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CLIMATE RESILIENCE AND OPERATIONS & MAINTENANCE

OVERVIEW

- Climate change and extreme weather events
- Impacts of climate change on transportation systems management and operations (TSMO) and maintenance
- Why address climate change?
- Getting started: an adaptation framework
- Resources

CLIMATE RESILIENCE
FHWA EFFORTS

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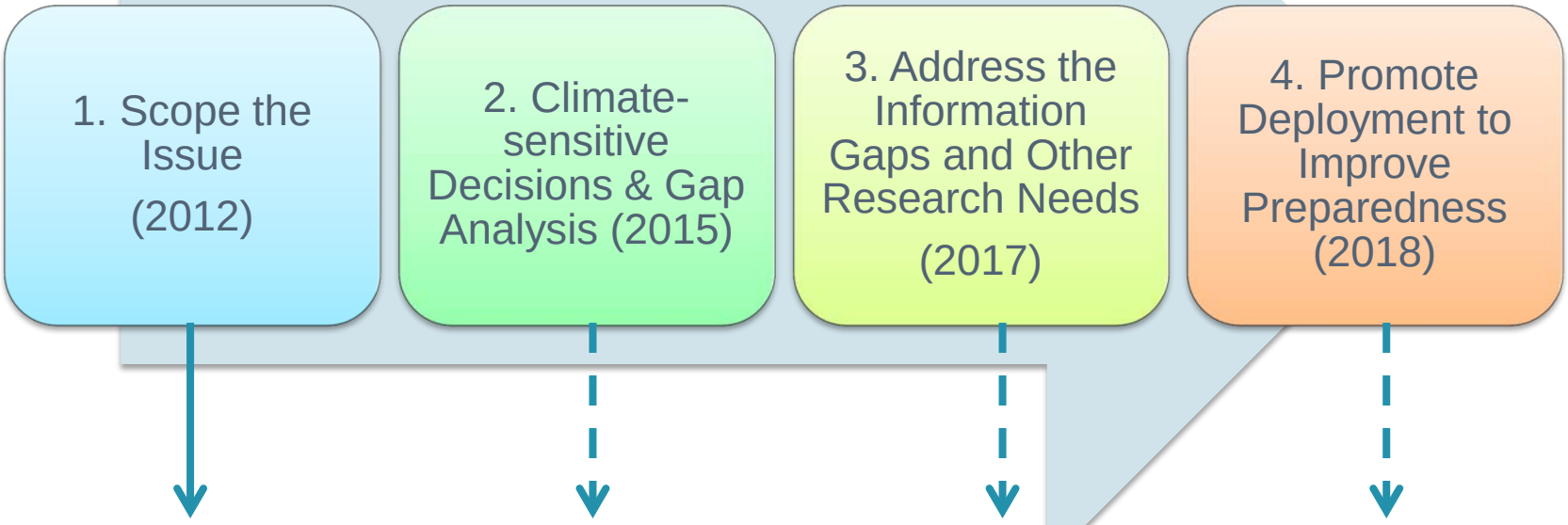
Goal: Develop resources and guidance materials for operating agencies to better prepare for the impacts of extreme weather on transportation management, operations and maintenance



Report: *Planning for System Management & Operations as Part of Climate Change Adaptation*

Report: Primer on Climate-Sensitive Decision-making for O&M; Information Gaps

Product: Current Practices
Reports: Research results to fill Information Gaps

Deployment Toolkit for Operating Agencies

CLIMATE CHANGE

KEY FINDINGS FROM SCOPING EFFORT

- Captured climate effects and began framing potential responses for:
  - System Maintenance
  - System Operations
  - Travelers and Traveler Behavior
  - Freight Transportation

Travelers and Traveler Behavior

- **Increased exposure to hazardous driving conditions (e.g., flooding, road conditions, smoke from wildfires) and human health impacts**
  - Increased need for timely, accurate, relevant and consistent traveler information from TMC's and private sector information service providers to support route & mode choice, departure times
  - Less consistent mode split impacting day-to-day congestion and safety issues
  - Potential mode shift to/from alternate modes, e.g., using transit, biking, or walking
  - Increased emphasis on carpooling and teleworking to reduce impacts to highways

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EFFECTS AND POTENTIAL RESPONSES:

