Infrastructure Adaptation Workshop Webinar: Adapting Infrastructure to Extreme Events

AASHTO Sustainable Transportation: Energy, Infrastructure and Climate Solutions Technical Assistance Program

June 27, 2012

We will start in a few minutes. Thank you for joining us.

Logistics and Agenda

Workshop Background

- AASHTO hosted a 3-hour workshop on May 20th, titled, *"Adapting Infrastructure to Extreme Weather Events: Best Practices and Key Challenges"*
- **Purpose:** Exchange information on past experiences and future plans for managing impacts of extreme weather events on transportation infrastructure
  - Leverage related experiences from abroad with members of the International Transport Forum
- **Audience:** State DOTs, particularly State Engineers
- **White Paper:** Provided background for workshop http://climatechange.transportation.org/pdf/adapt_background5-20-12.pdf

AASHTO The Voice of Transportation

AASHTO Committee on Environmental Stewardship

U.S. Department of Transportation Federal Highway Administration

Agenda

1:00 PM	**Welcome and Logistics** • Logistics, Anne Choate and Emily Rowan • Welcome, Rick Land
1:10 PM	**State Case Studies** • Carol Lee Roalkvam, Washington State DOT • Rick Land, Caltrans • Bob Younie and Bonnie Castillo, Iowa DOT
1:45 PM	**Summary of Infrastructure Adaptation Workshop (Anne Choate, ICF International)** • Summary of challenges and barriers identified • Recommendations for AASHTO • Other lessons learned
2:00 PM	**Question and Answer Session**
2:20 PM	**Thank You and Next Steps for AASHTO (Jen Brickett)**

GoTo Webinar Software Logistics

- You will be muted throughout this webcast to minimize background noise. Please submit your questions and comments in writing.

- Materials from this webinar and the workshop will be available on AASHTO's Center for Environmental Excellence and Transportation and Climate Change Resource Center

- Throughout the webcast, if you have technical difficulties, please contact Emily Rowan from ICF at: Emily.Rowan@icfi.com

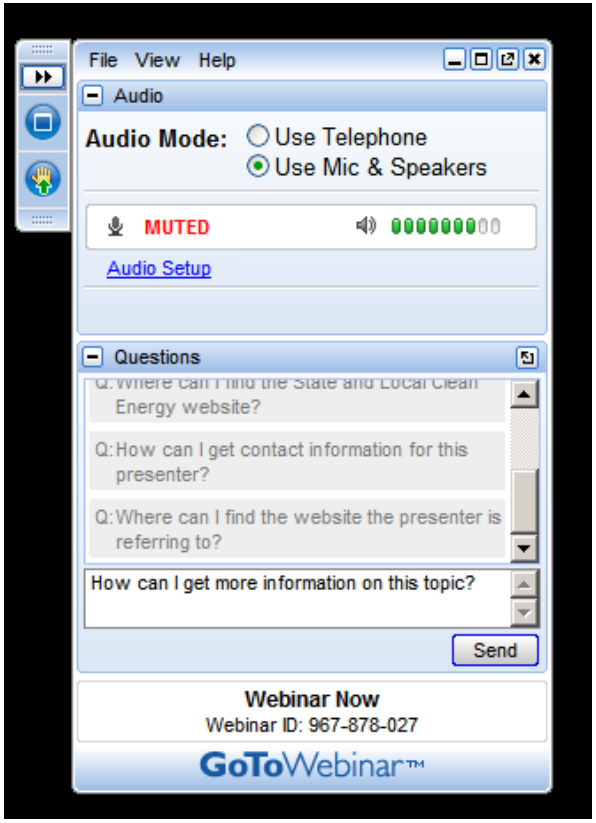
AASHTO The Voice of Transportation

AASHTO Center for Environmental Excellence

U.S. Department of Transportation Federal Highway Administration

Questions

- If you have a question, submit through the question pane.
- Please include the name of the presenter you would like to answer your question.
- We will compile these questions and ask them during the Q&A session.



Welcome

Rick Land

CalTrans

State Case Studies

- Carol Lee Roalkvam, Washington State DOT
- Rick Land, Caltrans
- Bob Younie and Bonnie Castillo, Iowa DOT

Washington State DOT's Vulnerability Assessment: *Asking the "Climate Question"*

Paula Hammond, P.E.
Secretary of Transportation

Presentation by:
Carol Lee Roalkvam
Environmental Policy
Branch Manager

Dave Dye
Deputy Secretary

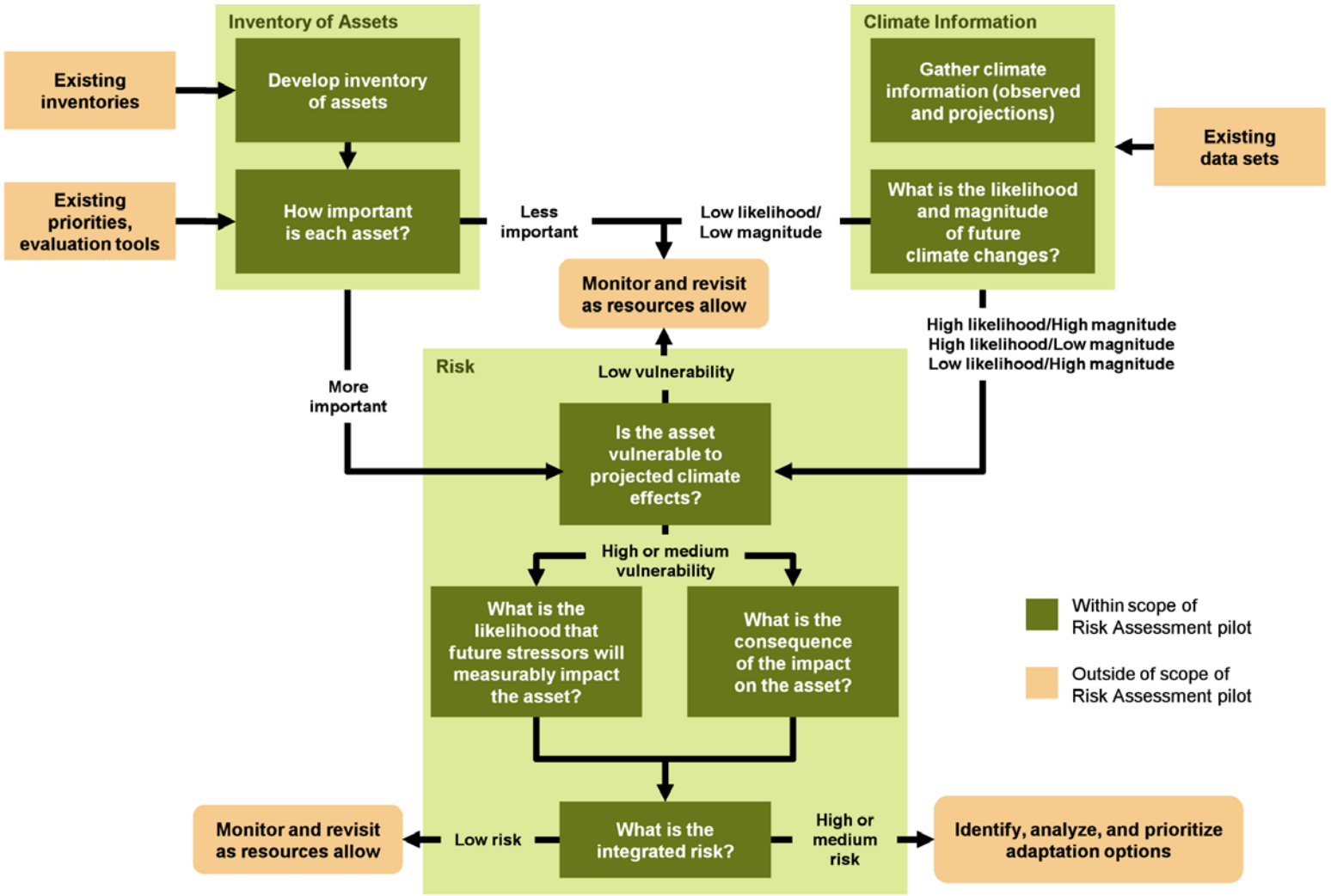
AASHTO Infrastructure Adaptation Workshop Webinar:
Adapting Infrastructure to Extreme Weather Events
Jun 27, 2012 at 1:00 PM EDT.

