

Transportation Asset Management Webinar Series

Webinar 50

Improving your TAMP:

Improving Risk Management and Resilience

Sponsored by FHWA and AASHTO



Webinar 50 – February 17, 2021

FHWA-AASHTO Asset Management Webinar Series

- This is the 50th in a webinar series that has been running since 2012
 - And the fifth in the *Improving Your TAMP* miniseries
 - One final webinar is planned in the miniseries
 - Date TBD
- Webinars are regularly held every two months
 - 3rd Wednesday of the month
- We welcome ideas for future webinar topics and presentations
 - Submit your questions using the webinar's Q&A feature

FHWA/AASHTO TAM Webinar Series
Improving Your Next TAMP Webinar Miniseries

The next TAMP development is right around the corner and agencies need to figure out how to develop their next TAMP. A TAM webinar mini-series is kicking off to take a deeper dive into the topic of improving the next TAMP. The purpose of the series is to provide knowledge, capacity building, and motivation to build a better TAMP. The series is designed so that it can be a catalyst for agencies to improve their next TAMP, with webinars delivered more frequently in order to build momentum and increase engagement.

Visit the AASHTO TAM Portal for more information: <https://www.tam-portal.com/tam-webinars/>

Upcoming Webinars

- 16 December**
2PM EDT
Improving Your Next TAMP: Needs and Priorities
This webinar will use an interactive format to get your input on what is most needed to improve your next TAMP. Polls will assess the audience's opinions in real time on a variety of topics related to the next TAMP and address topics including: the areas that most need improvement, elements of the TAMP that most help agencies, areas where additional resources are most needed, and what those resources are. The polls will be complemented by an interactive discussion with the facilitator and participants. A summary of the federal requirements and an overview of available resources will also be presented. Panelists include Steve Gaj, and William Johnson, FHWA; Matt Hadravsky, Iowa DOT; Anne Marie McDonnell, Connecticut DOT; Matt Hardy, AASHTO; Hyun-A Park, and Spy Pond Partners, LLC.
[Register](https://attendee.gotowebinar.com/register/5588875128856588)
- 3 February**
2PM EDT
Improving the Financial Plan
A financial plan is a required element of the TAMP. How well the financial plan is integrated with other elements of the TAMP can provide an indication of an agency's TAM maturity. This webinar will share some of the advancements in financial planning at transportation agencies and highlight new and upcoming resources to assist agencies in improving their TAM financial plans. Presenters include: William Johnson, FHWA; Bill Robert, Spy Pond Partners, LLC; Matt Hadravsky, Iowa DOT; Brent News, South Carolina DOT; and David Schwartz, Kansas DOT.
[Register](https://attendee.gotowebinar.com/register/48712279589806539)
- 10 February**
2PM EDT
Improving Life Cycle Planning and Management
Life cycle planning and management is a foundational component of transportation asset management. The progress that agencies are making in this area is noteworthy. Many resources are also available to help agencies with improving practices. This webinar will share an overview of the progress that agencies are making in improving life cycle planning and management practices and share new and soon-to-be available resources. Presenters include: Steve Gaj, FHWA; Katie Zimmerman, Applied Pavement Technology; Jig Malhotra, WSP; Ken Valentine, VTtrans; and Tho Anderson, Arizona DOT.
[Register](https://attendee.gotowebinar.com/register/47473914358993227)
- 17 February**
2PM EDT
Improving Risk Management and Resiliency
Risk management and building resiliency is of growing importance for transportation agencies and is an integral part of an agency's TAMP. This webinar will feature discussion from DOTs on how they have used their initial TAMP risk registers and how they plan to enhance their risk registers and risk management and resiliency building processes in their updated TAMPs. Presenters include: Jean Wallace, Minnesota DOT; Rob Kafalatos, Heather Heinger, Elisabeth Habic, FHWA; Matt Lauffer, North Carolina DOT; and Mike Johnson, Caltrans.
[Register](https://attendee.gotowebinar.com/register/29377693427686324)
- TBD**
Baseline Assessment of TAMP Enhancement Opportunities
A recent FHWA study reviewed all of the 2019 TAMPs to assess the state of the practice at state DOTs. The NCHRP TAM Gap Analysis Tool and the AASHTO TAM Guide were applied to understand the maturity of practice across all states. An overview of this study's findings will be shared along with highlights showing mature practices. Presenters include: William Johnson, FHWA, and Katie Zimmerman, Brad Allen, Applied Pavement Technology.

Past Webinars

- 21 October**
Video
Asset Management Practices and Benefits
This webinar set the context for the webinar series by sharing lessons learned from the 2018 and 2019 TAMP reviews that is presented in the FHWA Case Study 3: Asset Management Practices and Benefits. Presenters included: Steve Gaj, FHWA; Gordon Proctor, GPA; and Justin Bruner, PennDOT.
[Video](https://www.tam-portal.com/resources/tam-webinar-46/)

Welcome

FHWA and the AASHTO Sub-Committee on Asset Management are pleased to sponsor this webinar series

- Sharing knowledge is a critical component of advancing asset management practice

Improving Your Next TAMP mini-series is an important resource for agencies to start building their next TAMPs

Learning Objectives

- Sharing lessons-learned, ideas, and knowledge
- Building working knowledge of key concepts and definitions relevant to risk management and resiliency
- Beginning to apply this knowledge in order to answer the following questions:
 - What opportunities exist to strengthen risk management and to improve the next TAMP?
 - What benefits can my agency expect by strengthening practices related to risk management and resiliency?
 - What are key lessons-learned from the first round of TAMP development that can help improve risk management– and the next TAMP?

Webinar Agenda

- 2:00** **Welcome and Introduction**
Steve Gaj, FHWA and Hyun-A Park, Spy Pond Partners
- 2:10** **Topic Introduction**
Jean Wallace, Minnesota DOT
- 2:25** **FHWA Resiliency Overview**
Elizabeth Habic, FHWA
- 2:40** **Improving Risk Management and Resilience**
Matt Lauffer, North Carolina DOT
- 2:55** **Developing a Risk Based Asset Management Plan**
Mike Johnson, Caltrans
- 3:10** **Q&A and Wrap-Up**

Improving your TAMP Miniseries: Improving Risk Management and Resiliency

Topic Overview

Jean Wallace, Minnesota DOT

Chair, AASHTO CPBM Subcommittee on Risk Management

Risk, Asset, and Performance Management

Risk Management enables strong asset and performance management to support strategic objectives



Risk, Risk Management, and Resilience Defined

- Risk: the positive or negative effects of uncertainty or variability on agency objectives [AASHTO ERM Guide, 23 CFR 515.5]
- Risk Management: (1) the culture, processes and structures that are directed toward the effective management of potential opportunities and threats [AASHTO ERM Guide]
- (2) the processes and framework for managing potential risks, including identifying, analyzing, evaluating, and addressing the risks to assets and system performance. [23 CFR 515.5]
- Resilience: (1) Resilience or resiliency is the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions [FHWA Order 5520].
- (2) the ability of the transportation system to recover and regain functionality after a major disruption or disaster [AASHTO].

Risk-based TAMPs

Objectives:

- Create an inventory and condition of assets
- Identify, assess and prioritize risks that could affect performance
- Assist in making informed tradeoff capital and maintenance decisions acknowledging limited resources
- Improve resilience to external and highly disruptive threats

Risk Management and Resilience in TAMP

Risk-based asset management and **resilience** are still relatively new concepts. In order to be effective, agencies must:

- Know asset location and criticality in terms of service delivery;
- Understand potential natural and man-made threats and probability of impact to assets;
- Quantify potential consequences to their assets, while addressing the uncertainty in those consequences; and
- Understand the link between risk and resilience.

Efforts to better understand risk and resilience

NCHRP Synthesis 527, *Resilience in Transportation Planning, Engineering, Management, Policy, and Administration*

NCHRP 08-113, *Integrating Effective Transportation Performance, Risk, and Asset Management Practices*

Colorado DOT, Utah DOT, and others' experiences with RAMCAP (Risk Analysis and Management for Critical Infrastructure Protection), an all-hazards approach to critical infrastructure risk assessment.

FHWA Order 5520, resilience guidance, vulnerability assessments and reviews; first round of TAMPs; learning from others; etc.

NCHRP Problem Statement Proposed

“Scoping Study to Develop the Basis for a Highway Standard to Conduct an All-Hazards Risk and Resilience Analysis”

Proposed in 2018 by:

- Committee on Transportation System Security & Resilience
- Committee on Performance-Based Management’s Subcommittees on Risk Management and Asset Management

And approved for funding as **NCHRP Project 23-09**

NCHRP 23-09 Scope and Deliverables

- Develop Risk and Resilience Related Glossary of Terms
- Conduct State of Practice (SOP) Review
- Identify Gaps in State of Practice
- Develop Research Roadmap
- Develop Research Problem Statements



Standard for Conducting Risk & Resilience Analysis

Risk-based asset management and Resilience:

- Takes an “all-hazards” approach and a system view
- Ensures investment decisions are data-driven and tradeoffs are known
- Prioritizes resources toward managing highest risks and biggest gains

NCHRP 23-09 Stakeholder Engagement

Risk and Resilience Standard Industry Workshop

- **Monday, March 22nd 1:00-4:00 PM ET - or -**
- **Monday, April 12th 2:00-5:00 PM ET**

Share your ideas and needs for developing the basis for a standard to conduct an all-hazards risk and resilience analysis for transportation assets.

To register, contact Maria Pena, Principal Investigator,
Maria.Pena@aemcorp.com

Watch for future engagement opportunities as the project progresses!

AASHTO
CPBM
Subcommittee
on Risk
Management

Mission

The focus of this subcommittee is on the development, implementation, and use of tools, methods, and strategies by a state transportation agency in order to take advantage of opportunities and mitigate potential threats.

SRM meetings: 2nd Monday of even-numbered months
1-2 p.m. Eastern
(next call is April 12th)

Contact: Matt Hardy (mhardy@ashto.org)
Jean Wallace (Jean.Wallace@state.mn.us)
Nathan Lee (nlee@utah.gov)

Thank you!



U.S. Department of Transportation
Federal Highway Administration

Addressing Resilience in Asset Management

Improving Risk Management and Resiliency
February 17, 2021

Elizabeth Habic
Sustainable Transportation
& Resilience Team
FHWA



TAMP Contents

- Asset Management Plan contents:
 - Pavement and bridge inventory and conditions on the NHS
 - Objectives and measures
 - Performance gap identification
 - **Lifecycle planning**
 - **Risk management analysis**
 - Financial plan
 - Investment strategies

Asset Management Requirements

23CFR515.7(b)

- A State DOT shall **establish a process for conducting life-cycle planning** for an asset class or asset subgroup at the network level (network to be defined by the State DOT).
- As a State DOT develops its life-cycle planning process, the State DOT should include future changes in demand; **information on current and future environmental conditions including extreme weather events, climate change, and seismic activity; and other factors that could impact whole of life costs of assets.**

Asset Management Requirements

- 23CFR515.7(c)
- (1) **Identification of risks** that can affect condition of NHS pavements and bridges and the performance of the NHS, including risks associated with **current and future environmental conditions, such as extreme weather events, climate change, seismic activity, and risks related to recurring damage** and costs as identified through the evaluation of facilities repeated damaged by emergency events carried out under part 667 of this title. Examples of other risk categories include financial risks such as budget uncertainty; operational risks such as asset failure; and strategic risks such as environmental compliance.
- (2) An assessment of the identified **risks in terms of the likelihood of their occurrence and their impact and consequence** if they do occur;
- (3) An evaluation and prioritization of the identified risks;
- (4) A mitigation plan for addressing the top priority risks;
- (5) An approach for monitoring the top priority risks; and

What is Risk?

23CFR515.5

Risk means the positive or negative effects of uncertainty or variability upon agency objectives.

When developing a process for a risk management plan it shall include.