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- **Increased frequency, duration and intensity of droughts; increased coastal and inland flooding**
  - Restricted access to ports and shipping channels for inland waterways
  - Mode shift – e.g., from inland waterways to highways due to changes in reliability
- **Increase in magnitude & duration of severe heat waves**
  - Mandatory freight diversion to more robust alternate routes
  - Dynamic or seasonal restrictions for trucks or rail during times of high heat, reducing either acceptable speed or weight
  - Policy and regulation changes to restrict truck size and weights

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A CHANGING CLIMATE

- DOTs are already observing and responding to the impacts of climate change
- Accelerating climate change means more frequent or more intense weather events (e.g., large storms, changes in winter precipitation, heat waves)
- These events will have critically important ramifications on the planning, design and engineering, management, operations, and maintenance of transportation facilities and services

Flooding in Phoenix in 2014. Source: http://jimbakkershow.com/news/record-rainfall-causes-phoenix-flooding/

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A CHANGING CLIMATE

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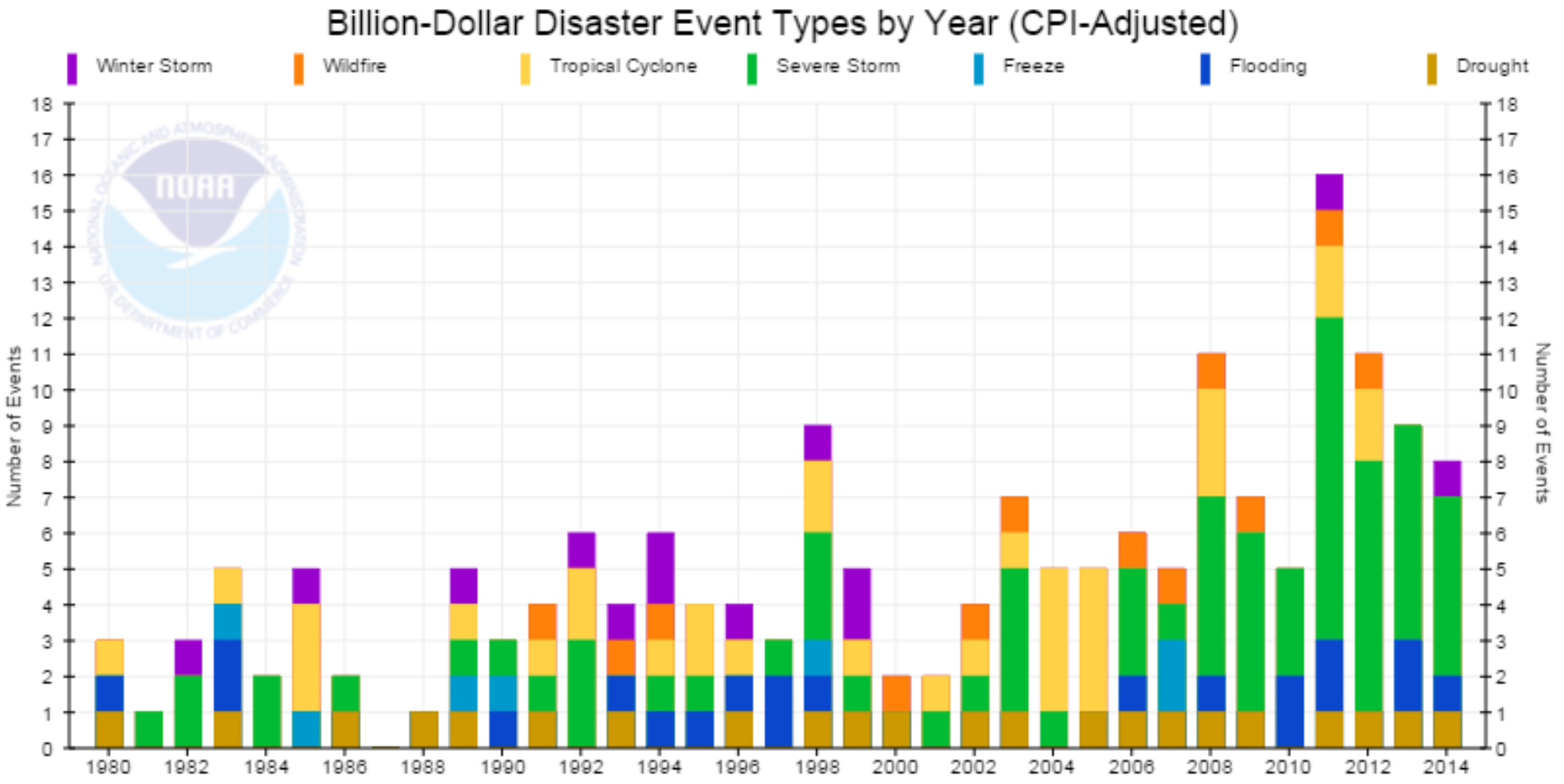
Extreme weather events are becoming more frequent and severe



