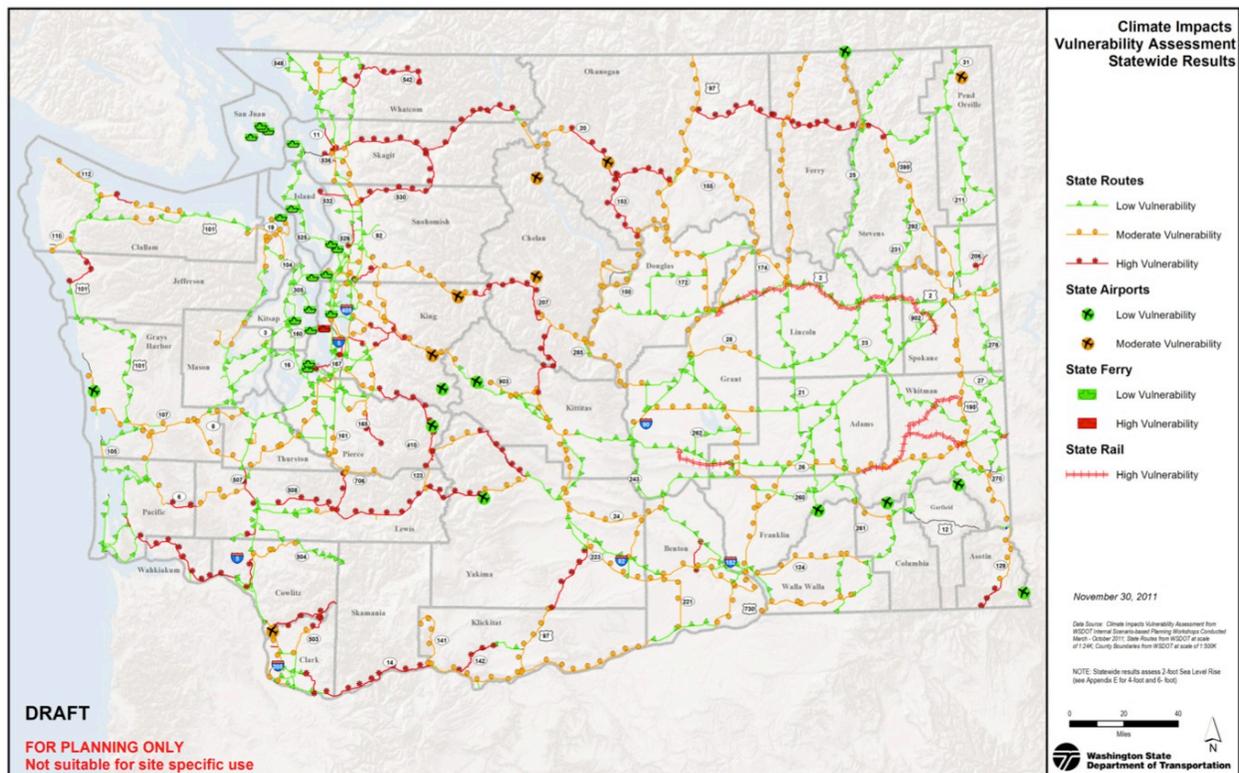


# Guidance for Considering Impacts of Climate Change in WSDOT Plans



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## Introduction

Planning for sustainable multimodal transportation systems is a challenge. Consideration of climate change during planning allows for practical long-term decisions that result in more resilient outcomes.

This document provides guidance for Washington State Department of Transportation's planners to implement [Results WSDOT](#) Strategy 3.2: *WSDOT's plans and projects undergoing environmental review, will document how climate change and extreme weather vulnerability are considered, and propose ways to improve resilience*. WSDOT has developed similar guidance for project-level climate change assessments.

## Who is this guidance intended for?

This guidance is intended to be used by WSDOT planners across all modes and regions for infrastructure owned and operated by WSDOT as well as infrastructure owned and operated by multimodal transportation partners, as applicable. The work is intended to be accomplished by WSDOT staff using available data and tools. The Environmental Services Office is available to help planners and planning teams use this guidance and to answer questions about climate impacts.

