State Mitigation Planning Key Topics Bulletin: Risk Assessment

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1. Introduction

The Federal Emergency Management Agency (FEMA) released the State Mitigation Planning Policy Guide (the Guide) on April 19, 2022. The Guide is FEMA's official policy on and interpretation of the mitigation planning requirements in the Code of Federal Regulations (44 CFR Part 201). The Guide will go into effect on April 19, 2023. All state mitigation plans approved on or after April 19, 2023, must follow the updated Guide.

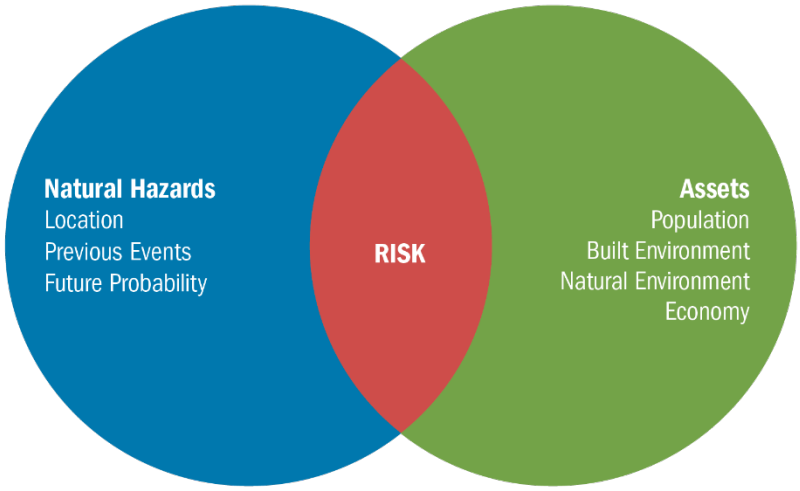
The State Mitigation Planning Key Topics Bulletins provide advice and ways to meet the requirements in the Guide. They supplement the Guide with "how-tos" and resources.

This bulletin is the second in the series. It covers state risk assessments. [1]

2. Risk Assessment Overview

2.1. What is a Statewide Risk Assessment?

At its core, hazard mitigation planning is about developing a strategy to reduce risk in the long term. An essential part of the process is identifying hazards, risks, impacts, and vulnerabilities. In mitigation planning, "risk" is the potential for damage or loss when a hazard interacts with an asset. Assets can be people, buildings, infrastructure, the economy, or natural and cultural resources.



Risk is the overlap between a natural hazard and a state or community asset.

The risk assessment helps communicate vulnerabilities, develop priorities, and inform decision making. It is the factual basis for the mitigation strategy. The hazards and associated impacts in the

[1] In mitigation planning, "state" refers to the 50 states, Washington, D.C., and the five U.S. territories.

risk assessment should be the hazards and impacts the mitigation strategy seeks to address. If, for example, the risk assessment shows that the state will have hurricane damage in a specific area, the mitigation strategy should include actions to protect state assets and jurisdictions, especially underserved communities and socially vulnerable populations, in those areas.

What are Socially Vulnerable and Underserved Communities?

Social vulnerability, according to FEMA's Guide for Expanding Mitigation: Making the Connection to Equity, is the potential for loss within an individual or social group. The term recognizes that there are characteristics that influence an individual's or group's ability to prepare, respond, cope, or recover from an event. Populations that are disproportionally impacted often include:

- Underserved communities with a low socioeconomic status.
- People of color.
- Tribal and indigenous communities.
- Women.
- Members of the LGBTQ+ community.
- Individuals experiencing homelessness or displacement.
- Rural communities.
- Elderly and youth populations.
- Populations with limited English proficiency.
- Service workers and migrant laborers.
- Populations with limited cognitive or physical abilities.
- Institutionalized populations, such as those in prisons and nursing homes.
- Renters.

Underserved communities are defined by Executive Order 13985 On Advancing Racial Equity and Support for Underserved Communities Through the Federal Government as "populations sharing a particular characteristic, as well as geographic communities, that have been systematically denied a full opportunity to participate in aspects of economic, social, and civic life."

The risk assessment can also be useful for planning and decisions outside the mitigation plan. It is a robust, data driven analysis of what might happen and where the state is vulnerable to hazards. This can support more resilient investment decisions. Here are some examples of plans where the risk assessment data would be useful.

- **Threat and Hazard Identification and Risk Assessment (THIRA) and Stakeholder Preparedness Review (SPR):** The THIRA is a three-step risk assessment process. It helps states, territories, and tribes understand their risks and what level of capability they need to prepare for those risks. It also helps them learn their capability gaps and how to address them. During the THIRA process, states come up with a list of the most challenging threats and hazards that could affect them. While not exactly the same, these processes often use the same data points. States can raise their efficiency by coordinating the analyses for determining THIRA content and the hazard mitigation plan's risk assessment. This will ensure consistency and align plan outcomes. The Increasing Resilience Using THIRA/SPR and Mitigation Planning job aid explains how to do this.

- **Emergency Operations Plans:** Emergency operations plans and emergency management functional plans have information on how to save lives and protect property in a hazard event. Response agencies should know hazard risks and vulnerabilities. This will help them learn the potential impacts of their activities before and during an event.

- **Pre-Disaster Recovery Plans**: Pre-disaster recovery plans help states prepare before a disaster. The risk assessment can guide the type and severity of events the state plans for. FEMA's Pre-Disaster Recovery Planning Guide for State Governments has more details.

- **Post-Disaster Recovery Plans:** After a disaster, states and communities go through large planning efforts to rebuild stronger. The vulnerability assessment from the mitigation plan is a good starting point. The findings from recovery planning can also inform the mitigation plan update.