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EXTREME EVENTS IN 2014

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Source: The Daily Record

Source: breakingnews.com

- Anne Arundel County in Maryland received over ten inches of rain on August 12, 2014, washing out roadways

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WEATHER, EXTREME WEATHER EVENTS, AND CLIMATE CHANGE

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Weather refers to the atmosphere state in a particular location at a particular time

Extreme weather events refer to **significant anomalies in temperature, precipitation and winds** (e.g., heavy precipitation and flooding, heatwaves, drought, wildfires and windstorms (including tornadoes and tropical storms)

Climate change refers to any significant change in the measures of climate lasting for an extended period of time

Climate change includes major variations in temperature, precipitation, or wind patterns, among other environmental conditions, that **occur over several decades or longer** (e.g., a rise in sea level, increase in the frequency and magnitude of extreme weather events now and in the future)

THE PAST IS NO LONGER A RELIABLE PREDICTOR OF THE FUTURE

Historical climate ≠ Future climate

- Because of climate change, historical climate is no longer a predictor of future climate
- Assumptions based on historical climate may need to be revisited
  - Expected timing of freeze/thaw, snow melt, vegetation growth
  - Rates of weather-related degradation
  - Weather conditions over asset lifetime
  - Optimal construction work times

CHANGES WILL BE NEEDED IN:

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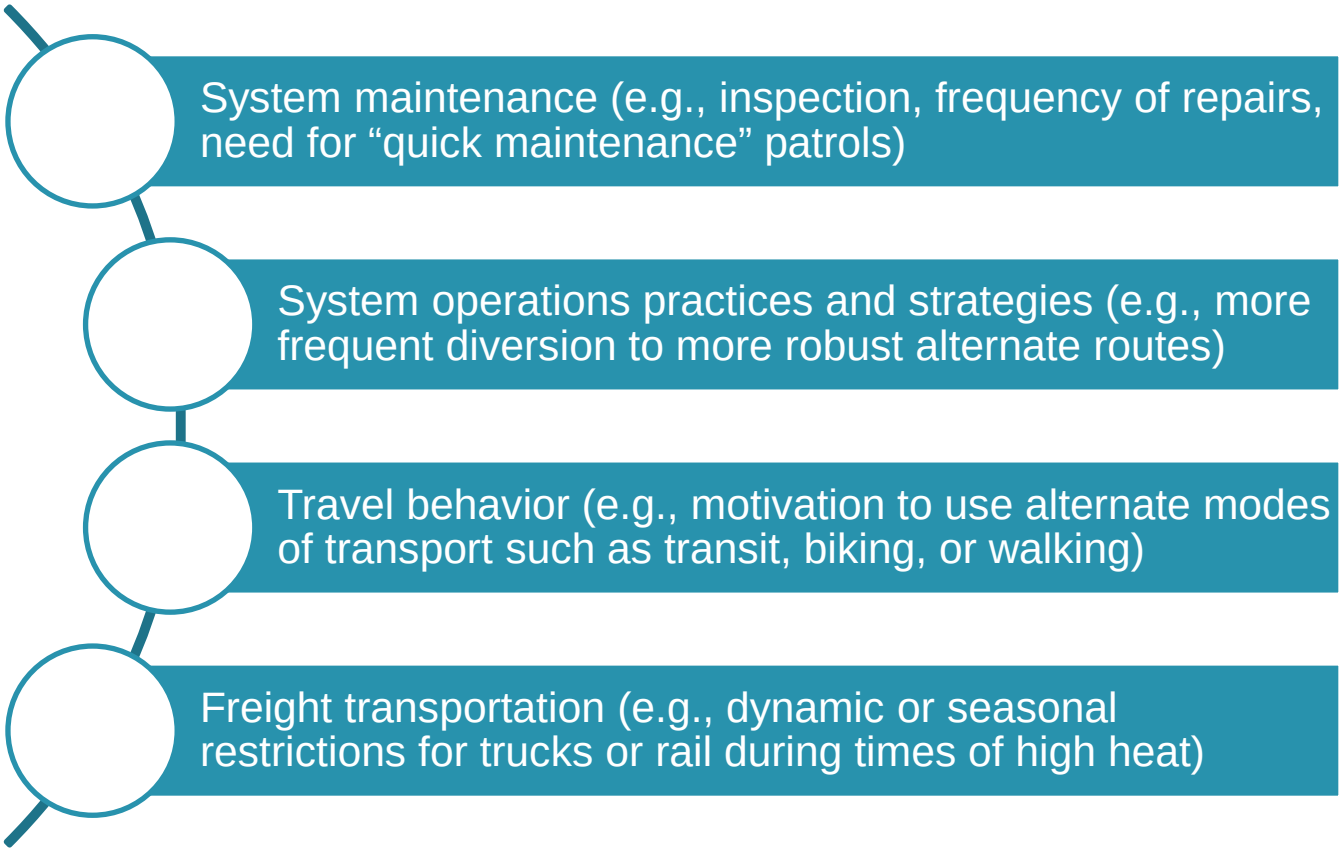

