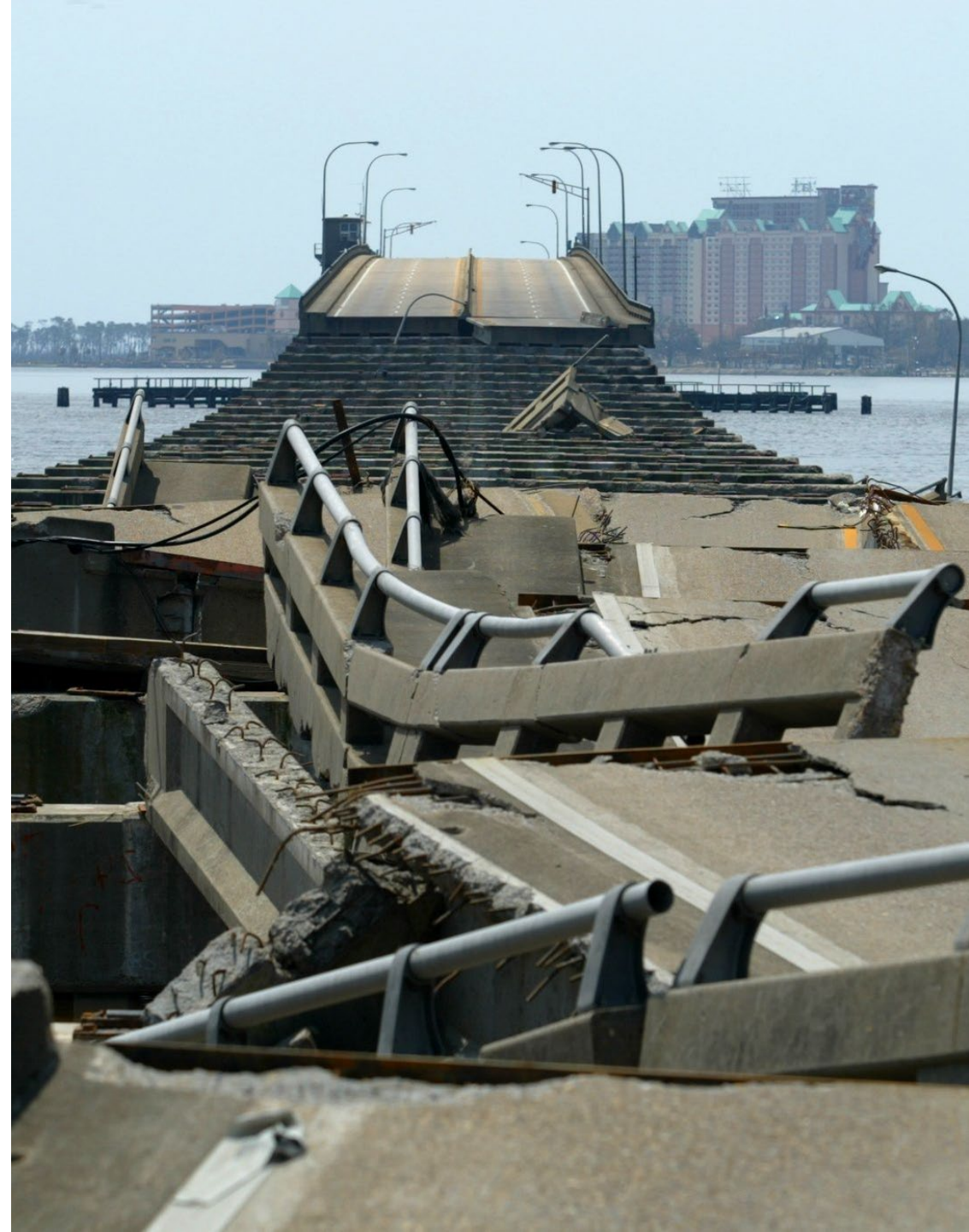
Sustainability & Transportation

- » 3rd party standards for sustainability in planning, design, delivery & O&M infrastructure
- » INVEST
 - FHWA
 - Transportation Agencies (DOTs, MPOs, Authorities)
 - *Illinois Tollway (\$200M 10-year benefit from sustainable materials)*
 - Program-level evaluation
- » ENVISION
 - ACEC, ASCE & APWA
 - Public & Private Org's
 - Project-level only



Resilience & Transportation

- » FHWA Order 5520 (2014)
 - *“integrate...climate change and ...adaptation into planning, operations, policies and programs...”*
 - *“[Encourage] consideration of...resiliency in...risk-based asset management plans...”*
 - *Based on EO 13514, rescinded by current administration*
- » FAST Act (2015)
 - Requires agencies to take resilience into consideration during the transportation planning process (e.g. LRTP)



Transportation Resilience Projects

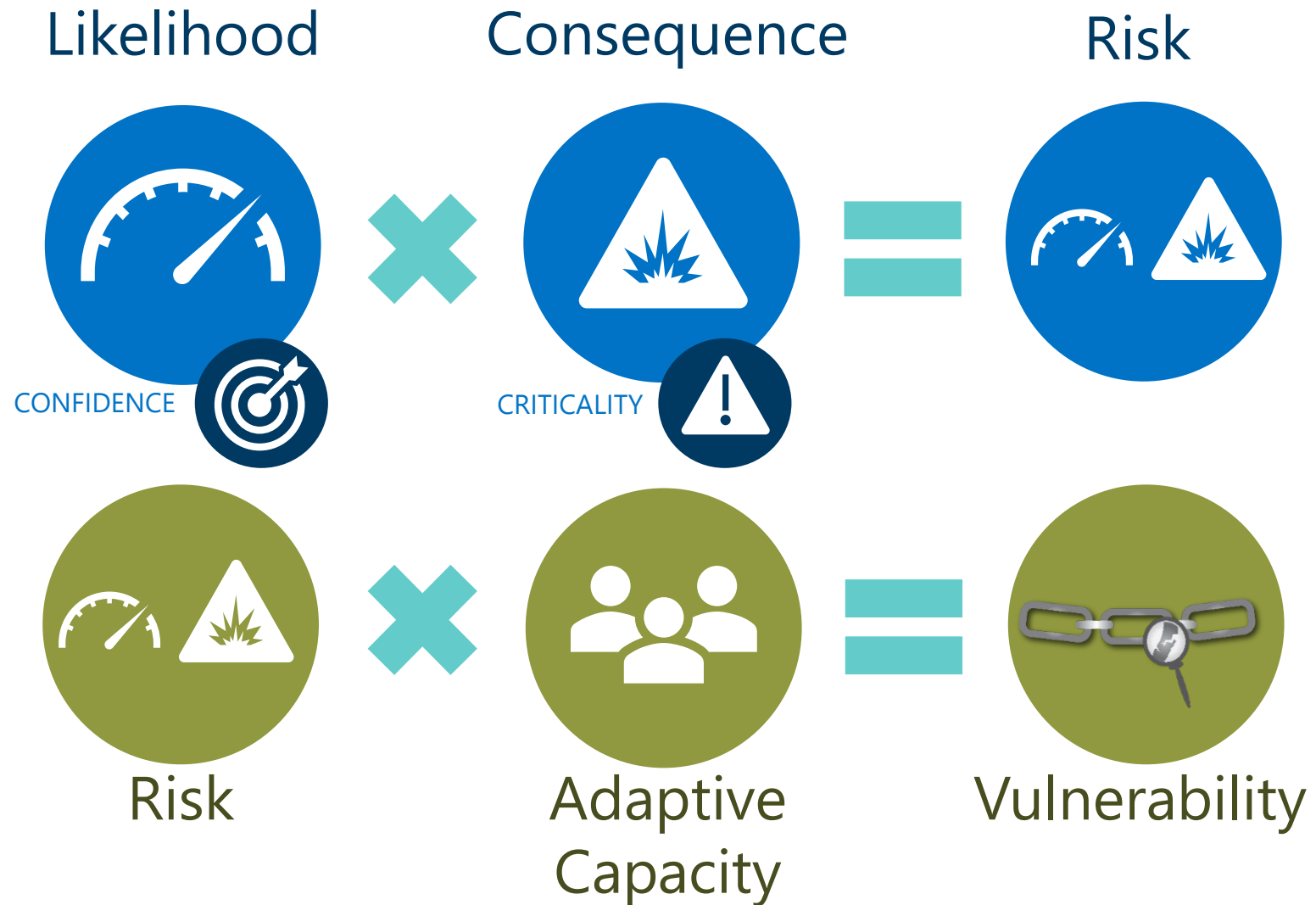
- » FHWA is piloting resilience solutions in partnership with DOTs and MPOs
 - Vulnerability assessments
 - Adaptation options
 - Nature-based resilience
 - Asset management
 - Durability to extreme weather