As the state updates the risk assessment, use the planning partners to identify if the risk assessment can benefit other plans or processes. The work done for the mitigation plan should support resilience efforts across the state.

Guiding Principle: Focus on Risk-Informed Mitigation Strategies

The risk assessment is critical to developing a mitigation strategy that reduces the unique risks in a state. It is not just an exercise but can benefit from coordination with various departments, agencies, and partners. Connecting the state mitigation strategy to overall vulnerability helps develop relevant mitigation actions at various scales. The risk assessment can also help prioritize efforts that will address the most pressing risks to assets or populations.

2.2. State, Local, and Tribal Plan Risk Assessments

The state risk assessment does more than guide statewide mitigation efforts. The risk assessment is a resource for local and tribal governments as they prepare their mitigation plans. It is important for the state plan's risk assessment to be accurate, current, relevant, and thorough. It is even more practical when developed with sharing in mind. Local and tribal plan developers can and will use the state plan when developing their risk assessments. Doing so may reduce their level of effort and help them focus on the mitigation strategy. The state can advise local and tribal plan developers on

datasets and ways of assessing risk to make it easier to incorporate the information into the state mitigation plan.

Remember! All state plans are updates.

The plan update is an opportunity for continued improvement. Don't start from scratch every 5 years. Build on the previous plan and make sure the risk assessment is accurate, current, and relevant. Look at any comments from FEMA on the previous plan review tool. Use the state THIRA and information from the SPR. Review the Guide for changes in the risk assessment requirements. Based on this evaluation, you may:

- Update existing hazard profiles to reflect climate change, and changes in development and population.
- Add new hazard profiles.
- Incorporate new or updated data and studies, such as those from Risk MAP, NOAA, or the state climatologist.
- Enhance the quality and detail of data.
- Document hazard events from the last 5 years.
- Add or incorporate outreach methods and data that identify underserved communities and socially vulnerable populations. This can show where mitigation investments will reduce vulnerabilities and provide co-benefits to those populations.

This is not a complete list. The risk assessment may need other updates.

3. Steps to Conduct the Risk Assessment

There are generally five steps in the risk assessment process:

1. Identify and describe hazards. This step helps the state understand what hazards may occur and where.
2. Describe future probability. This step describes how the probability of hazards will change in the future based on climate change and other future conditions.
3. Analyze the vulnerability of state assets. The Guide defines state assets as state-owned or operated critical facilities, buildings, infrastructure, and community lifelines. This step looks at which state assets are most vulnerable to current and future disaster losses.
4. Analyze the vulnerability of jurisdictions. This step examines which jurisdictions are most threatened by hazards and which are most vulnerable to losses. It includes understanding the vulnerability of socially vulnerable and underserved communities.

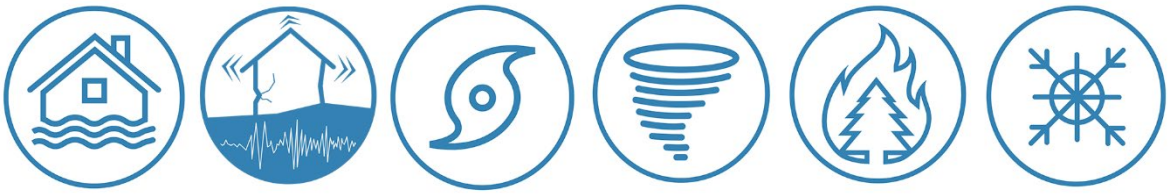
5. Summarize vulnerability. This step brings all the analysis together. It encourages the state to draw conclusions based on the risk assessment to support developing the strategy to protect its citizens, businesses, economy, and other vital assets.

However, each state can use its own approach to complete the risk assessment. Examples of other planning approaches include visioning, adaptation pathways, and scenario planning. These methods are flexible ways to plan differently, especially when it comes to future conditions. FEMA's requirements list what must be in the plan. They do not dictate the process or how the plan is written.

3.1. Step 1: Identify and Describe Hazards

This step asks the state to identify and describe all natural hazards that can affect the state. It answers the questions "What might happen? How minor or major might those events be?" The result is an overview called a hazard profile.

To start, the state must list the type of hazards that may occur (flood, earthquake, tornado, etc.). Many states already profile a robust list of hazards. In a plan update, review recently declared disasters, new or updated studies and data, news articles, and local mitigation plans to decide if new hazards need to be added to the plan. This is a good time to leverage the expertise of the state planning team. They may help identify hazards that have not been identified before and/or have information on previously identified ones.



Mitigation plans must identify and describe all natural hazards that can affect the state.

The plan should include all hazards of concern, not just high-risk or recent hazards. Hazards that have not occurred in several years may still affect the state. If a commonly recognized hazard that could affect the state is omitted, the plan must include the rationale for not including it.

Spotlight on the Fire Management Assistance Grant (FMAG) Program

The FMAG Program provides assistance to any state or local government to mitigate, manage, and control wildfires. To be eligible for the FMAG Program, the state mitigation plan must fully address wildfires, the same way it would address any other identified hazard. For more information, see Section 3.9 of the Guide.

The FMAG program gives states an incentive to include wildfires in their mitigation plans. Regardless of FMAG interest, if wildfire is a commonly recognized hazard in the state, it must be included in the plan.