Washington State Department of Transportation

Washington Climate Change Impacts Assessment

- Funded by the Washington State Legislature
- Published in 2009
- Comprehensive report on climate change impacts in Washington
- Downscaled from global climate models
- Detailed data and technical support available

FHWA risk assessment model



Goal: Preserve assets in a changing environment

- **Apply an asset management approach**
  - Be ready for severe weather events *and* long-term changes in site conditions
  - Inform long-term decisions
  - Build resilience where possible
- **Conduct a statewide vulnerability assessment**
  - Test-drive the FHWA model
  - Understand and communicate current science
  - Scope: Consider impacts on our all WSDOT assets

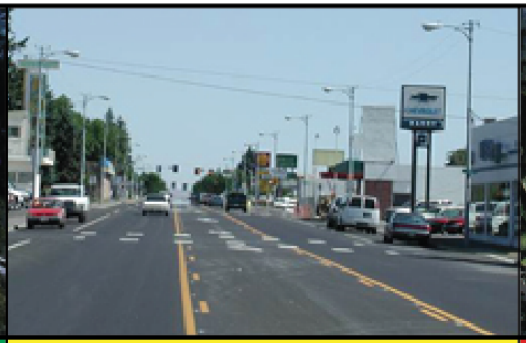
    Highways, Ferries, State-owned Rail and Airports

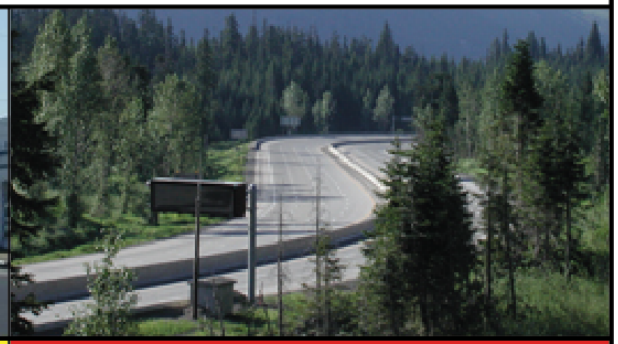

Step 1 – How critical is the asset?

WSDOT Methodology

Very low to low			Moderate			Critical to Very Critical			
1	2	3	4	5	6	7	8	9	10
Criticality of asset									

Notice that along with the qualitative terms there is an associated scale of 1 to 10, this is to serve as a facilitation tool for some people who may find it useful to think in terms of a numerical scale - although the scoring by each individual is of course subjective. The scale is a generic scale of criticality where "1" is very low (least critical) and "10" is very critical.





Typically involves:	Typically involves:	Typically involves:
non-NHS low AADT alternate routes available	some-NHS non-NHS low to medium AADT serves as an alternative for other state routes	Interstate Lifeline some NHS sole access no alternate routes

Step 2: What are the Climate Threats?

- Began with climate change forecast from UW Climate Impacts Group
- Talked about observed changes and extreme events – what is happening now
- WSDOT"s internal experts ranked all WSDOT assets
- Key Questions:
  - "What keeps you up at night?"
  - "What if it gets worse (given the scenario)?"
  - "How resilient is our existing system?

We used our experience to gauge future impacts

Scour and damage to structures - Just off US 12 Davis Creek

Oct. 4, 2009: Dust storm closes I-90 between Moses Lake and Ritzville

Workshops: How might climate impact assets?

Primary climate drivers		*Can lead to impacts on...*
Temperature	→	Expansion joints, pavement, rail tracks, construction periods, habitat projects, electrical equipment
Precipitation	→	Flooding of surface roads & tunnels, road washout, pump capacity, drainage
Hydrologic shifts	→	Soil instability, water supply, bridge and road support structures
Sea level rise, storm surge	→	Coastal erosion, coastal and upriver flooding, bridge footings, drainage, roadside stability, salt / corrosion

Record impact score

10 9 8 7 6 5 4 3 2 1

Complete catastrophic failure

Results in total loss or ruin of asset. Asset *may* be available for *limited* use after at least 60 days and would require major repair or rebuild over extended period of time. "Complete and/or catastrophic failure" typically involves:

- Immediate road closure;
- Disruptions to travel;
- Vehicles forced to re-route to other roads;
- Reduced commerce in affected areas;
- Reduces or eliminate.es access to some destinations;
- May sever some utilities located within right-of-way;
- May damage drainage conveyance or storage systems.

Temporary operational failure

Results in minor damage and/or disruption to asset. Asset would be available with either full or limited use within 60 days and may have immediate limited use still available.

"Temporary Operational Failure" typically involves:

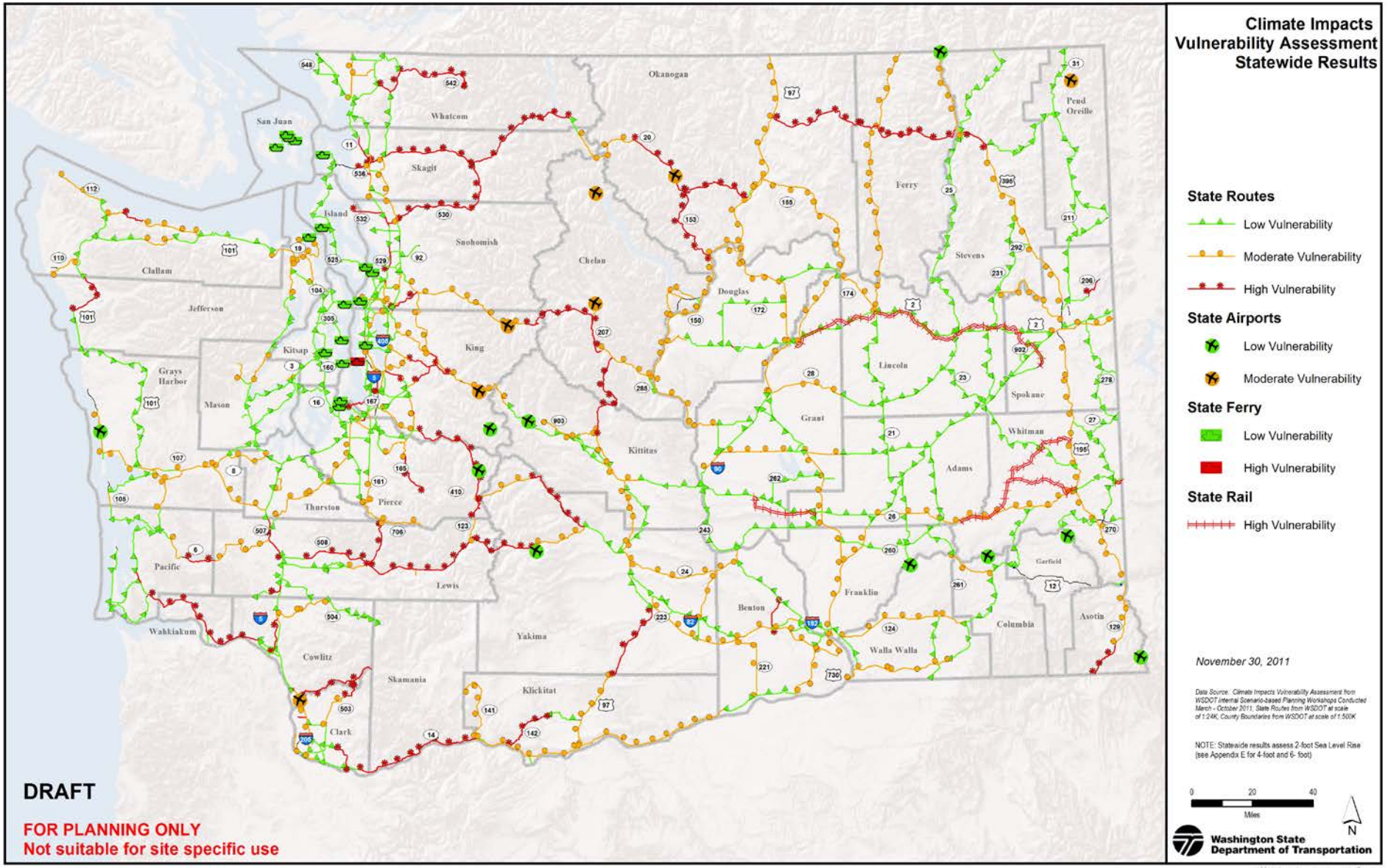
- Temporary road closure, hours to weeks;
- Reduced access to destinations served by the asset;
- Stranded vehicles;
- Possible temporary utility failures.