23CFR515.7(c)(2)

An assessment of the identified **risks in terms of the likelihood of their occurrence and their impact and consequence** if they do occur

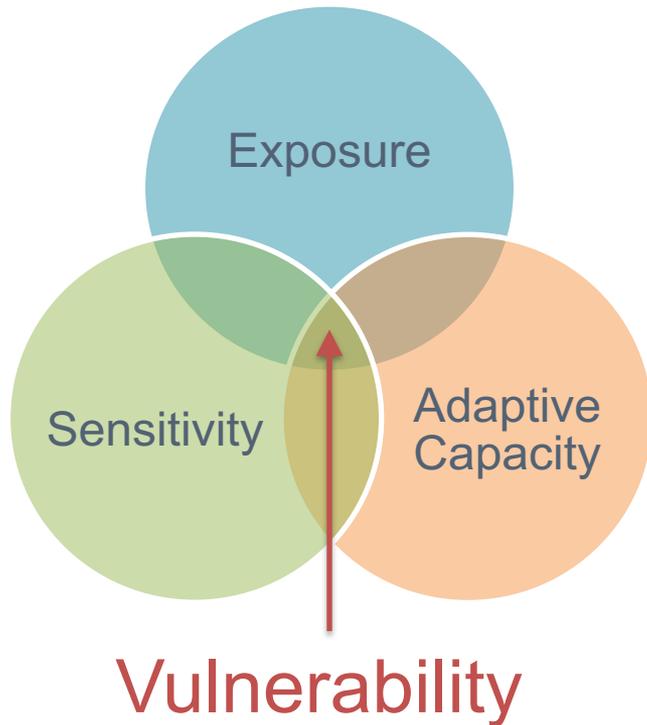
What is Resilience?

Resilience: the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions. FHWA Order 5520.

Waldo Canyon Fire, CO, 2012, credit: CO DOT

Battery Park Underpass in NYC following Superstorm Sandy, credit: NYC DOT.

What is Vulnerability?



Vulnerability is a function of a transportation system's:

- **Exposure**
- **Sensitivity**
- **Adaptive capacity**

What is a Vulnerability Assessment?

A starting point for identifying and assessing resilience concerns and potential adaptation options

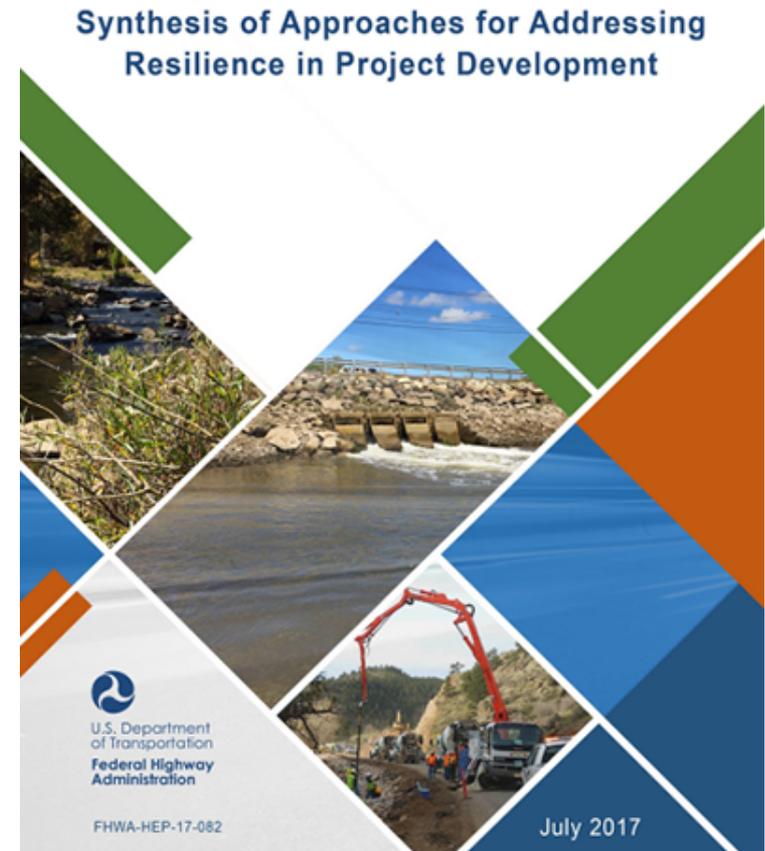
- Identifies the amount of stress to assets under current and projected conditions.
- How might future precipitation, sea levels, temperatures impact your transportation system?

Scale

- System level vulnerability assessment (city or region)
- (Project level)
 - Preliminary Planning/Alternatives
 - Engineering/Design

Synthesis of Approaches for Addressing Resilience in Project Development (2017)

- Lessons learned, etc., for four engineering disciplines
 - Coastal Hydraulics
 - Riverine Hydraulics
 - **Pavement and Soils**
 - Mechanical & Electrical Systems
 - Overall Lessons learned for engineering
- Addressing resilience in the project development process
- Economic analysis



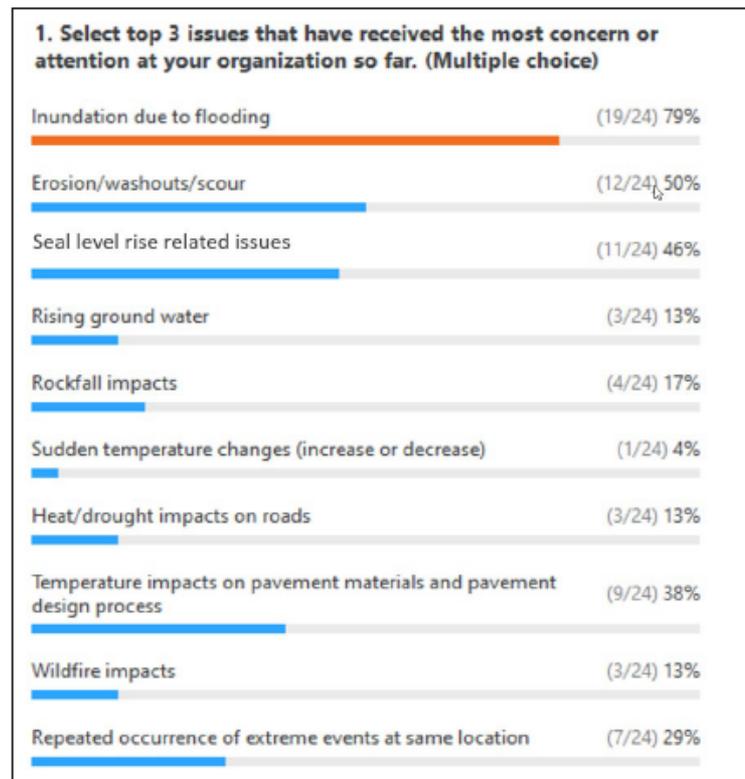
Pavement Resilience Peer Exchanges

Peer Exchanges held in October and December 2020

Objective – Identify strategies and barriers for designing, constructing, and maintaining more resilient pavement systems.

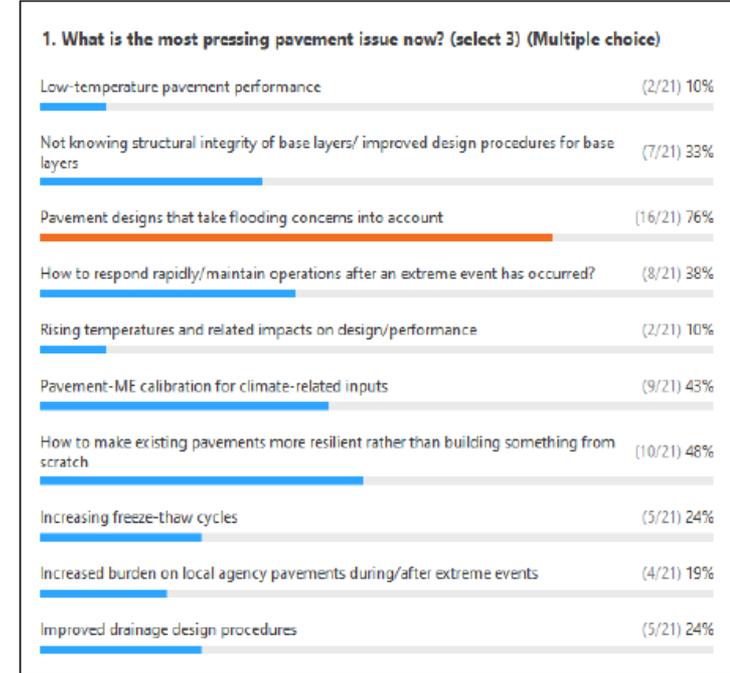
Poll #1—Issues of Concern

The following poll was conducted after Breakout Session #1.



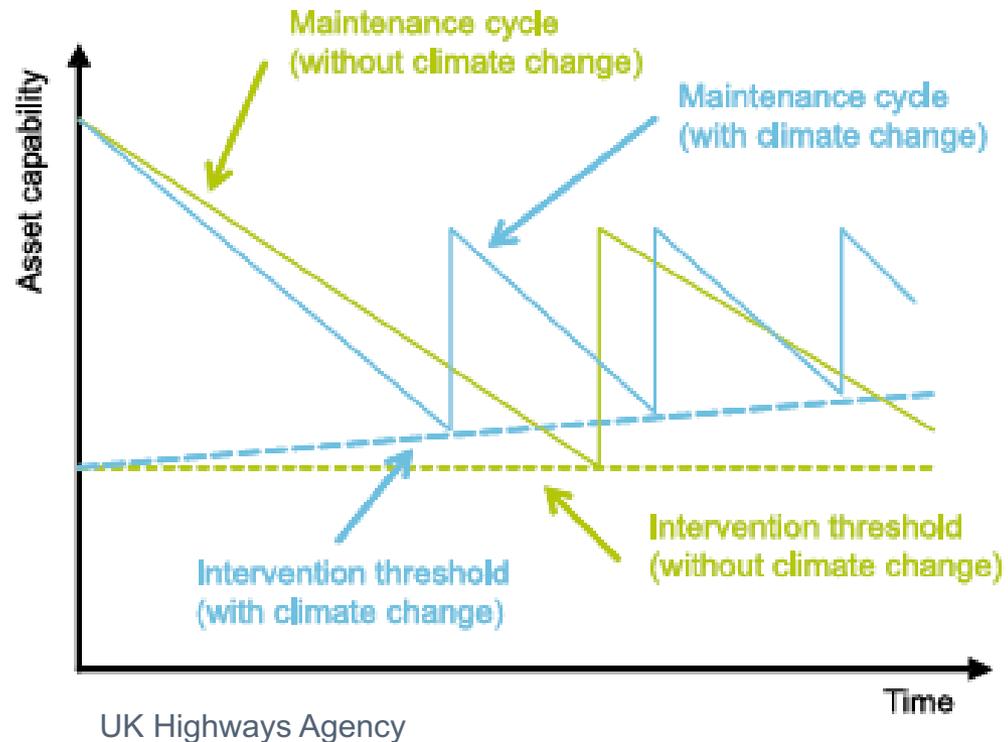
Poll #2—Pressing Pavement Issues

The following poll was conducted after Breakout Session #2.



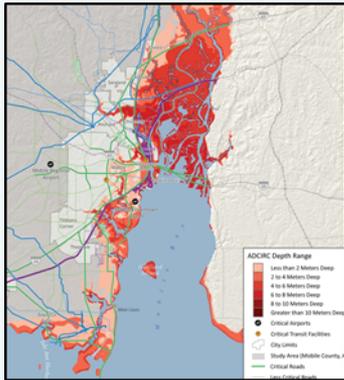
Acceleration of Deterioration Rates

- Caused by extreme weather events & more gradual changes in environmental conditions
- More frequent interventions, \$
- Concern: Models based on historic deterioration rates.