The hazard profile must include:

- **The location where hazards have or could happen**. At a minimum, this must be a narrative overview. Maps strengthen the narrative and help visualize where hazards can occur. They can also be helpful in later steps. If a hazard affects the whole state equally, the plan should say so. Location can be explained as the absence or presence of a hazard. It can also describe areas of higher or lower risk within a known hazard area. For example, the U.S. Forest Service maps severe wildfire danger areas using a low-to-severe scale.
- **Information on previous occurrences of each hazard**. This history should be as complete as possible. This part of the hazard profile should include when and where events have happened. As data allows, include damage, duration, and magnitude of each event. The previous events narrative must also include information on the range of intensities of hazards. Explain how minor or severe events have been. This description should use scientific scales like the Modified Mercalli Scale for earthquakes or the Saffir-Simpson Scale for hurricanes. Consider adding a summary of the worst instance of a hazard event in the state.

Including Data in the Risk Assessment

FEMA encourages states to include overviews and summaries from data analysis. The conclusions drawn from data are more important than the raw data. Raw data can be included in appendices or annexes to support conclusions. When the planning team identifies data gaps or limitations, they should note the issues and include a mitigation action to fix them.

Finding Risk Data

There is no shortage of federal data to use in the risk assessment. These data sources cover a variety of hazards.

- FEMA maintains the National Risk Index. It is a geographic information systems (GIS) dataset and online tool to help illustrate the communities most at risk for 18 natural hazards. It also has OpenFEMA, a one-stop shop for available FEMA data.
- Data from FEMA's mapping program, Risk Mapping, Assessment, and Planning (Risk MAP), provides detailed flood risk information to states and communities. Visit the Map Service Center to get regulatory Flood Insurance Rate Maps (FIRMs) or non-regulatory Flood Risk Products to support the risk assessment.

- The U.S. Forest Service maintains the National Avalanche Center and the Wildland Fire Assessment System. Its Wildfire Risk to Communities site has interactive maps, charts, and resources to understand wildfires.
- The National Drought Mitigation Center provides drought monitoring, decision support tools, and resources.
- National Aeronautics and Space Administration (NASA) updates an open-source catalog of rainfall-induced landslides.
- The U.S. Geological Survey (USGS) has data and analysis on earthquakes, landslides, wildfires, and volcanoes. USGS's Coastal and Marine Hazards and Resources Program is a resource for information on coastal erosion and shoreline change.
- The U.S. Department of Agriculture (USDA) shares insured crop losses, many of them due to natural hazard events, going back to 1989.
- The National Oceanic and Atmospheric Administration (NOAA) runs the National Hurricane Center. It provides data and analyses for hurricane events. NOAA's 2022 Sea Level Rise Technical Report provides the most up-to-date sea level rise projections for all U.S. states and territories. NOAA's Natural Hazards Data, Images and Education website has long-term natural hazard data. NOAA is also a partner for climate data and analysis (See Section 3.2).
- The U.S. Army Corps of Engineers (USACE) maintains three resources for flood-related risks: the Ice Jam Database, the National Inventory of Dams, and the National Levee Database.

Federal government agencies should not be the only source for risk assessment data. Academic institutions, state natural resources, environmental protection, economic development, or community development agencies and departments also have data on hazards and assets. These entities should be part of the planning team. Reach out to them early to get and use their data.

3.2. Step 2: Describe Future Probability

The mitigation plan is a multi-year strategy for risk reduction. Risk is not static over time, so it is important to understand and plan for future events. The risk assessment must provide an overview of the probability of future hazard events. At its most basic, probability is the likelihood of a hazard happening. This overview must include projected changes in all the traits of a hazard: location, range of anticipated intensities, duration, and/or frequency.

States have accounted for climate change and other future conditions in their mitigation plans since 2016. Climate change continues to drive up the number, cost and severity of natural disasters. The challenges posed by climate change will change the type and magnitude of many hazards in the future. The Guide specifies that probability must include considerations of changing future conditions on the **type**, **location**, and **range of intensities** of hazards. Ask yourself:

- Will changing future conditions mean new hazards will impact my state?
- Will hazards reach places or people they have not before?
- Will hazards we already face become more severe? Less severe? For example, rising temperatures may make extreme heat events longer and more deadly, but they may mean milder winters.

It is essential to plan now for future conditions.

Defining Future Conditions

A lot of things in the future might change the type, location, severity, and frequency of hazards. The term "future conditions" includes more than just weather. Future conditions include changes in climate, population patterns, and how land is used. Changes in weather patterns, average temperatures, and sea levels can bring more extreme storms, droughts, wildfires, and other disasters. Population changes mean changes in demographic trends, migration, density, or the makeup of socially vulnerable populations. How your community uses and develops land can put more or fewer people, businesses, and homes in harm's way. These changes can all bring changes in risk and vulnerability. Investments in mitigation will reduce those risks.

A state can choose the methods and data sources it wants to use to estimate future probability. Many climate studies and models are available. There is no single "right" projection or data source. Early on, decide which source(s) to use in the risk assessment. It is important to consult with partners who have expertise in climate change and climate adaptation to select and use climate projections. This may be the state climatologist, academic partners, or a state department responsible for climate planning. The state may also have an officially adopted climate projection to support planning. If so, use it. Massachusetts and California are examples of states with official projections.

It is also important to note that regardless of what data source is used, the state will have to make assumptions. The data will have limitations. The state plan should list any caveats to the data. The U.S. Climate Resilience Toolkit shares some of these:

- Climate projections are not exact predictions. They identify likely future trends and plausible scenarios based on today's best available science and data.
- They do not predict where or when extreme weather will occur. However, they can help identify future probability and potential changes in intensity for certain types of events (heavy precipitation, extreme heat, or drought conditions).
- Climate projections will vary from model to model. It is wise to consider several sources and a range of scenarios to gain a more complete picture of potential future risks.

- The spatial resolution of climate data may vary greatly. Increased data resolution does not necessarily mean higher accuracy or reliability.

Caveats and uncertainty do not mean projection data is bad or inaccurate. The data is a tool to understand climate change. Uncertainty in data should not be a barrier to good planning.