## What is the primary source for climate science that WSDOT uses?

WSDOT utilizes the *Washington Climate Change Impacts Assessment* (University of Washington, June 2009; updated 2013) as its primary source for climate information. The UW's *Washington Climate Change Impacts Assessment* provides sufficient information to enable planning-level considerations of Washington's forecasted climate impacts. WSDOT staff maintain close ties with University of Washington researchers to track actionable climate science and information on emerging resilient asset management techniques.

## Analysis starts with WSDOT's Climate Impacts Vulnerability Assessment

WSDOT's Climate Impacts Vulnerability Assessment (CIVA) is a qualitative assessment of risks to the state's transportation infrastructure from climate change. In 2010 and 2011, WSDOT collected an inventory of department-owned and managed assets and climate change data using Geographic Information Systems. UW climate scientists provided us with climate data.

Key points about the CIVA:

- WSDOT leveraged its 10 years of project risk management experience through its signature Cost Estimate Validation Process® and Cost Risk Assessment Workshops to develop an appropriate risk assessment method for the climate change analysis.
- 14 workshops engaged experts across all regions, state ferries, rail, and aviation.
- The outcome of each workshop is a qualitative assessment of the vulnerability agreed upon by workshop participants.

The Climate Impacts Vulnerability Assessment (CIVA) maps, like the one on the cover, show climate vulnerability ratings, and denote their severity by color.

- Red represents assets with a high likelihood of vulnerability.

- Yellow denotes assets that could experience temporary operational failures at one or more locations.
- Green indicates assets that could experience reduced capacity somewhere along the roadway segment, or asset.

Please note that the accuracy of the vulnerability ratings are *generally* suitable for planning purposes. Roadway segments shown as having a high climate change vulnerability rating (shown in red) may not be vulnerable the entire length of segment, rather one or two locations along the segment may be vulnerable to failure.

High vulnerability areas are typically located:

- In the mountains
- Either above or below steep slopes
- In low-lying areas subject to flooding
- Along rivers that are aggrading due to glaciers melting
- In low-lying coastal areas subject to inundation from sea-level rise

Planners, asset managers and project teams should consider the climate vulnerability ratings in addition to examining existing conditions and other identified risks (such as unstable slopes, seismic, fires, and tsunamis).

#### **Where are the CIVA results located?**

Internal to WSDOT:

- Intranet website Development Division (or Design Office) contains all the raw data from the workshops, including excel spreadsheets and pdf map products.  
[http://wwwi.wsdot.wa.gov/Design/HRM\\_ClimatImpacts.htm](http://wwwi.wsdot.wa.gov/Design/HRM_ClimatImpacts.htm)
- WSDOT GIS data layer is available on the GIS Workbench under the Environmental Business Area.

External:

- The final report containing methods and results is posted on WSDOT's "Climate Change Adapting and Preparing" website  
<http://www.wsdot.wa.gov/SustainableTransportation/adapting.htm>.
- The GIS layer is available on the WSDOT's Community Planning Portal for external stakeholder use:  
<http://www.wsdot.wa.gov/planning/community/CommunityPlanningPortal.htm>.

#### **What other programs are considering climate or extreme weather risks?**

WSDOT is committed to the consideration of climate change as part of the long-term management of state transportation assets. Climate and extreme weather preparedness are considered in all program areas, as illustrated in the table below.

**Table 1: Consideration of Climate and Extreme Weather by Program Area**

<i>Program Area</i>	<i>How are climate change and extreme weather considered?</i>
Planning	Major emphasis in WSDOT’s strategic plan: Consider climate change and propose ways to improve resilience in planning documents
Design & Environmental Review	Evaluate potential climate related risks during the environmental and design phase, and design projects to accommodate anticipated future changes Project teams follow <a href="#">WSDOT’s NEPA /SEPA guidance</a>
Construction/ Implementation	Look at potential for new issues: Salt water corrosion, heat or precipitation changes for long-term impacts on materials
Maintenance & Operations	Multi-hazard risk reduction, awareness of maintenance activities that may be affected by heat or extreme weather events

There is a strong interest in WSDOT’s climate vulnerability efforts by external stakeholders. WSDOT has partnered with other state agencies to develop suggestions for local planners who are interested in conducting their own vulnerability assessments for local roads and public works facilities.

