

Assessing Vulnerability and Consequences: Getting Started

INTRODUCTION

An important step in developing your agency's climate adaptation strategy is the assessment of the vulnerability of infrastructure assets and services. This document discusses some of the key decision points and considerations when embarking on a vulnerability assessment, and provides resources for existing assessment frameworks, climate models, and guidance for applying assessment results.

CLEARLY ARTICULATE YOUR VULNERABILITY ASSESSMENT GOALS

The single most important thing to remember is to 'start with the end in mind'. In other words, it is worthwhile to spend time thinking through the ultimate goals of your vulnerability assessment. Without explicit goals, assessments can get bogged down on issues that are ultimately not useful. For example, a disproportionate amount of time and resources could be dedicated to developing detailed climate impact assessments on climate change factors that ultimately provide more information than what is needed to take action.

To help think through your ultimate goals it is helpful to think through three dimensions of your vulnerability assessment: *Scope, Scale and Solutions*. The prompting questions will help work this through.

Scope:

1. What sort of actions are within my agency's control?
2. What information does my agency need to achieve my assessment goals?

Scale:

3. Am I interested in understanding potential impacts on specific assets or service locations, or am I more interested in general vulnerabilities across my system?

Solutions:

4. Once I know what my vulnerabilities are, what do I plan to do with this information?

The answers to these and similar questions can help drive the methods and data you use to complete your vulnerability assessment. For example, if you're looking to start a general discussion within your agency about potential vulnerabilities, you may only need to understand vulnerabilities at a general level, and less detailed climate projection information would be

sufficient. On the other hand, if you are concerned about a specific asset or stretch of route, or are interested in adjusting building design or procurement decisions, it might be necessary to obtain more detailed climate projection information and conduct more specific asset-level analyses. As another example, you might decide that your resiliency actions will focus only on actions within your agency's control, and analyses that consider drainage and hydrology wouldn't be that useful since you cannot influence roadway drainage or design.

CONSIDER WHETHER THERE ARE REFINEMENTS TO YOUR ASSESSMENT FOCUS THAT CAN BE MADE EARLY ON

Prior to beginning your assessment, you may be able to refine the focus somewhat so that resources are spent on priority topics. Further refinement can happen down the road, as your assessment progresses and you learn more. But some initial questions to consider are:

1. At a very general level, how is the climate projected to change in my area?
2. What problems has my agency faced from climate hazards in the past? Is there anything about the general climate projections in my area that has me worried?
3. Are there particular assets that I'm especially concerned about?
4. Are there specific transit riders, population centers, or geographic areas to which I should pay particular attention?

Combined, Questions 1 and 2 can help you hone in on the hazards and potential impacts of most significance to your agency. You may find that you don't need to devote extensive resources exploring hazards that are unlikely to change significantly or are unlikely to result in notable impacts.¹ The type of data you need, and the people you need to engage, may differ depending on your answers to these questions.

Question 3 can help you focus on priority assets or service lines. *Resource #5: Assessing Criticality* may assist you in identifying the most critical aspects of your system.

Question 4 will help you build resilience in a manner that addresses the needs of your agency's most vulnerable transit riders. Disruptions in transit disproportionately limit the mobility of transit-dependent riders, such as elderly populations and [disadvantaged communities](#)². When developing resilience strategies, it is important to consider the implications for these riders.

UTILIZE EXISTING VULNERABILITY ASSESSMENT FRAMEWORKS AND METHODS

There is no need to reinvent the wheel. There are excellent resources out there that will kick-start your vulnerability assessment process:

- [FHWA's Vulnerability Assessment and Adaptation Framework](#) – The Federal Highway Administration (FHWA) provides a detailed guide for vulnerability assessments for transportation systems. Although designed with highway systems in mind, the steps will be similar for a transit agency. FHWA provides detailed steps for defining scopes (Ch. 2),

¹ The SCAG Resiliency Toolbox Resource #1 (Projected Changes in Climate in the SCAG Region) is an easy way to get a sense of general projected trends in climate in your area.

² [CalEnviroScreen 3.0](#) can help you identify disadvantaged communities, or those that are disproportionately burdened by environmental conditions and have population characteristics that make them more sensitive to adverse environmental impacts.

obtaining climate data projections (Ch. 4), and executing different approaches in vulnerability assessments (Ch. 5).

- [FTA's Climate Change Adaptation Initiative](#) – the Federal Transit Authority (FTA) funded seven pilot projects in 2013 for assessing climate change vulnerabilities and identifying adaptation solutions. The reports are case studies, but several, such as [SEPTA's regional rail report](#), provide detailed accounts of transit agency vulnerability assessments.
- [Caltrans regional vulnerability assessments](#) – starting with District 4 (Bay area) Caltrans are doing climate change vulnerability assessments for all 12 Caltrans districts. Each assessment includes an online mapping system of regional-scale impacts of sea-level rise, wildfire, temperature and rainfall. It's also worth checking [Caltrans Climate Change Branch website](#) for additional resources.
- FHWA has sponsored a number of case studies and pilots that assessed climate change impacts and potential adaptation measures at an asset-level scale. The methods used for these analyses may be useful when considering asset-level analyses. Please see the resources listed on FHWA's [Resilience web page](#).

OBTAINING AND INTERPRETING CLIMATE PROJECTION DATA

Obtaining climate projection data is a critical step in any climate vulnerability assessment. Depending on your goals, you may require high-level regional data, or very specific data points unique to your agency's service area. SCAG's *Guidance on Obtaining Climate Data* compiles and guides users through the relevant California and U.S. resources for climate data projections, including specific information on interpreting climate hazards and uncertainty in projections.

The following resources give quick references for finding relevant, regional climate projections at different levels of detail:

- National climate data resources:
 - [USGS National Climate Change Viewer](#)
 - U.S. DOT CMIP [Climate Data Processing Tool](#)
- California data resources and climate data guidance:
 - [California's Climate Change Assessments](#)
 - Localized Climate Projections: [Cal-Adapt](#)
 - [Cal-Adapt Guidance on Using Climate Projections](#)
 - [State of California Sea-Level Rise Guidance: 2018 Update](#)

For more information on obtaining detailed climate projection data, see [Chapter 4: Using Climate Information](#) of [FHWA's Synthesis of Approaches for Addressing Resilience in Project Development](#), which provides sources for climate projections, and discusses how projections are developed.

APPLYING VULNERABILITY ASSESSMENT RESULTS

Your vulnerability assessment will give you an understanding how your greatest climate risks to planning and operations. Through these results, your agency can begin to identify, develop, and implement strategies for mitigating those risks through adaptation. There are several useful resources to support interpreting and applying your vulnerability results:

- [FTA's Climate Change Adaptation Initiative](#) – FTA's case studies provide transit agency examples for moving from a vulnerability assessment to development of adaptation alternatives.
- [AASHTO's Integrating Extreme Weather Risk into Transportation Asset Management](#) – the American Association of State Highway and Transportation Officials (AASHTO) provides step-by-step guidance for incorporating climate data into asset management practices.
- [FHWA's Synthesis of Approaches for Addressing Resilience in Project Development](#) – Chapter 3 of FHWA's Synthesis gives recommendations and guidance for integrating vulnerability results and climate data into project development processes.