Climate Data Terms

Here are some basic terms that may be helpful to understand climate data.

- An **ensemble** is a collection of data from multiple climate models. Scientists and policymakers may prefer an ensemble because no single model perfectly simulates change. Using an ensemble helps users better explain the range of possible climate outcomes. The National Climate Assessment uses an ensemble.
- **Downscaling** is the general term for taking climate information for a bigger geographic area and translating it into a statistical projection for a smaller area. The availability of downscaled data will vary from place to place. It can be more accurate and relevant but it can also result in greater uncertainty. Downscaling is an intense computational process. Rely on experts to downscale for you. NOAA's Climate Explorer provides downscaled projections, maps, and graphs for any county in the U.S.
- **Regional Climate Models** are the result of downscaling global climate models. These help produce more refined and region-specific results based on higher resolution data.

Sound climate models will generally agree on broader trends like higher average temperatures, higher sea levels, or more frequent heavy precipitation. They will differ in the specifics, like 3 feet of sea level rise versus 4. Those specifics are more important for regulatory or design standards. States can effectively plan for climate change even with some data variability.

The exact method a state uses to estimate future probability may vary by hazard. For example, there may be climate projections that show how much more precipitation a state can expect. Similar information may not exist for landslides. The state's approach will depend on data, analysis capabilities, and capacity to integrate the data. Use scientific and reputable climate projections to describe the probability of future occurrences. Projections can be an ensemble, a downscaled projection, or a regional climate model.

Hazard Mitigation Plans and Climate Adaptation Plans

Climate adaptation refers to actions taken to reduce risks from changed climate conditions and to prepare for impacts from additional projected climate changes. Hazard mitigation tries to reduce risk from hazards. Traditionally, adaptation deals with the more chronic aspects of climate impacts and the changes to events, or "shocks." Hazard mitigation planning has been

more focused on reducing risk from shocks. However, as climate change continues to drive more frequent and extreme events, the need to address chronic stressors and shocks in each plan becomes more crucial. Massachusetts went so far as to integrate its adaptation and mitigation plans into a single document. This approach created a framework for the plan to evolve and include new information and data as it becomes available.

Both plans help reduce long-term risk to climate-related hazards. Integrating them helps create a holistic picture of risk reduction. The climate adaptation plan can inform the mitigation plan and vice-versa. Climate adaptation plans identify climate change vulnerabilities and prioritize strategies to lessen the long-term impact of climate change. This information should go in the mitigation plan. Vulnerable assets identified in the state plan may be candidates for adaptation projects.

In the absence of all other data, states can use a historical analysis or qualitative approach to describe probability. Use these methods with caution because climate trends show that the frequency and magnitude of events are growing. The state should note data gaps and include ways to fill those gaps in the mitigation strategy.

- Historical Analysis Approach**:** Use past events to indicate future events. For example, an event that has occurred 20 times over the past 50 years has a 40% annual probability.

- Qualitative Approach: Describe projected changes using lived experiences and anecdotal evidence. This method can use general descriptors. General descriptors must be defined, though. For instance, “highly likely” could mean a hazard will happen every year. Defining descriptors keeps them consistent across the risk assessment.

The end result of this step is not just a statement of the probability of an event. States must *use* the climate data, along with population and land use projections, and determine the right metrics to evaluate projected changes. These may include:

- Average daily maximum temperature.
- Average number of extreme heat days.
- Average number of extreme cold days.
- Average daily precipitation.
- Population change.
- Growth or development pressure indices.

Then, the state can use those metrics to develop summaries of how the type, location, and range of intensities of each profiled hazard will change. The effects of future conditions can be qualitatively or quantitatively described. Think about a state where the data shows that there will be twice as many days with a maximum temperature of over 95˚ Fahrenheit in the year 2090. That may mean that communities that already experience extreme heat will experience more. This would be a change in the range of intensity. Communities that don’t experience extreme heat now will in the future. This is a change in location.

Examples: Describing Climate Impacts

The 2018-2023 Colorado Hazard Mitigation Plan has tables that say how the location, intensity, frequency, and duration of each hazard event will change over time. The example below is for droughts.

Location	Mountains and plains both experience drought. Drought changes geographically from year to year and decade to decade. Location is not projected to change.
Extent / Intensity	Property damage that does not threaten structural integrity is common. Little or no impact to critical services or facilities expected. Economic and water resource impacts foreseen. Extent is not projected to change.
Frequency	Droughts are projected to increase in frequency due to shifts in seasonal precipitation patterns, including dryer summers and less precipitation falling as snow in early spring/late fall.
Duration	Droughts are projected to have a longer duration due to a changing climate, e.g. shifts in seasonal precipitation patterns, including drier summers and less precipitation falling as snow in early spring/late fall.

The 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan has summaries of each hazard, including the potential effects of climate change.

Potential Effects of Climate Change		
	CHANGES IN PRECIPITATION → MORE INTENSE AND FREQUENT DOWNPOURS	More intense downpours often lead to inland flooding as soils become saturated and stop absorbing more water, river flows rise, and urban stormwater systems become overwhelmed. Flooding may occur as a result of heavy rainfall, snowmelt or coastal flooding associated with high wind and storm surge.
	EXTREME WEATHER → MORE FREQUENT SEVERE STORMS	Climate change is expected to result in an increased frequency of severe storm events. This would directly increase the frequency of flooding events, and could increase the chance that subsequent precipitation will cause flooding if water stages are still elevated.
	CHANGES IN PRECIPITATION → EPISODIC DROUGHTS	Vegetated ground cover has been shown to significantly reduce runoff. If drought causes vegetation to die off, this flood-mitigating capacity is diminished.