**How should WSDOT’s plans consider future conditions related to climate change?**

Planning teams are expected to examine the CIVA results for the study area. By doing so, planners can understand the potential risks and consider how to make proposed strategies more resilient to future climate impacts and severe storm events.

The following table was created with the assistance of the UW Climate Impacts Group to illustrate some potential impacts of particular concern to transportation infrastructure.

**Table 2: Potential Climate Impacts in Washington**

<i>Projected Climate Change</i>	<i>Potential Impacts on Certain State-Owned Facilities (Highways, Rail, Airports, and Ferries)</i>
<ul style="list-style-type: none"> <li>• Increase in average winter precipitation and more extreme precipitation</li> <li>• Change in timing of precipitation (more rain, less snow)</li> <li>• Change in storm track with some extreme storms with higher than normal snow accumulation</li> </ul>	<ul style="list-style-type: none"> <li>• More rock fall, mudslides, sink holes, road bed failure</li> <li>• Increased large-scale river flooding (bridge scour, roadway erosion, inundation)</li> <li>• More localized flooding due to poor drainage or higher groundwater table</li> <li>• Severe wind-related road closures</li> <li>• Blown-down trees, signs</li> <li>• Less snow removal, on average (some extreme snows)</li> </ul>
<ul style="list-style-type: none"> <li>• Sea-level rise, higher storm surge</li> <li>• More frequent and extensive inundation of low-lying areas (both temporary and permanent)</li> </ul>	<ul style="list-style-type: none"> <li>• Coastal erosion and landslides weaken roadbed and bridge footings</li> <li>• Damage to stormwater drainage and tide gates</li> <li>• Saltwater corrosion of facilities</li> <li>• Detours around frequently flooded coastlines</li> </ul>
<ul style="list-style-type: none"> <li>• Higher average temperatures</li> <li>• Increase in extreme heat events (heat waves)</li> <li>• Drought and low stream and ground water flow</li> </ul>	<ul style="list-style-type: none"> <li>• Wildfire or extreme fire risk</li> <li>• Adverse impacts on road and rail tracks (buckling)</li> <li>• Loss of roadside vegetation (leading to erosion and landslides)</li> <li>• Wetland site failure</li> </ul>

It is very important that planners and technical experts understand that climate science changes how the environmental context is described. No longer can we look only at past

climate and weather conditions – we must also examine the future climate forecast. Past trends for a specific resource (for example, water, habitat, air) may not be accurate predictions for the future. WSDOT’s approach to wetland mitigation provides a clear illustration of this; WSDOT teams are looking at future issues that may impact the success of environmental mitigation (e.g., saltwater inundation or drought as concerns for long-term wetland viability).

### **How is WSDOT incorporating climate into various stages of planning?**

WSDOT is engaged in many different types of planning. Plans that are entirely controlled by WSDOT should use this guidance. For plans that we partner on, or that we comment on, such as local plans or regional plans, we recommend WSDOT planners share the information about potential climate threats, and encourage the planning partners to consider ways to address climate resilience in the plan. See resources section.

Some of the key plans that should apply this guidance are:

- Statewide Policy Plans (such as Washington Transportation Plan)
- Asset Management Plans
- State-interest Modal Plans (Freight Mobility; Public Transportation; Aviation; Rail; Active Transportation)
- State-owned Modal Plans (Highway System; Ferry System)
- Corridor Sketch Initiative (more detail below)
- Other Highway Corridor or Network Plans (more detail below)

For all types of plans, teams are expected to ask and answer the question, “how will my plan be affected by climate change?”