Source: FHWA, 2013, “Planning for Systems Management & Operations as part of Climate Change Adaptation,” available at: http://ops.fhwa.dot.gov/publications/fhwahop13030/index.htm#toc

CLIMATE CHANGE

CLIMATE CHANGE EFFECTS ON TSMO AND MAINTENANCE

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Climate changes could result in:

- Loss of roadway capacity
- Loss of alternative routes
- Loss of situational awareness (due to power/ communications outages)
- Inability to evacuate
- Loss of service life (due to faster deterioration)
- Increased safety risk
- Loss of economic productivity
- Reduced mobility

Landslide from heavy rain in August 2013.
Source: TN DOT

CLIMATE CHANGE

WHY ADDRESS CLIMATE CHANGE?

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- Climate change presents a business risk for transportation agencies
  - *Not addressing climate change could put transportation agencies at greater risk than changing practices now*
- TSMO is the public face of extreme weather response
- Even though many agencies that are successful operators and maintainers of facilities, they still need to revisit their approach and practices given these changes

STAFF MAY BE ASKING…

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- Over the last 20 years, we have gotten really good at managing winter storms. We will deal with whatever nature throws at us. **Do I need to plan for climate change?**
- My last few summers have resulted in a lot of delays in construction due to the heat. **Should I change how I bid out my projects?**
- Over the last 20 years, we've never had an ice storm, and I don't typically budget for ice removal equipment. We got one last year. **Should I invest?**
- My maintenance budgets are typically insufficient, and I end up going over each year. **How can I plan ahead and better use my limited resources?**
- We worked well together during Hurricane Sandy, but there were still a lot of challenges. **What will help us be better prepared?**