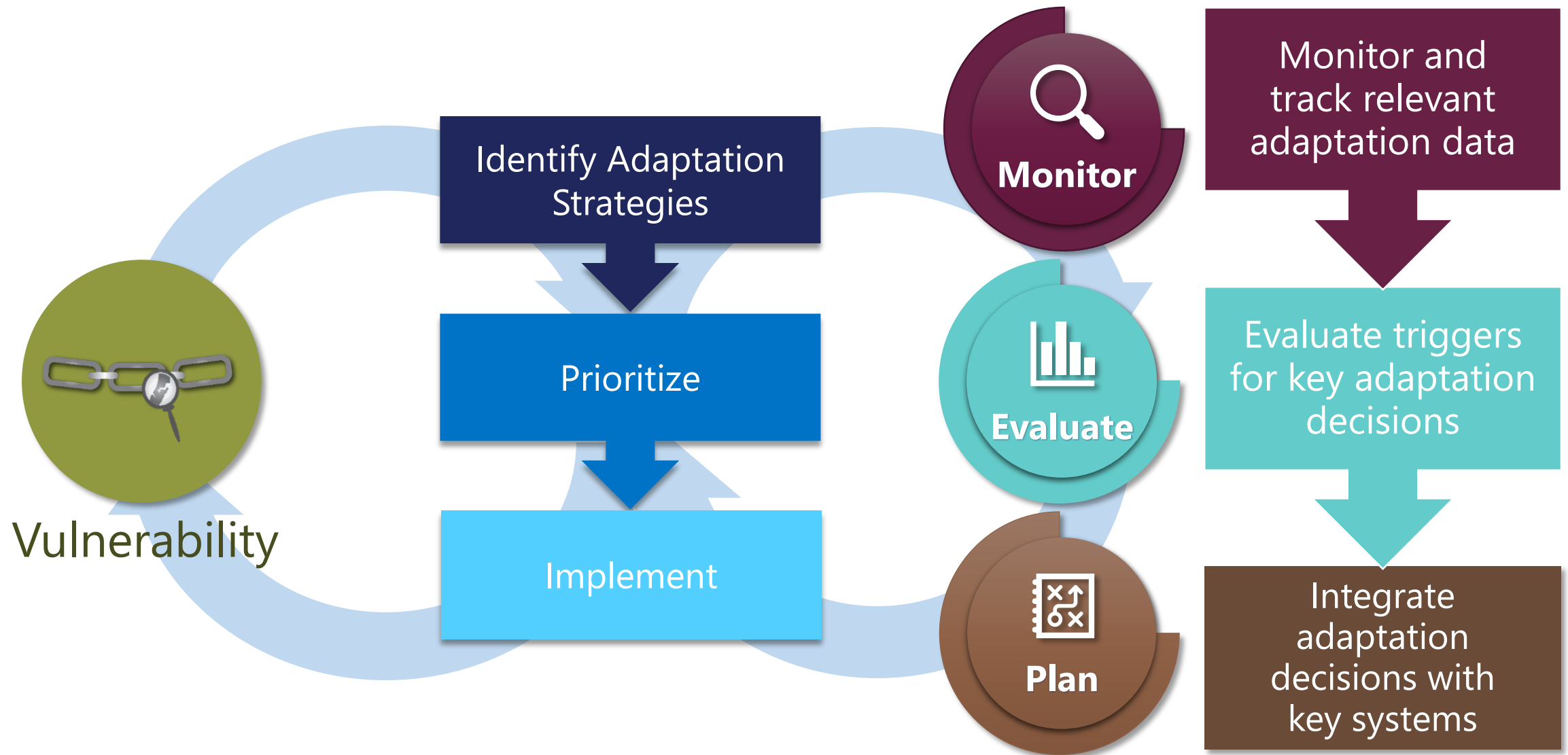
Resilience & Transportation

- » AASHTO Resiliency Case Studies (2018)
 - Interviews of 8 DOTs (CA, CO, FL, GA, LA, OK, NC, VT) after extreme weather events (Storms, Flooding, Landslides, etc.)
 - Selected Lessons Learned
 - *Understand full range of hazards & ID vulnerable assets*
 - *Rank the most vulnerable assets to establish priorities*
 - ***When decision making data does not exist, create it***
 - ***Integrate climate change into planning and design guidance***
 - *Achieve leadership support*
 - *Establish regional coordination*