The mitigation plan is a long-term strategy. It must be future-oriented. The probability of future hazards should be used to develop the mitigation strategy. It should also support prioritizing and implementing projects. The state plan's analysis is also very important for local and tribal partners. They may not be able to find and analyze climate and future conditions data on their own. They will rely on the state doing a thorough and scientifically sound analysis to inform their plans.

3.3. Step 3: Analyze the Vulnerability of State Assets

Next, the state identifies state assets and analyzes what will happen to them during a hazard event. FEMA suggests the state planning team agree on the categories and types of state assets to include early on.

Finding State Asset Data

Start with the previously identified assets. Determine if they are operational or if there has been a change in their function. Then, add additional asset data as needed. Data on state assets will come from across the state planning team, including from the seven sectors and lifeline partners. State departments of general services, real estate, insurance or procurement often maintain inventories of state-owned and leased facilities. These lists are needed to build the inventory of state assets. Other agencies can supplement this with state-owned and operated infrastructure, critical facilities, and lifelines data.

States should gather or update location data for each asset as needed. Location data can be the latitude and longitude or the address of each asset. States do not need to map every asset in the plan, but it can be helpful to summarize their locations by region or county. Because the location and specific details of some state assets can be sensitive, the planning team may want to categorize the assets so they can be easily summarized in the plan. Raw data can go in an appendix and be protected as needed.

The inventory of state assets is most useful when it also includes replacement or assessed value and other traits like age and protective features. Value usually comes from the state agency who maintains or insures the assets. Other traits may include construction type, size, backup power, or protective features like sprinkler systems. Buildings built to a recent, hazard-resistant building code or higher floodplain standard will usually perform better during an event. For example, buildings built above the base flood elevation will be less vulnerable to floods.

A robust asset inventory includes data on protective features. A floodwall protects Binghamton, NY's Our Lady of Lourdes hospital during Tropical Storm Lee. Image: FEMA.

After the state identifies its assets, it must analyze their vulnerability and summarize the most at-risk assets. Analyzing vulnerability starts with knowing which assets are in current and projected future

hazard areas. This analysis is usually done using GIS. Overlaying assets with mapped hazard areas is an exposure analysis. Any building-specific characteristics will add additional context; just being in a hazard area does not necessarily make an asset vulnerable. Its size, materials, construction type, and use may increase or decrease vulnerability on top of location.

After identifying which assets are in the identified hazard areas, the state must estimate the potential dollar losses to those assets. The potential dollar losses can include structural, functional, or content losses. GIS is an important tool here, too. If the state asset data includes their value, the state can summarize the dollar value of assets exposed to hazards. During a hazard, assets will see various degrees of damage and loss. However, it is still a useful estimate to understand and summarize which assets are most vulnerable.

States can also use scenario analysis to find the most vulnerable assets and estimate losses. This kind of analysis uses modeling or scenario software to show which assets are at risk and to calculate graduated losses. This has the benefit of estimating loss based on expected damage. Unlike exposure analysis, it can show partial losses based on specific hazard inputs. The most common scenario analysis software is FEMA's Hazus program. Hazus can model losses for earthquakes, floods, tsunamis, and hurricanes. For more information, read Using Hazus for Mitigation Planning (2021).

Looking for Hazus Analyses? Try the Hazus Loss Library.

FEMA's Hazus Loss Library is an online collection of Hazus-generated risk assessments. This library has downloadable Hazus GIS data, spreadsheets, and reports. Check it out and see if there is data available to support your plan.

In the absence of GIS data, a state can analyze the vulnerability of its assets by looking at past events. It can also use scenarios or risk assessments from other planning processes. For example, states may have used hazard scenarios in their Threat and Hazard Identification and Risk Assessment (THIRA) process. States should review their THIRA or SPR for any content that can inform the mitigation plan.

3.4. Step 4: Analyze the Vulnerability of Jurisdictions

Because the mitigation plan is a statewide strategy, the state must look at the vulnerability of its jurisdictions, not just its own assets. State plans must identify the local jurisdictions that are most vulnerable to each of the identified hazards, with a focus on underserved communities and socially vulnerable populations. This must be based on the state's and local governments' risk assessments.

There are two parts to jurisdictional vulnerability:

1. Jurisdictions that are most threatened because of how each hazard occurs in the state.

2. Jurisdictions most vulnerable to damage and losses. These jurisdictions are vulnerable because their people, buildings, infrastructure, and community lifelines are at risk.

While these two parts are explained separately, it is crucial to keep in mind that they connect. Often, the jurisdictions with the most event exposure and most vulnerable populations and infrastructure have the greatest risk.

Jurisdictions Most Threatened by Hazards

These jurisdictions are vulnerable because hazards are most likely to occur there. They may be places where climate change and future conditions are driving significant changes in risk. This includes effects on people, structures, and lifelines. They may be most threatened because when hazards do occur, these are the jurisdictions where the impacts will be most severe. To understand which jurisdictions are most vulnerable based on hazard characteristics, the state could:

- Look at the state hazard profiles to analyze which jurisdictions are most likely to see hazards.
- Look at future conditions data to see which jurisdictions will face increased risks in the future.
- Review previous emergency and disaster declarations and losses to see where events have occurred.
- Review the estimated losses in local mitigation plans to determine where the highest losses are expected.
- Review local mitigation plans to assess how they understand their own risk. Local plans often rank hazards. Jurisdictions most vulnerable to a hazard may be the ones that ranked that hazard as high risk or high priority.

Jurisdictions Most Vulnerable to Damage and Loss

There is a second way to think about the most vulnerable jurisdictions. It requires analysis of impacts to populations, structures, and infrastructure and community lifelines.