Reduced capacity

Results in little or negligible impact to asset. Asset would be available with full use within 10 days and has immediate limited use still available. "Reduced capacity" typically involves:

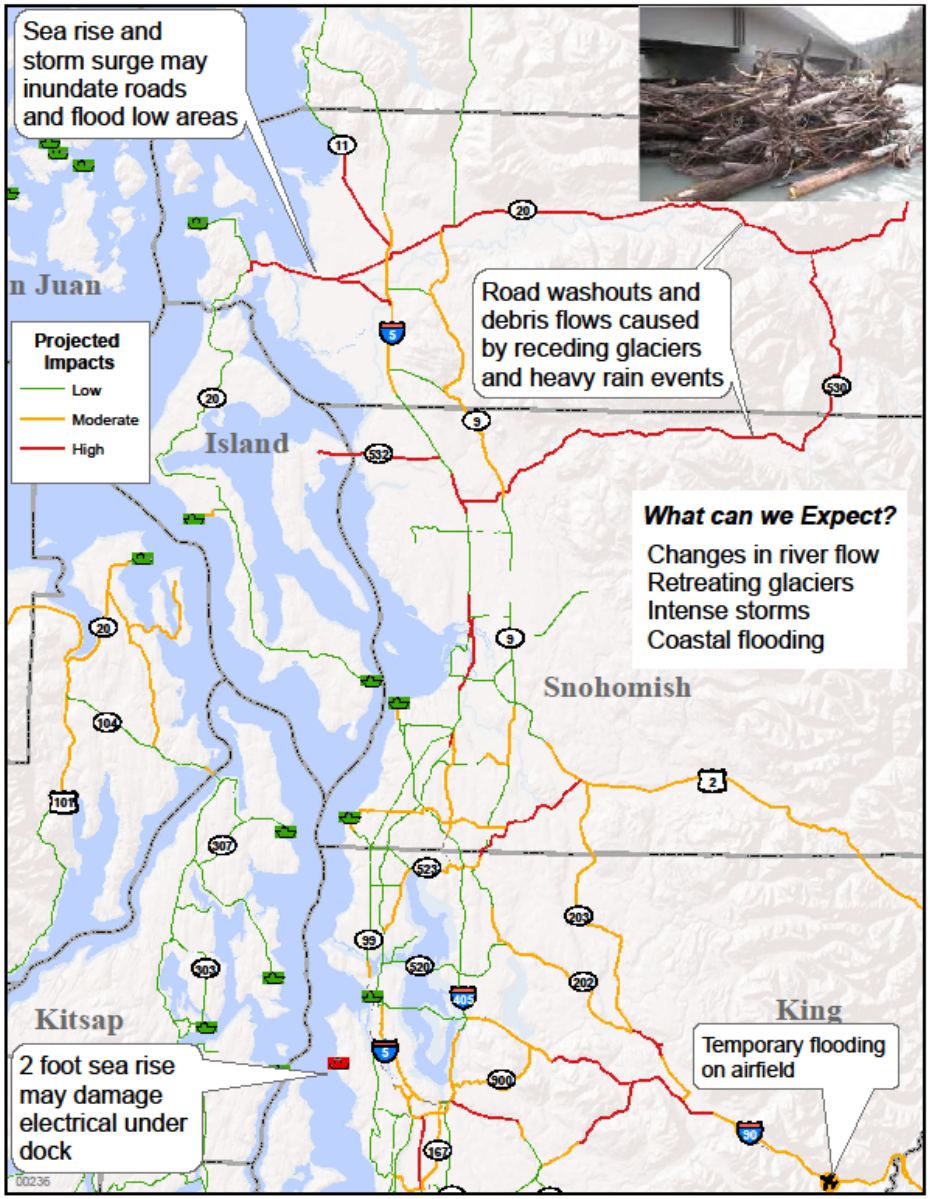
- Less convenient travel;
- Occasional/ brief lane closures, but roads remain open;
- A few vehicles may move to alternate routes;

Figure 2.1 Photo depictions of qualitatively assessed climate change consequences