Resilience Assessment Concepts

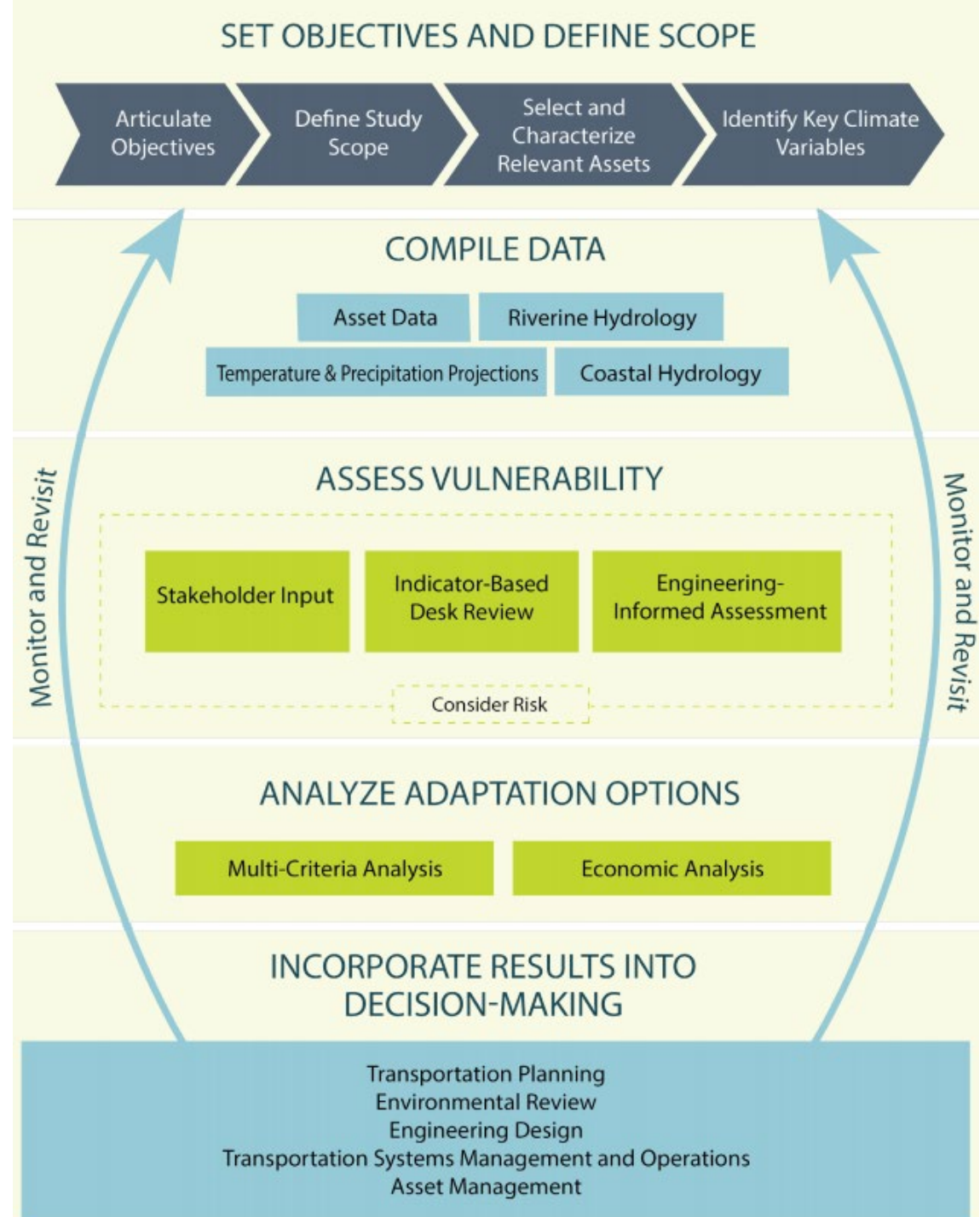


Resilience Assessment Concepts



Resilience Assessment

- » Vulnerability Assessment & Adaptation Framework (FHWA, 2017)
 - Systems-level
 - Strategies:
 - *Manage & Maintain*
 - *Increase Redundancy*
 - *Protect or Harden*
 - *Accommodate*
 - *Relocate*



Resilience in Long Range Transportation Planning



LIKELIHOOD



% probability of occurrence of a Category 3 storm w/in 20 years (5-point scale)

CONFIDENCE



Certainty of climate projection (High, Medium, Low)

CONSEQUENCE



Total centerline miles affected by storm surge (5-point scale)

CRITICALITY



Segment is an evacuation route, urban street, or rural road (High Medium, Low)

ADAPTIVE CAPACITY



Miles of detour impact (Low, Medium, High)



		WEIGHTED CONSEQUENCE				
WEIGHTED LIKELIHOOD		Negligible (1)	Minor (2)	Moderate (3)	Major (4)	Catastrophic (5)
Very Unlikely (1)		LOW (1)	LOW (2)	LOW (3)	LOW (4)	LOW (5)
Unlikely (2)		LOW (2)	LOW (4)	MODERATE (6)	MODERATE (8)	MODERATE (10)
As likely as not(3)		LOW (3)	MODERATE (6)	MODERATE (9)	HIGH (12)	HIGH (15)
Likely (4)		LOW (4)	MODERATE (8)	HIGH (12)	HIGH (16)	EXTREME (20)
Very Likely (5)		LOW (5)	MODERATE (10)	HIGH (15)	EXTREME (20)	EXTREME (25)

		ADAPTIVE CAPACITY		
RISK		High (1)	Medium (2)	Low (3)
Low (5)		LOW (5)	LOW (10)	LOW (15)
Moderate (10)		LOW (10)	MODERATE (20)	MODERATE (30)
High (15)		LOW (15)	MODERATE (30)	MODERATE (45)
Extreme (20)		MODERATE (20)	MODERATE (40)	HIGH (60)
Extreme (25)		MODERATE (25)	HIGH (50)	HIGH (75)