The state risk assessment must analyze the vulnerability of the population. People are the state's most important assets – and what the state is protecting in the mitigation plan. This analysis must include impacts to socially vulnerable populations and underserved communities. Including these populations is essential. The most at-risk members in a community often experience the greatest losses from disasters. The negative effects of historic government policies continue to add to this issue, and these community members may not trust the government. . They may be left out of planning activities or have little access to information about what to do before or after a hazard event.

There are a number of data sources and indices to scan for and learn about socially vulnerable or underserved communities. They are both standalone like the CDC's Social Vulnerability Index and part of other tools like the National Risk Index. The state can choose any dataset that adequately

represents socially vulnerable and underserved communities statewide. It can also create or use its own more specific dataset. The state should work across the planning team and with partners representing underserved and socially vulnerable communities to make sure the data reflects the lived experience of these populations. As more and more local plans include socially vulnerable and underserved communities, include this information in the state plan.

Once the state assembles data on its socially vulnerable populations and underserved communities, it can be helpful to map the data and see where they overlap with known hazard areas. Socially vulnerable populations and underserved communities often do not have the resources on their own to become more resilient. Identifying where they live in relation to hazards can help prioritize future outreach and investments to reduce their risk. It can also help reduce cascading impacts from nearby communities.

Understanding jurisdictions whose people are most vulnerable to hazards is not just about a GIS overlay. Not all measures of social vulnerability or disadvantage can be mapped. Understanding the most vulnerable populations means looking at the ways state and local policies and programs affect them. For example, discriminatory housing policies may have pushed low-income people and communities of color onto the least valuable and highest-risk land. Communities may be more exposed to the impacts of hazards because they do not have the funds or the manpower to invest in mitigation. Look at both historic and current policies, programs, and decisions that have caused disproportionate harm to these communities. Refer to the Mitigation Capabilities Bulletin for more information on how to work these considerations into the mitigation plan.

This analysis of socially vulnerable populations and underserved communities helps the state create a more equitable mitigation strategy. It also supports reducing risk for the people most affected. Growing the resilience of these populations helps the state overall. Use the results of the analysis to identify mitigation actions that support these groups' resilience.

Example: Baltimore City's Social Vulnerability Analysis

The City of Baltimore's Disaster Preparedness and Planning Project is their combined hazard mitigation and climate adaptation plan. Its risk and vulnerability assessment does a good job of incorporating social vulnerability into the risk assessment. Beyond mapping the locations of socially vulnerable populations, the plan defines which socially vulnerable populations are at risk to specific hazards. It also maps where socially vulnerable populations overlap with hazard areas. Most importantly, the plan links the vulnerable populations' risk to specific mitigation actions.

For example, the plan maps areas of extreme heat (or heat islands). Then, it overlays the heat islands with the most vulnerable populations. In this case, the most vulnerable are people over the age of 65 and people with limited access to a vehicle. The plan explains that people over 65 face increased health risks from heat, and that people with limited access to a vehicle may

not be able to get to a cooling center. The city used this analysis to identify activities to reduce the impact of heat events: "Community resiliency planning in the Rosemont neighborhoods south of North Avenue and just east of Leaking Park, for example, should take into account the need for outreach and support for seniors in heat events as future mitigation strategies and actions."

While this is an example from a local plan, it is a great example of how to define socially vulnerable populations, connect where they live to hazard areas and use the analysis to make equity-informed mitigation actions. State plans could go beyond this to find the right state agencies or non-governmental partners to support community outreach before an event.

The next lens to evaluate jurisdictional vulnerability is analyzing at-risk structures, including critical facilities. This could include a GIS analysis of all statewide buildings and critical facilities. The state may have its own building dataset. FEMA released a national building dataset in 2022. Hazus also has general building stock data with estimated replacement costs per square foot. While not perfect, these national datasets are helpful as a planning-level estimate.

Finally, the state must evaluate which jurisdictions will be most threatened because their infrastructure and critical facilities that support state resilience are threatened. Like the evaluation of structures and critical facilities, this may include a GIS analysis or a review of local mitigation plans and other plans and studies. If it does not have its own data on infrastructure and community lifelines, the state can use the data included in Hazus. Hazus inventories line up well with the community lifelines: Safety and Security; Food, Water, Shelter; Health and Medical; Energy; Communications; Transportation; and Hazardous Materials. Hazus data includes:

- Essential facilities vital to emergency response and recovery (medical facilities, police and fire, emergency operations centers, schools).
- High potential loss facilities (hazardous materials).
- Transportation systems (highways, rail, bus systems, ports, ferries, and airports).
- Utility systems (potable water, wastewater, oil, natural gas, electric power, and communication systems).

A statewide GIS analysis of structures, critical facilities, infrastructure and community lifelines is not required. The state can review local mitigation plans, Hazus analyses, and other plans and data to find which communities expect the most damage and losses to their assets during hazard events.

Finally, remember that the analysis of the vulnerability of jurisdictions does not need to discuss every jurisdiction. The state must provide an *overview* of those most threatened by hazards. The state should document its analysis methodology in the plan.

Spotlight on High Hazard Potential Dams

The Water Infrastructure Improvements for the Nation (WIIN) Act added a new FEMA grant program. The Rehabilitation of High Hazard Potential Dams (HHPD) Grant Program provides technical, planning, design, and construction assistance grants. This program requires states to have a mitigation plan that includes all dam risk.

In the Guide, the HHPD requirements are briefly referenced under the plan elements (planning process, risk assessment, etc.) that link to the HHPD requirements. The full list of HHPD requirements are listed in Section 3.9. The HHPD requirements do not need to be addressed in a separate section of the plan. They can be woven into the appropriate section.