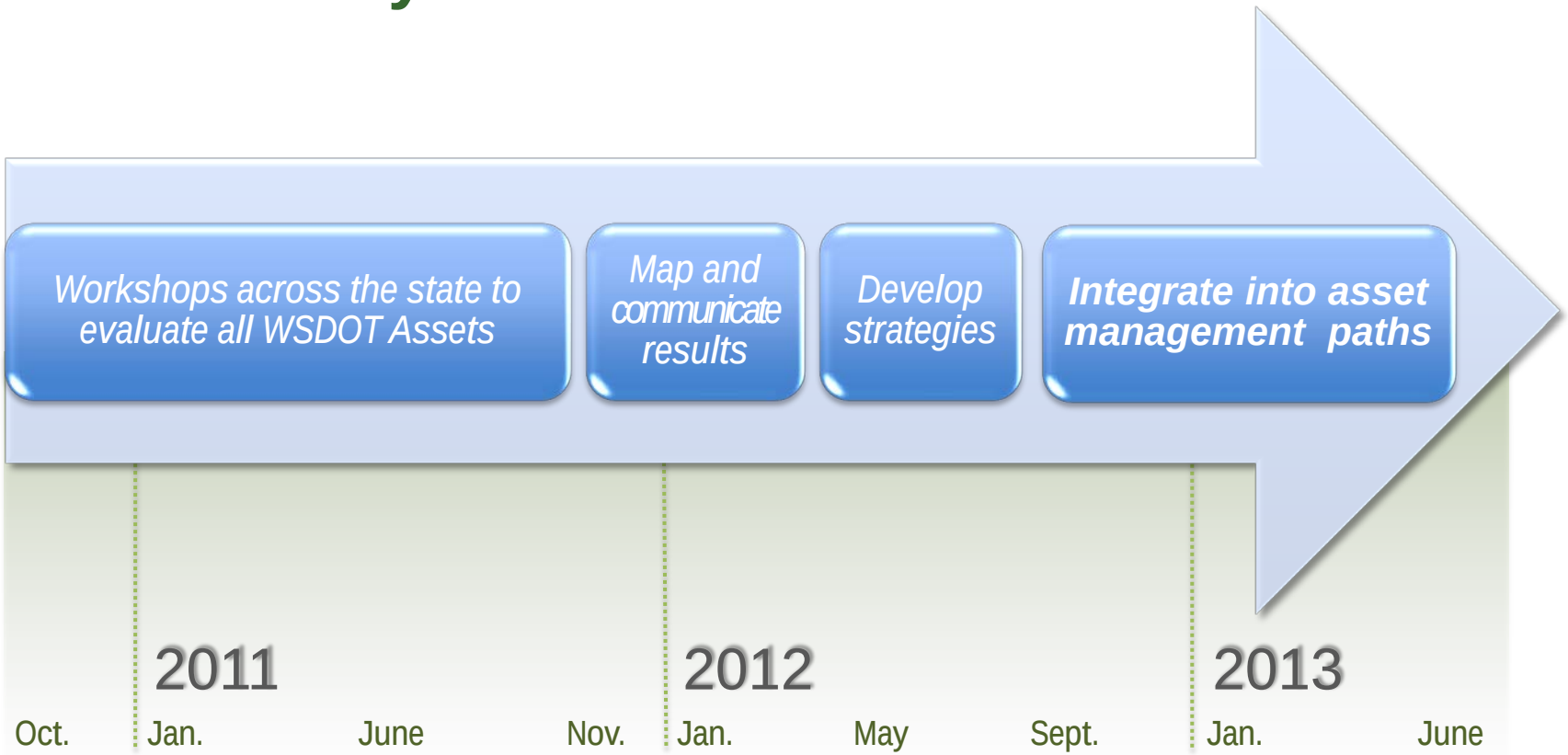

Climate Impacts
Vulnerability Assessment
Statewide Results
State Routes
Low Vulnerability
Moderate Vulnerability
High Vulnerability
State Airports
Low Vulnerability
Moderate Vulnerability
State Ferry
Low Vulnerability
High Vulnerability
State Rail
High Vulnerability
November 30, 2011
Data Source: Climate Impacts Vulnerability Assessment from WSDOT internal Scenario-based Planning Workshops Conducted March - October 2011; State Routes from WSDOT at scale of 1:24K; County Boundaries from WSDOT at scale of 1:500K
NOTE: Statewide results assess 2-foot Sea Level Rise (see Appendix E for 4-foot and 6- foot)
0
20
40
Miles
N
Washington State Department of Transportation
DRAFT
FOR PLANNING ONLY
Not suitable for site specific use
San Juan
Whatcom
Skagit
Island
Snohomish
Okanogan
Chelan
Douglas
Ferry
Pend Oreille
Stevens
Clallam
Jefferson
Kitsap
King
Grays Harbor
Mason
Thurston
Pierce
Kittitas
Lincoln
Spokane
Grant
Whitman
Adams
Pacific
Lewis
Wahkiakum
Cowlitz
Skamania
Clark
Yakima
Klickitat
Benton
Franklin
Walla Walla
Columbia
Asotin
Garfield

What did we find?

- Intensifies known threats
- Reinforces value of our current maintenance and retrofit programs
- Some surprises
- Unique way to capture knowledge of field staff



WSDOT's study of climate impacts vulnerability



Where are we today and what are we saying?

Report to FHWA is on-line

NEPA/SEPA Document Project-level guidance updated

Finishing the GIS-data layer

Sharing results internally & externally

Key talking points we are using:

- Not looking at new programs to address climate change
- Use this info like we use other environmental site condition information
- Link with our emergency preparedness/storm-readiness
- We don't want to be caught off guard, but we don't want to OVER-design either." – *Rick Keniston (5/1/12 Columbian)*
- 50 years from now, we want people to say: "I'm so glad they thought about this!"

We want to illustrate current practices that are effective adaptation strategies

From disaster to resiliency

Drilled shaft bridges like this one on I-90 near Gold Creek make those structures more resistant to high-velocity flooding.

Washington State Department of Transportation

March 2012



Adapting to a changing climate

Statewide study of climate-related infrastructure risks

Our climate is changing. Demand for transportation resources continues to grow. Keeping state-owned and managed infrastructure safe and operational is key to a growing economy and building a more resilient and sustainable transportation system.

Protecting infrastructure, freight routes and keeping drivers safe for the long-haul

Our economy and quality of life can take serious hits when inclement weather floods interstates, closes critical bridges and brings relentless snow to our mountain passes. The past has shown how storms can wreak havoc on our daily lives and prevent goods and services getting to customers.

WSDOT's job is to keep the state's transportation system safe and operational. This means planning and preparing to protect and manage our vital roads, bridges, ferry terminals and other facilities that could be vulnerable to severe weather. We must be resilient and adapt to future environmental conditions. Thanks to a $189,500 Federal Highway Administration (FHWA) national pilot project grant, WSDOT was able to complete the groundwork on assessing how our state-owned and operated transportation assets may fare under extreme weather changes.

WSDOT pilots infrastructure vulnerability assessment

We conducted workshops with our field staff from across the state to assess the vulnerability of our highways, ferry terminals and other infrastructure to changes in our climate and weather extremes. We presented the participants with climate scenarios such as extreme temperatures and sea-level rise, asking "What would be the likely impact on our facilities?" The results from each workshop were used to create a series of planning-level maps.

USDOT Climate Change Policy

In addition to the federal dollars from the FHWA pilot project, United States Department of Transportation (USDOT) policy supports climate adaptation efforts. In a June 2011 policy statement, U.S. Transportation Secretary Ray LaHood directed USDOT agencies (such as the federal highway and transit administrations) to consider climate change impacts on current systems and future investments.

The USDOT climate change policy statement further states that "planning for climate adaptation assists State and local transportation agencies, and DOT, to identify how climate change is likely to impact their ability to achieve their mission, continue operations, and to meet policy and program objectives."

www.dot.gov/docs/climatepolicystatement.pdf

http://www.wsdot.wa.gov/SustainableTransportation/adapting.htm

Caltrans Efforts to Adapt to a Changing Climate

Climate Change Branch
Division of Transportation Planning
Department of Transportation (Caltrans)

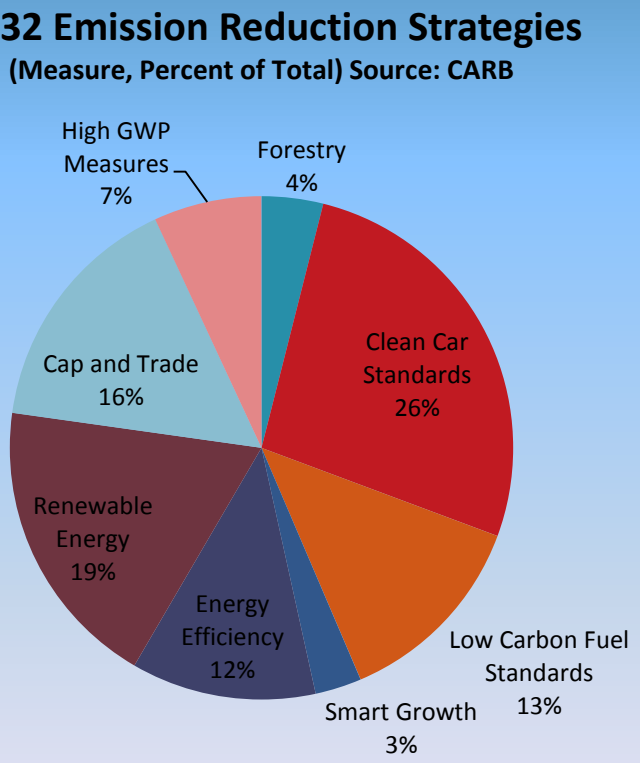
California's Diverse Landscape

- North to South, California extends nearly 800 miles
- Local climates are very diverse, from temperate rainforests in the North to arid deserts in the South
- Within 80 miles of one another lie the highest and lowest points in the lower 48 states – Mount Whitney at 14,495 ft. and Death Valley at 282 ft. below sea level