FHWA Resilience Resources

Gulf Coast 2 Study



Resilience Pilots with State DOTs & MPOs



Hurricane Sandy Project

Engineering Assessments

Credit: NYC DOT

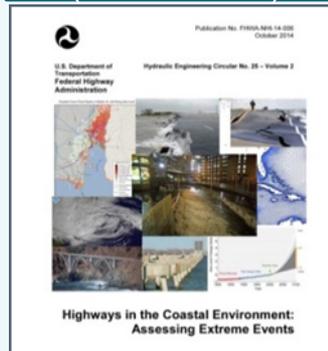
Credit: Brian Beudler

<https://www.fhwa.dot.gov/environment/sustainability/resilience/>

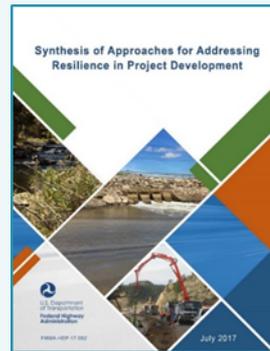
Vulnerability & Adaptation Framework



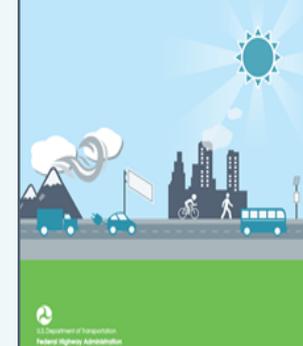
Engineering Guidance (HEC-25 & 17)



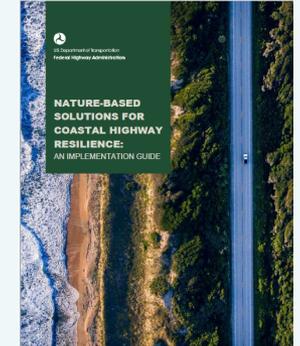
Project Development



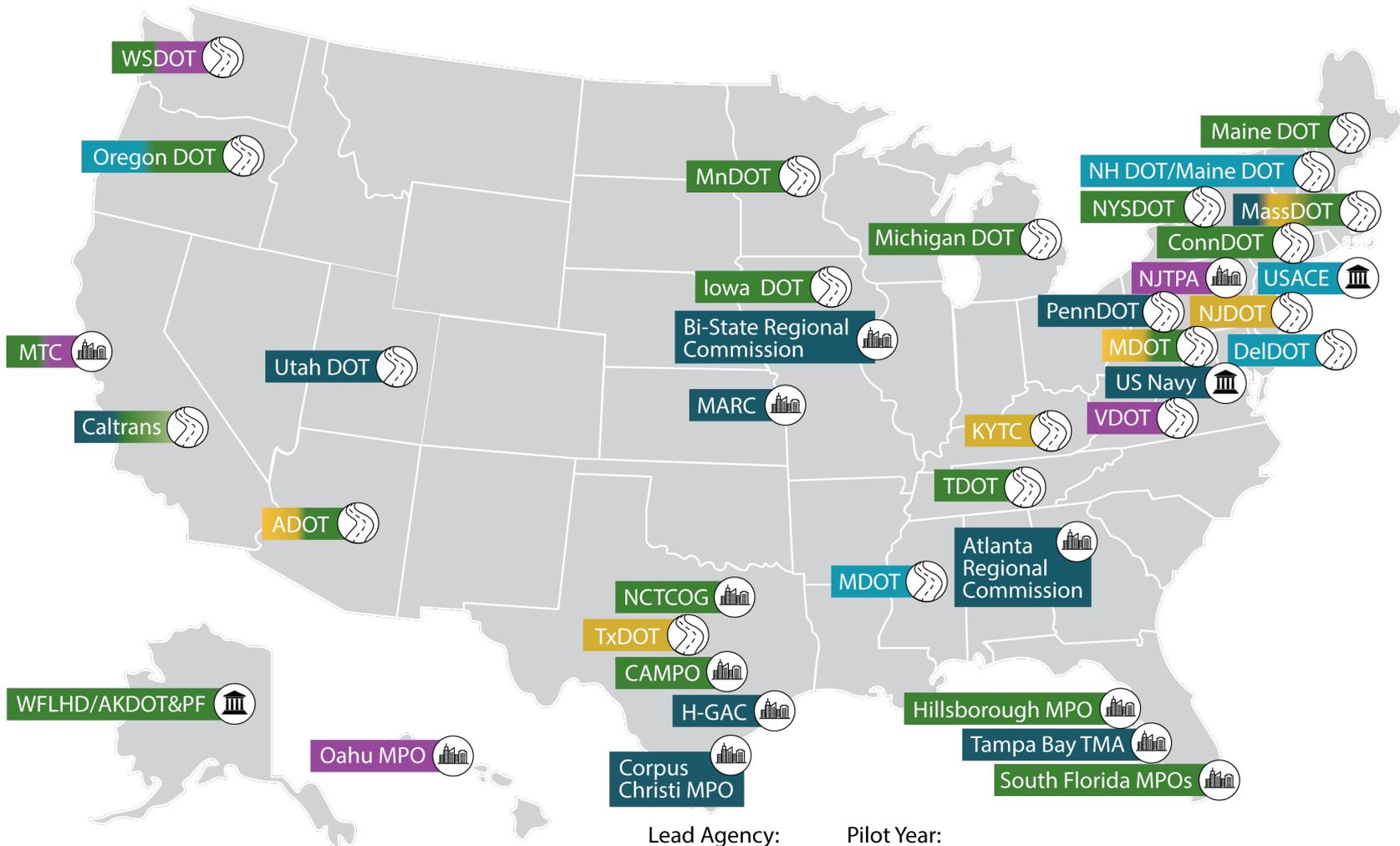
CLIMATE CHANGE ADAPTATION GUIDE FOR TRANSPORTATION SYSTEMS MANAGEMENT, OPERATIONS, AND MAINTENANCE



Nature-Based Solutions



FHWA Sponsored Resilience Pilots



Lead Agency:

-  = MPO
-  = DOT
-  = Federal

Pilot Year:

-  = 2010-2011 Vulnerability Assessments
-  = 2013-2015 Vulnerability and Adaption
-  = 2016-2017 Nature-Based Resilience
-  = 2017-2018 Asset Management
-  = 2018-2020/2024 Extreme Weather

Six Asset Management and Resilience Pilot Reports and Guidebook

Asset Management, Extreme Weather, and Proxy Indicators Pilot Program (2017-2019)

Arizona DOT

- Integration of extreme weather risks into Asset mgt practice
- Assessment of costs as part of life cycle planning
- Consideration of proxy indicators for identifying resilience concerns

Kentucky Transportation Cabinet

- Use of vulnerability assessment in development of risk register
- Consideration of the effect of extreme weather events on asset deterioration rates and LCP

Maryland SHA

- Development of methods to pull coastal vulnerabilities and hazards into bridge and pavement management systems
- Update of life cycle management plans to reflect future environmental risk

Massachusetts DOT

- Assessment of resilience of bridges, culverts and roads to inland flooding risks, inclusion in asset management systems.
- Culvert inspection protocols and test out proxies for vulnerability

Six Asset Management and Resilience Pilot Projects, & Guidebook

New Jersey DOT

- Reduce system risk by linking management of culverts and drainage systems to extreme weather and climate resilience

Texas DOT

- Assessment of vulnerability of critical assets to extreme weather events in Houston district, inform asset management practices including LCP, deterioration curves

Final Pilot Reports Online

<https://www.fhwa.dot.gov/asset/pilot/>

Guidebook on Addressing Resilience in Asset Management (2021)

Resilience & Asset Management Resources

- Asset Management, Extreme Weather, and Proxy Indicators Pilot Program (2017-2019)
- Guidance on Incorporating Risk Management into Transportation Asset Management Plans (2017)
- Guidance on Using a Life Cycle Planning Process to Support Asset Management (2017)
- Risk-Based Transportation Asset Management Reports: Building Resilience into Transportation Assets (2013)
- AASHTO:NCHRP 25-25 (94) Integrating Extreme Weather into TAMPs (2015)

Coming Soon

- *Incorporating Resilience into the Transportation Planning Process Case Studies and Guidebook*
- Addressing Resilience in Transportation Asset Management
- HEC 25, Highways in the Coastal Environment, 3rd Ed.
- Geohazards, Extreme Events and Climate Change Resilience Manual
- 2018-2020 Resilience and Durability Pilot Studies
- CMIP Data Processing Tool update with Users Manual
- NHI Course - Addressing Resilience in Highway Project Development & Preliminary Design



FHWA Asset Management and Resilience Contacts

Headquarters:

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- Rob Kafalenos, Robert.Kafalenos@dot.gov
- Heather Holsinger, Heather.Holsinger@dot.gov
- Elizabeth Habic, Elizabeth.Habic@dot.gov



NCDOT – Improving Risk Management and Resilience

Patrick Norman, Highway Operations

Matt Lauffer, Hydraulics Unit

FHWA/AASHTO TAM Webinar 50

Improving Risk Management and Resiliency

Wednesday, February 17th, 2021

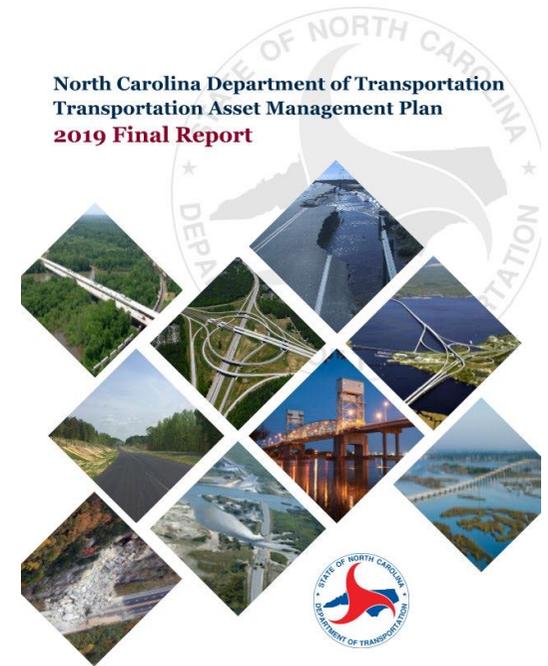
Agenda

- NCDOT TAMP
- Disruptions/Changing Conditions
- Opportunities/ Investment
- Improving Resilience
 - NCDOT Resilience Program
 - Planning
 - Design
 - Operations/ Maintenance
 - Research



NCDOT 2019 TAMP

- NCDOT 2019 TAMP focused on pavements and bridges.
- NCDOT maintains 80,000 miles roadway of which 5,700 miles are National Highway System
- NCDOT maintains 15,000 NBIS Structures over water 3,700 are on the NHS.
- NCDOT is meeting or exceeding the federal minimum performance standards for NHS pavements and bridges.
- Coordinated with the State Maintenance Operations and Performance Report (MOPAR)
- Chapter 5 Focused on Risk Management Analysis and a Risk Register



Improving Flood Risk Management and Resilience

Risk: Is an event that is a deviation from the expected outcome. Risk is measured by likelihood and consequence if the event did occur.