To meet requirement HHPD2, the state mitigation plan must:

- Provide a list of identified high hazard potential dams with their National Inventory of Dams identification numbers, locations by jurisdiction, and other relevant information and maps.
- Summarize statewide vulnerabilities to and from high hazard potential dams from hazards and the potential consequences of dam incidents.
- Document any data limitations and describe how they will be fixed.

Including all dam risks is done at a scale appropriate to the planning area. It should include descriptions of incremental, breach, and non-breach risks for high hazard potential dams as described in Section 5.8 of the Rehabilitation of High Hazard Potential Dams Grant Program Guidance (FP 104-008-7, June 2020). State mitigation planners should consider the entire inventory of dams that have potential impacts in the planning areas no matter the hazard potential classification or eligibility for HHPD funding.

3.5. Step 5: Summarize Vulnerability

The risk assessment and vulnerability analysis usually produce a lot of data. In the last step of the process, the state should bring everything together and summarize key insights.

States can elaborate on vulnerability by ranking the identified hazards. This ranking can be based on impact, probability, warning time, duration, and geographic area. This is a quantitative method of comparing hazards. In this method, each aspect of a hazard is assigned a numerical value and weight. The values can be compared across all hazards. Ranking hazards allows for an apples-to-apples comparison. It can help states prioritize vulnerabilities and determine mitigation strategies.

States can also summarize the risk assessment using problem statements. Problem statements identify the specific areas of vulnerability. This could be a jurisdiction that may have major losses after a hurricane, an asset that is inaccessible or that will lose functionality during a flood, or a region that will see severe ground shaking in an earthquake. These statements help the state planning team understand the impacts of a hazard and the areas that are most vulnerable to them. Problem statements bring vulnerabilities to life with narratives.

4. Updating the Risk Assessment with Changes in Development

Where people live, how they build, and where they build influence natural hazard risk. It is important that the state mitigation plan reflect recent development and potential or projected development in hazard-prone areas. This must be based on the state risk assessment and information from local mitigation plans. This includes changes in development since the last approved plan and changes expected in the future.

Describing changes in land use and the built environment recognizes that increased development can increase risk. Investing in mitigation and development policies and standards can lower risk to the built environment. Consider:

- Land use changes. New development in an identified hazard-prone area will probably increase the vulnerability of the jurisdiction and any state assets in that area.
- Building code or other standards changes. A more hazard-resistant building code can reduce risk to new buildings. A weakened building code will have the opposite effect. There may be other statewide codes that also impact risk.
- Future growth and redevelopment areas. Are projected future growth and redevelopment areas in identified hazard areas? Are there standards to ensure these areas are resiliently developed?

State agencies responsible for planning, economic, and environmental policies may know where growth is expected based on past trends. They may also know areas that are targeted for future growth.

The state mitigation plan must summarize recent development. It must also include potential or projected future development in hazard-prone areas.

Changes in population can either increase or decrease risk. Population growth in an area can strain existing or aging infrastructure. For example, dams nearing or past their design life may not be sufficient to protect expanding communities from floods. States losing population may have fewer people straining resources or in hazard areas, but lower tax revenues can mean fewer mitigation investments or aging infrastructure not being adequately maintained. States usually have official population projections. Ask for this data early in the planning process. Statewide projections can be of limited use. Regional, county, or community-level projections better show areas of growth and decline.

When talking about changes in demographics that may affect vulnerability, the plan must discuss how changes in the number and type of socially vulnerable populations and underserved communities will affect risk. Include any programs that are building resilience in these communities.

Changes in the vulnerability of state assets should capture if new assets were built in hazard areas. It should also capture if mitigation projects made any state assets less vulnerable to damage or loss. These can be projects from any funding source or program, not just mitigation grants.

Finally, the summary of recent and potential development must include changes in development that could affect the most at-risk jurisdictions. This involves understanding the compound impacts of development and climate change. For example, a state with counties who are developing open space may see an increase in urban and flash flooding, especially combined with more intense and frequent rainfall.

Summarizing these changes ensures they are considered in the mitigation strategy.

5. Resources

States may use the following resources to inform their risk assessments. This list focuses on nationally available data. Other data will come from state agencies and departments, non-governmental organizations, academia, and local jurisdictions. These resources supplement the publications, websites, and data referenced in this bulletin.

For more information about mitigation planning and to view the latest FEMA resources, visit the Hazard Mitigation Planning website.

5.1. General Risk Assessment Resources

Data.gov

U.S. General Services Administration, Office of Citizen Services and Innovation Technologies maintains this collection of government datasets. It includes over 100,000 downloadable GIS datasets from across the federal government.

FEMA's National Risk Index

The National Risk Index is a dataset and online tool that identifies communities most at risk for 18 natural hazards. The National Risk Index visualizes risk metrics, includes data on expected annual losses, and incorporates social vulnerability and community resilience data.

FEMA's Flood Map Service Center

This website is the official public source of flood hazard information produced in support of the National Flood Insurance Program. The Map Service Center has effective and historic flood mapping products, including FIRMs, Flood Insurance Studies, and Letters of Map Change. The National Flood Hazard Layer includes GIS data on all digital, effective flood map data nationwide.

FEMA's GeoPlatform

The FEMA GeoPlatform hosts FEMA's geospatial data and applications. It is a central repository for geospatial data. The Geospatial Resource Center has hazard-specific resources to support the emergency management community.

Hazus

Hazus is a loss estimation software that evaluates risk for earthquakes, floods, tsunamis, and hurricanes. This How-To Guide helps users conduct risk assessments with the Hazus software. The Hazus team also has online training on YouTube and maintains open source risk assessment tools.