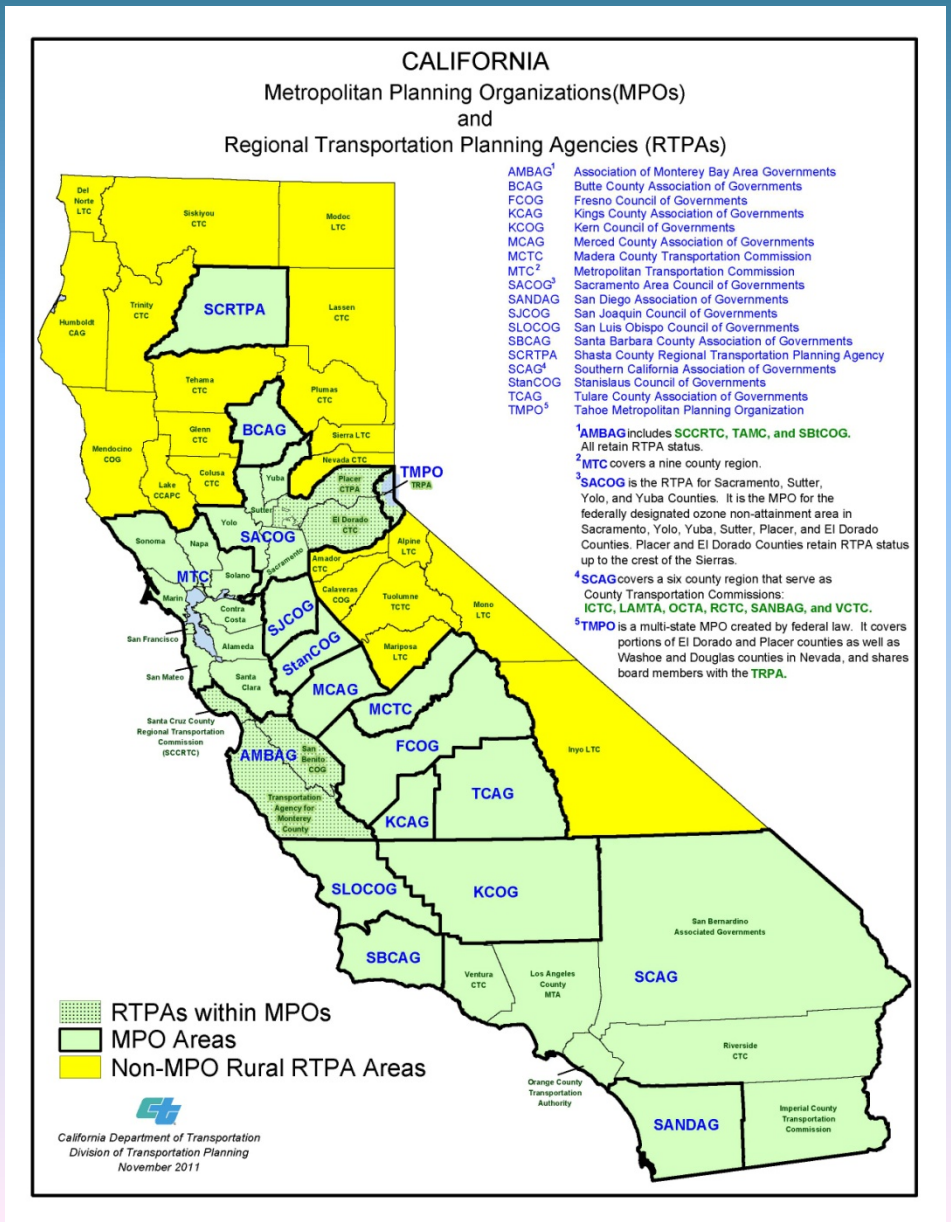
California Climate Change Legislation

- Assembly Bill 32 (AB32) – The Global Warming Solutions Act of 2006
  - Requires reductions of GHG emissions to 1990 levels by 2020

- Senate Bill 375 (SB375)
  - Enhances California's ability to reach our AB 32 goals by promoting good land use and transportation planning with the goal of more sustainable communities



California Regional Planning Partners

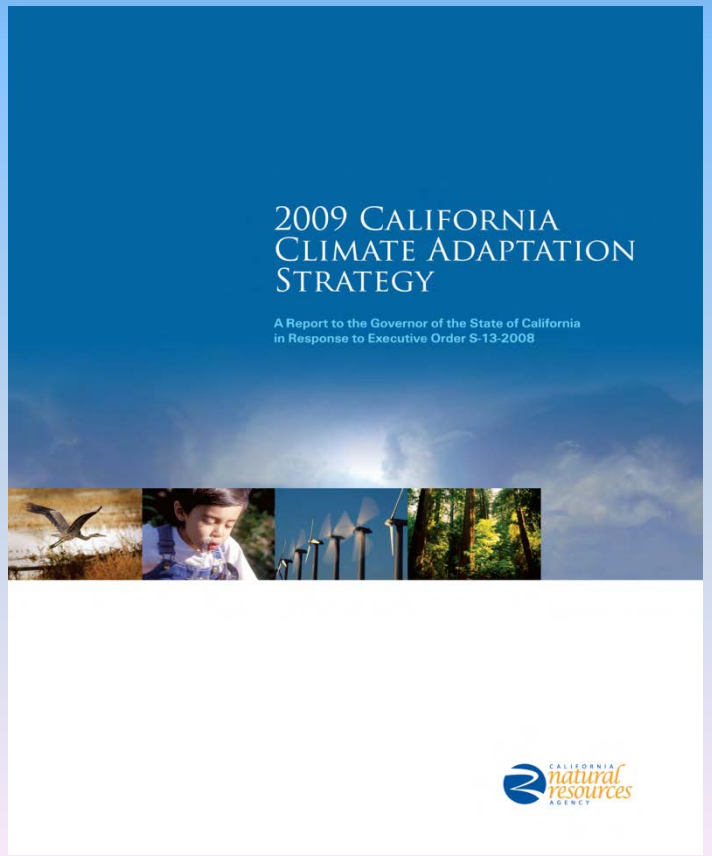


California's Executive Order to Address Sea Level Rise

- Executive Order S-13-08 (EO S-13-08) Identify and prepare for expected sea level rise impacts

  - Requires a sea level rise assessment be prepared by the National Academies of Sciences – currently underway, estimated completion date June 2012.