Vulnerability Index

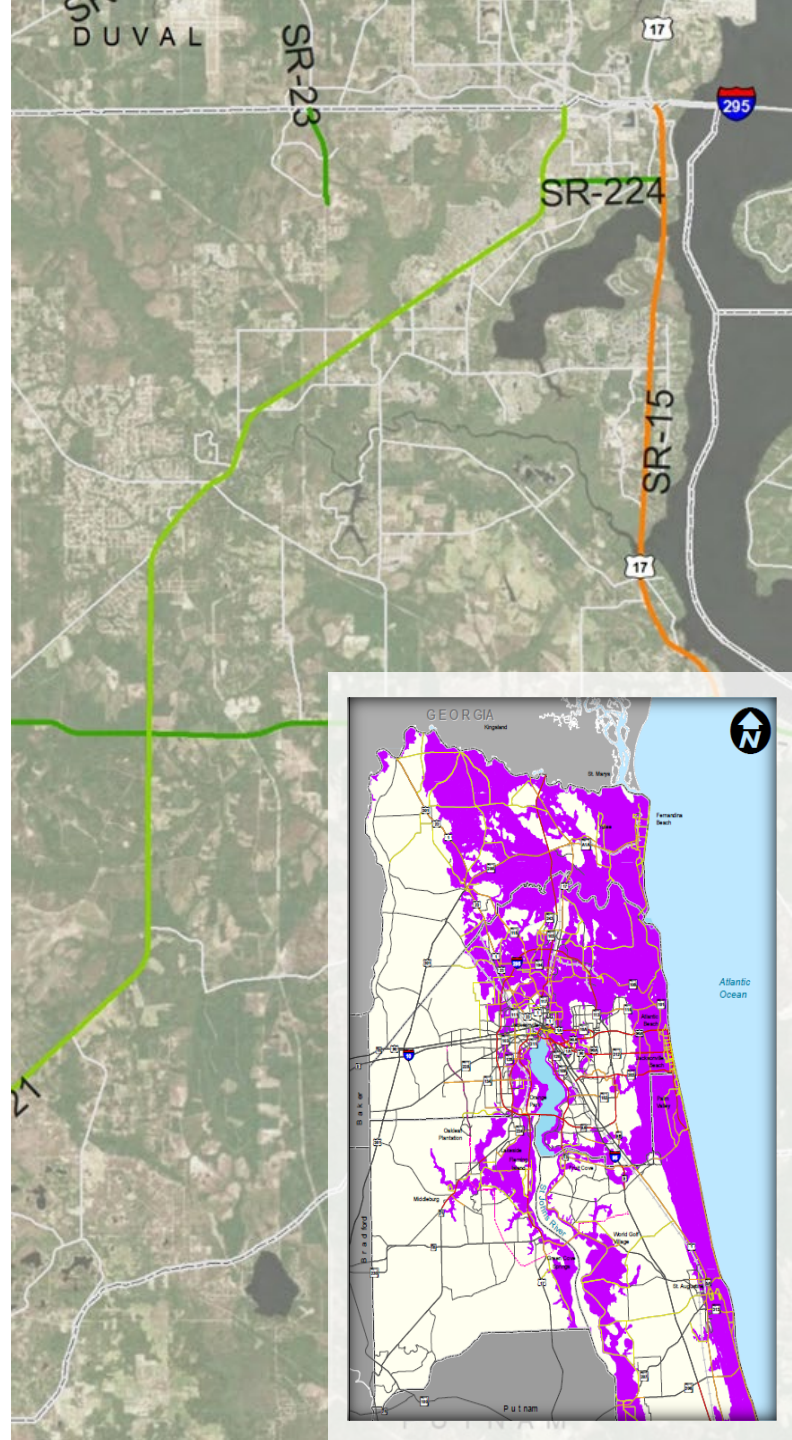
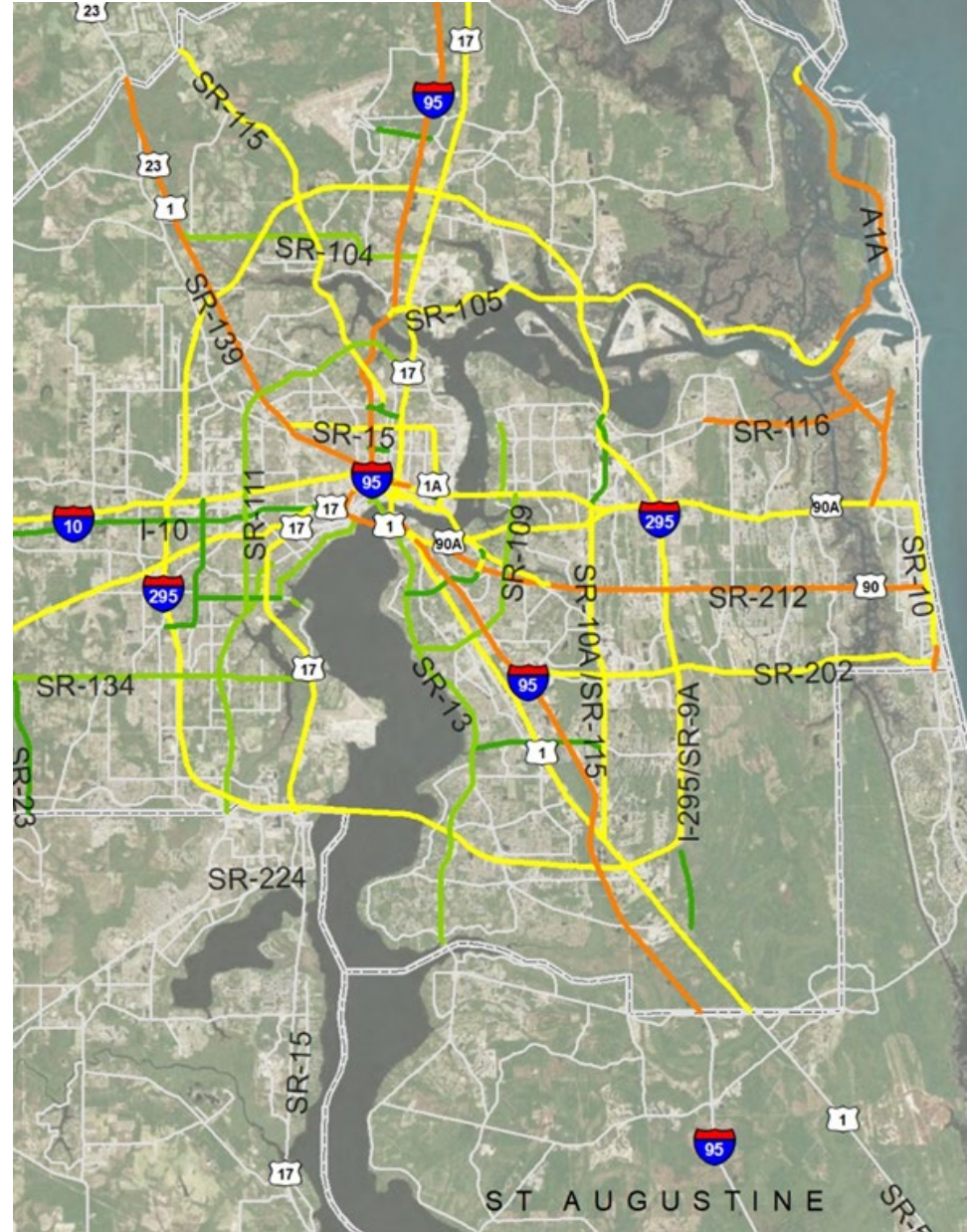
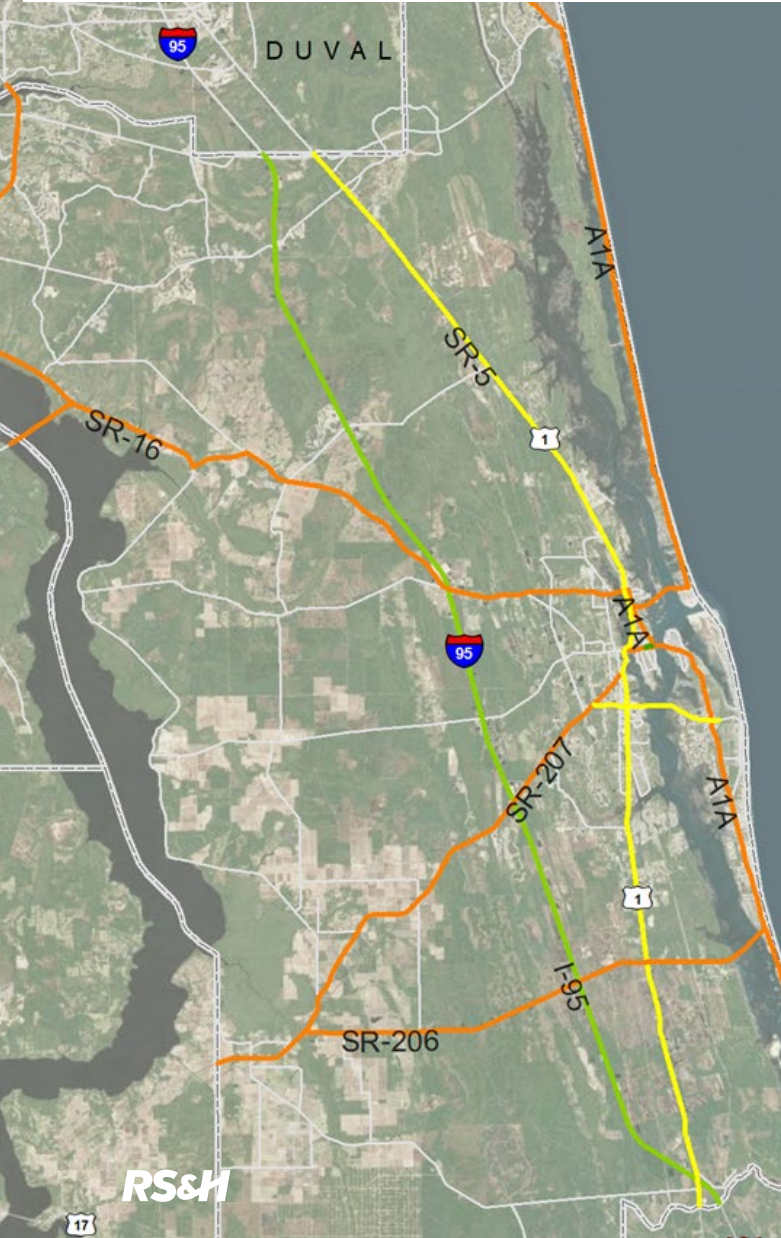
0-15 (Low)