### **Follow these steps for all plans listed above:**

1. Examine the results of WSDOT’s 2011 Climate Impacts Vulnerability Assessment (CIVA) for the project area. CIVA results are on the GIS workbench and Corridor Sketch database (see page 3 – where to find CIVA results). Continue to remaining steps if CIVA results do not apply.
2. Contact the WSDOT Environmental Services Policy Branch Manager at (360) 705-7126, for guidance on how to tailor this information for a specific planning area or mode.
3. Collaborate with planning partners. Many local, state, federal, and tribal governments have their own climate vulnerability assessments and plans for improving resilience. Planners should look for ways to leverage existing strengths, such as emergency plans and natural hazard reduction plans (including flood protection efforts) with long term transportation strategies.
4. Develop planning-level strategies that integrate resilience. Given the scope of the plan, and the information collected about any anticipated climate threats, document findings. Consider the following:
  - Whether or not climate change will adversely impact current or future multimodal transportation infrastructure;

- Whether the planning partners have adequately considered transportation assets in the local or regional long-term natural hazard reduction plans; and
  - Whether or not climate change will impact transportation services to vulnerable or underserved populations.
5. Document the potential risks associated with extreme weather, and how the plan will promote climate resilience.

**For Corridor Sketch Initiative (State Highway)**, follow the step by step guidance above. Specific to Corridor Sketches, we recommend the following additional guidance for planners:

1. Examine the results of WSDOT’s CIVA for the corridor. These are noted on Page 2 of the summary, however, the details are not listed. The details are available internally on GIS and intranet page (see page 3).
2. Identify ways to reduce long-term hazards from extreme weather and gradual changes in sea-rise, flood patters, etc. as you are developing strategies for performance gaps.
3. Discuss risks and resilience in the Region multimodal, multi-disciplinary, multi-agency (M<sup>3</sup>) teams<sup>1</sup>, and document results.

**For Area, Network, and Corridor – Planning Studies and Related Efforts**, follow the step by step guidance above. In addition, planning studies are expected to complete the following:

1. Create a short section containing a “Climate Change Assessment Summary.” This section should document CIVA data for the study extents. For highway studies include CIVA summary from the Corridor Sketch Initiative Database (if complete).
2. Consider ways to address climate resilience in recommendations. Include discussion about resilience in study recommendations.
3. Coordinate with Region and/or Headquarters Environmental for technical assistance. Headquarters Environmental (ESO) should be part of the draft review process.

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<sup>1</sup> “Region M3 teams” are multi-modal, multi-disciplinary, and multi-agency groups that are formed to discuss corridor information.

## Supporting Materials

### Resources and Examples

Examples:

- Corridor Study: [US 2 Corridor Study Deer Road to Elk-Chattaroy Road](#)
- Corridor Study: [US 195 Corridor Crash Analysis](#)
- Corridor Study: [SR 520 Multimodal Corridor](#) (see Chapter 5)

Resources:

- [Climate Change Impacts and Adaptation in Washington State \(state of knowledge\)](#)
- [Climate Impacts Vulnerability Assessment \(CIVA\)](#)
- [WSDOT, Adapting to Climate Change](#)
- [WSDOT Community Planning Portal](#)
- [Growth Management: How can Cities and Counties Plan for Climate Resiliency](#)
- [Climate Impacts Group at the University of Washington](#)
- [FHWA - https://www.fhwa.dot.gov/environment/sustainability/index.cfm](https://www.fhwa.dot.gov/environment/sustainability/index.cfm)
- [Georgetown Climate Center—Helping Communities Adapt to Climate Change](#)
- [AASHTO, Transportation and Climate Change Resource Center](#)



[National Fire Protection Association's Firewise Communities](#)

### What state policy or directives support this guidance?

WSDOT's vision is to be the best at providing a sustainable and integrated multimodal transportation system. Sustainability is one of WSDOT's core values. Climate consideration is part of our asset management approach as well as part of our implementation of practical solutions.

The following strategic directives support our role in building a resilient transportation network for the future:

#### ***Results Washington***

Governor Inslee's [Results Washington](#) includes indicators of success for five goal areas. WSDOT is directly responsible for indicators related to clean transportation and sustainable and efficient infrastructure. WSDOT also contributes to other goals such as quality of life, vibrant communities, clean and restored habitat, and healthy air and water.