  - Also required the development of adaptation strategies document



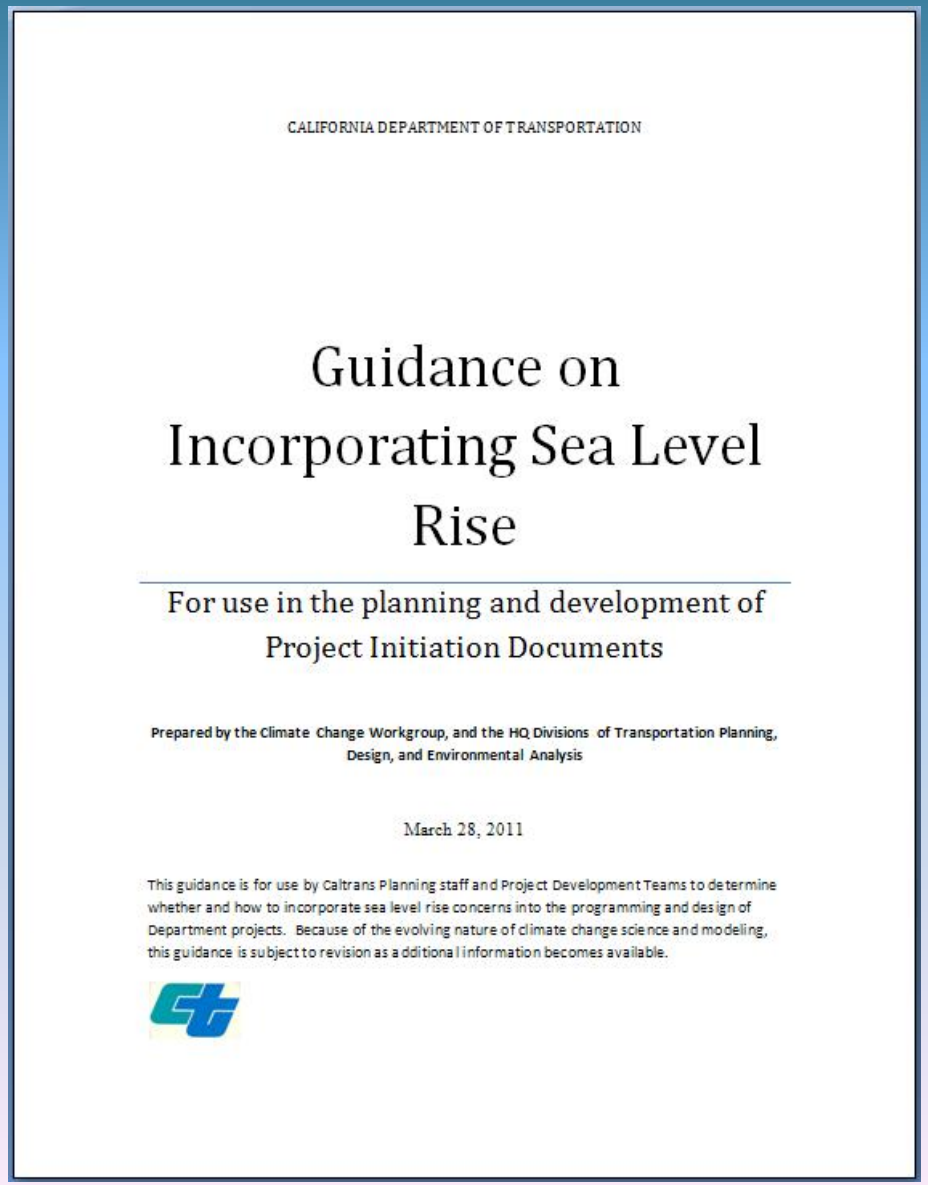
Sea Level Rise

California has coastal routes along the entire coast of the state

California state route 1 beach buildup

San Francisco Airport 1 meter SLR

Sea Level Rise Guidance



CALIFORNIA DEPARTMENT OF TRANSPORTATION

Guidance on Incorporating Sea Level Rise

For use in the planning and development of Project Initiation Documents

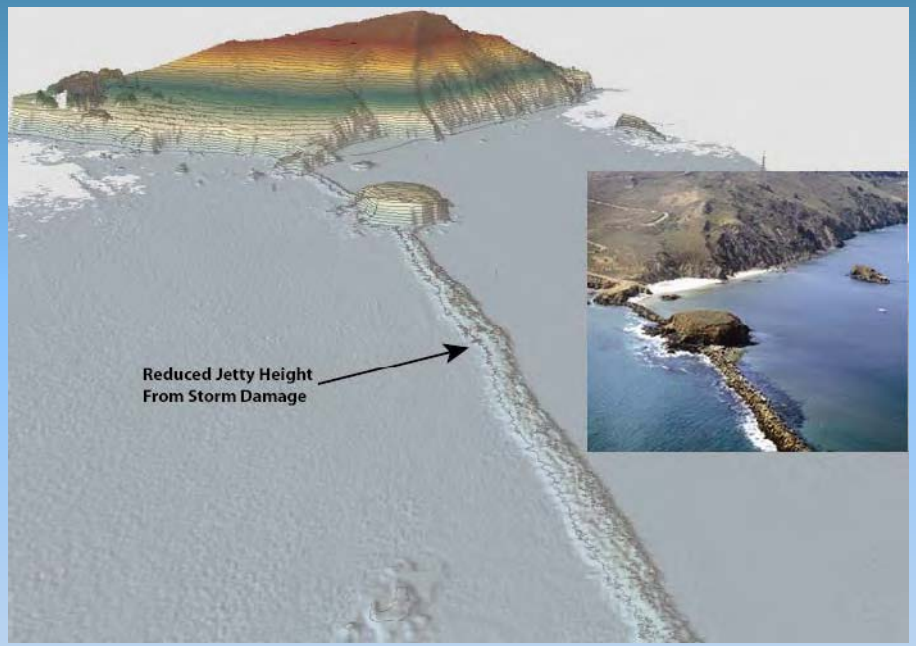
Prepared by the Climate Change Workgroup, and the HQ Divisions of Transportation Planning, Design, and Environmental Analysis

March 28, 2011

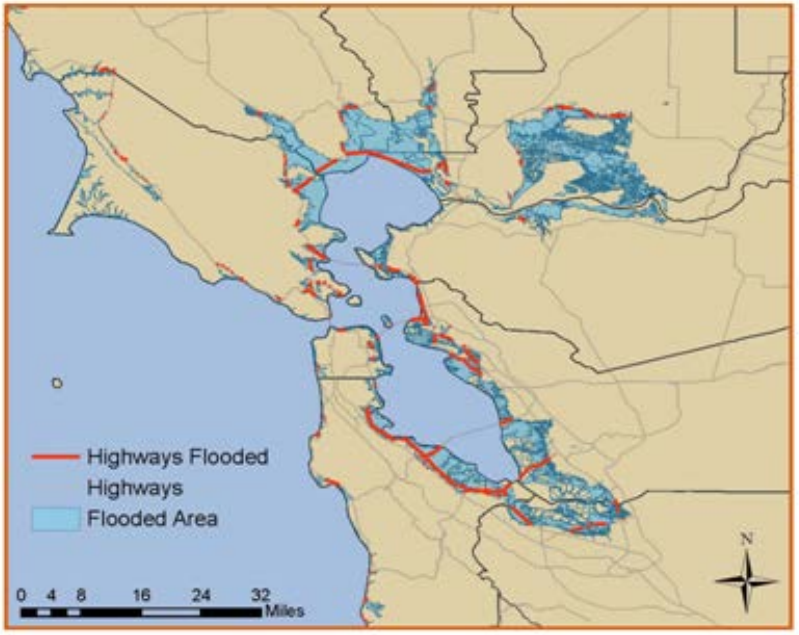
This guidance is for use by Caltrans Planning staff and Project Development Teams to determine whether and how to incorporate sea level rise concerns into the programming and design of Department projects. Because of the evolving nature of climate change science and modeling, this guidance is subject to revision as additional information becomes available.