16-29 (Moderate-Low)

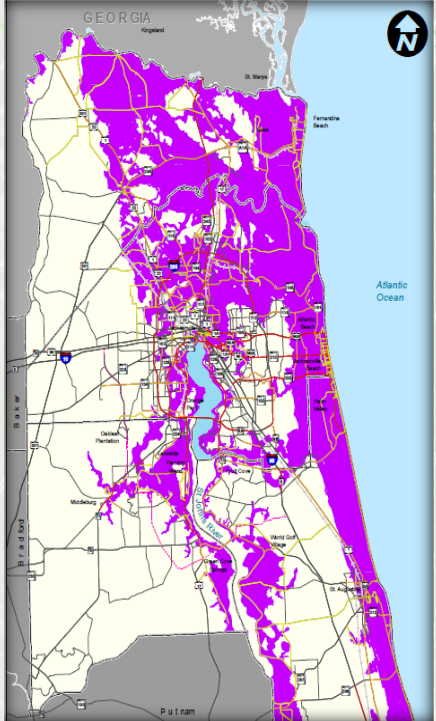
30-39 (Moderate)

40 - 49 (Moderate-High)

50-75 (High)



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Historic 2013 Colorado Floods - US 34



Historic 2013 Colorado Floods - US 34

Colorado Response to 2014 Floods

- » US 34 PEL - Resiliency Report
 - Natural and manmade threats
 - Operational Resiliency



Transportation Sustainability Projects

- » City and County of Denver (CCD)
 - Executive Order on Sustainability (2013)

EXECUTIVE ORDER NO. 123

TO: All Agencies Under the Mayor

FROM: Michael B. Hancock, Mayor

DATE: March 11, 2013

SUBJECT: Office of Sustainability and Citywide Sustainability Policy

PURPOSE: This Executive Order creates the Office of Sustainability and establishes it as the successor to the Greenprint Denver Office. This Executive Order also establishes key sustainability policies for the City and County of Denver. Executive Order 123 and Memoranda A through G dated December 17, 2010 are hereby canceled and superseded by this Executive Order 123 and Memoranda A-G dated March 11, 2013.

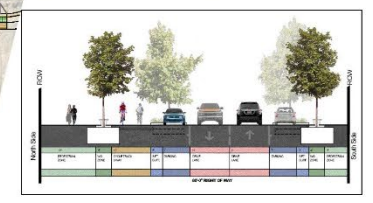
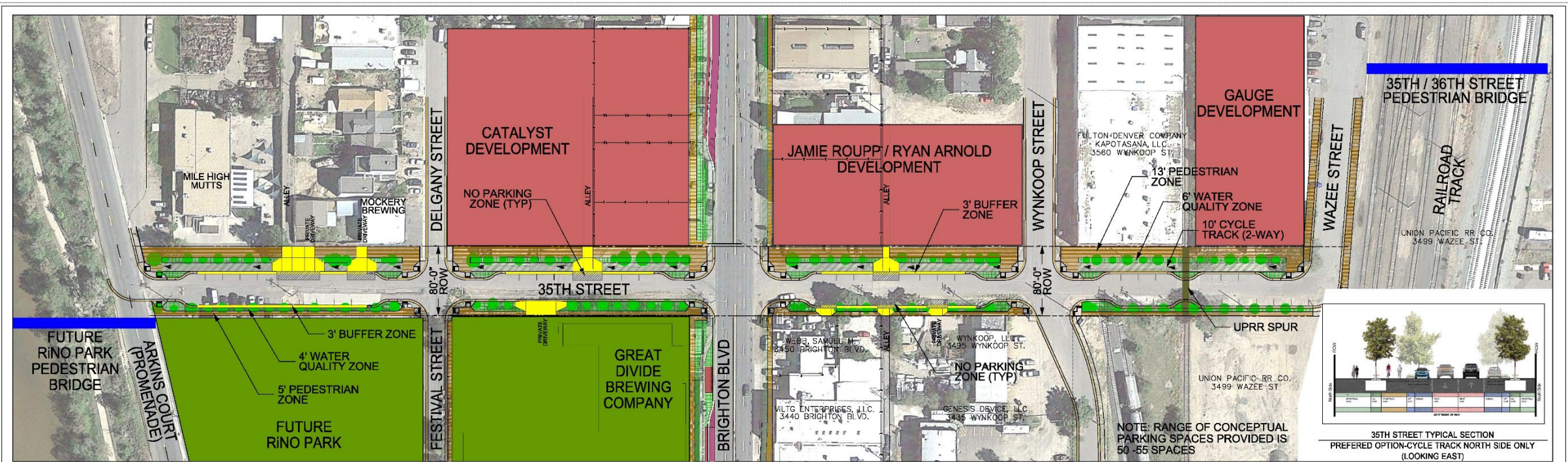
The applicable authority relevant to the provisions and requirements of this Executive Order 123 is found in Section 2.2.10 of the 2002 Revised Charter.