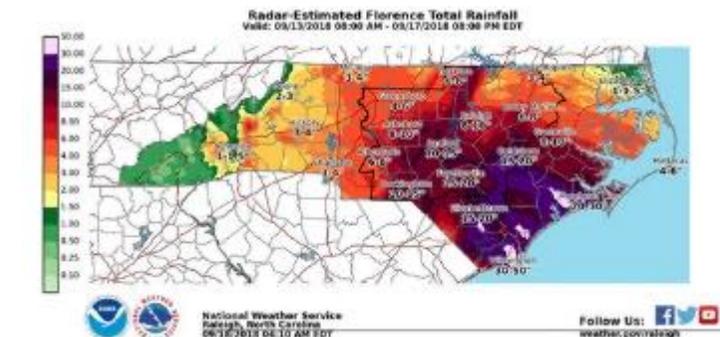
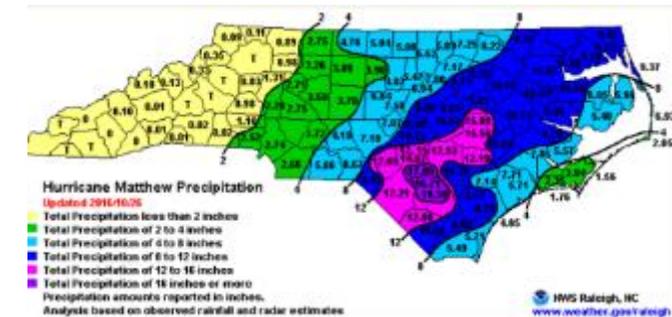
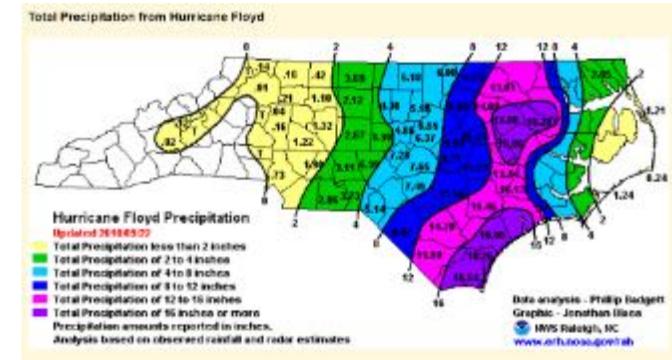
Vulnerability : $f(\text{exposure, sensitivity, and adaptive capacity})$ Extent to which an asset is susceptible to sustaining damage from a flood hazard.

Resilience: Is the ability to anticipate, plan for and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions.



Disruptions

- Hurricane Floyd – 1999
- Hurricane Matthew – 2016
- Hurricane Florence -2018



2020 North Carolina Storms				
Storm Event	# of Damage Sites	# Damage Bridges	# Damage Pipes and Culverts	# of Pipe Replacement Requests
2020 February 6 th Rain Event	286	22	92	27
2020 April 13 th Rain Event	80	5	18	2
2020 May 19 th Rain Event	71	3	23	6
Bertha	92	0	9	5
2020 June 17 th Rain Event	61	2	12	9
Isaias	128	4	4	2
2020 August 14 th Rain Event	30	1	24	3
2020 August 31 st Rain Event	79	6	37	16
2020 September 17 th Rain Event	6	1	2	2
Zeta	78	4	29	14
2020 November 11 th Rain Event	809	42	174	98
Totals	1720	90	424	184

*30% of damage sites are related to drainage structures

*45% of damage pipes are replaced

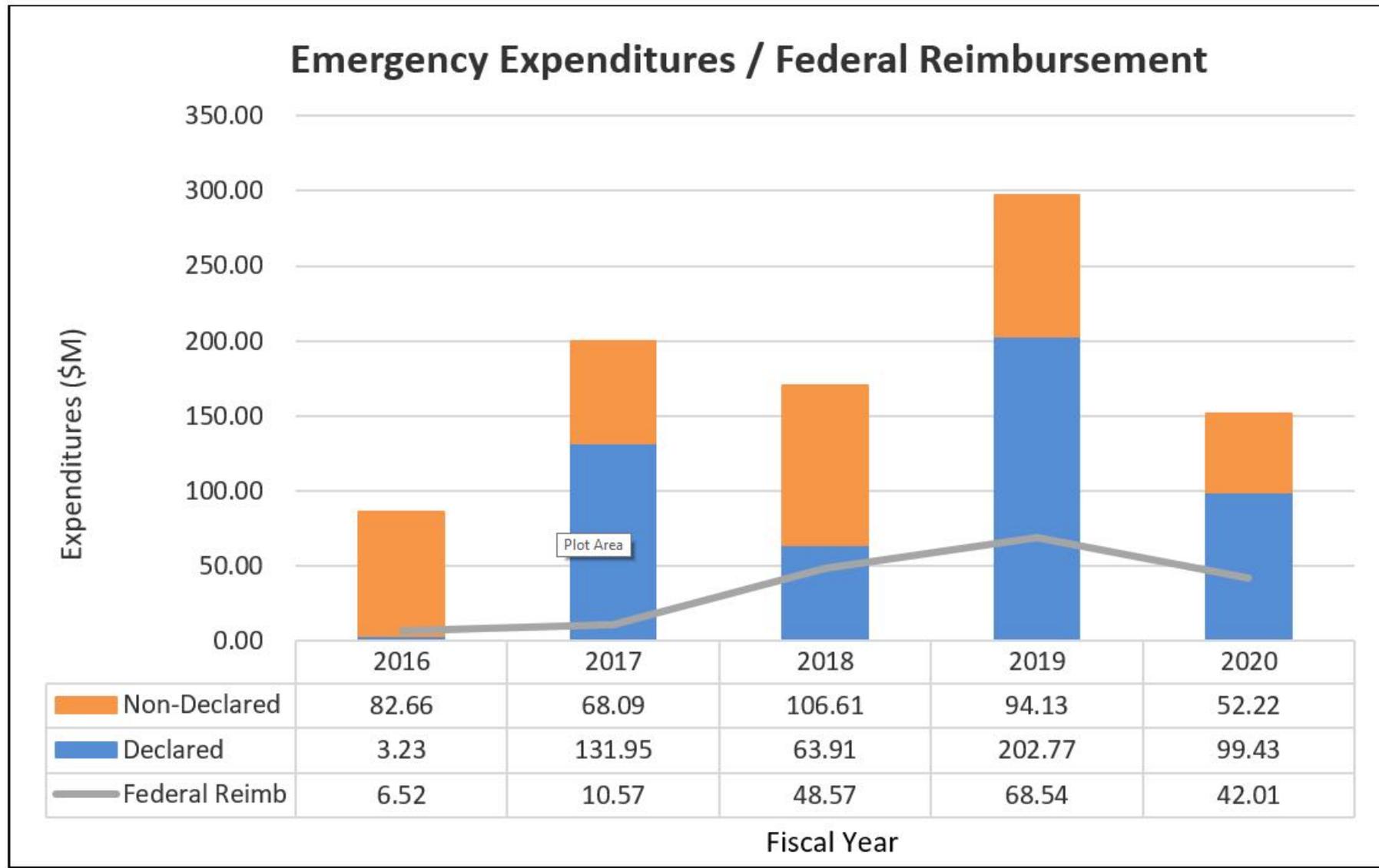
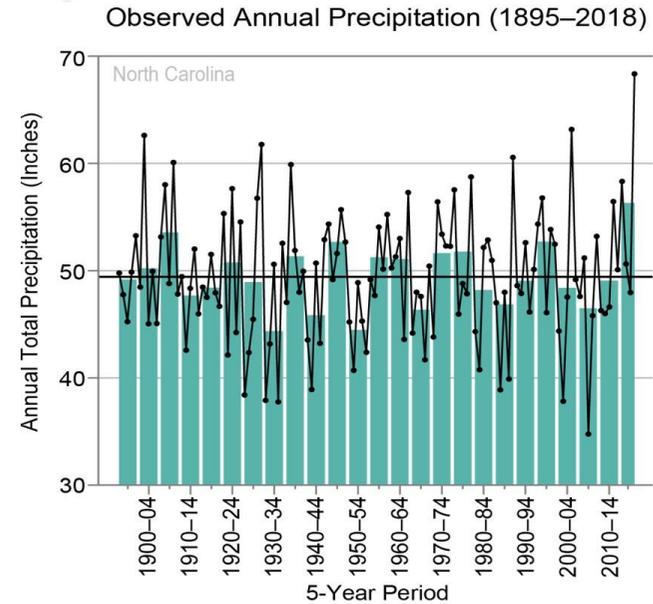
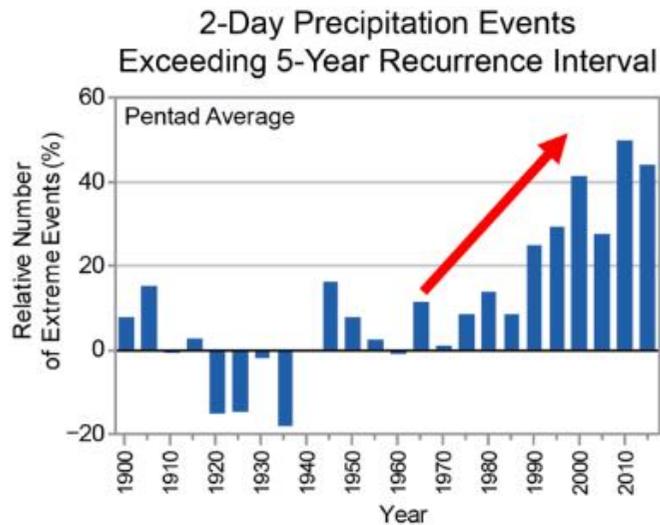
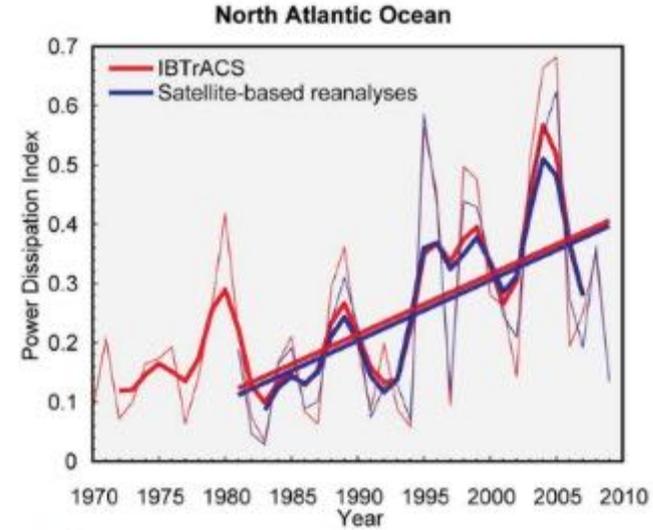
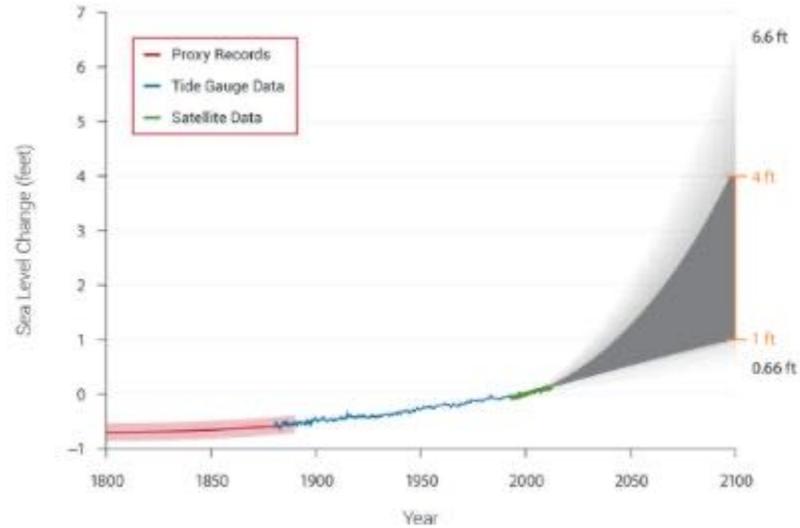