Year		Average of Models	Range of Models
2030		7 in (18 cm)	5-8 in (13-21 cm)
2050		14 in (36 cm)	10-17 in (26-43 cm)
2070	Low	23 in (59 cm)	17-27 in (43-70 cm)
	Medium	24 in (62 cm)	18-29 in (46-74 cm)
	High	27 in (69 cm)	20-32 in (51-81 cm)
2100	Low	40 in (101 cm)	31-50 in (78-128 cm)
	Medium	47 in (121 cm)	37-60 in (95-152 cm)
	High	55 in (140 cm)	43-69 in (110-176 cm)

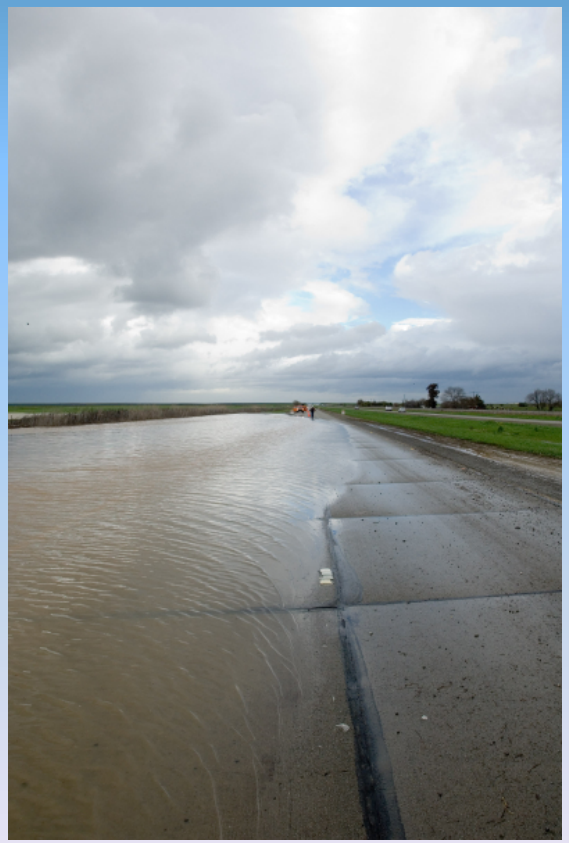
Climate Change Adaptation Hot Spot Map



Using high-resolution elevation data, we are mapping the coast of California, highlighting infrastructure vulnerable to sea level rise impacts



Changing Precipitation Patterns – Flooding and Landslides



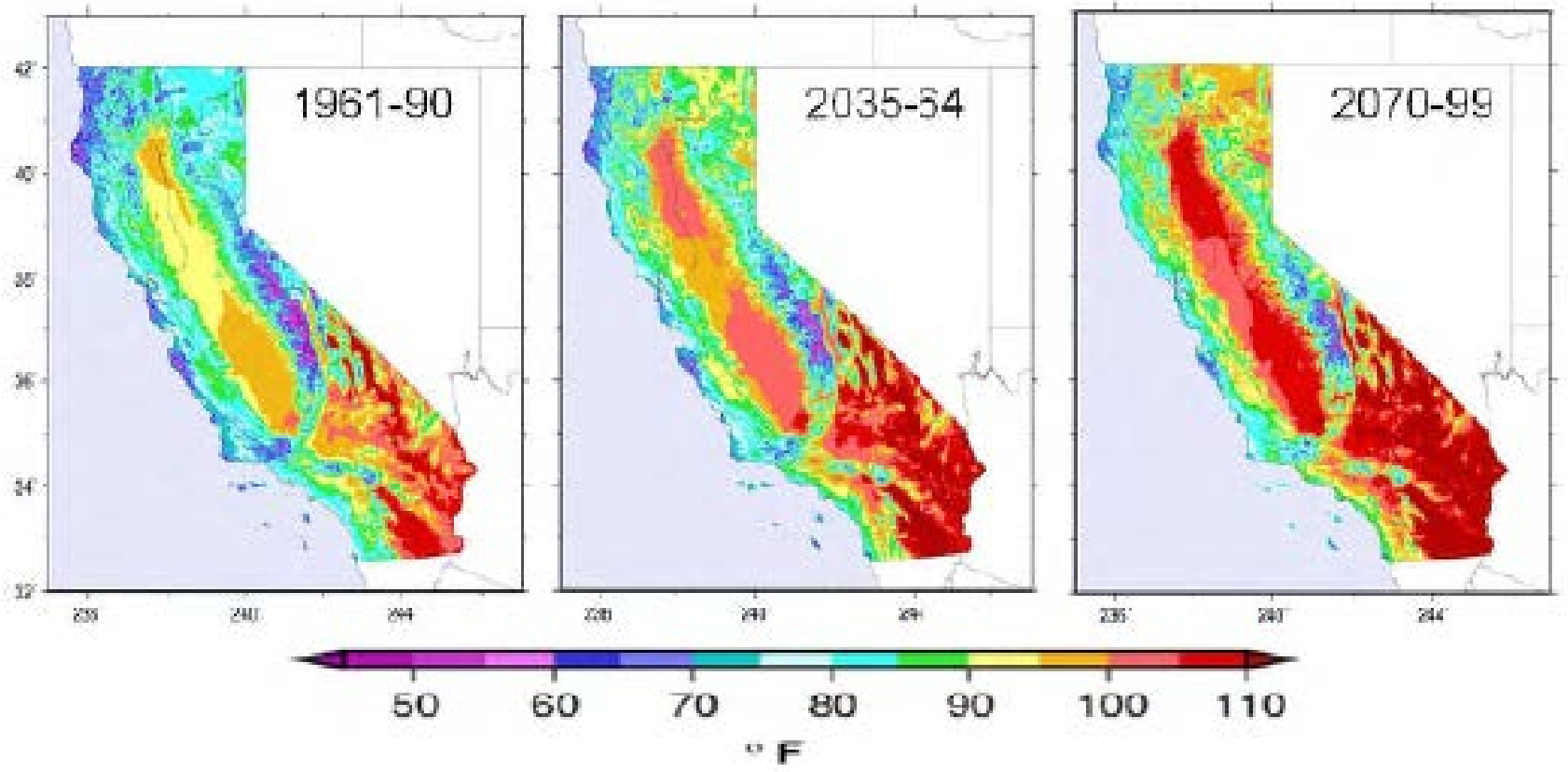
Interstate 505 flood

State Route 162

State Route 1

Projected Temperature Increases

Figure 1. California Historical & Projected July Temperature Increase 1961-2099



Source: Dan Cayan et al. 2009.

Addressing Climate Change Adaptation in Long Range Transportation Plans

Photo by D. Revell – 2/23/08

Caltrans activities and efforts to prepare for climate change

Caltrans Efforts to Adapt to a Changing Climate

Climate Change Branch
Division of Transportation Planning
Department of Transportation (Caltrans)

IOWA'S DISASTER RECOVERY PROGRAM

PRESENTED BY

Bob Younie

State Maintenance Engineer

Iowa Department of Transportation

Bonnie Castillo

Disaster Operations Manager

Iowa Department of Transportation

Definitions

- **FHWA Emergency Relief (ER) Program**: Main federal program to help states, counties and cities receive damage repair compensation for the federal-aid road system.