This Executive Order is divided into the following chapters and subjects:

- Chapter 1 – Office of Sustainability
- Chapter 2 – High Performing Green Buildings
- Chapter 3 – Green Fleet Program
- Chapter 4 – Electric Vehicle Readiness
- Chapter 5– Materials and Waste Management
- Chapter 6 – Water Conservation
- Chapter 7 – Water Quality
- Chapter 8 – City Tree Preservation
- Chapter 9- Local Food
- Chapter 10 – Environmental Management System Policy
- Chapter 11 – City Land Use Policies
- Chapter 12 - Climate Resilient Denver
- Chapter 13– Memorandum Attachments

Chapter 1 – Office of Sustainability

The Office of Sustainability is hereby established. The Office of Sustainability is the successor to the Greenprint Denver Office. Sustainability is an end result and a process of planning and operating that provides for the needs of our people and businesses today without impairing our ability to continue providing for their needs in the future. The City's central purpose in pursuing sustainability is to conduct City communications, business transactions and governance in ways that will help to make the City a prosperous, world class community where people and nature thrive by providing for the needs of current residents and businesses while preserving the City's ability to do the same for residents and businesses in the future. The mission of the Office of Sustainability is to provide leadership, guidance, and coordination to city agencies to implement



35TH STREET TYPICAL SECTION
PREFERRED OPTION-CYCLE TRACK NORTH SIDE ONLY
(LOOKING EAST)

NOTE: RANGE OF CONCEPTUAL
PARKING SPACES PROVIDED IS
50 -55 SPACES

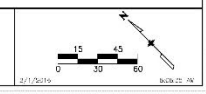
DEPARTMENT OF PUBLIC WORKS
201 WEST COLFAX AVENUE
DENVER, CO 80202
PHONE: (720) 913-4501
FAX: (720) 913-4544

TSIOUVARAS SIMMONS HOLDERNESS
CONSULTING ENGINEERS

LEGEND:

	PROPOSED ROADWAY FEATURES		WATER QUALITY ZONE		ROW IMPROVEMENTS BY CCD
	ROW FEATURES		CYCLE TRACK		ACTIVE PROJECTS, ROW IMPROVEMENTS BY PRIVATE DEVELOPER
	BUFFER ZONE		PEDESTRIAN ZONE		