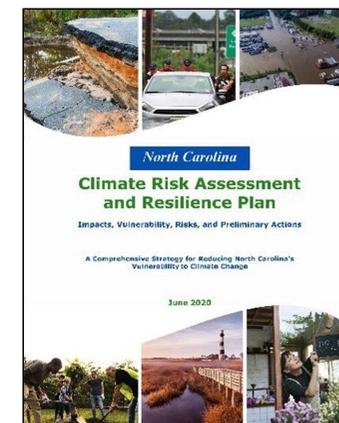
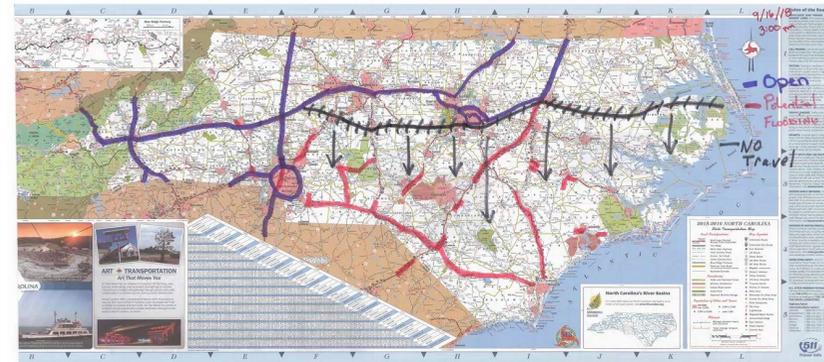
Figure 1: Emergency Expenditures and Federal Reimbursement

Climate Assessment – Changing Conditions to Continue



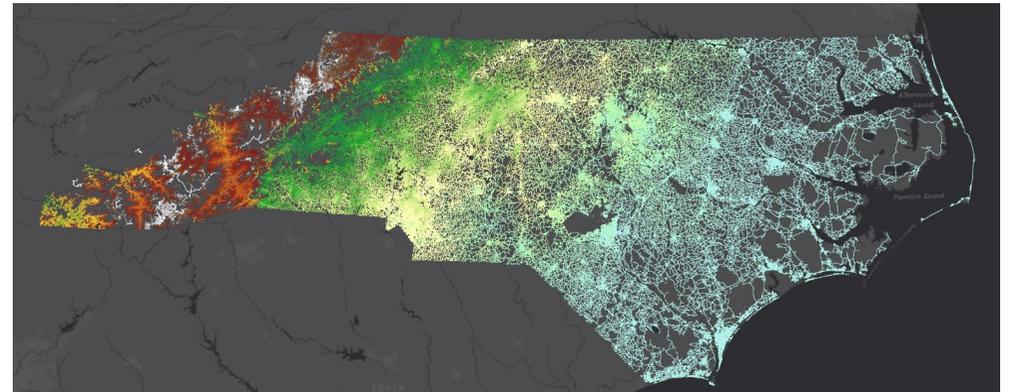
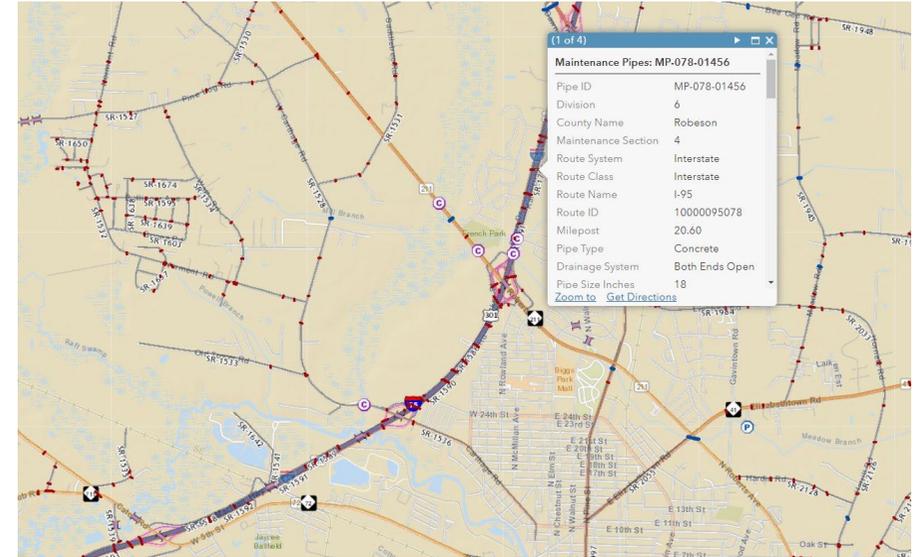
Opportunities:

1. September 14th, 2018
2. Executive Order 080



Investment:

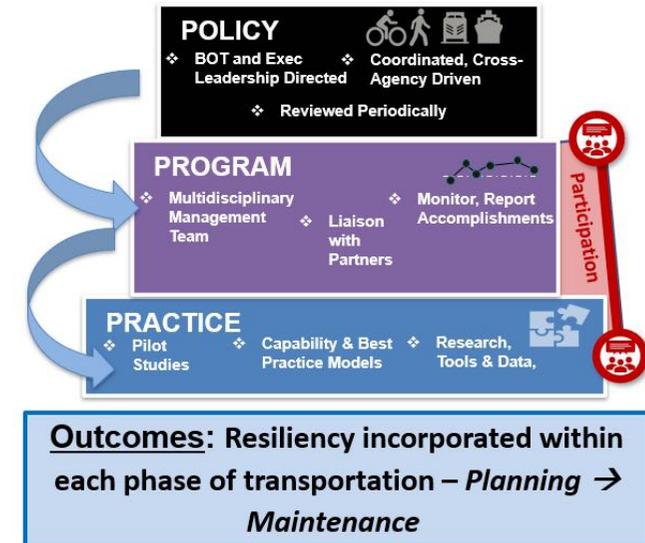
- Asset Inventory of over 375,000 Pipes
- Bridge Management Information System
- Statewide LIDAR Data
- 3D Elevation Model of Roadway Network
- Flood Studies from Emergency Management
- Wave Analysis and Surge Study of Coastal Bridges
- Partnership



NCDOT Resilience Program

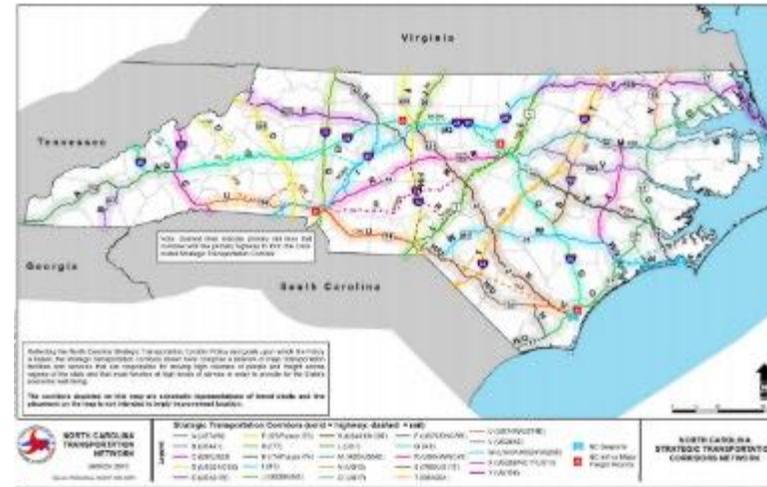


- absorptive capacity
- restorative capacity
- adaptive capacity
- equitable access



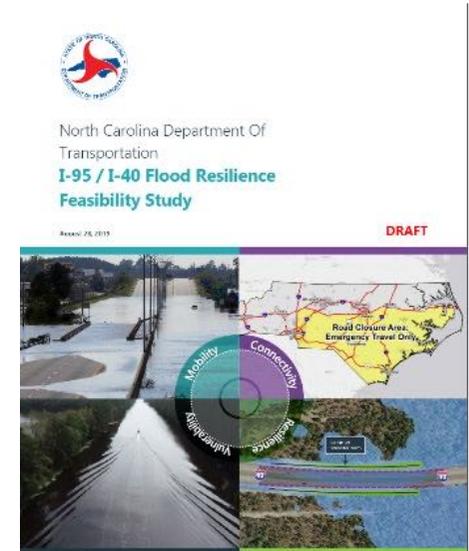
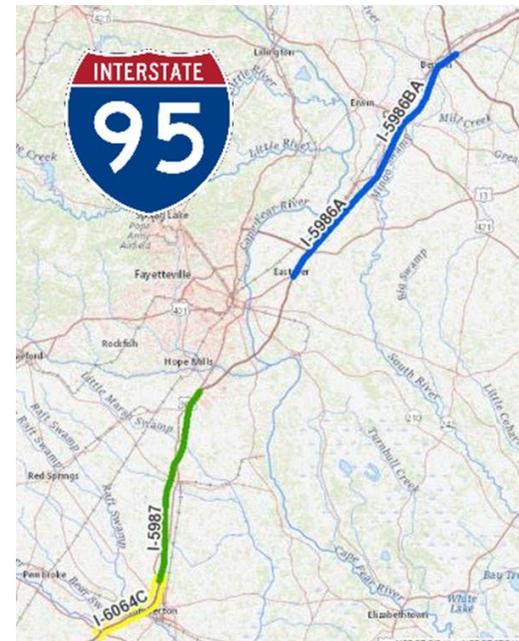
Planning - Strategic Transportation Corridor Vulnerability Assessment

- Identify Hazards
- Assess Risk and Vulnerability
- Determine Level of Resilience
- Incorporate into Prioritization



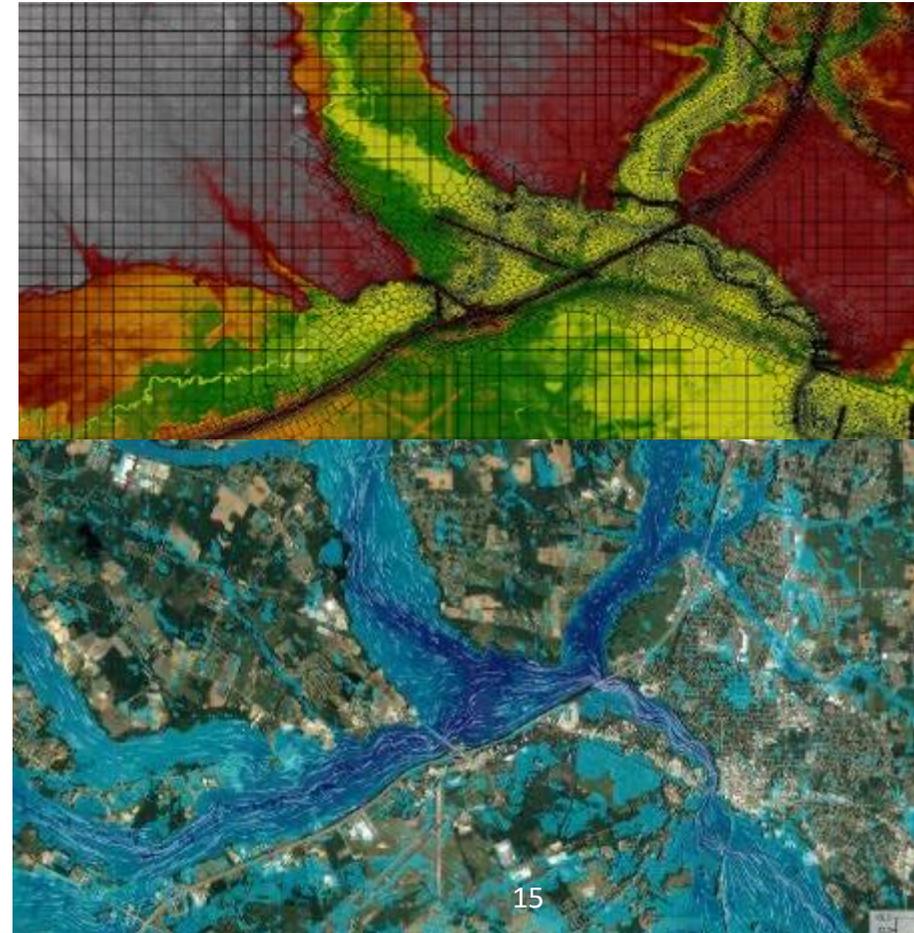
Planning - I-95/I-40 Flood Resilience Feasibility Study

- Directed by the Secretary
- Identified Flood Improvement Options and Costs to Increase the Flood Resilience of I-95/ I-40
- Incorporated 100-year design into active I-95 projects where feasible.
- Provided valuable information for Grant pursuits.
- Provided valuable insight for the need for resiliency modeling for project delivery.