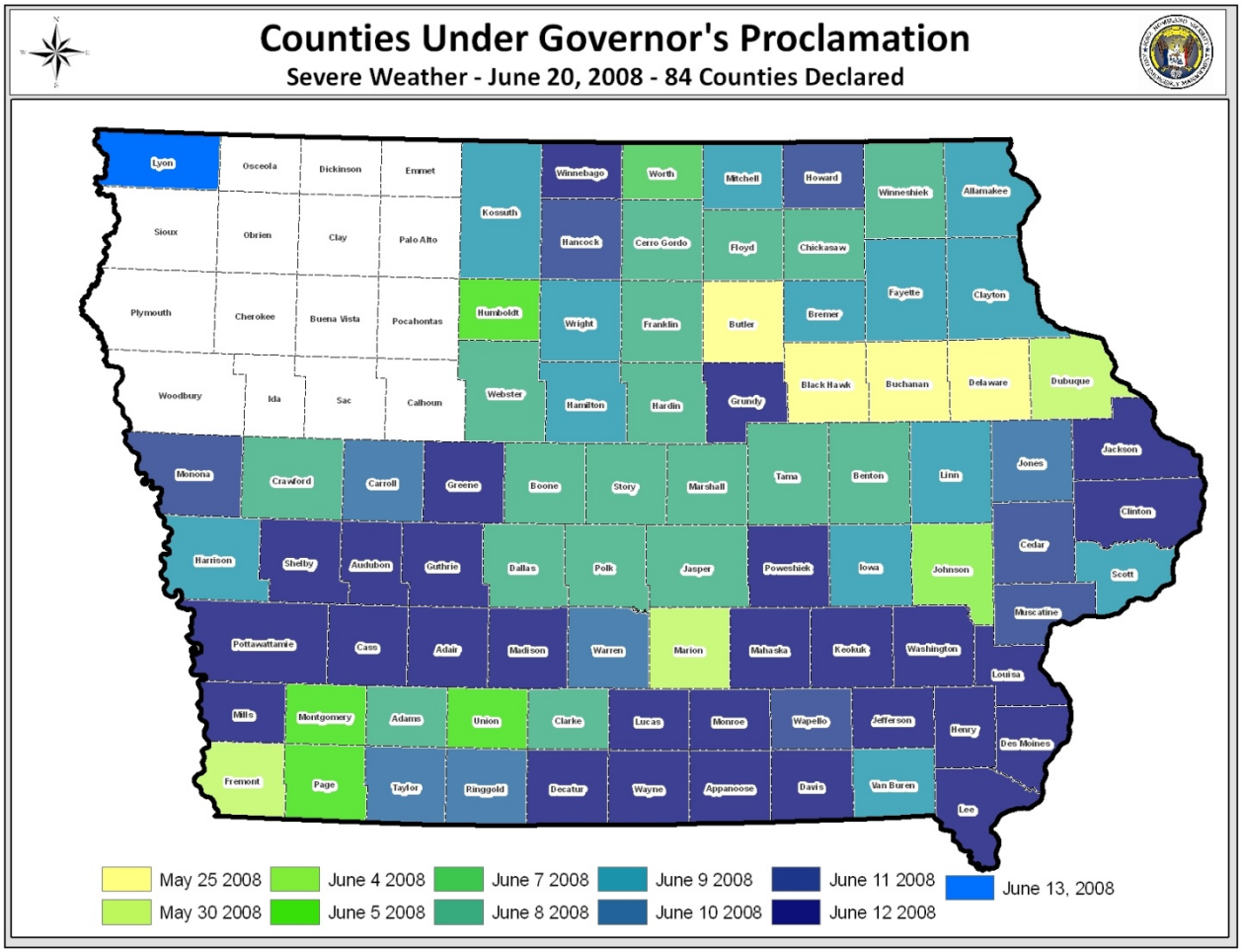
- **Detailed Damage Inspection Report (DDIR)**: ER program document used to convey damage location and amount.

- **Resource Management System (RMS):** Iowa DOT in-house developed program to collect labor, equipment and materials costs for field based employees.

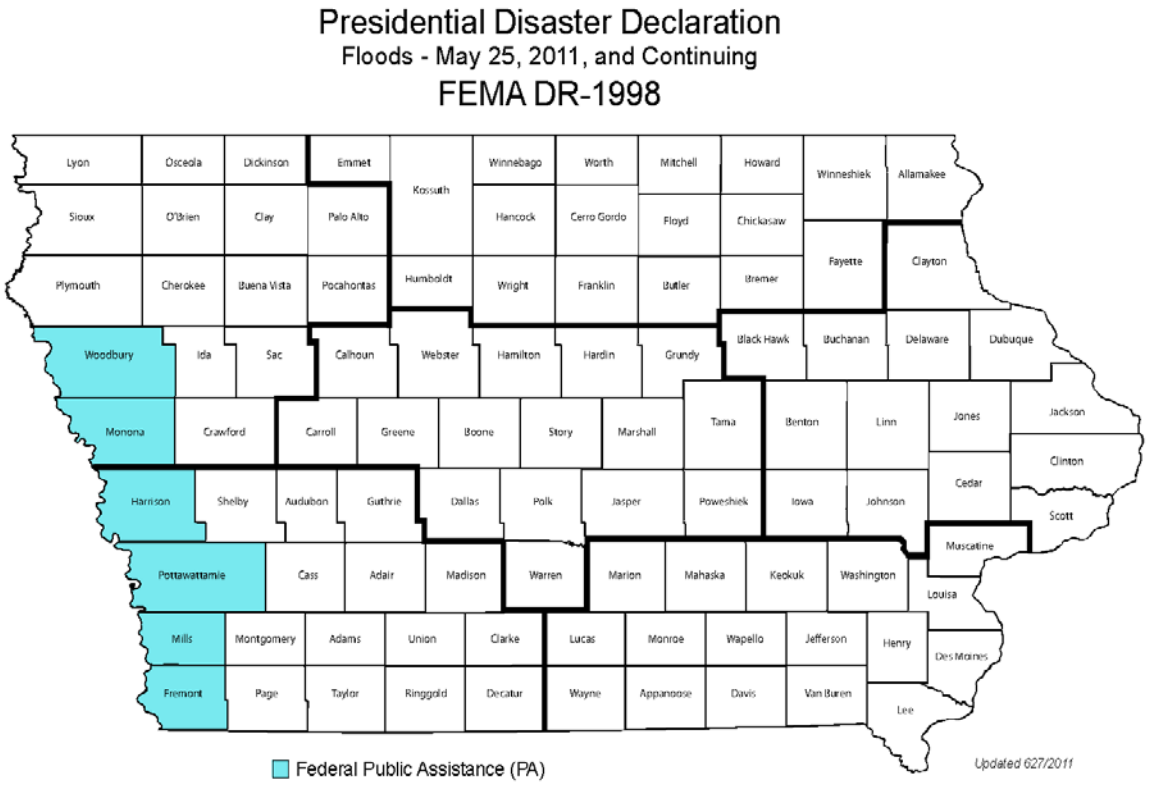
Iowa Infrastructure

- Iowa DOT
  - 9000 Miles of Public Roadways
  - 4100 Bridges
- 99 Counties
  - 89,000 Miles of Public Roadways
  - 19,000 Bridges
- 948 Cities
  - 16,000 Miles of Public Roadways
  - 1,100 Bridges

Iowa's 2008 Flooding Event



Iowa's 2011 Flooding Event



Electronic DDIR System

2008 floods

Submittal Issues Identified

- Inconsistencies in Submitted Reports
- Form Errors
- Submittal Process Errors
- Electronic Form not available

2011 floods

New System Proven Successful

- Listed as best practice in FHWA ER National Review Team report
- Simplified submittal process for all users
- Improved consistency of reports and reduced errors

FEMA/ER Billing Module

- Created in Resource Management System (RMS)
- FEMA/ER Costs Identified Quickly
- ER & FEMA Equipment Costs
- Prevents Duplicate Billing
- Reduced Labor Hours
- Increased Cost Reimbursements
- Improved Audits

CONTACT INFORMATION

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Summary of Infrastructure Adaptation Workshop

Anne Choate

ICF International

Challenges and Barriers Identified

- Hard to make the case for increased system resilience over the mid- and long-term when state DOTs currently lack sufficient resources to maintain current system function
- DOTs' ability to respond quickly to extreme weather can be hindered by institutional and organizational barriers that exist after the event
- Long-term strategies are not aligned with political cycles, funding cycles, etc.
- Scientists are unable to predict extreme weather events with a level of certainty desired to justify expenditures

Recommended Actions for AASHTO

- Infrastructure adaptation is a priority for AASHTO
- During the workshop, participants suggested the following:
  - Define a research agenda for adaptation tied to different stages in project development (e.g., planning, design, construction, operations & maintenance)
  - Engage a broad range of states in an ongoing conversation about impacts
  - Research the relationship between weather impacts and infrastructure damage in order to identify the threshold points
  - Examine the emergency response program and suggest ways that it could be improved to better handle escalating extreme weather events
  - Develop and distribute materials and guidance to help state DOTs conduct workshops with staff and stakeholders on this topic
  - Help states develop improved predictive models for extreme weather events
  - Facilitate a national conference to bring together various state DOT disciplines

Questions?

Thank You and Next Steps for AASHTO

Jen Brickett, AASHTO