**35TH STREET VISIONING PROJECT
PLAN VIEW
(PARALLEL PARKING BOTH SIDES WITH CYCLE TRACK NORTH SIDE ONLY)**





Design Criteria for Rebuilding after Hurricane Michael

2 meter (6.5 ft) rise in SLR by 2100

Elimination of all standing water within 72 hours

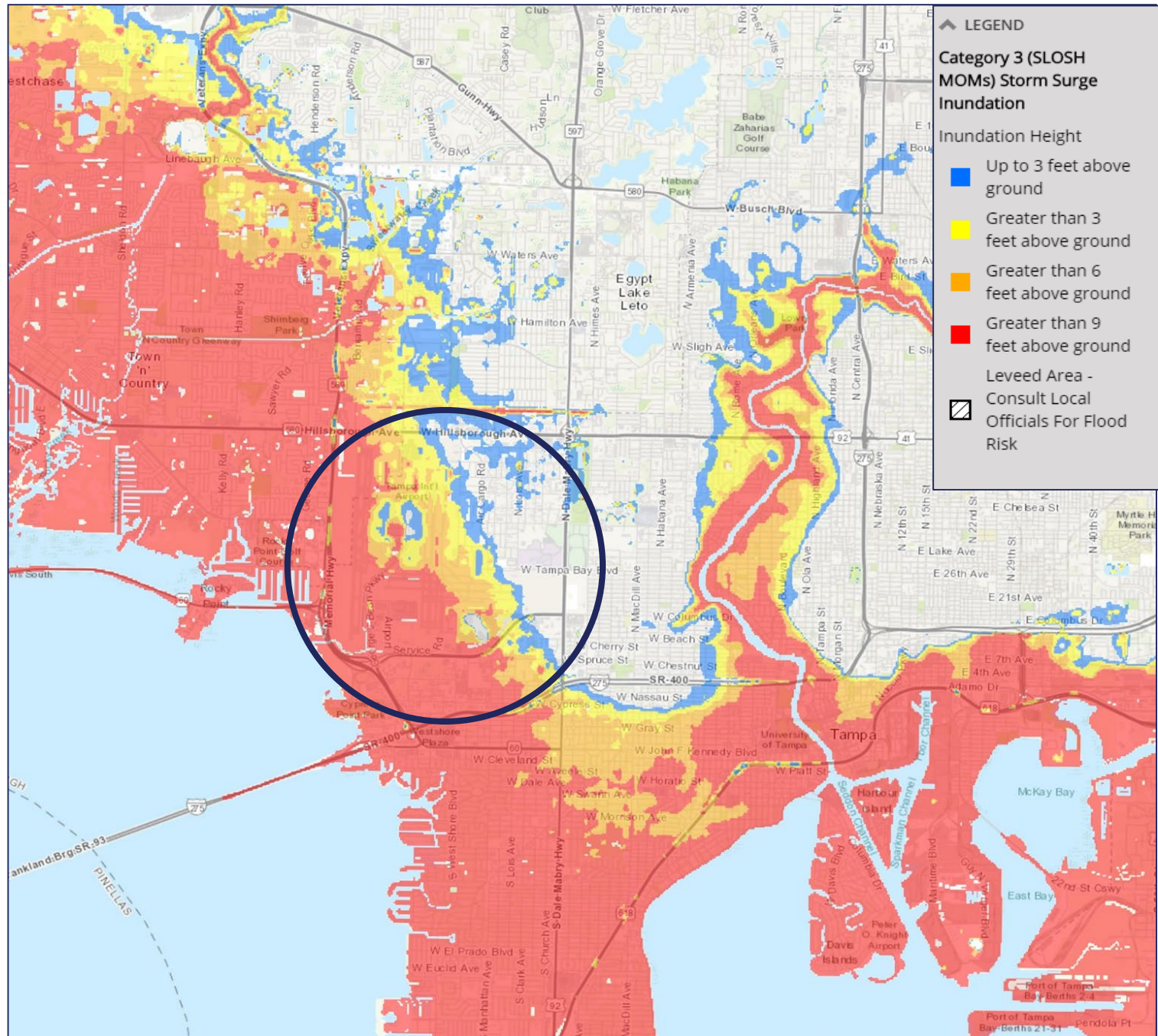
100-year storm event

Tampa Vulnerability



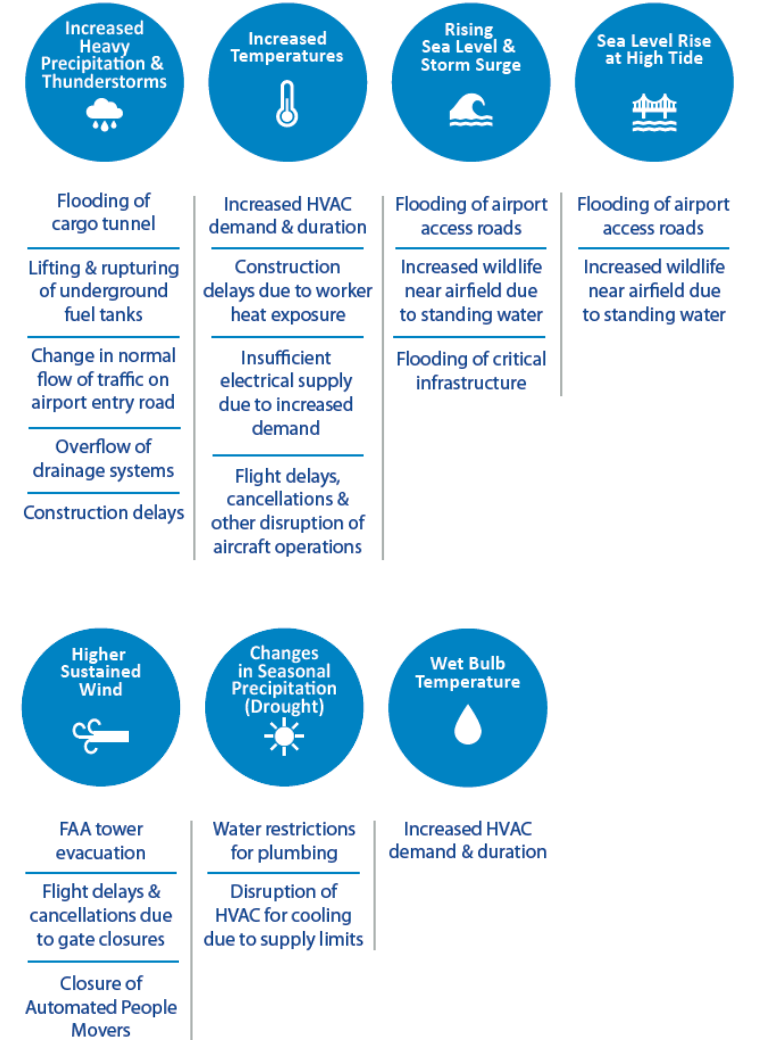
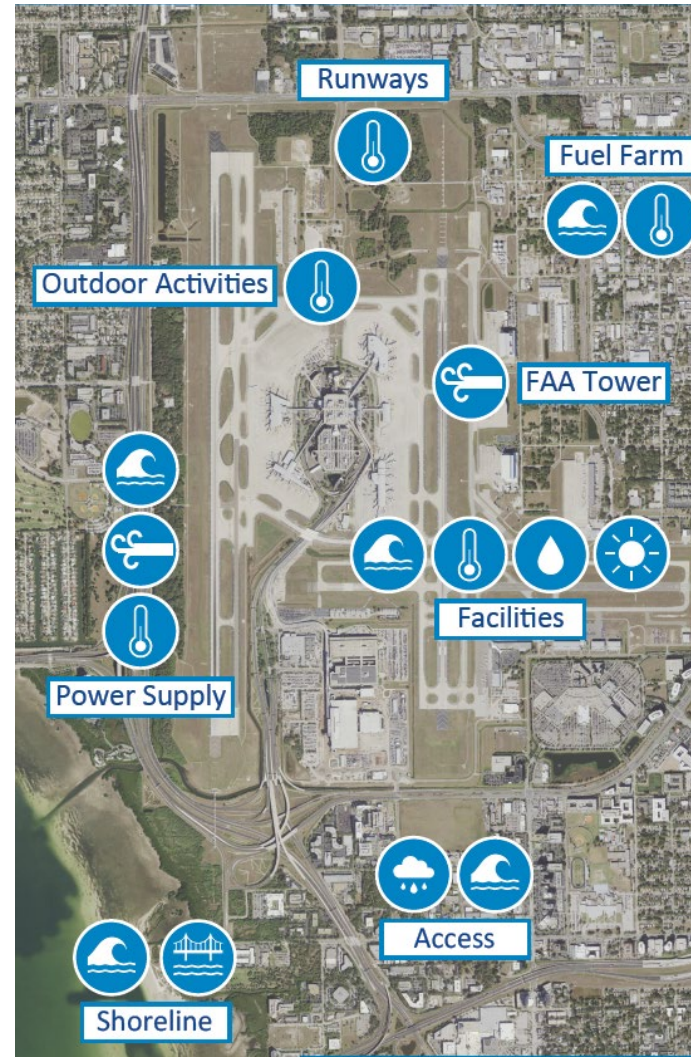
NEWS

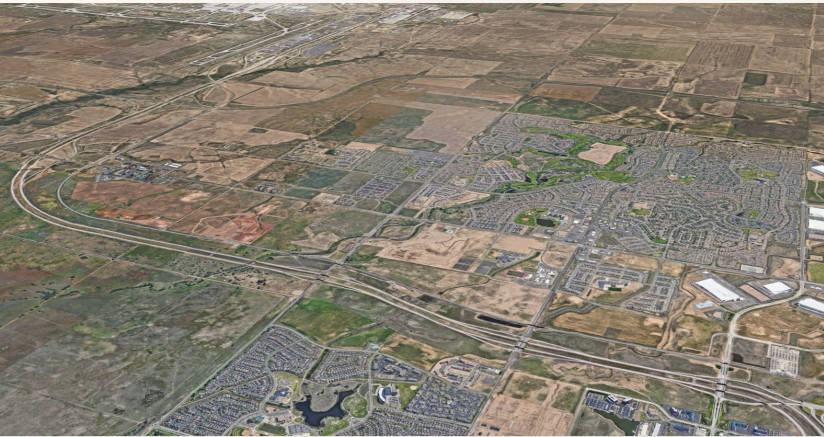
Tampa Bay's heat index hit 101 degrees. It could have been worse. No, really.



TPA Resilience

- » Identify TPA assets and operations that are susceptible to climate stressors
- » Raise awareness of staff and engage them in identifying and evaluating vulnerabilities
- » Provide a roadmap for adaptative management of highly vulnerable assets and operations





**Denver
International
Airport (DEN)
Pena Boulevard
Design-Build
Denver, Colorado**



5.6 SUSTAINABILITY

DEN emphasizes a sustainable community and has adopted CCD *Executive Order 123* (provided in the Reference Documents), which includes sustainable practices. The Contractor shall comply with CCD *Executive Order 123* and incorporate sustainable principles and BMPs in the Design and Construction of the Project.