Design – I-6064 Resilient Design

- Largest 2D rain on grid model NCDOT has completed.
- Design Criteria for Resilience
 - 100-Year Design Storm
 - Evaluate Performance for Florence and Matthew
- Provide Information on road profile, bridge lengths, culvert sizing to meet FEMA floodplain requirements and performance criteria for Design Build Project.



Operations and Maintenance - Retrofitting Resilience

- NFWF Grant awarded in partnership with NC Coastal Federation in March 2020
- Protect ~1/2 mile of NC 24 exposed to tidal surge, overwash and wave forces.
- Establish Tidal Marsh, Oyster Bed, and Riparian Upland Habitat
- Increased Resilience through Nature Based Design



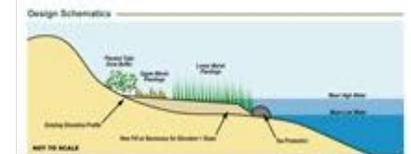
MARSH (SILL)

The construction of a marsh, including fill and plantings, bonded by toe protection in the intertidal zone of a shoreline.



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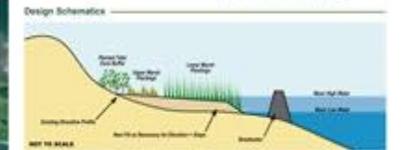
MARSH (BREAKWATER)

The construction of a marsh, including fill and plantings, in the intertidal zone of a shoreline, including segmented breakwaters to reduce incident wave energy.



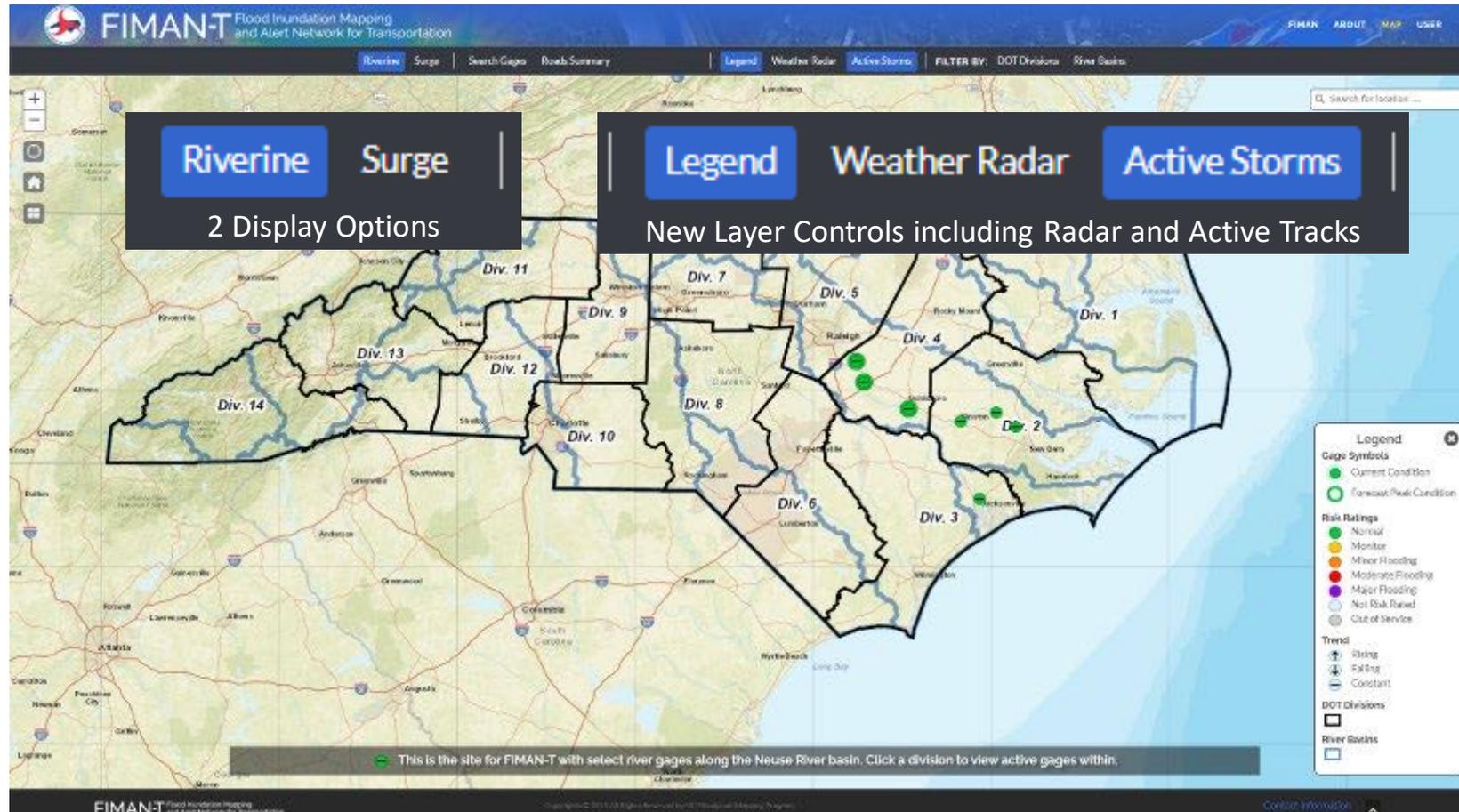
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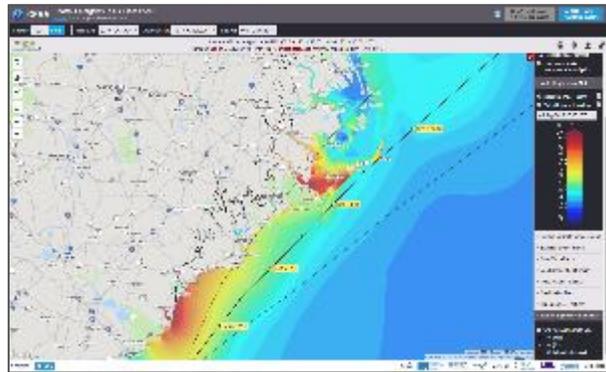


Storm Preparedness – FIMAN-T

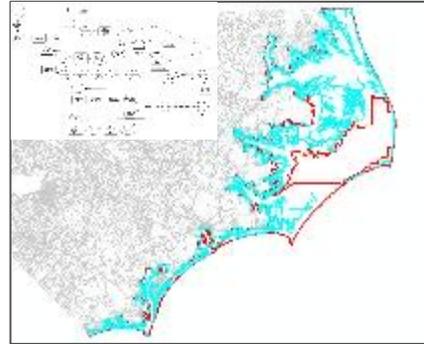


A New Tool for NCDOT's Response to Flood Impacts to Transportation Assets

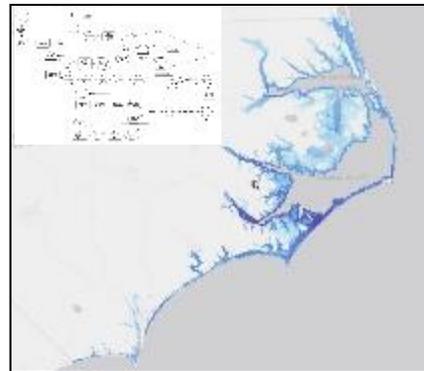
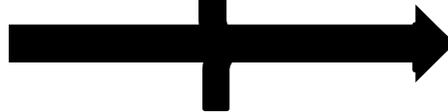
FIMAN-T Surge Concept



SURGE Modeling from CERA

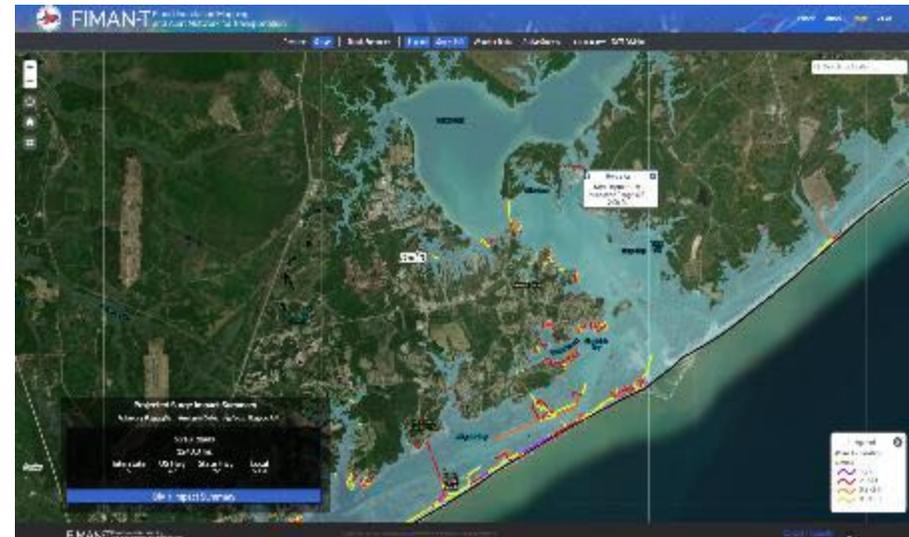


Statewide 3D Road Raster QL2



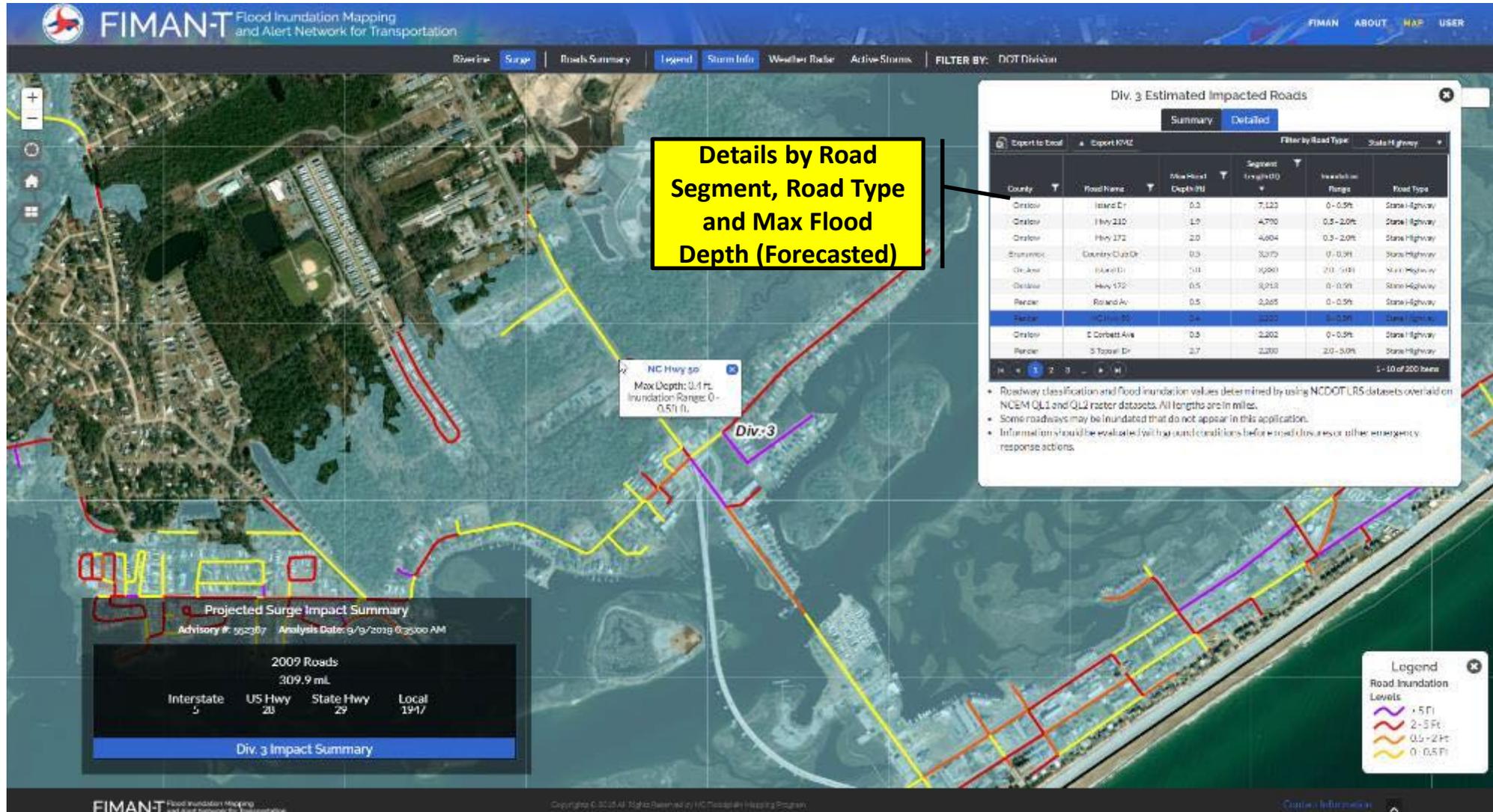
Event-wide Surge Depth Raster

Automatically Runs Every 6 Hours (During Events)



FIMAN-T – Surge Forecast Module Showing Maximum CERA Inundation Boundaries and Roadway Impacts – Statewide.