GETTING STARTED: AN ADAPTATION FRAMEWORK

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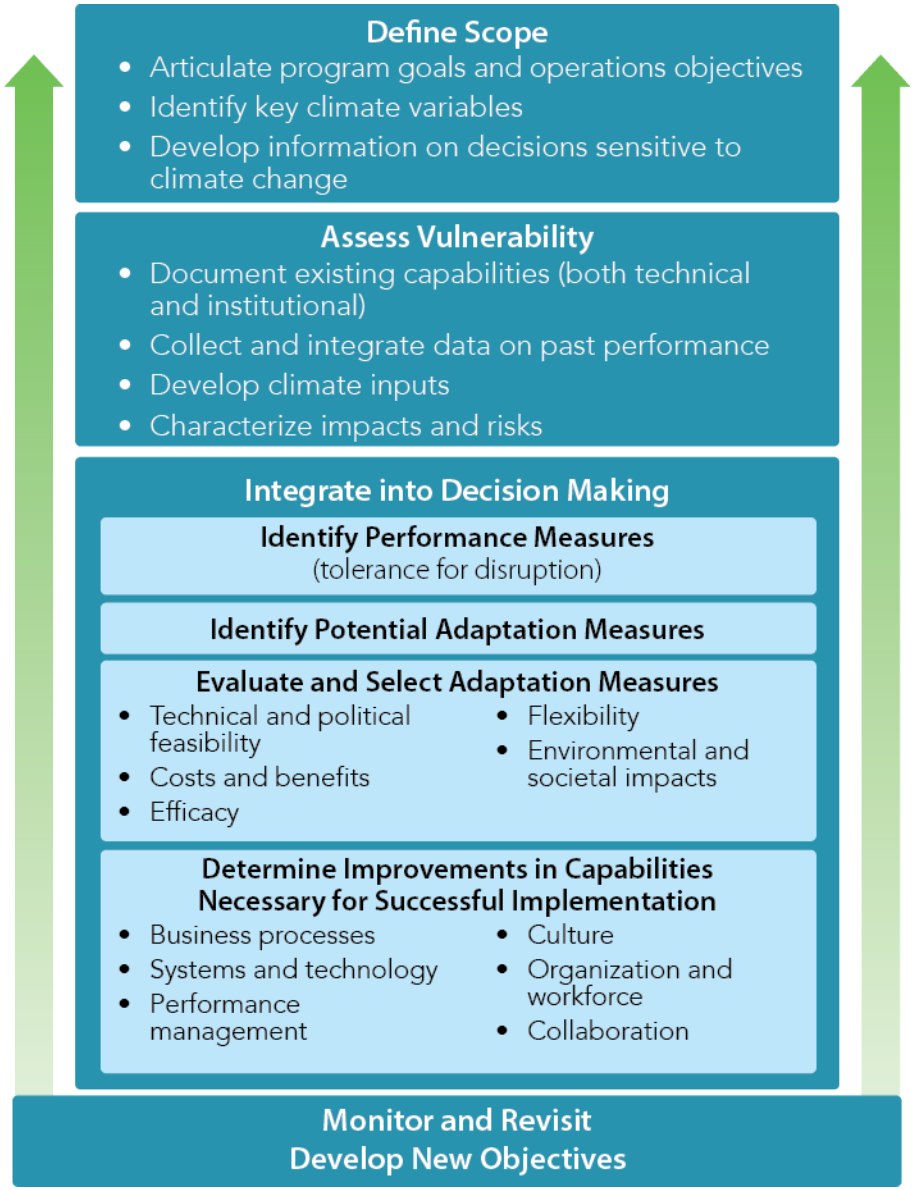

CLIMATE CHANGE

DEFINE SCOPE

Articulate Program Goals and Operations Objectives

- Define what must be achieved to ensure resilient operations
  - Include expected level of performance during adverse weather
- Determine outcome-based operations objectives

Identify Key Climate Stressors

- Which climate change stressors or extreme weather events are projected to occur locally?
- Which climate change stressors or extreme weather events could affect TSMO and maintenance programs?

Develop Information on Decisions Sensitive to Climate Change

Decisions are climate-sensitive if their continued effectiveness could be compromised by projected changes in climatic conditions (e.g., changes in temperature, precipitation, weather patterns, and the frequency and intensity of extreme weather events)

Climate-Sensitive Decision Areas	Specific Decisions	Description
1. Plan for future workforce needs.	Determine the right level of workforce requirements and capabilities.	Operating agencies make a variety of workforce related decisions, including the number of staff required, their locations, and capabilities necessary to monitor, control, report and maintain the roadway system.
2. Plan for Operations and Maintenance investments.	Determine criteria to prioritize operational resource investments (including capital improvements).	Resource investments may include new capital improvements for operations and maintenance. They may also include investments for annual maintenance.

ASSESS VULNERABILITY

Document Existing Capabilities (both technical and institutional)

- Document current capabilities across the six areas of the Capability Maturity Framework (CMF):

Business processes	**Systems and technology**	**Performance management**
Culture	**Organization and workforce**	**Collaboration**

INTEGRATE INTO DECISION MAKING

Identify Performance Measures

- Integrate climate change adaptation and resiliency into existing performance measures
- Adopt as stand-alone measures
- Consider whether existing measures will be achievable with a changing climate

Source: MnDOT

INTEGRATE INTO DECISION MAKING

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Vulnerability	Response	Implementing Department
Increased frequency of extreme events may require additional personnel to monitor, control, report, and respond to events Changes in long-term climate trends may also change seasonal work requirements	**Short-term**: Train staff on climate change and how this may affect their roles and responsibilities **Medium-term**: Increase availability of contract staff to assist during extreme events **Long-term**: Hire additional staff to keep pace with increasing TSMO, maintenance, and emergency management needs	TSMO, Maintenance, Emergency Managers