The Contractor shall implement the Institute for Sustainable Infrastructure Envision self-assessment and third-party Project verification to achieve the highest award level practicable. **At a minimum, the Project shall achieve an Envision Silver Sustainability Award. The Contractor shall designate an Envision-certified sustainability lead with previous experience completing at least one Envision or similar sustainability rating on a similar transportation Project. The Contractor's sustainability lead shall coordinate throughout the Design and Construction, the Project's sustainability self-assessment documentation with DEN. Submit a draft self-assessment to DEN for Acceptance with the Final Design Documents.**

GT Holding Lot facilities shall be Leadership in Energy & Environmental Design (LEED) certified, as required in Section 16, GT Holding Lot.

ENVISION Credits

- » Silver - 30% of applicable points
- » Quality of Life
 - Improve Construction Safety
 - Minimize Construction Impacts
- » Leadership
 - Provide Effective Leadership
 - Foster Collaboration and Teamwork
- » Resource Allocation
 - Use Recycled Materials
 - Use Renewable Energy

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GLOSSARY		

ENVISION Credits

- » Natural World
 - Maintain Floodplain Function
 - Reduce Pesticide & Fertilizer Impacts
- » Climate and Resilience
 - Evaluate Risk & Resilience
 - Assess Climate Change Vulnerability

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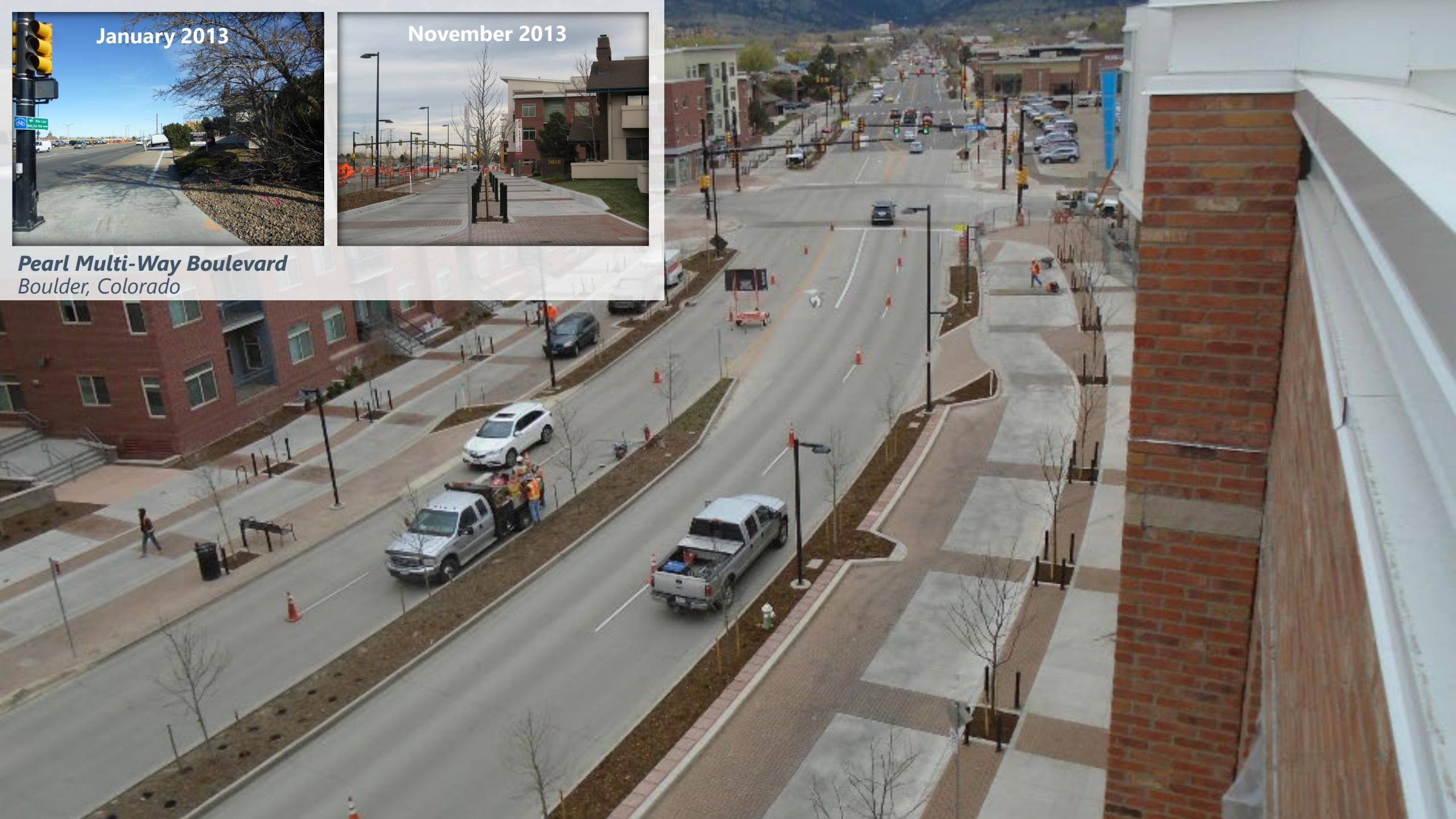
January 2013



November 2013



Pearl Multi-Way Boulevard
Boulder, Colorado





Pearl Multi-Way Boulevard: *Recycling of Removed Materials*



Pearl Multi-Way Boulevard: *Permeable Brick Paver System*



Pearl Multi-Way Boulevard: *Silva Cells under Tree Strip*

Funding Sources

- » FHWA
 - New legislation will make Resilience eligible for traditional funds
- » FEMA
 - Building Resilience into our Cities (BRIC) funds pre-disaster projects
- » Community Development Block Grants (CDBGs)
- » Americas Transportation Infrastructure Act (ATIA) (Senate and House versions) \$9.7B in resilience related Programs



Funding

A Cultural Shift is Occurring

- » FEMA is incurring costs of \$11B per year for storm recovery
- » FHWA is spending an additional \$1B per year in Emergency Relief Funding
- » FEMA/US HUD announced a separate grant program where \$8B was awarded for Storm Mitigation – Resiliency (Florida will be awarded \$635M of this amount)
- » Efficient use of these funds is imperative
- » Education and resources are lacking



Summary

» Trends

- FHWA likely to will require consideration of sustainability and resilience in all projects (Directive 5520)
- Empowers each state to figure out how to implement
- FHWA endorses a collaboration approach and peer to peer outreach

» Outlook

- Sustainability and Resilience will change the way we work on infrastructure for the rest of our careers





THANK YOU!

RS&H