Storm Preparedness – FIMAN-T : Surge



Storm Preparedness – FIMAN-T : Riverine

FIMAN-T Flood Inundation Mapping
and Alert Network for Transportation

FIMAN ABOUT MAP LOGIN

Search Gages Roads Summary Bridge Summary Legend Weather Radar Show Local Roads Show Assets Show Bridges

Neuse River near Goldsboro

Forecast Stage: 27.6 Ft
Elevation: 97.1 (NAVD 88)

Bridges Assets

Export to Excel

Road Name	Bridge Number	Flood Source	Road Elevation (ft)	Low Chord Elevation (ft)	Current / Scenario WSEL	Floodboard (ft)
NC581	950014	Neuse River Overflow	65.2	60.7	65.5	-4.8
NC111	950042	Neuse River Overflow	63.0	59.8	61.9	-2.1
NC111	950054	Pond Off Neuse River	63.9	60.7	61.9	-1.2
NC581	950016	Neuse River	72.5	69.1	69.7	-0.6
US13/US117	950052	Neuse River Overflow	74.4	72.2	72.6	-0.4

1 5 of 10 items

Current Scenario Forecast

Drag to simulate forecasted flood height (Min. Library Stage 14.1 Ft)

Stage (ft) 22.4 22.9 23.4 24.6 25.4 26 26 26 27.6 27.6 27.5 27.4 27.2 27 26.8 26.6 26.4

Hours from now 6 12 18 24 30 36 42 48 54 60 66 72 78 84 90 96 102 108 114 120 126

Neuse River near Goldsboro

Last updated: 9/16/2018 12:00:00 PM Gage datum: 41 gft NAVD88 Site ID: 02089000 Owner: USGS

Report

Stage: 22.3 ft
64.2 ft NAVD88

Stream Elevation

Rising

Peak Stage: 27.6 ft
9/18 2:00 PM
No Data Available

Forecasted Peak

92 Roads - 26.6 Mi.

Interstate US Hwy State Hwy Local

0 1 3 88

Roads Affected

18 Assets
10 Bridges

DOT Assets Affected

Legend

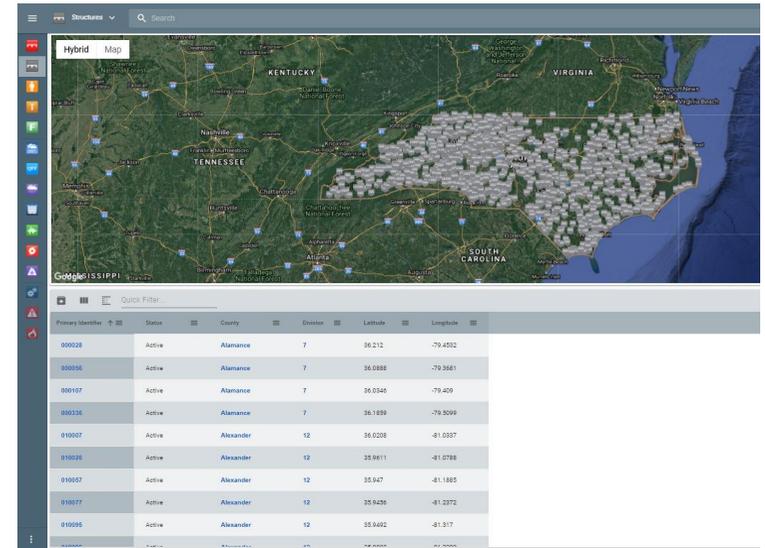
NCDOT Assets

- ▲ Bridges
- Road Trundation Levels
- ~ > 5 Ft
- ~ 2-5 Ft
- ~ 0.5-2 Ft
- ~ 0-0.5 Ft

Storm Preparedness - BridgeWatch



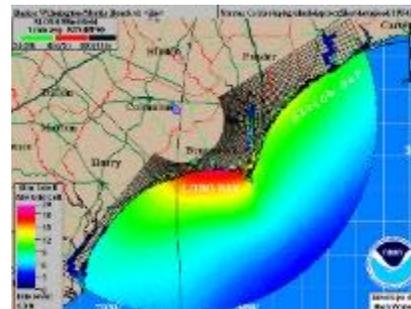
- BridgeWatch – Continuous Flooding, Scour and Structure Awareness.
- Integrate with DamWatch
- Derivatives



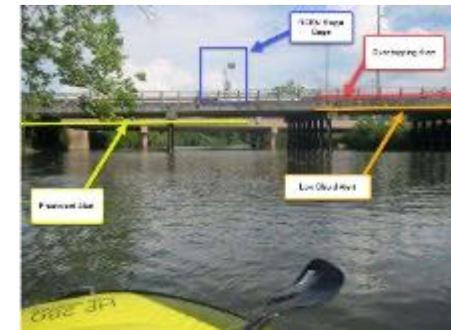
NEXRAD



SLOSH/ CERA



USGS/ EM Gages



Research and Studies

- NC Future Precipitation for Resilient Design
- IDF Rainfall Update – Atlas-14, Volume 13
- NCSU Flood Abatement Studies – Resilient Routes
- USACE – DRA 19 Flood Risk Reduction Feasibility Study
- NCHRP 51-10 – Practices for Integrated Flood Prediction and Response Systems
- NCHRP – Climate Change for Hydrologic and Coastal Design (NCHRP 15-61/20-44(23))

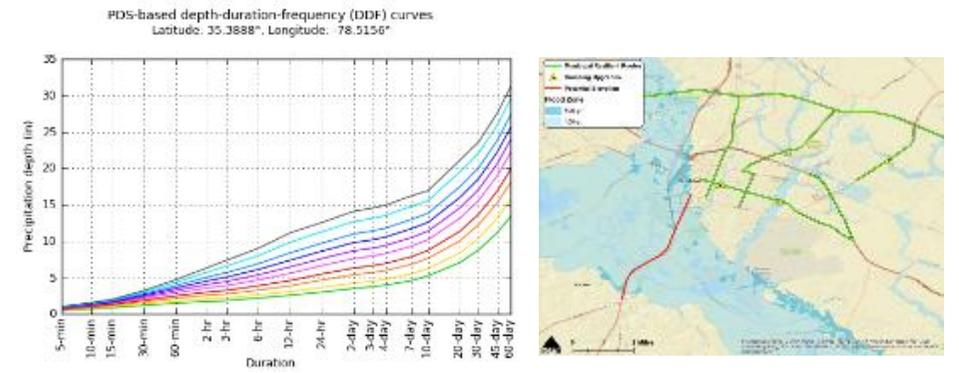
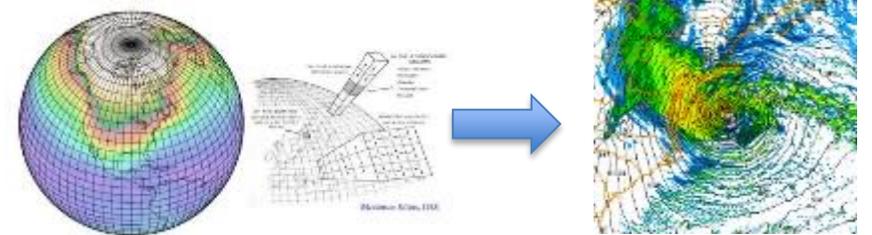


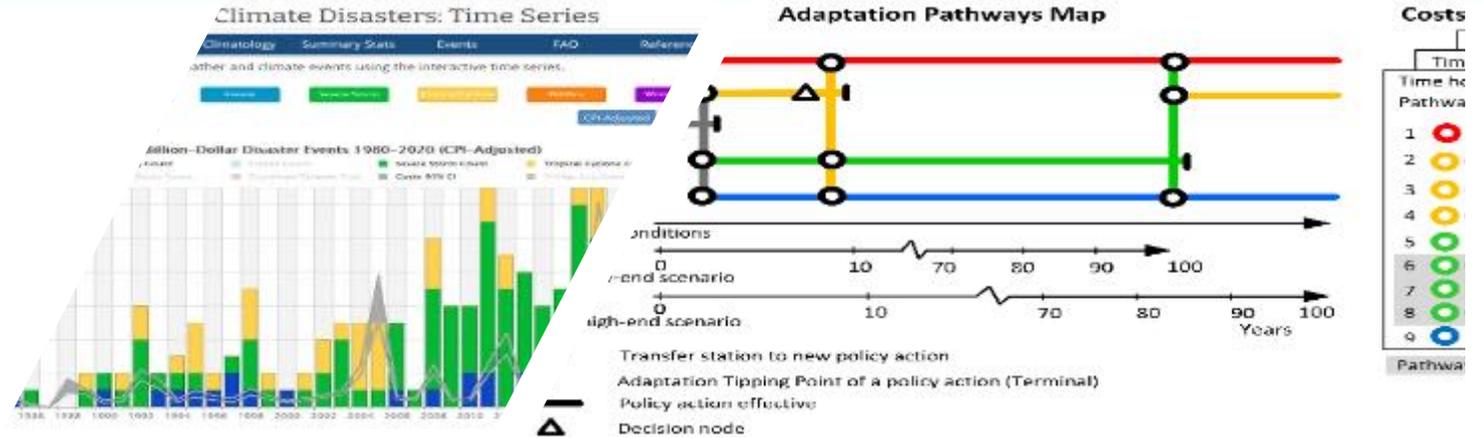
Figure 2.1. Levels of analysis, effort, and climate information.

Building Partnerships



=





Closing Thoughts

- Climate Assessments Identify that Extreme Events will continue and increase in Intensity and Frequency.
- NCDOT is working to integrate Risk and Resilience Strategies into TAM.
- Our opportunities for Resilience increase as we partner internally and externally.

Questions?



Thank You!

Matt Lauffer

mslauffer@ncdot.gov

919-621-0443



Developing a Risk Based Asset Management Plan

Michael Johnson P.E.