RESOURCES

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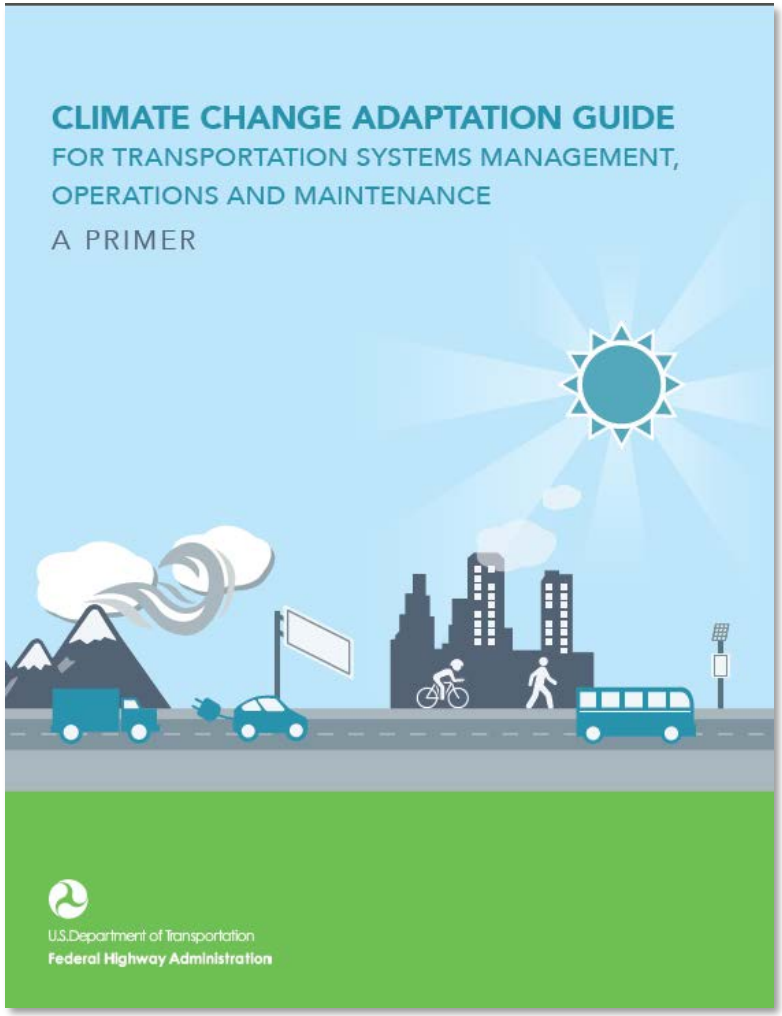
- Guide developed to lead State/local DOTs and MPOs in adopting climate change adaptation strategies at the institutional, technical, and financial levels for their TSMO and maintenance programs.
- Available at: http://www.ops.fhwa.dot.gov/publications/fhwahop15026/index.htm



WHAT'S IN THE GUIDE?

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- How to obtain buy-in
- Risk assessment checklists and guidance
- Climate change focused performance measures
- How to track progress over time
- Existing benefit-cost assessment tools
- Matrix of climate sensitive decisions
- Sample handout for workshop on climate risk
- Gap assessment for climate ready TSMO and maintenance
- Glossary of terms

Figure 2. Diagram. Overlapping Responsibilities of Different Transportation Agency Offices.

A. Who Should Use this Guide?

This guide is meant for practitioners involved in the day to day management, operations, and maintenance of surface transportation systems at State and local agencies. Climate change will affect different offices and their varying responsibilities in different ways. As shown below in Figure 1, some responsibilities among this staff are also overlapping and will require coordination. For example, DOT emergency management staff and TSMO staff need to coordinate during an emergency to provide accurate and up-to-date traveler information. In some DOTs, staff may serve both a TSMO and maintenance function. All staff might have a role in major emergencies. In a majority of functional areas, TSMO and maintenance depends on the collaboration between multiple agencies.

Unless otherwise specified, the content in the guide is applicable to all:

- State and local DOT TSMO and maintenance managers.
- State and local DOT planning staff.
- Metropolitan planning organization (MPO) staff.
- State and local DOT emergency management staff.

B. How Will this Guide Help Agencies Adapt?

The guide provides the rationale and specific guidance for integrating the capability for climate change adaptation and extreme weather response into TSMO and maintenance programs. It also articulates why doing so will lead to greater sustainability.

OPERATIONS GUIDE BOOK | 3

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FOR MORE INFORMATION

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