National Earthquake Hazards Reduction Program (NEHRP)

This program leads the federal government's efforts to reduce injuries, loss of life, and property losses from earthquakes. The four agency partners in NEHRP are FEMA, the National Institute of Science and Technology, National Science Foundation, and USGS. NEHRP provides earthquake hazard maps, publishes studies, and provides trainings.

NOAA's Digital Coast

The Digital Coast program is NOAA's home for resources that relate to a changing climate and growing population. It includes data, tools, training, and stories of resilience. While the focus is the coast, the data, resources and training topics are not limited to coastal communities. For example, the Digital Coast houses land cover, wetlands, and soil survey data from across the nation.

NOAA's National Centers for Environmental Information (NCEI)

The NCEI's Storm Events Database records occurrences of storms and other significant weather events. It includes dates and types of events as well as intensity, loss of life, injuries, property damage, and crop damage. The level of detail of each event may differ based on the details received from the National Weather Service. The Storm Events Database goes back to 1996 for all hazards, 1955 for thunderstorm wind and hail events, and 1950 for tornadoes.

NOAA's Storm Prediction Center

The Storm Prediction Center forecasts severe thunderstorms and tornadoes and monitors hazardous winter weather and fire events. It also conducts research and issues publications about severe weather, including tornado and severe weather summaries, tornado-related fatality data, and information about storm trends.

USGS Natural Hazards Programs

The USGS Earthquake Hazards Program provides earthquake science information to support reducing loss of life and property from earthquakes. It provides necessary data to understand earthquake risks and mitigate them. The Earthquake Hazards Program provides real-time data feeds of earthquakes worldwide. It provides an extensive catalog of publications, maps, and datasets.

The USGS Landslide Hazards Program has been gathering information, conducting research, responding to emergencies, and providing scientific data on landslides since the mid-1970s. The Landslide Hazards Program provides archives of occurrences, maintains the National Landslide Hazards Map, and compiles news and research about landslide hazards.

5.2. Equity Resources

These resources support identifying, mapping, and understanding social vulnerability.

For more information about mitigation planning and to view the latest FEMA resources, visit the Hazard Mitigation Planning website.

American Planning Association's Planning for Urban Heat Resilience

In this Planning Analysis Report, the American Planning Association provides guidance to make communities more resilience to extreme heat events. It will help practitioners understand urban heat and the equity issues associated with heat resilience.

Climate and Economic Justice Screening Tool

The Council for Environmental Quality built the Climate and Economic Justice Screening Tool to help federal agencies identify disadvantaged communities. It uses U.S. Census data to identify disadvantaged communities that may experience disproportionate adverse impacts due to climate change and/or natural hazards. As of July 2022, the tool was in beta form. It will be updated based on feedback and added research.

Guide to Expanding Mitigation: Making the Connection to Equity

One of FEMA's Guides to Expanding Mitigation, this document helps mitigation planning partners have a deeper understanding of equitable mitigation, and how it can be implemented within communities and plans. The guide defines social vulnerability and the differences between equity and equality.

Hazards Vulnerability and Resilience Institute's Social Vulnerability Index

The Hazards Vulnerability and Resilience Institute is a research entity at the University of South Carolina. Their Social Vulnerability Index, known as SoVI, uses 29 socioeconomic variables to understand the vulnerability of communities to environmental hazards. It is a comparative tool to see the geographic variation of social vulnerability. The National Risk Index also uses SoVI.

Social Vulnerability Index

The Centers for Disease Control and Prevention and the Agency for Toxic Substances and Disease Registry partnered. The index analyzes the social vulnerability of a community using 15 social factors. These factors include poverty, lack of vehicle access, crowded housing, and more. It has an interactive mapping feature backed by U.S. Census data. The index can help identify communities that will need support before, during, or after a disaster.

5.3. Climate Change Resources

Climate change data and projections are rapidly evolving. FEMA's climate change website is the agency's hub for its climate change resources, initiatives, tools, and data.

FEMA's Resources for Climate Resilience

This document outlines the different resources and programs available to address climate resilience nationwide. It discusses resources to identify and assess climate risk, plan for it, and fund climate adaptation and mitigation activities.

Intergovernmental Panel on Climate Change (IPCC): Sixth Assessment Report and Data Distribution Center

The IPCC is the United Nations body for assessing the science related to climate change. Their Fifth Assessment Report evaluates the scientific basis of climate change. It includes its impacts and future risks as well as options for adaptation and mitigation. The Data Distribution Center provides historic climate, socio-economic, and environmental data and projections for future scenarios. *Note: The IPCC is currently in its Sixth Assessment cycle. Check the IPCC's website often for the most recent data and tools.*

National Climate Assessment

Every 4 years, the U.S. Global Change Research Program delivers the National Climate Assessment to Congress and the President. The next report is due for release in late 2023. The assessment presents an in-depth look at climate change impacts on the United States. It is not a raw data resource. It is a discussion and report on how the climate is changing and its impacts on regions and sectors. The report also presents an overview of response strategies, including mitigation.

NOAA's Climate.gov

This website provides timely and authoritative data about climate science, adaptation, and mitigation. It includes a Climate Data Primer with basic information to help people understand and explore climate data. Climate.gov also includes teaching resources, maps, and data.

U.S. Climate Resilience Toolkit

The toolkit provides tools and information to support communities with improving resilience and managing climate-related risks. It pulls information from across the federal government to a single location. The toolkit connects users to climate tools, data and visualization. It also offers training on how to use those tools.

U.S. Global Change Research Program

This interagency program shares resources, reports, data, multimedia, and indicators that could inform a risk assessment. It has several visualizations of global climate change from member agencies. These visualizations can assist in evaluating and communicating future risk. The program also maintains a library of scientific assessments, annual reports, research plans, fact sheets, brochures, and other resources.