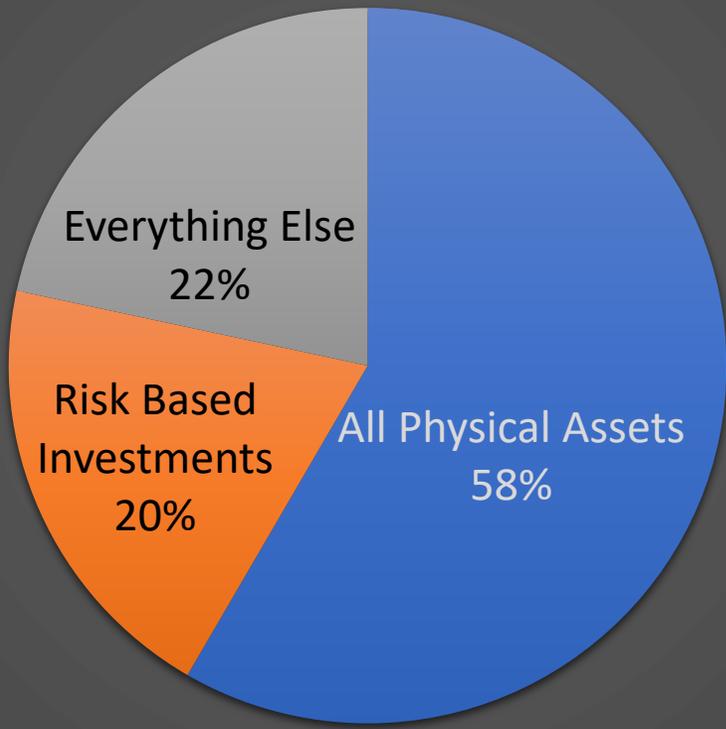
State Asset Management Engineer

California Department of Transportation

February 2021

TAMP Investment Plans - Risk Mitigation

10 Year Investment Plan



TAMP Risks

Risk Categories	Can it be Anticipated?	TAMP Treatment	Within TAMP or Elsewhere?
Succession planning	Yes	Mitigate	Elsewhere
Continuity of operation	Yes	Mitigate	Elsewhere
Changes in policy or priorities	No	Accept	NA
Tort Liability	Yes	Mitigate & Accept	TAMP
Sudden change in funding	No	Accept	NA
Gradual Funding Loss - Fuel Tax paradox	Yes	Accept & Mitigate	TAMP
Changing legislation	No	Accept	NA
Scour vulnerabilities	Yes	Mitigate	TAMP
Seismic vulnerabilities	Yes	Mitigate	TAMP
Geotechnical vulnerabilities	Yes	Mitigate	TAMP
Climate vulnerabilities	Yes	Mitigate	TAMP



An aerial shot shows the massive landslide that, in an instant, wiped out all traces of a road and surrounding landscape along the Bia Sur coast. Recognizing the highway's importance, Cr

Common System Risks

ROCK STRENGTH

		1	2	3
SLOPE CLASS	1	0	0	0
	2	0	V	VII
	3	0	V	VII
	4	III	VIII	IX
	5	VI	IX	X
	6	VII	IX	X
	7	VIII	IX	X
	8	VIII	IX	X

LANDSLIDE SUSCEPTIBILITY CLASSES

Criterion	Attribute	Weight
Hazard	Soil Conditions	33%
	Peak Rock Acceleration	38%
	Seismic Duration	29%
Impact	Average Daily Traffic (ADT) On Structure	28%
	ADT Under/Over Structure	12%
	Detour Length	14%
	Leased Air Space (Residential, Office)	15%
	Leased Air Space (Parking, Storage)	7%
	RTE Type on Bridge	7%
	Critical Utility	10%
Vulnerability	Facility Crossed	7%
	Year Designed	25%
	Hinges (Drop Type Failure)	16.5%
	Outriggers, Shared Columns	22%
	Bent Redundancy	16.5%
	Skew	12%
	Abutment Type	8%

Varied Risk Assessment Criterion

CALTRANS CLIMATE CHANGE VULNERABILITY ASSESSMENTS

2019

District 1

PHASES FOR ACHIEVING RESILIENCY

California has been a national leader in responding to extreme climatic conditions (see Executive Order B-30-15). Successful adaptation to climate change includes a structured approach which anticipates likely disruptions, while also institutionalizing changes in agency operating procedures. The steps shown below outline an approach to achieve resiliency at Caltrans and show how work performed on this study fit within that framework.

AASHTO RESILIENCE DEFINITION:
THE ABILITY TO PREPARE AND PLAN FOR,
ABSORB, RECOVER FROM, OR MORE
SUCCESSFULLY ADAPT TO ADVERSE EVENTS.

PREDICT CLIMATE CHANGE EFFECTS:

Climate change projections suggest that temperatures will be warmer, that precipitation patterns will change, sea levels will rise, and that a combination of these stressors could lead to other types of disruptions, such as those associated with wildfires.

COORDINATE WITH FEDERAL/STATE RESOURCE AGENCIES ON APPLICABLE CLIMATE DATA:

Many state agencies have been actively engaged in predicting more specific future climate conditions for various purposes (i.e. water supply, energy impacts, and environmental impacts). Federal agencies have also been studying change for other purposes (coastal erosion, wildfires, etc.)

IDENTIFY EXPOSURE OF CALTRANS HIGHWAYS TO POSSIBLE CLIMATE CHANGE DISRUPTIONS:

Identifying locations where Caltrans' assets might be exposed to extreme weather-related disruptions provides an important foundation for decisions to protect and minimize potential damage. The exposure assessment examines all climate stressors, e.g., extreme temperatures, heavy precipitation, sea level rise, etc., and relates the likely consequences of these stresses to disruptions to the State Highway System.

UNDERSTAND POSSIBLE TRANSPORTATION IMPACTS:

Higher precipitation levels could cause more flooding and landslides. Sea level rise and/or storm surge could inundate or damage low-lying coastal roads and bridges. Higher temperatures could effect maintaining the state's highways and contribute to wildfire risk for highways. Understanding these potential impacts provides an impetus to study ways to enhance the resiliency of the State Highway System.

INITIATE VULNERABILITY ASSESSMENT:

Alternative climate futures will have potentially varying impacts on the State Highway System. This step includes an examination of the range of climatic stressors and where, because of terrain or climatic region, portions of the State Highway System might be vulnerable to future disruptions.

IDENTIFY PRIORITIZATION METHOD FOR CALTRANS INVESTMENTS:

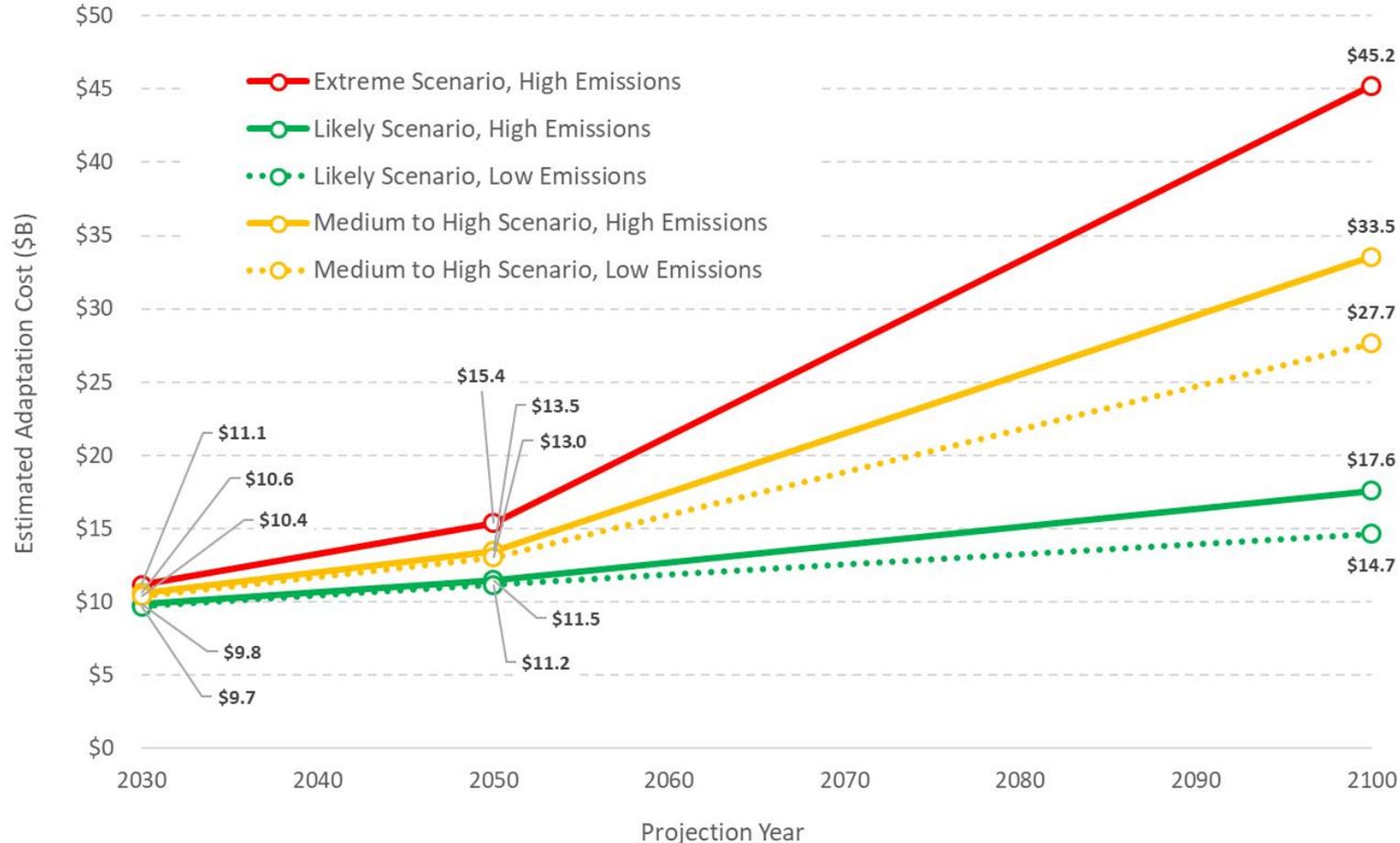
This step identifies the process that can be used by Caltrans to prioritize projects and actions from the perspective of their likely system resiliency benefits, through reduced impacts to system users.

This process will focus on resiliency benefits and the timeframe of potential impacts, and could guide the timing of investment actions.

SCOPE OF THIS STUDY

2021 SHSMP – Sea Level Rise Models

Estimated Statewide Adaptation Cost for SHS Roadways and Bridges from Sea Level Rise + Storm Surge



Notes:

- Costs are escalated 8.5 years at 3.2%/year.
- Sea level rise and storm surge projections based on GIS data used in the 2019 Caltrans Vulnerability Assessment Reports.



Methods to Assess Risks – TAMP Refinement

Likelihood of Occurrence

< 1 yr	Med-Low	Medium	Mid-High	High	High
1-2 Yrs	Med-Low	Medium	Mid-High	High	High
2-5 Yrs	Low	Med-Low	Medium	Mid-High	High
5-10 Yrs	Low	Med-Low	Medium	Mid-High	High
10-25 Yrs	Low	Low	Med-Low	Medium	Med-High
> 25 Yrs	Low	Low	Med-Low	Medium	Med-High
	No Impact	Short Term Lane Loss	Short Term Loss of Route	Long Term Loss of Route	Loss of Critical Route

Consequence

Monetizing Risks

- ❑ Monetizing risks allows for different types of risks to be quantitatively compared.
- ❑ Process involves determining total costs associated with each risk
- ❑ Considers agency and user costs
- ❑ The common units of dollars allows disparate vulnerabilities to be compared against each other

TAMP Competing Investments



Risk mitigation generally competes with many other potential investments in an Transportation Asset Management framework



How much an agency can invest in risk mitigation is often a function of competing needs and available funds



Understanding what can be expected for a given investment level is key



Trade-off analysis scenarios can help guide TAM risk mitigation investment levels

Conclusion

- TAMP Risk Management provides a way to plan for predictable risk based events
- Not all agency risks belong in the TAMP
- Qualitative risk assessments methods can help agencies begin to evaluate risks on a common scale
- Multiple risks can be evaluated using a monetization approach
- Investments in Risk Mitigation is often judgment based on each agencies risk tolerance

Questions?

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A bimonthly webinar series, Wednesdays at 2:00 PM EST

Next Webinars in the Miniseries

TAM Maturity Levels from 2019 TAMP Reviews
Date TBD

More to follow!



For more information or to register:

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