#### ***Executive Order 14-04***

The Governor's [Executive Order 14-04](#), "Washington Carbon Pollution Reduction and Clean Energy Action," directs state agencies to reduce carbon emissions and improve energy independence. WSDOT is directed to encourage electrical vehicle (EV) use, expand the EV network, and improve multimodal planning to chart the path to a "multimodal, coordinated, cost-effective, safe and low-carbon transportation system."

### **Washington's Integrated Climate Response Strategy**

Published in 2012, the [response strategy](#) lays out a framework that decision-makers can use to help protect Washington's communities, natural resources and economy from the impacts of climate change. WSDOT's vulnerability assessment and the recommendation to consider climate in plans and projects are among the actions contained in the state's strategy.

### **Results WSDOT: Moving Washington Forward**

WSDOT's Strategic Plan for 2014–2017, "[Results WSDOT](#)," frames future agency actions to ensure WSDOT is the leader in providing a sustainable, integrated, and multimodal transportation system. Results WSDOT links agency actions to the six goals outlined in the Strategic Plan:

1. Strategic Investments
2. Modal Integration
3. Environmental Stewardship
4. Organizational Strength
5. Community Engagement
6. Smart Technology

Results WSDOT **Goal 3: Environmental Stewardship**, "Promote sustainable practices to reduce greenhouse gas emissions and protect natural habitat and water quality." The outcomes, strategies, and actions under this goal tie directly to this guidance:

- Improve environmental conditions: leave it better than before
- Reduce WSDOT's overall carbon footprint
- Improve energy efficiency of transportation systems and WSDOT operations

The strategic plan makes the following commitment: **WSDOT plans and projects undergoing environmental review (at NEPA EIS and EA level) will document how climate change and extreme weather vulnerability are considered, and propose ways to improve resilience.**

### **Definitions and Terminology**

Except where otherwise noted, these definitions are based on Intergovernmental Panel on Climate Change's (IPCC) *Climate Change 2007: Impacts, Adaptation and Vulnerability Report*<sup>2</sup> and their *Climate Change 2007: Mitigation*.<sup>3</sup>

**Adaptation** – Initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects.

**Adaptive Capacity** – The ability of a system to adjust to climate change to moderate potential damages, to take advantage of opportunities or cope with the consequences.<sup>4</sup>

**Climate** – The long-term average of conditions in the atmosphere, ocean, and ice sheets and sea ice described by statistics, such as means and extremes.

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<sup>2</sup> Accessed at <http://www.ipcc.ch/ipccreports/ar4-wg2.htm>, 9/20/2010.

<sup>3</sup> Accessed at <http://www.ipcc.ch/ipccreports/ar4-wg3.htm>, 9/20/2010.

<sup>4</sup> IPCC 2001; also referenced in 2009 California Climate Adaptation Strategy.

**Climate Change** – A significant and persistent change in the mean state of the climate or its variability. Climate change occurs in response to changes in some aspect of Earth’s environment: these include regular changes in Earth’s orbit about the sun, re-arrangement of continents through plate tectonic motions, or anthropogenic modification of the atmosphere.

**Climate Forecasts and/or Projections** – A prediction about average or extreme climate conditions for a region in the long-term future (seasons to decades). Pacific NW climate projections are available from the Climate Impacts Group at the University of Washington: <http://cses.washington.edu/cig/fpt/ccscenarios.shtml>.

**Climate Variability** – Natural changes in climate that fall within the normal range of extremes for a particular region, as measured by temperature, precipitation, and frequency of events. Drivers of climate variability include El Niño.

**Weather Forecast** – A prediction about the specific atmospheric conditions expected for a location in the short-term future (hours to days).

**Global Warming** – The observed increase in average temperature near the Earth’s surface and in the lowest layer of the atmosphere.

**Resilience** – The capacity of a system to absorb disturbance and still retain its basic function and structure.

**Vulnerability** – The degree to which physical, biological, and socio-economic systems are susceptible to and unable to cope with adverse impacts of climate change.<sup>5</sup>

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<sup>5</sup> AASHTO, Primer on Transportation and Climate Change, 2008.